Management Science

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

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informs
http://pubsonline.informs.org/journal/mnsc

MANAGEMENT SCIENCE
Vol. 66, No. 5, May 2020, pp. 2075–2082
ISSN 0025-1909 (print), ISSN 1526-5501 (online)

Channel Auctions

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Received: August 5, 2019
Revised: August 16, 2019
Accepted: August 16, 2019
Published Online in Articles in Advance: March 4, 2020

https://doi.org/10.1287/mnsc.2019.3487

Abstract. Standard auction formats feature either an upper bound on the equilibrium price that descends over time (as in the Dutch auction) or a lower bound on the equilibrium price that ascends over time (as in the English auction). We show that in some settings with costly information acquisition, auctions featuring both (viz., a narrowing channel of prices) outperform the standard formats. This *Channel auction* preserves some of benefits of both the English (truthful revelation) and Dutch (security for necessary information acquisition) auctions. Natural applications include housing, online auction sites like eBay, recording transactions on blockchains, and spectrum rights.

History: Accepted by Joshua Gans, business strategy.
Funding: E. M. Azevedo acknowledges support from the Sloan Research Fellowship [Grant FG2018-10387].

Keywords: games group decisions • bidding auctions • marketing • pricing • economics • game theory • bargaining theory

1. Introduction

When the competitive market price for an asset is not widely known and relevant information is held by many parties, auctions are a common method for simultaneously determining prices and allocating the asset in question. The central goal of auction design is to facilitate the acquisition, revelation, and integration of this information to facilitate this process. In this sense, auctions are a search and information processing scheme, like those studied in computer science, albeit one involving many agents with potentially conflicting incentives.

Despite this parallel, common dynamic auction designs are quite different from search schemes employed in computer science. In computer science, search protocols involving bounds honing in on an answer from both sides (such as binary search, jump search, and interpolation search) are more efficient in many circumstances than are linear search protocols that start at one end and approach an answer. Yet, nearly all auctions involve a linear procedure. The goal of this paper is to suggest that this may be improved in cases by narrowing in on equilibrium prices rather than starting on one side and moving toward them.

We propose an auction in which an upper-bound price descends as a lower-bound price rises. Bidders all begin in the auction at the lower-bound price; this represents a commitment to buy at this price. As this lower-bound price rises, bidders may at any time drop out. Any bidder who is still in the auction may buy at the upper-bound price at any time she wishes and be awarded an object. This process continues until the number of bidders remaining at the lower-bound price is at most the number of objects remaining unassigned. We refer to this design as a *Channel auction* because it involves a narrowing channel of prices honing in on the optimum and because it mixes features of ascending (usually called English) and descending (usually called Dutch) price auctions.[1]

In this paper, we analyze Channel auctions in a setting where information acquisition may be important but also may be unnecessary and wasteful. Our main result gives conditions under which an optimal Channel auction generates higher welfare than the standard auction formats. The intuition is that Channel auctions give bidders information that the final price will be in some interval. This allows bidders to wait until the price is guaranteed to be close to their possible valuations to incur information acquisition costs. In contrast, standard auction formats only give information that the final price will be either below some value (in the Dutch auction) or above some value (in the English auction). We discuss some potential applications, including the sale of houses and online auctions, where we argue it is already informally in use, though not widely discussed as such.

2. Background

Most auctions fall into one of two camps. Since the pioneering work of Vickrey (1961), economists have tended to endorse or extend *English auctions*. These involve a price or prices that gradually move upward from zero or a low number toward the levels that clear the market. Participants stay in the auction until they are no longer willing to pay the price offered, and eventually the number of remaining participants matches the supply.

Economists have been attracted to this format because the points at which bidders drop out will typically reflect their values, given there is no cost of staying in until one's best estimate of value is reached. This tends to suggest goods will be allocated to their highest value (Vickrey 1961) and that much information will be revealed in the process by observing bidders drop out (Milgrom and Weber 1982). This information helps to ensure that a good allocation is made if it informs bidders about how much the objects may be worth to them (Dasgupta and Maskin 2000).

The other common auction format operates on the opposite principle. In Dutch auctions, prices start at a high level and gradually descend. At any point, a participant may claim an object at the quoted price and the process proceeds until no objects remain. Since Vickrey, Dutch auctions have been seen mostly as a foil to highlight the benefits of English auctions, as bidders typically will wait until the price has fallen below the amount they would be willing to pay before claiming the object. Because this incentive to delay purchase may differ across bidders and because the Dutch process reveals little about bidders' information until it is too late for other bidders to act, Dutch auctions have been seen as inferior.

However, Kleinberg et al. (2018) show that Dutch auctions have an important advantage: they provide bidders with a useful price guarantee as the auction proceeds. Because it is often necessary for bidders to research a purchase, they will often be unwilling to seriously engage with the auction if the price may rise arbitrarily high. Most people, for example, would not spend hours looking at a house if they had no clear sense of at least an upper bound on what its price might be. English auctions provide no such upper bound: a bidder may fear that after looking at the house, the price will head far beyond what she would ever consider paying. During a Dutch auction, on the other hand, upper bounds always exist and thus bidders can feel safe investing in acquiring information, at least as necessary for a purchase. Thus in cases where information acquisition is important, the Dutch format may greatly outperform the English format.

This suggests an improvement on both schemes. If the role of the upper-bounding Dutch prices is primarily to give bidders security, while the role of the lower bounding English price is to promote information revelation, it may be possible to have a bit of each of these advantages. A Dutch price can descend as an English price rises. The Dutch price provides security and occasionally may be used for allocation, while most sales will occur through the English phase expiring. In this design, a channel of prices between the Dutch and the English gradually narrows in on the equilibrium price, similar to the honing of a binary search.

Another important potential advantage of the Channel auction, on which we focus in the next section, relates to the possibility that information acquisition may turn out to be wasteful. Consider a bidder who does not know how much the object is worth to her and has an opportunity to pay a price for information about its value. The analysis of Kleinberg et al. (2018) indicates that she will not be willing to pay this price (or may end up regretting paying it) unless she has confidence that the price is below some level. Effectively, if the price is above some level, it is out of her price range, and she would like to know that before she investigates it.

Conversely, if the price turns out to be low, she may regret having acquired information because she would have been willing to take the object without knowing its exact value to her, and thus acquiring information turns out to have been a waste. Effectively, if the price is low enough, she would buy the object regardless of how good she finds it to be. A Channel auction can avoid both the risk of too high a price and the risk of too low a price.

Before the formal analysis, we illustrate these main points in a simple example.[2] A seller is auctioning off an object to three buyers. Two of the buyers, whom we refer to as the competitors, are identical. The competitors' valuation is \$1, \$50.10, or \$100 with equal probability. The competitors know their common valuation, so that they always compete away their rents in the auction. The third buyer, whom we refer to as the collector, has a valuation v uniformly distributed between \$0 and \$100, independently of the valuation of the competitors. The collector has to pay \$10 to learn her valuation.

Consider what happens in a standard ascending auction. The collector should stay in the auction at a price up to \$1 without acquiring information. She will win at a price of \$1 whenever the competitors have a value of \$1, which happens with probability 1/3. In that case, profits equal the expected valuation of \$50 minus \$1, for a total of \$49. But, if prices go up to \$1.01, what should the collector do? In that case, she knows that the price will be at least \$50.10. Therefore, she cannot make profits without acquiring information. But information is costly, so she has to gauge whether it is better to acquire information or to drop out.

The expected profits of acquiring information are the product of the probability that the final price is \$50.10, the probability that v is greater than \$50.10, and the conditional expectation of v minus \$50.10.

This equals

$$\frac{1}{2}\cdot\frac{100-50.10}{100}\cdot\left(\frac{50.10+100}{2}-50.10\right)\approx \$6.22.$$

Therefore, the collector does not acquire information and instead drops out of the auction as soon as the price hits \$1.01.

The key point is that the gain from acquiring information is zero when the competitors' value is \$100, but the gain is about \$12.45 when the competitors' value is \$50.10. Therefore, investing in information is fruitless half of the time. It would be advantageous for the collector to know whether getting information is fruitless *before* incurring the information acquisition cost.

This is where a Channel auction can increase efficiency. Namely, the seller can first run a descending price phase where a Dutch price descends to \$99. The object will be sold in this phase only when the competitors' value is \$100.[3] After the Dutch phase, the seller runs the standard ascending English phase. Even though the ascending phase works exactly like the traditional ascending auction, the outcome is different. When the price reaches \$1.01, the collector knows that the competitors' valuation is \$50.10. So her value of acquiring information is about \$12.45, and she will acquire information. The remainder of this paper defines Channel auctions and formalizes this main insight in a simple model.

3. Definition of the Single-Item Channel Auction

The simplest, single-item Channel auction works as follows. There is a single object to be auctioned to one of N bidders. Time t starts at 0 and proceeds until one of three conditions listed below is met. The auction has a weakly decreasing upper price $P(t)$ at time t, called the "Dutch price," at which any bidder still in the auction can clinch the object. The auction also has a weakly increasing lower price $p(t) \le P(t)$, called the "English price," at which every bidder remaining in the auction commits to be willing to purchase the object.[4] At any time, bidders in the auction can buy the object at a price of $P(t)$ or drop out of the auction. The three conditions for termination of the auction are as follows:

1. Only a single bidder remains in the auction. In this case, that bidder pays the English price and receives the object.
2. A bidder claims the object. In this case, that bidder pays the Dutch price and receives the object.
3. The Dutch and English prices converge. In this case, the object is uniformly randomly allocated among the remaining bidders at the common Dutch–English price.

We illustrate this basic process in Figure 1.

Note that the English and Dutch auctions are special cases of the Channel auction. The English auction corresponds to the case of $p(t) = \bar{v}\cdot t$ and $P(t) = \bar{v}$, where $\bar{v}$ is greater than any bidder's valuation. The Dutch auction corresponds to the case of $p(t) = 0$ and $P(t) = \bar{v}\cdot(1-t)$.

4. Theory

4.1. Model

We consider an auction game with information acquisition. Three risk-neutral bidders with quasi-linear preferences want to acquire an object. One of the bidders is the *collector*. The collector's *valuation* v for the object has a distribution F with density f. The collector is uncertain about her valuation. She needs to pay an *inspection cost* c to learn her valuation. If she receives the object without inspection, she eventually learns everything at no cost, receiving an average payoff $\mathbb{E}[v]$, which we denote $\bar{v}$.

The collector faces two other *competitors*. The competitors have the same *value* w for the object, which they both know. The competitors also know each others' value. Their value w has a distribution G with density g with bounded support and is independent from the collector's value.

The object is initially owned by a risk-averse *seller* with quasi-linear preferences and zero value for the object. Social welfare is defined as the sum of individual utilities.[5]

4.2. First-Best

We start with the first-best with no asymmetric information, that is, how to maximize social welfare given the information available to the bidders. Initially, the bidders only know w. So we have to decide whether to inspect given w, then decide how to allocate the object. We call the optimal inspection decision conditional on w the *first-best inspection strategy*. We call the set of values of w for which inspection is optimal the *first-best inspection range*. We call the optimal welfare *first-best welfare*.

The following proposition summarizes the optimal inspection strategy.

Proposition 1 (First-Best Inspection Strategy). *Consider the first-best inspection strategy. Given F and c, there are values of w for which it is optimal to inspect if and only if*

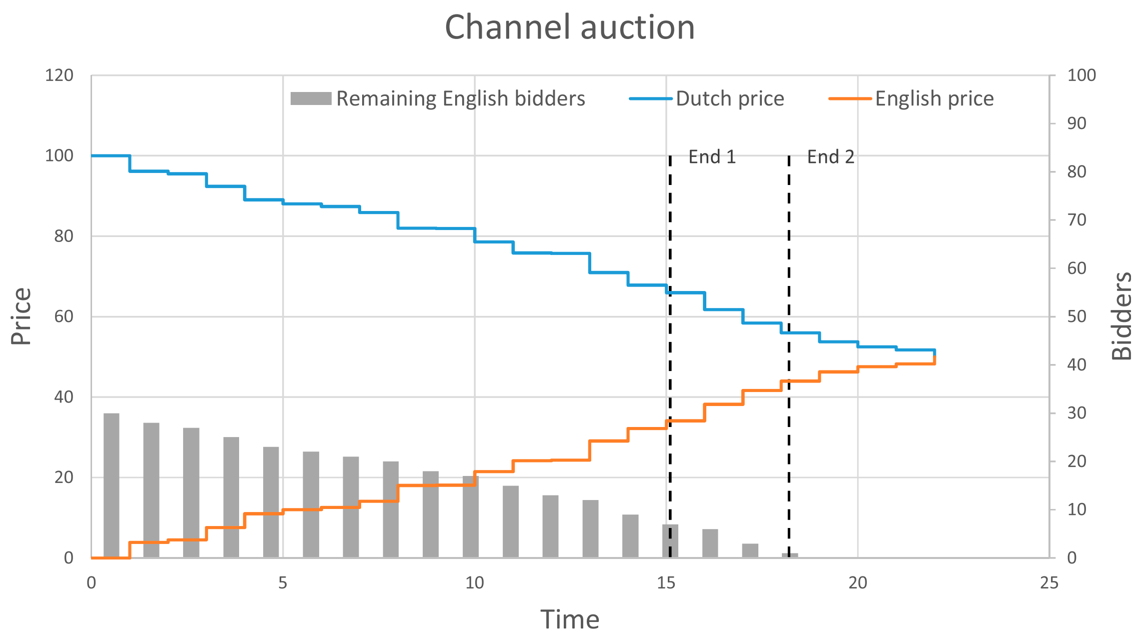
$$E[(v-\bar{v})^+] \ge c. \tag{1}$$

If this holds, inspection is optimal if and only if $\underline{\sigma} \le w \le \bar{\sigma}$, *where*

$$\mathbb{E}[(v-\bar{\sigma})^+] = c, \tag{2}$$

$$\mathbb{E}[(\underline{\sigma}-v)^+] = c. \tag{3}$$

Figure 1. (Color online) Illustration of a Single-Item Channel Auction with Continuous Price Changes



Notes. As the ascending price rises (ascending line), bidders drop out of the auction (bars). The auction may end when a bidder claims the item at the Dutch price (End 1) or at the English price when only one bidder remains (End 2).

Proof. There are three options:

1. Do not inspect and allocate to the collector, obtaining $\bar{v}$.
2. Do not inspect and allocate to a competitor, obtaining w.
3. Inspect and allocate to the larger value (v or w), obtaining $\mathbb{E}[\max\{w, v\}] - c$.

First, we consider the condition that option 3 is better than option 1:

$$\begin{aligned} &\mathbb{E}[\max\{w,v\}] - c \geq \bar{v} \\ \iff\ &\mathbb{E}[\max\{w,v\}] - \mathbb{E}[v] \geq c \\ \iff\ &\mathbb{E}[\max\{w,v\} - v] \geq c \\ \iff\ &\mathbb{E}[(w-v)^+] \geq c. \end{aligned}$$

The left side is strictly increasing in w, so we find this holds if and only if $w \geq \underline{\sigma}$. Similar calculations show that option 3 is better than option 2 if and only if $w \leq \bar{\sigma}$. This proves that inspection is optimal if and only if $\underline{\sigma} \leq w \leq \bar{\sigma}$.

This also shows that there exist cases where inspection is optimal if and only if $\underline{\sigma} \leq \bar{\sigma}$. It only remains to prove that this is the case if and only if Equation (1) holds. Let

$$M(w) := \min\{\mathbb{E}[(w-v)^+]\ ,\ \mathbb{E}[(v-w)^+]\}.$$

We first claim that $\underline{\sigma} \leq \bar{\sigma}$ if and only if there exists w such that $M(w) \geq c$. If $\underline{\sigma} \leq \bar{\sigma}$, then $M(w) \geq c$ for every w in between, by the above calculations. If $\underline{\sigma} > \bar{\sigma}$, then every w is either strictly below $\underline{\sigma}$, in which case $\mathbb{E}[(w-v)^+] < c$, or strictly above $\bar{\sigma}$, in which case $\mathbb{E}[(v-w)^+] < c$.

We next observe that $\bar{v}$ is the unique value of w such that $\mathbb{E}[(w-v)^+] = \mathbb{E}[(v-w)^+]$. This implies that $M(w)$ is maximized at $w = \bar{v}$, because one term is strictly decreasing in w and the other is strictly increasing. So there exists w with $M(w) \geq c$ if and only if $M(\bar{v}) \geq c$. □

The proposition makes two points. First, the first-best inspection range is a (possibly empty) interval. This is intuitive. If the competitors' value is very low, then it is better to just give the object to the collector without incurring the inspection cost. Likewise, if the competitors' value is very high, it is better to just give the object to one of the competitors. So inspection is worthwhile only for w between $\underline{\sigma}$ and $\bar{\sigma}$.

Second, the first-best inspection strategy is related to option pricing. As mentioned in Kleinberg et al. (2018), Equation (2) defining $\bar{\sigma}$ is a standard formula in option pricing. Namely, value $\bar{\sigma}$ is the strike price of a call option for an underlying asset with value v and actuarially fair price c (cf. Dixit and Pindyck 1994). Given that it is always possible to allocate to a competitor for w, inspecting can be interpreted as paying c for the option to allocate to the collector instead. If $v \geq w$, we exercise the option, gaining the asset for value v but giving up or "paying a price" of w. Therefore, it is worthwhile to purchase the option (inspect the item) only if w is less than the strike price.

Similarly, $\underline{\sigma}$ is the strike price of a *put* option for an asset with value v and fair price c. Given that it is always possible to allocate to the collector without inspecting, for a welfare of v, inspection can be interpreted as paying c for the option to allocate to a competitor instead. If $w \geq v$, we exercise the option, gaining a "payment" of w but giving up the asset valued at v. This is worthwhile only if w exceeds the strike price of this put option.

The key implication of this proposition is that neither the English nor the Dutch auction can generate optimal inspection behavior. In the English auction, price only goes up. In the Dutch auction, price only goes down. Either way, it is impossible for inspection to take place in an interval of values of w. In contrast, we will see how to use the option pricing formula to design a Channel auction that achieves first-best welfare.

4.3. Analysis of Auction Formats

We analyze three auction games, following the notation from Section 3. Define the *English* and *Dutch* auctions as in Section 3. Define the *optimal Channel auction* as the auction that first lowers the Dutch price to the strike price $\bar{\sigma}$, then raises the English price to the strike price. Formally,

- for $0 \leq t \leq 1$, $p(t) = 0$ and

  $P(t) = (1 - t) \cdot \max\{w | w \in \text{support}(G)\} + t \cdot \bar{\sigma}$,

- for $1 \leq t \leq 2$,

$$p(t) = (t - 1) \cdot \bar{\sigma} + (2 - t) \cdot 0$$

and $P(t) = \bar{\sigma}$.

We consider perfect Bayesian equilibrium. The exact games can be specified in standard ways as in Milgrom and Weber (1982) but are cumbersome. So we follow the literature in stating the results and analyzing the key points in the proof without defining all of the moves in each game. We assume elimination of weakly dominated strategies. This implies that in equilibrium of a Dutch, an English, or a Channel auction, a competitor obtains the item whenever a price reaches w. In a Dutch portion of an auction, a competitor has negative utility for claiming the item if the price is still above w, while either competitor will attempt to outbid the other if he waits for the price to go strictly below w, so this cannot occur in equilibrium. In the English portion, we have assumed no weakly dominated strategies, so competitors do not drop out either strictly before or strictly after the price reaches w.

We establish two results. The first result shows that the Dutch and English auctions cannot achieve first-best welfare.

Proposition 2. *If there is positive prior probability on all three possibilities $w < \underline{\sigma}$, $w > \bar{\sigma}$, and $\underline{\sigma} < w < \bar{\sigma}$, then equilibria of the English and Dutch auctions do not achieve first-best welfare.*

Proof. First consider either auction and suppose that, in equilibrium, the collector never chooses to inspect. There is a positive chance that $\underline{\sigma} < w < \bar{\sigma}$, in which case this choice is strictly suboptimal for social welfare.

Now consider the English auction and suppose the collector chooses to inspect at some ascending price t. In this case, given that the competitors have not yet dropped out, there is a positive probability that their value w is, in particular, above $\bar{\sigma}$. Conditioned on this case, it is strictly socially suboptimal to inspect.

Similarly, suppose in equilibrium of the Dutch auction that the collector inspects at some descending price t. In this case, given that the competitors have not yet claimed the item, there is positive probability that their value w is, in particular, below $\underline{\sigma}$. Conditioned on this case, it is strictly socially suboptimal to inspect. □

The next result shows that an appropriate Channel auction does achieve first-best welfare.

Proposition 3. *There is an equilibrium of the optimal Channel auction that achieves first-best welfare.*

Proof. The case where inspection is never optimal, $\underline{\sigma} > \bar{\sigma}$, is trivial. We now consider the interesting case where $\underline{\sigma} \leq \bar{\sigma}$.

We show that the collector inspects precisely when socially optimal, and the item is awarded in a socially optimal way. First, imagine the collector knew w, which could only improve her utility. Given a fixed value of w, the collector's utility for choosing to inspect at any time before the end of the auction would be

$$U(w) := \mathbb{E}[(v - w)^+] - c.$$

This follows because she pays c to inspect and wins only in the event $v \geq w$, paying w.

Now by definition, if and only if $w \geq \bar{\sigma}$, then $U(w) \leq 0$. If and only if $w \leq \underline{\sigma}$, direct calculation shows $U(w) \leq \bar{v} - w$, which is the expected utility for obtaining the item without inspection. Therefore, if the collector knew w exactly, she would conclude that a best response is to not win the item if $w \geq \bar{\sigma}$; win the item without inspecting if $w \leq \underline{\sigma}$, paying w; and inspect otherwise, winning if $v \geq w$ and paying w. Note this matches the socially optimal inspection and allocation decision.

Now, we argue the collector can achieve this optimal utility without knowing w as follows: do not claim the item during the Dutch portion; wait to inspect until the English price rises to $\underline{\sigma}$; then inspect and drop out when the English price exceeds v. This is a best response by all players, hence an equilibrium. □

4.4. The Channel Auction Captures the Benefits of Traditional Formats

Channel auctions have two other notable properties. Both properties hold by definition and capture key advantages of the English and Dutch auctions. The first advantage is that the Dutch and Channel auctions solve an exposure problem. At any point in the auction, a bidder who invests in collecting some information is guaranteed to be able to buy the object at the price $P(t)$.[6] So the bidder does not run the risk of investing in evaluating the item and then finding out that she is outbid. In fact, the only points in time when it makes sense for a bidder to incur the inspection cost is when the inspection can influence her decision. Naturally, a bidder may inspect and decide to wait for prices to go down further, but she is always guaranteed to be able to buy at $P(t)$. Of course, this benefit applies only to the extent that the Dutch price actually falls to levels sufficient to provide appropriate guarantees to participants.

The second advantage is that with private values, the Channel and English auctions make it a dominant strategy for a bidder to stay in the auction as long as the English price $p(t)$ is below her expected valuation.[7] This has some of the traditional advantages of strategy-proofness, such as outcomes being less sensitive to higher-order beliefs, lowering the costs of strategizing, producing preference data, and not disadvantaging bidders who are less sophisticated. We caution that the Channel auction has a muted version of these advantages because the optimal clinching does depend on other players' strategies.

5. Applications and Discussion

We discuss three areas where it may be possible to use Channel auctions.

5.1. Online Consumer Goods

eBay auctions are not Channel auctions. But, because of the way the auctions are run, there are some similarities to an informal Channel auction. The Dutch price is the eBay Buy It Now price, which rarely decreases. However, if an object fails to sell after a long period of time, we suspect sellers will lower this price, thereby effectively decreasing the Dutch price. Simultaneously, eBay runs an English ascending auction. Einav et al. (2018) show that more commoditized objects tend to be purchased using Buy It Now, and some items, with less certain value, tend to be purchased in the English auction (see also Ding 2015 and references therein). This suggests that allowing both a descending and an ascending price may be useful. This is reinforced by the findings of Cao and Zhang (2018), who find that, in a closely related context, information acquisition costs are typically a large fraction (approximately 40%) of the value of objects purchased. But that information acquisition is "optional" in the sense that the amount of information individuals acquire before purchasing varies widely across individuals, contexts, and price levels. These conditions suggest that explicitly incorporating a descending Buy It Now price and thus effectively converting to a Channel auction could add clarity to the process and could help overcome the primary cost of delay that Einav et al. (2018) find is the cause of the increasing switching away from auctions toward sales at fixed prices. Two important differences are that the Buy It Now price is not determined in a formal auction and that it may go away once bidding starts.

Many individual sales that used to be conducted at garage sales and later on eBay are now conducted on Facebook. Facebook garage sale groups exist for millions of locations around the world. In a garage sale group, the convention is as follows. The seller posts a picture and short description of the item and a price to the group's news feed. The first buyer willing to pay the price gets the item. Some people may post a comment that they are willing to buy for less than the seller's price. Thus the convention is a Dutch auction where the price never descends and an informal English auction. In practice, if the item does not sell, the seller will repost with a lower price, implementing an informal and manual Dutch auction. So in an informal way, these communities are implementing Channel auctions. With a small amount of logic, these garage sale posts could be mechanized, adding a clock to descend the seller's price (say, by $1 per day), and allowing more formal bids below the seller value. Such formalization may be particularly useful in contexts where communication is harder and trust lower, such as more decentralized versions of this procedure facilitated by blockchain technologies.

5.2. Real Estate

Home buyers are often legally required, by governments and/or lenders, to conduct detailed inspections and appraisals. Still, these processes do not resolve all potential uncertainties about the value of a home. If a foreclosed home is cheap enough, a buyer may need little due diligence to be confident in a good return on investment. But if the price of a foreclosed home goes up, the buyer may need to spend considerable time and effort to evaluate whether the opportunity is worthwhile. In a way, real estate works like an informal Channel auction, analogous to the consumer goods example given earlier. A buyer can usually buy a house at the seller's price. The seller will lower the price over time if the house is not selling. Otherwise, buyers compete in an informal English-style auction.[8]

5.3. Cryptocurrencies

Many assets within cryptocurrency and blockchain communities are sold via auction and involve substantial information acquisition. Two examples are auctions for including transactions in blocks and auctions for wallet addresses. We briefly describe each and discuss how Channel auctions could improve outcomes in each case.

In popular cryptocurrencies such as bitcoin and ether, the demand to include transactions in the blocks that constitute the only reliable record of changes in the state of the system has outstripped the space available to record these transactions. Transaction fees are used to clear the market, most commonly by every transaction proposer (viz., currency user) submitting a bid price for including their transaction in a block, block makers and validators taking the top set of offers. Assuming that the value of inclusion continues to rise and limits on availability remain tight, the quality of price discovery and allocation via these competitive processes will play a significant role in the success of cryptocurrency communities.

Transactions waiting to be included are held in a queue called a mempool. Transactions are pulled from this pool in a priority order given by the transaction fee they bid. Thus, in practice, the transaction fee chosen determines the rate at which the transaction is included on a block, and most transactions are eventually processed in a low-demand period. As demand grows, latency in posting transactions is thus expected to rise.

A number of projects have recently been developed to increase the value and reduce the volume of transactions posted to the fully public, decentralized chains. Some prominent examples within the Ethereum community are State Channels and Plasma. Both of these solutions aim to create lower-cost means of recording transactions by conducting many transactions off the main chain and reporting only summaries or net versions on the public chain. Eventually, the optimal versions of such protocols may be adaptive in the sense that they will post to the public chain less frequently if and when transaction fees are high, though they will also post more frequently when more consequential transactions have take place internally and thus the security of a summary on the public chain is needed.

In such cases, price signals and a thoughtful allocation process will be critical to allow the algorithms or individuals administering these side chains and channels to determine when it makes sense to post to the public chain. The present queue structure leads to uncertainty about latency in transaction inclusion, potentially creating security cost and some degree of chaos. A potential alternative is a batched Channel auction that takes place in the run-up to the epoch associated with the block in question and that closes just before the block does, so that prices can be increasingly well forecast as the block closing approaches. Given the rapid growth of this space and the strong openness to experimentation, this may be the nearest-term application for Channel auctions.

Another interesting application in this burgeoning space is domain names (such as addresses for wallets where tokens are held). Many within the blockchain space refer to the movement as Web 3.0, and domain names and other addresses are important real estate in blockchain communities. Within Ethereum, Maurelian (2016) describes the auction currently being used to sell names. At any time, anyone can show interest in a name and start an English auction that lasts three days for this name.

A difficulty this system creates, however, is that trolls may sit and watch for auctions and if an interesting name arises may enter the auction and extract surplus from someone attempting to register a name. This problem is particularly acute in blockchain environments because everything is, by design, public in a way that invites such front-running behavior. This may undermine investments that are complementary with obtaining this name, harm acquisition of information, create exposure problems, and so forth. A natural solution is to add a Dutch element to the system. Since it began operation in 2017, the current system has had a deadline of four years until it stops accepting new registrations. A global declining price could be introduced that is a cap on the price of currently unregistered domains. This cap could gradually fall until that final date, guaranteeing a buy-it-now price for domain names. English auctions could still be triggered, but any participant could buy a name immediately at the global Dutch price. This approach would bring the benefits of the Channel auction while preserving the general structure of the present system.

5.4. Discussion of the Assumptions

We consider a particular and stylized setting that has three bidders, a specific joint distribution of valuations, and a specific information structure. This stylized setting makes it simple to explain the potential advantages of Channel auctions. But it also stacks the comparison in favor of Channel auctions, since it is a setting where the advantages appear with no costs.

More important, in our stylized setting we can reach first-best welfare with a simple Channel auction, with a Dutch phase followed by an English phase. But, in general, the optimal Channel auction might be different. For example, we may want to switch more often between the Dutch and English phases, so that effectively the Dutch price changes during the English phase. Or we may want to forbid clinching the object at the Dutch price at some points (effectively setting $P(t) = \infty$ sometimes, so that P would not be weakly decreasing).[9] An interesting direction for future research is to consider more general settings and to derive prescriptions for how to design Channel auctions.

We also make the stark assumption that the collector can instantaneously learn her valuation upon paying the inspection cost. In practical applications, inspection takes time. Therefore, depending on the application, it may or may not be practical for inspection to occur during the auction. For example, it may be reasonable to have a privatization auction with a descending Dutch phase, followed by an ascending English phase that takes place a month later. And it may be reasonable to have a large spectrum auction that takes place over the course of a month, so that firms can perform research on their valuations as the auction proceeds. However, in other settings, auctions have to be conducted more quickly so that inspection during the auction is not practical. It would be interesting to model this issue formally to better understand the situations where Channel auctions can perform well.

6. Conclusion

The most puzzling thing about Channel auctions is why they are not already more prevalent, at least as a formal proposal by economists. If Dutch auctions have some benefits and English auctions others, then it is natural that there are circumstances in which combining lower and upper bounds on prices through a process of honing in would be superior to either. Our analysis formalizes this point in a simple setting. We hope that our results will inspire further research and practical experimentation on this topic.

Acknowledgments

Microsoft Corporation has patents pending on many of the methods described in this document. The authors thank Eva Beylin and Vitalik Buterin for useful comments on this paper and Charlie Thompson for research assistance.

Endnotes

[1] Although the English Channel actually runs between England and France rather than England and Holland, the pun seems close enough to be worth making.

[2] We thank an anonymous referee for this example.

[3] It can be shown that the collector does not want to clinch the object during the Dutch phase. This will become clear from the theoretical analysis in Section 4 because the strike price $\bar{\sigma}$ in this example is about \$89.44.

[4] More precisely, the ascending phase is a Japanese auction, where prices rise according to a clock, as opposed to an English auction, where prices rise in an open outcry.

[5] We consider this particular, stylized setting rather than general joint distributions of valuations and information structures. As such, our analysis is closer to an example than to a general analysis of Channel auctions. This stylized setting both stacks the comparison in favor of Channel auctions and makes the analysis simple so that we can make the key points in a transparent way.

[6] This relies on mild assumptions about the dynamic game that the bidders play. This property will hold, for example, if prices are updated in discrete time, but at each price update, bidders take turns deciding whether to drop out or clinch.

[7] This property also relies on mild assumptions about the exact dynamic game played by bidders.

[8] Whereas this description often applies to individuals selling their homes, foreclosure sales may be different. It is rare for banks to both list a house and subsequently run an auction. We thank an anonymous referee for pointing this out.

[9] We thank an anonymous referee for making this point.

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