"Setting the Tone" and "Drawing the Line" in Chittagong Tea Auctions*

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Abstract

We characterize the impact of the auctioneer in a large market in the context of tea auctions in Chittagong, Bangladesh. Rather than naïvely applying agency logic, we argue that the auctioneer's behavior is better understood using the lens of market design. In a rapidly moving auction, with four lots of teas sold per minute, we find that there is positive externality on subsequent lots from raising the acceptable price for a lot. Hence, an auctioneer, who must prevent auction prices from collapsing, will attempt to withdraw teas that are not fetching high prices, incurring short run costs. Because the auctioneer needs to keep the sellers' trust that he is taking the best actions for them, he implements such a withdrawal policy mainly with the tea produced by estates in which he has a stake. While these teas receive a high price when sold, they sell less frequently creating an overall positive impact on market prices. Thus, it is the auctioneer's desire to appear non-opportunistic, rather than opportunism, which results in his differential treatment of tea from estates which are related and not related to him.

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1 Introduction

In traditional auction theory, the auctioneer does not play a significant role: typically, auctions are assumed to be run by sellers – the auctioneer is essentially treated as a non-entity, indistinguishable from the seller.[1] In practice, however, many auctions are administered by third party auctioneers – market makers who do not own the product and may get a small share of the total revenue as a commission. The auctioneer's payoff depends, to a great extent, on how attractive the selling venue is to sellers and buyers. As such, the success or failure of the overall auction is largely shaped by the actions of the auctioneer. While the importance of the market maker has been noted in the market design literature, traditional auction literature does not offer much evidence to capture precisely the role of an auctioneer.

We study a unique data set from tea auctions in Chittagong, Bangladesh, a large well-organized market for tea, which provides a rich and colorful economic environment to examine market design and the role of the auctioneer. We explore how the auctioneer chooses the strategic variables within an auction market based on his incentives and the incentives of the other market participants. Given the potential divergence in incentives between auctioneers and his clients, the producers of tea, the clients may limit the auctioneer's flexibility in choosing the strategies that affect auction outcomes. We find that, however, a greater flexibility in choosing auctioneer's strategies leads to higher prices in an auction.

On the surface, a study of the auctioneer's incentives in these auctions might proceed by focusing on the potential agency problem between the auctioneer and his clients, the tea estate owners who contract with the auctioneer to sell their tea. Because the auctioneer earns only a percentage of the auction revenue, he may enjoy benefits from agency which enable him to maximize his own payoff at the expense of the sellers and buyers in the auction. We take a different approach: we argue that a naive application of agency

[1] The role of auctioneer is typically missing in theory models and empirical analysis of auctions as can be seen in Krishna (2002) and Hendricks and Porter (2007). While recent papers such as McAdams and Schwarz (2007) or Skreta (2010) consider auctioneer's preferences and incentives, they do not consider diveregence in preferences between the auctioneer and the owner of the object.

theory may not yield the right explanations for outcomes in these auctions. Numerous conversations with market participants and personal observations of the auctions suggest a deeper story of the auctioneer's role in these auctions. The auctioneer is a long run player who represents all the market participants and must balance relationships with individual clients (sellers) to ensure that they do not move to a competing auction house.[2] He is an emcee who "sets the tone" and "draws the line," who must be willing to take steps to keep the auctions interesting for buyers and prevent prices from collapsing. The auctioneer needs to earn the trust of all clients, and establish a reputation for non-opportunism. He is a market maker, an eBay or Amazon.com in miniature and "market makers are in the trust business" (McAfee, 2004).[3]

The potential divergence in objectives between a market maker and an individual seller can be illustrated using this somewhat different scenario. Consider a market maker who has been hired to sell 10 identical units of a product. However, perhaps after receiving more information about the demand, he realizes that selling only 8 units will actually maximize the overall profit. Then, as a market designer who wants to maximize the overall profit, he will choose the prices so that two of the units are not sold. Suppose that each unit is owned by a different seller. Then, a seller will not want her unit to go unsold. Thus, the objectives of the sellers and the market maker are not aligned. If sellers are aware of this issue, they will be wary of this misalignment and may leave the market maker if they feel they were wronged. Thus, the auctioneer may take suboptimal actions (from the market point of view) to keep the clients happy. The auction scenario with heterogenous products is more complicated than the above situation. Nevertheless, when there is interdependence in prices across auctions, the main tension between the

[2] We use the terms "auction house" and "auctioneer" interchangably. We focus on the auction houses' strategies, based on their incentives, in the context of an auction market. Recently, Capizzani (2008) and Lacetera et al. (2013) have investigated how auction outcomes are affected by the presence of a live auctioneer or heterogeneity among auctioneers. We do not look at the effects of individual auctioneers. Rather, we focus on the importance of studying the auction house's strategies in the context of an auction market.

[3] There has been a number of papers that investigate the impact of trust between buyers and sellers on auction outcomes, especially, in the context of reputation ratings in online auctions. See, for example, Resnick and Zeckhauser (2002), Hauser and Wooders (2006), Cabral and Hortacsu (2010), or Nosko and Tadelis (2014). However, as far as we know, ours is the first paper to analyze how trust between the auctioneer and market participants impact auction outcomes.

incentives of the auctioneer and the sellers will be similar.

If a seller does not trust that the auctioneer is taking actions that is optimal for her, she can choose a different auction house when her current contract with the auctioneer expires. As a result, even if there is a difference in incentives between the sellers and the auctioneer, the auctioneer is likely to follow the seller's directives. Identifying the difference in the preferred strategies is, thus, difficult. We exploit a difference in ownership of tea estates, with some being affiliated with the auctioneer, to highlight the auctioneer's role. In our data, one auction house is a *pure auctioneer*, which only sells tea from estates owned by client sellers. The other one is an *integrated auctioneer*, which also sells from estates owned by its own holding company (we often refer to these estates as *affiliated estates* for brevity) along with tea from clients. Tea from its affiliated estates represents a significant part of the integrated auctioneer's portfolio (18.4%).

Another special feature of our data set is noteworthy. A particular challenge for empirical analysis of market data is the heterogeneity, especially in terms of the quality, of different products up for sale. An especially useful feature of our data is that the auctioneers provided us with their private quality notes on the tea they sold; these allow us to control for virtually all differences in the quality and other characteristics of tea and, hence, cleanly identify the impact of the auctioneer's actions on auction outcomes.

We find that an auctioneer is able to obtain a higher price on average for tea from affiliated estates. Also, he is more willing to postpone the sale of tea *lots* from affiliated estates.[4] At first blush, one may be tempted to interpret this as another example of an opportunistic agent favoring tea from his affiliated estates. Interestingly, however, we find that postponing the sale of a lot does not typically increase the price of the lot when it is again up for sale on a future auction day. Thus, there seems to be a withdrawal penalty, which apparently hurts the auctioneer's affiliated estates adversely: this contradicts the simple agency story. Our explanation is more subtle. In a dynamic auction setting, the auctioneer needs to manage the externalities between auctioned lots well. For example, a

[4] On an auction day, an auctioneer sells many *lots* of tea individually auctioned off via sequential English auctions. We refer to the auction day with many independent English auctions as the auction and each individual auction within it as a lot.

high price on a current lot may positively impact the price of a future lot and a low price may do the opposite.[5] By taking costly actions on lots from estates with whom he enjoys greater trust and whose policies he has greater control on, the auctioneer creates benefits for all sellers and, presumably, increases own payoff in the process.

We now give more precise details of the above argument. As mentioned above, our auctioneers are better viewed as market designers and market makers rather than standard sellers' agents. Although they capture only a fraction of the price from a tea lot as a commission, each lot of tea is also an instrument to impact the market as a whole. Conversations with auctioneers suggest that establishing and maintaining *momentum in prices* is of prime importance. Thus, we begin with the premise (which we verify empirically) that if a lot of tea fetches a higher price, it generates a positive price externality on subsequent lots. For each lot, the outcomes of prior lots provide a "benchmark," by which we mean the price the previous lot sold at or the reserve price for the lot if it did not sell. A high benchmark makes bidders on subsequent lots more aggressive.[6] Similarly, a low sale price generates a negative externality. Hence, strategic withdrawal of a lot that is not receiving a high enough bid may keep tea prices of future lots listed in the auction from falling. An auctioneer who is charged with setting the tone by keeping tea prices from collapsing for *all* lots, therefore, would like to choose a higher reserve price than sellers who benefit less from this externality. This suggests that, fixing the number of potential buyers, the probability of selling a tea lot will be lower but the price conditional on selling will be higher if the reserve prices were chosen by the auctioneer.

The optimal reserve price for a lot, from the viewpoints of both the auctioneer and the seller, may depend on some information that is available only to the auctioneer or is not verifiable by the seller. Hence, if a seller fully trusts the auctioneer, she will give him

[5] Such an dynamic price externality may arise from buyers' rational updating from prices about an unobserved demand state. It may also arise from behavioral models of "reference price dependence" (cf. Koszegi and Rabin (2006)). We do not explore the causes of the price externality here.

[6] Optimal strategies for the overall market depend on the demand function. In our setting, the uncertainty in demand is characterized by the price that is received or the price that the auctioneer wants to receive. Suppose lots within an auction market can be affected by some common demand shock. This common demand shock is communicated through the price a lot receives or the minimum acceptable price; *i.e.* the reserve price. We posit that there is a positive externality of the benchmark price on the price for a lot.

more flexible guidelines regarding the reserve price to exploit his informational advantage. On the other hand, as the seller may be concerned that the auctioneer has the incentives to choose a higher reserve to capture the market externality, she will be wary of the auctioneer using asymmetric information to mask a high reserve price. In that case, she will give the auctioneer more rigid guidelines regarding the lowest acceptable price for a lot. Thus, greater the degree of trust with a client, the greater would be the auctioneer's flexibility to react to changing conditions.[7] This would imply that as the auctioneers have a greater control in determining reserve prices for lots from affiliated estates, these lots will receive higher prices conditional on sale. This is exactly what we find with our data.

Additional results confirm our main story. Although we do not directly observe the reserve price, an interesting market feature allows us to indirectly test the impact of the auctioneer's strategic behavior on the reserve price. Before each auction the auctioneers announce an expected price, known as the valuation, for each lot of tea. This publicly announced valuation, on average, tells us the reserve price for a lot. We find that the valuations for lots from affiliated estates are higher than other lots. Another significant feature is that some sellers own a number of tea estates and have many more lots up for sale compared to a typical seller. These sellers with larger portfolios gain more from the positive externality that an auctioneer can affect in the market. Thus, they internalize some of the externality gained from the auctioneer's strategic behavior. Their objective functions are more aligned with those of an auctioneer implying they are likely to allow the auctioneer more flexibility in choosing the reserve price. Indeed, in our data set, lots from larger sellers have higher valuations and, hence, reserve prices than do lots from sellers with small portfolios but have lower valuations than do affiliated lots.

Another aspect of this auction market comes from large vertically-integrated buyers. These buyers also own tea estates, and they buy tea to market it under their own label of tea to final consumers. They value an unsold lot from their estate differently from the typical seller. They can use their own tea for their own blend of tea rather than incurring the cost associated with an unsold lot or letting a competitor buy the lot at a low price.

[7] Conversations with market participants are consistent with this notion.

We find that their strategy implies sort of a price floor for their tea and the probability of sale is higher. Thus, the purchase strategy for integrated buyers for their own tea creates effects similar to the withdrawal strategy of auctioneers on tea from their affiliated estates.

In the following section, we first describe tea auctions in Bangladesh. Then we sketch a simple model of auctioneer behavior, and derive some empirical predictions related to the auctioneer's willingness to withdraw lots of tea when a reserve price is not met. Subsequently, we test these predictions using the data.

2 Data and Market Description

Bangladesh, where tea is the most popular and affordable drink, is a large tea producer. The bulk of the produced tea is sold in the open market via auctions as the producers are required, by government regulation, to sell at least 80% of tea in the open market.[8] There are usually 45 auctions every year, with an auction held each Tuesday during the months of April to January except for the two religious holidays.[9] The auctions are organized by the Tea Association of Bangladesh (the association of tea estate owners) and are administered by six auction houses or auctioneers in the same venue in the city of Chittagong.

The time line or auction design is as follows: The tea to be sold on a specific auction day is entered in a catalog almost two weeks in advance. Sellers send tea from various tea estates of the country to Chittagong, where the auctioneers take control and store them in bonded warehouses dedicated for tea storage. The auction catalog by a specific auctioneer for a specific auction day lists the sequence of the lots of tea that auctioneer will put up for sale on that day and typically includes all the tea that he has in the warehouses. The catalog describes each lot by the grade of tea denoting the type or category of the tea, the

[8] The purpose is to create credible base for the excise tax government charges for tea sale. However, the restriction does not seem to be binding as sellers choose to sell almost all of their tea via the auction. These well-run auctions provide transparency in the pricing process for all the stakeholders—government, tea estates, buyers, and auctioneers. Indeed, even integrated producers, who are also retail packaged tea sellers, prefer to sell almost all their tea through the auction rather than engaging in transfer pricing between producing and marketing units.

[9] December and January are lean periods in tea production and, as a result, the auctions are not held in February and March.

name of the tea producing estate, the tea leaf processing factory, the warehouse where the tea is stored, number of bags in the lot, net weight of each bag, and the total weight of the lot. A lot usually contains 10 bags of identical weight (usually around 55-60 Kg.). Once the catalog is prepared, the auctioneer tastes every lot of tea, from which he derives the valuation for the lot which is entered into the catalog. We will say more about this valuation process later. Five days before each auction, the final catalog is sent to buyers along with randomly drawn tea samples from each lot.

On the auction day, the six auctioneers sell their lots one after another. The sequence of auctioneers in the first auction of the year is decided by lottery. This sequence is changed every week where the first auctioneer in the previous auction goes to the sixth position and all other auctioneers move up one position in the sequence. During his turn, an auctioneer sells his lots sequentially (according to the sequence listed in the catalog) using English auctions.[10] The auction determines the per Kg price of tea in the lot.[11] An auctioneer is allocated 15 seconds (on average) to auction off a lot. After an auctioneer auctions off all the lots on his catalog, the auctioneer next in line sells his lots. The auction day ends after all six auctioneers auction off the lots on their catalogs. The lots that are sold in the auction are delivered to the buyers from the warehouses and the lots that are not sold are kept in the warehouses to be sold in a future auction.

Sellers, who are the owners of the tea estates, contract with an auctioneer to sell tea on their behalf. Contracts between a seller and an auctioneer are typically a year long and the tea estate can choose a new auctioneer once the contract expires. However, in practice, only a small number of estates move from one auctioneer to another each year. There is variation among the sellers. As mentioned earlier, some tea estates are owned by the auctioneer's holding company, but most are owned by client companies. We refer to these two kinds of sellers as *affiliated* and *unaffiliated* sellers, respectively. Some tea estates are stand alone operations owned by companies that own a single tea

[10] For a discussion on optimal lot sequencing, see Grether and Plott (2009).

[11] Unlike Athey and Levin (2001), however, the total weight of a lot is clearly known to all the bidders. Any potential uncertainty about a lot from a buyer's point of view can only come from the unobserved quality as all other relevant information such as the category, the producing estate, and the processing plant for a lot are publicly known.

estate. On the other hand, some companies own a number of tea estates. In our data set, almost 42% of the auctioned lots are from estates owned by two large and established tea producing companies. These two companies specialize in tea production and do not engage in retail tea sale. We refer to them as *major* estates. Major estates are known for greater uniformity in the quality of the tea they produce.

There is also considerable variations among the buyers in this auctions, who have to be registered with the Tea Traders Association of Bangladesh. They vary by size and the types of markets they serve. Some of the buyers are wholesalers of tea who later sell the loose tea to retailers country-wide. Some buyers are large packeteers who blend and package the loose tea for retail sale to the public under recognized brand names. Some buyers buy tea for direct export as loose tea. However, with the steady income growth, the domestic demand is increasing, and the share of tea sold for export has decreased over time. With the rise in incomes, the market for blended tea sold under recognized labels is also becoming very significant. An interesting feature of Chittagong tea auctions is that some of these large buyers, in addition to having their own brand of packaged tea for the retail market, also own tea estates and even purchase their own tea from the auctions. We refer to these buyers as *vertically integrated* buyers or estates as they can be both the seller and the buyer for a lot.

The auctioneer receives 1% of the sale price as a commission from the seller and Tk. 0.05/Kg, irrespective of the sale price, from the buyer of each lot. The commission rates have been fixed by negotiation between the Tea Traders Association of Bangladesh, The Tea Association of Bangladesh, and the Bangladesh Tea Board of the government. These rates have not been changed in a long time.

We have catalog data from the two largest auction houses for 16 auction days from August 2005 to November 2005 totalling 17629 lots of tea.[12] These two houses account for more than 65% of the total tea sold. We also have the list of the lots that succeeded in selling during the auction and the final price and winner list for these auctions.

[12] The exchange rate was around USD 1 = Tk. 65.70 during the time the data was collected.

Auctioneers' private tasting and publicly announced valuation From each lot of tea, 1.8 Kg of tea is set aside as a sample. From this, the auctioneer as well as all buyers can sample each lot prior to the auction. The auctioneers in Chittagong tea auctions are typically expert tea tasters who taste the tea to be auctioned off themselves prior to the publication of the final catalog to judge the quality of each lot. The auction houses provided us with their private tea tasting notes. These notes, which are only for the auction houses' internal use and are never shared with buyers or sellers, clearly state the quality of the tea. The tasters (auctioneers) usually write detailed comments on the appearance of the tea leaves and the liquor or give some alpha-numerical rating to the lot. From these notes, in consultation with the auctioneers, we created an index of quality rating and assigned a numerical score between 1 to 10 to each lot. This private information from the auctioneers allows us to control for unobserved quality heterogeneity across lots. As strategic choices by the auctioneers, sellers, and buyers are likely to be different depending on the quality of a lot, this is a particularly useful feature of our data set. Our quality rating aids us in disentangling the differences in auction outcomes arising from participant strategies and those arising from heterogeneity in tea quality. Instead of figuring out the quality of lot from bidding behavior, we can directly use the quality ratings to analyze auction outcomes and choice of reserve. In a recent paper, Roberts (2014) presents a novel way of controlling for unobserved heterogeneity using the reserve price under the assumption that it is chosen by seller. By directly controlling for product heterogeneity, we can more easily analyze the strategic interaction between the auctioneer and the seller that determines reserve prices.

The auctioneers actively conduct market research about the future demand of tea due to local consumer demand and demand from exporters. They use the information on quality and future demand to estimate a valuation for each lot. This valuation is listed on the catalog and we refer to it as the publicly announced valuation. This is an indicator of the expected price for a lot.

Withdrawing of lots The auctioneer is allotted around 15 seconds, on average, to auction off a lot. To quicken the auction process, he typically starts the auction of a lot around Tk. 1 to 2/Kg below the publicly announced valuation. If there is a bid at the starting price, the auction proceeds as a regular English auction. However, this starting price is typically above the (unannounced) reserve price. If there is no bid at the starting price, the auctioneer decides whether to reduce the price, in intervals of Tk. 0.50/Kg or Tk. 1/Kg. A buyer can place a bid and buy the lot at the reduced price during this process. If no buyer offers a bid even at the reserve price, the auctioneer moves on to the following lot in the catalog without selling the current one. We refer to this as *withdrawing* a lot or keeping a lot *unsold*.[13] Withdrawing of a lot, hence, is a strategic variable that is exercised during the auction. If the auction outcome of a lot affects the outcome of subsequence lot, each lot acts an instrument for the auctioneer to influence the overall auction. We will explicitly model the auctioneer's withdrawal decision during the auction of a lot in the context of the auction market in the following section. A withdrawn lot can be re-listed in a future auction, typically two weeks after the lot is withdrawn (there must be at least a two week gap before the lot can be re-auctioned as the lots for the auction on the following week are already decided). The seller incurs costs associated with storage and bank loans, and also needs to provide an additional 1.8 Kg from the tea lot as a sample; the auctioneer incurs some re-auctioning costs which are relatively small. Moreover, while tea is not perishable, the freshness of tea reduces over time losing some of its value.

How much lower the actual reserve price is relative to the starting price is uncertain. This depends on a number of variables such as the quality of the lot, expected supply and demand in future auctions, and realized demand in the current auction. As the auctioneer usually has more information than the buyers and sellers due to deep knowledge of the client tea estates and market research, there is asymmetric information between the auctioneer and the other market participants. Nevertheless, the reserve price is, on average, very closely correlated with the publicly announced valuation. Thus, even though we do not observe the exact reserve price in these auctions, this valuation provides us with

[13] If the starting price equals the actual reserve price, then the auctioneer withdraws the lot without reducing the price from the starting price if there is no bid. As the auctions are run extremely fast and there is uncertainty about the price at which the auctioneer will withdraw the lot, buyers typically do not collectively refrain from bidding if they are interested in buying at the starting price.

a good proxy for that.

2.1 Auctioneer Behavior: A Model Incorporating Externalities

Given the auctioneer's superior information and the power in influencing sale prices, the potential for opportunism arises. However, numerous conversations with market participants (not only the buyers and sellers, but also the auctioneers) have convinced us that it is overly simplistic to assume that auctioneers exploit their advantageous position to line their pockets. Typically, being an auctioneer is a lifetime career, and in order to succeed, auctioneers need to earn the trust of sellers, as well as establish a reputation for non-opportunistic behavior. In this sense, tea auctioneers in Chittagong are akin to market makers like eBay or Amazon.com, in miniature scope. Thus, we assume that the auctioneer's goal is to maximize profit for *all* sellers. Interestingly, we illustrate below that when the prices from lots within an auction market are correlated, optimal strategies from the points view of the seller of a single lot and the market maker are different.

Model. In what follows, we sketch a model in which the auctioneer's goal is to maximize the total revenue from all auctions in the market where revenue from a lot equals the price if the lot is sold and equals the value to the seller of the unsold lot otherwise. There are T lots up for sale in the auction. The reserve price for lot $t \in \{1, 2, \ldots, T\}$ is denoted by r_t; that is, the lot is withdrawn if it fails to to sell even at a price of r_t. We refer to the highest amount a bidder is willing to bid in the English auction for lot t as her bid on that lot. Suppose the realized highest and second highest of all bids for lot t are denoted by p_{1t} and p_{2t}, respectively. Given the auction structure, the observed price equals zero if p_{1t} is below r_t, it equals r_t if p_{1t} is above or equal to r_t and p_{2t} is equal to or below r_t and equals p_{2t} if it is above r_t. Thus, the observed price for lot t is generated by the following equation:

$$p_t^* = \begin{cases} 0 \text{ if } p_{1t} < r_t \\ p_t = \max\{r_t, p_{2t}\} \text{ if } p_{1t} \geq r_t \end{cases} \tag{1}$$

Next, we introduce the dynamic price externality in a given auction. Let h_t denote the "benchmark" price for lot t; we define this benchmark as equalling the price that the previous lot (lot $t-1$) received if it was sold and the price at which the lot was withdrawn if the lot went unsold. That is:

$$h_t = \begin{cases} p_{t-1} & \text{if lot } t-1 \text{ was sold} \\ r_{t-1} & \text{otherwise} \end{cases} \tag{2}$$

Thus, the benchmark price is a measure of the "prevailing" price level around the time when lot t is on the selling block. This benchmark price can be an indicator of the overall market demand on the auction day, with a high benchmark indicating that the demand is likely to be strong and a low benchmark suggesting the opposite.[14]

The auctioneer's goal is to choose a sequence of reserve prices $\{r_1, r_2, \ldots, r_T\}$ to maximize the expected revenue across all the lots in an auction given the information she has. We assume that the auctioneer is better informed about market conditions, and the quality of the teas under his gavel, than the buyers and the sellers. Because of the dynamic price externality, the auctioneer faces a dynamic optimization problem in which the benchmark h_t is the state variable:

$$V_t(h_t) = \max_{r_t} \mathbb{E}\left[u_{0t}\mathbf{1}_{\{p_{1t}<r_t\}} + p_t^*\mathbf{1}_{\{p_{1t}\geq r_t\}} + V_{t+1}(r_t)\mathbf{1}_{\{p_{1t}<r_t\}} + V_{t+1}(p_t^*)\mathbf{1}_{\{p_{1t}\geq r_t\}}\right]$$

where

$$V_T(h_t) = \max_{r_T} \mathbb{E}\left[u_{0T}\mathbf{1}_{\{p_{1T}<r_T\}} + p_T^*\mathbf{1}_{\{p_{1T}\geq r_T\}}\right].$$

In this problem, $V_t(h_t)$ denotes the value function, the continuation revenue, starting from lot t when the current benchmark price is equal to h_t. We denote by u_{0t} the expected net future payoff from lot t if it is not sold in the current auction.

While the auctioneer's job is to maximize *overall* revenue from the auction, each individual seller desires only to maximize the revenue from the lots that she owns. The auctioneer chooses r_t to maximize her value function given the current information. If lot t sells at price p_t^* then the benchmark price for lot $t+1$ equals p_t^* and, otherwise, it equals r_t. On the other hand, the owner of the lot, assuming she does not own any other lot, aims to maximize the value $\mathbb{E}\left[u_{0t}\mathbf{1}_{\{p_{1t}<r_t\}} + p_t^*\mathbf{1}_{\{p_{1t}\geq r_t\}}\right]$. It is easy to see that if the price function is independent of the benchmark price h_t, *i.e.* the underlying market

[14] When a lot does not sell, a high reserve indicates that the auctioneer and seller believes that the demand that day should be high. A low reserve, on the other hand, indicates that the expeceted demand is low, but the lot still did not sell.

demand does not affect a bidder's bidding behavior, then the objectives of the seller and the auctioneer are aligned. As the outcome of lot t does not affect the value function for lot $t+1$, the optimal reserve price from the view point of the auctioneer is the one that maximizes just the expected revenue from lot t.

However, when the benchmark price and the underlying market demand affect a bidder's bidding behavior, the auction outcome of lot t affects prices for the subsequent lots. Specifically, suppose the price function is increasing in the benchmark price.[15] This can be viewed as a reduced form assumption to incorporate the interdependence in the bidding behavior across lots within an auction. In that case, the reserve price r_t for lot t will have positive externality on future prices. As a result, the optimal reserve from the auctioneer's point of view is higher than that from the point of view of the seller. This implies that if the auctioneer chooses the reserve prices, the probability of sale will be lower and the price conditional on sale will be higher relative to when the seller chooses the reserve. Nevertheless, we assume that the seller chooses the price at which to withdraw the lot or the reserve price if the lot is unaffiliated. For affiliated lots, the auctioneer chooses the reserve or at least has a bit of control there (the owner of the overall company *trusts* the auctioneer to take decision that is best for the company, but we can have the reserve price be completely transparent here). Hence, we will expect the reserve price higher, probability of sale lower, and conditional price higher for affiliated lots. To simplify the exposition and the proof of this result, we assume that all the bidders are symmetric in the sense that the highest bid a bidder is willing to place for a given lot is drawn from the same distribution for all bidders.

Proposition 1 *Between two otherwise comparable lots, an affiliated lot will have a lower probability of sale but a higher price conditional on sale compared to a lot owned by an unaffiliated seller.*

Proof. Suppose there are N bidders and the highest bid one is willing to place in the English auction is drawn from the distribution F on $[0,1]$. Here we implicitly assume a

[15] Below, we will verify empirically this assumption on the relationship between the price p_t and the benchmark h_t.

private-value paradigm in the sense that this value is not affected by the behavior of other bidders or the auctioneer. That is, the bidders do not receive any new information during the auction of the lot. Nevertheless, the function F can be allowed to be affected by the benchmark price for that lot. We assume that $f/(1-F)$ is an increasing function. The optimal reserve r_t^S from the viewpoint of the seller is

$$\begin{aligned} r_t^S &= \arg\max_r \mathbb{E}\left[u_{0t}\mathbf{1}_{\{p_{1t}<r_t\}} + p_t^*\mathbf{1}_{\{p_{1t}\geq r_t\}}\right] \\ &= \arg\max_r \left(F^N(r)\,u_{0t} + N(1-F(r))\,F^{N-1}(r)\,r + \int_r^1 y d\left(F^N(y) + N(1-F(y))\,F^{N-1}(y)\right)\right). \end{aligned}$$

Thus, r_t^S satisfies

$$f\left(r_t^S\right)\left(u_{0t} - r_t^S\right) + \left(1 - F\left(r_t^S\right)\right) = 0. \tag{3}$$

The above characterization of the optimal reserve is a standard result from auction theory (see, for example, Krishna, 2002).

On the other hand, the optimal reserve r_t^A from the viewpoint of the auctioneer is

$$r_t^A = \arg\max_r \left(\begin{array}{c} F^N(r)\left(u_{0t} + \mathbb{E}\left[V_{t+1}(r)\right]\right) + N(1-F(r))\,F^{N-1}(r)\left(r + \mathbb{E}\left[V_{t+1}(r)\right]\right) \\ + \int_r^1 \left(y + \mathbb{E}\left[V_{t+1}(y)\right]\right) d\left(F^N(y) + N(1-F(y))\,F^{N-1}(y)\right) \end{array}\right).$$

The first order condition is,

$$f\left(r_t^A\right)\left(u_{0t} - r_t^A\right) + \left(1 - F\left(r_t^A\right)\right) + \left(\frac{F\left(r_t^A\right)}{N} + 1 - F\left(r_t^A\right)\right)\left.\frac{\partial \mathbb{E}\left[V_{t+1}(r)\right]}{\partial r}\right|_{r=r_t^A} = 0. \tag{4}$$

If the benchmark price has a positive impact on the distribution of bids, and, hence, the price received for a lot, the value function is increasing in the benchmark price. That is, $\frac{\partial \mathbb{E}[V_{t+1}(r)]}{\partial r}$ is strictly positive. Then, comparing equations (3) and (4), we can easily see that $r_t^A > r_t^S$. Since the auctioneer chooses the reserve price for an affiliated lot and the seller chooses the reserve price for an unaffiliated lot, the probability of sale will be lower and the price conditional on sale will be higher for an affiliated lot for given F and N. ■

The above predictions are all testable if we assume that the publicly announced valuation is a good indicator of the reserve price. Moreover, unlike Levitt and Syverson (2008), we have made no assumption that the price of a specific lot is expected to be higher when it is finally sold in a future auction. In our case, the auctioneer and the market (meaning the overall revenue from all the lots together) have a higher value for an unsold lot than the seller does (in Levitt and Syverson the agent actually has a lower value for an unsold house than the principal does). In their case, suboptimality arises because the agent does not follow the principal's objective/instruction and there is asymmetric information (through a cheap talk game). On the other hand, in our case, suboptimality arises because the auctioneer (the market maker) does not want to appear opportunistic to sellers who are aware that the auctioneers can better internalize the impact of strategies on the market outcome. Hence, the seller would want the auctioneer to sell more often than optimal from the market maker's point of view. The divergence in optimal strategies come from the fact that the seller has a more narrow focus relative to the auctioneer.

3 Empirical Results

In this section, we report the empirical results pertaining to the auctioneers' actions and auction outcomes. Table 1 presents summary statistics on the number of lots, auction outcomes, and the publicly announced valuations for the two auctioneers. For the lots auctioned off by the integrated auctioneer, we also present the outcomes for the affiliated lots and unaffiliated lots separately. The last two columns of the table suggest that there is significant difference in auction outcomes between tea lots from affiliated and unaffiliated estates. Instead of analyzing the impact of the ownership structure on auction outcomes from Table 1, we investigate this impact more formally in the light of our theoretical model.

Our focus is on testing whether the implications of the model in the previous section – particularly, Proposition 1 – are confirmed in the data. With this objective, we transform the above into an empirical model: the price for lot t is given by

$$p_t = g\left(h_t, \Theta_t, \epsilon_t\right) = \alpha_0 + \alpha_1 h_t + \Theta_t^{\prime}\alpha + \epsilon_t. \tag{5}$$

Here, the vector Θ_t includes variables that describe the characteristics of lot t. The lot quality and the publicly announced valuation are elements of Θ_t. Moreover, ϵ_t denotes unobservables which affect price. Condition (5) summarizes the auction including the impact of all strategic decisions by participants. Note that, price p_t for lot t is only observed if the lot is sold. That is, as before, the observed price p_t^* equals p_t if the lot sells and equals 0 otherwise. We assume that whether a lot sells is generated by a latent variable model. That is, we define a linear index variable:

$$y_t^* = Z_t'\beta + \eta_t$$

where y_t^* is a dummy variable that equals 1 if lot t succeeded in selling. That is,

$$y_t^* = 1 \quad \Leftrightarrow \quad p_t^* > 0 \tag{6}$$

In the above, Z_t contains variables which affect whether the auctioneer decides to withdraw lot t. Specifically, equations (3) and (4) suggest that Z_t contains variables which affect *lot* ownership and also components of Θ_t. Moreover, η_t captures unobservables which also affect the withdrawing decision. Putting equations (1), (5), and (6) together, and assuming that (ϵ_t, η_t) are jointly normal distributed, we have a Heckman selection model.

3.1 Lot Ownership and Auction Outcomes

The theoretical model in Section 2.1 suggests that auction outcomes such as the price conditional on sale and the probability of sale depends on how closely the incentives of the auctioneer and the seller are aligned. Next, we present empirical tests of this. Based on the above empirical model, we present coefficient estimates for the price conditional on sale using a Heckman selection model. First, we ignore the benchmark price from equation (5) and regress price only on lot characteristics including whether the lot is from an affiliated or an unaffiliated estate. The basic regression equation for the price is:

$$p_{it} = \alpha_{0i} + \alpha_1 PV_{it} + \alpha_2 Aff_{it} + \alpha_3 Pure_{it} + \alpha_4 NT_{it} + X_{it}'\gamma + \epsilon_{it} \tag{7}$$

Here p_{it} denotes the price for the tth lot of auction day i. Note that the price is observed only when the lot succeeds in selling. The variable PV_{it} denotes the publicly announced valuation for the lot and Aff_{it} is a dummy variable denoting whether the lot is from an affiliated estate. Lots auctioned off by the pure auctioneer is denoted by the dummy variable $Pure_{it}$. The variable NT_{it} indicates the number of times that particular lot had been brought to the auction for sale (but was unsuccessful) prior to auction day

i. To control for the quality of tea, we include nine dummy variables to indicate the quality rating score generated from the auctioneers' tasting notes in the vector X_{it}.[16] In addition to these variables, X_{it} includes independent variables pertaining to the lot such as dummy variables that indicate the tea category, variables to indicate the position of the auctioneer on the day, whether the lot size is larger than average, etc. These variables allow us to control for most sources of lot-specific heterogeneity. The vector γ represents the coefficients associated with X_{it}. Auction day i specific constant is denoted by α_{0i}.

Table 2 presents the determinants of the price of a lot and whether it sold based on a Heckman selection model. The first specification presents regressions based on equation (7). Examining the price regression, we see that, relative to other lots, the price for a lot owned by an affiliated estate is higher by almost Tk. 0.54/Kg. From the selling equation, we see that the coefficient on affiliated estates is significantly negative (-0.316), indicating that the high revenue on these lots is achieved at the cost of selling less frequently. Thus, the result that affiliated lots that succeed in selling end up fetching higher prices although fewer of their lots sold, found in Table 1, survives even we control for lot characteristics and auction specific fixed effects. Proposition 1 suggests that, as the auctioneer will choose a higher reserve price for affiliated lots, the probability of sale will be lower and the price for conditional on sale will be higher for an affiliated lot relative to a comparable lot from an unaffiliated seller. The first column of Table 2 is supportive of the proposition. .

The above results are robust to decomposing the unaffiliated lots in terms of ownership. As described in section 2, there is heterogeneity among unaffiliated estates. Some estates are owned by major tea growers who own a number of estates and have many lots up for sale on an auction day while some sellers only own one estate and have few lots up for sale. On the other hand, some sellers also participate as buyers as they own tea estates and also tea packaging businesses. As the major and vertically integrated sellers may have somewhat different objectives, as discussed later in this section, Proposition 1 is most appropriate for a comparison between lots from affiliated estates and small unaffiliated estates. In column (2), we add a dummy variable to indicate lots from major

[16] Our results do not change qualitatively if we allow the impact of quality ratings to be different for the two auctioneers.

estates and one for vertically integrated estates. We also include these dummy variables in the selection equation. The addition of these variables do not significantly affect the coefficients for the affiliated lot dummy. We will discuss the coefficients of these two new ownership variables later in the paper. Overall, these regressions suggest that the auctioneers are less willing to reduce the price for their affiliated lots. As a result, these lots take a greater number of auctions to sell, but they obtain a higher price when they sell.

At first blush, these results may imply that the auctioneer may be exploiting his position to obtain higher prices for his affiliated tea lots by selling them in future auctions if the prices are not high, as the simple agency model would suggest. As a withdrawn lot is brought back for sale in an auction two weeks later, such explanation would require the price this lot will fetch in two weeks to be relatively high. However, other results in Table 2 cast doubt on this simple explanation. Specifically, we see that the coefficient on the number of times the lot was previously up for sale, is negative with a size of at least Tk. 0.61/Kg. This indicates that lots which have taken longer to sell received a lower price when they sold. That is, lots which have been withdrawn and subsequently resold on a future auction day suffer a substantial *withdrawal penalty* and the withdrawal penalty is magnified as a lot fails to sell more and more times. Taking this into account, it does not appear that the auctioneer's policy of withdrawing his own affiliated lots at a higher price is for his own benefit. This third result is inconsistent with the agency explanation for these phenomena, but is consistent with the idea that the auctioneer is willing to take costly actions – namely, withdrawing their affiliated lots in the face of a substantial penalty on subsequent sales – in order to maintain higher prices in the auctions, *even when these higher prices do not benefit him directly.* In column (3), we allow the impact of the number of times the lot failed to sell to vary for affiliated lots. Then, the net withdrawal penalty is positive but not statistically significant for affiliated lots, but is slightly larger than before for unaffiliated lots. Nevertheless, considering the cost of re-listing a lot that the auctioneer has to bear for affiliated lots, we can say that the auctioneers do not benefit from a higher future profit on the lots that they hold back.[17] The reduction in prices likely

[17] Another institutional details supports the finding that a withdrawn lot does not fetch a higher price

is caused by the reduction in freshness of the tea. An unsold lot may also provide some negative signal regarding the quality of the lot. Our main hypothesis is that the reserve price conditional on quality is higher for affiliated lots. Thus, fixing everything other than quality, an unsold affiliated lot is likely to have a higher quality than an unsold unaffiliated lot. This may explain why the withdrawal penalty is smaller for unaffiliated lots. Regardless of the exact underlying mechanism of why the price is reduced in a future auction, however, the result suggests that a simple agency model is not consistent with our results so far.

From conversations with market participants, and especially the auctioneers, it was clear to us that momentum of the price in the auction proceedings plays a critical role in determining auction outcomes. This also helps address the question raised by the preceding discussion – what is the benefit of keeping prices high? Thus, we include the benchmark price in the above price regressions to measure the effect of the price of the previously sold lot on the current lot. The results are presented in Table 3. We define the benchmark price for lot t to equal the price of lot $t-1$ if lot $t-1$ sold and to equal the reserve price of lot $t-1$ otherwise. We do not know the exact price at which the auctioneer withdrew a lot. Nevertheless, the reserve price is, on average, very closely correlated with the publicly announced valuation. Usually, the reserve price is Tk. 2 to 4/Kg below the publicly announced valuation. So, we approximate the reserve price of lot $t-1$ by that lot's publicly announced valuation minus Tk. 3/Kg.[18] In general, if a lot fetches a high price that raises the benchmark price for the following lot and it fetching a low price reduces the benchmark price. The auctioneer can also raise the benchmark price by refusing to reduce the price for a lot and not selling it. The benchmark price, in some sense, represents the current market price or the minimum acceptable price when there is not market price as the lot did not sell. The coefficient for the benchmark price is positive and significant (0.107), indicating that an increase in the previous price by Tk. 1/Kg increases the price conditional on sale by almost Tk. 0.11/Kg. Clearly, we see

when it is relisted in a future auction. The norm in Chittagong tea auctions is that an withdrawn lot is re-listed in the next feasible auction two weeks later, the re-listing date is not strategically chosen.

[18]Our results do not change if we deduct nothing, Tk. 1, 2, or 4 /Kg from the publicly announced valuation to define the reserve price.

that past prices have a strong positive externality on future prices, which would justify an auctioneer's attempts to keep price levels high as part of an overall policy of "setting the tone."[19] In column (2), we add two lags of the benchmark price. While, the effect of the first lag is negative and the second lag is positive, the net effect of the benchmark prices stay unchanged. The same holds true if we add even more lags.[20]

At the same time, withdrawing a lot appears to be a drastic way of keeping prices high, and one might worry that withdrawing a lot can also have adverse effects on future lot prices. To capture this possibility, under specification (3), we include a dummy variable to indicate whether the previous lot went unsold in the price regression. We also include the interaction of this variable with the benchmark price. These two variables together measure the effect on the current lot price if the previous lot went unsold. While the coefficient for the dummy variable is positive (2.510), the coefficient for the interaction term is negative (-0.02545). Evaluated even at a very high valuation of Tk. 100/Kg, the net impact of not selling a lot is equal to $2.51 - 97 \times 0.02545$, which is positive.[21] This finding is consistent with the idea that by withdrawing lots, the auctioneer credibly demonstrates that he "draws the line"; he does not tolerate soft bidding from buyers and will withdraw lots when the winning price is not high enough. Such credibility would naturally lead to more aggressive bidding, and hence higher prices for subsequent lots, especially for highly valued lots. All these results are robust to analyzing high and low quality lots separately or analyzing lots at different times during the auction day separately. We also find the same results if we use only a sub-sample of auction days such as the first or last eight days from our sample of 16 auction days. They are also robust to alternate definitions of the benchmark price when the lot does not sell. For example, suppose the benchmark price equals the price of the last lot that sold; that is, benchmark price for lot t equals the price of lot $t-1$ if lot $t-1$ sold and the benchmark

[19] The result does not change if we exclude the ownership dummy variables as regressors.

[20] Moreover, we also find that, once tea quality is properly controlled for via our measures, the sequencing of a lot within the auction has no effect on the auction price – put differently, there is no evidence of a deterministic trend in prices, once across-lot heterogeneity is controlled for using our quality measures.

[21] Note that we assumed that the benchmark price for the following lot when a lot goes unsold equals the valuation minus Tk. 3/Kg. Thus, if a lot with publicly-announced valuation of Tk. 100/Kg goes unsold, the benchmark for the following lot equals Tk. 97/Kg. The mean of valuations of all lots is below Tk. 80/Kg and 98.7% of all lots had valuation below Tk. 100/Kg.

price for lot $t-1$ if it went unsold. The results do not change in that case. Moreover, note that auction day specific fixed effects captures any systematic difference in prices between auction days. The impact of benchmark price, thus, shows how a high realization of price for a lot or a high reserve for that lot affects the bids in the next lot.

These four results together suggest that the auctioneer' strategic decisions respecting whether to sell or withdraw an affiliated lot end up – for the most part – benefiting sellers unrelated to the auctioneer. While these results are puzzling from the point of view of traditional agency theory, they support a story whereby auctioneers wish to acquire a reputation for being "tough" – that is, he draws the line in the manner described previously. In order to establish such a reputation, auctioneers need to credibly demonstrate their willingness to withdraw lots to keep benchmark prices high, even at a cost to himself. Hence, the auctioneer's *desire to appear non-opportunistic, rather than opportunism*, leads him to withdraw lots from estates related to them (affiliated sellers), because such actions – which work against their self-interest – internalizes the revenue loss from the withdrawn lots and makes their message more credible.

At the same time, a more subtle implication of this story is that auctioneers may be reluctant to withdraw lots sold by unrelated estates. This is because the relationship of the auctioneer with these sellers is more distant than vis-a-vis his affiliated estates, and the unrelated sellers may (mis-)attribute such drastic actions as opportunism on the auctioneer's part. Indeed, from the results for the sold regression, we see that the coefficients on dummy variables for groups of unrelated sellers, including major gardens and vertically integrated gardens, are positive and significant, indicated that the auctioneer is, ceteris paribus, less likely to withdraw lots from these unrelated sellers. For the auctioneers, the most convenient way to establish their *tough* reputation is by withdrawing lots sold by their own affiliated estates; this sustains a positive price externality which creates benefits for all sellers in the auction. One implication of this story is that the integrated auctioneer will have more flexibility in choosing optimal reserve prices and hence, will lead to higher prices than the pure auctioneer. Both Tables 2 and 3 show that the price is lower for lots sold by the pure auctioneer when we control for auction characteristics. This further supports our story.

Our results here, that auctioneers are more willing to withdraw their affiliated lots for later sale, are similar to results in Levitt and Syverson (2008) showing that real estate agents are more willing to keep their own houses on the market longer and waiting to sell at a higher price. However, in the Levitt and Syverson setting, there is no withdrawal penalty in our sense. The expected price rises as a result of waiting for a higher valued buyer in the future, so that the real estate agents' actions are purely in their self-interest, and are consistent with the usual agency theory. In Chittagong tea auctions, however, auctioneers Moreover, they incur a loss by withdrawing their lots; such actions against their self-interest are thus inconsistent with the agency model. Rather, they are consistent with our model of auctioneers as market makers who must gain the trust of market participants, and maintain a good reputation for non-opportunistic behavior. An important difference between an auctioneer in a large market and a real estate agent is that the auctioneer can influence the overall market outcomes by his actions while an individual real estate in a large market do not have much power to influence the overall market. As a result, the auctioneer acts more as a market maker while agency issues may be more problematic for a real estate agent.

Corroborating evidence: Impact of ownership on auctioneers' announced valuations Next, we consider another implication of Proposition 1 above, that reserve prices will tend to be higher for the auctioneer's affiliated lots and, more generally, for lots of tea in which the incentives of the auctioneer and the seller are better aligned. While we do not observe the reserve price directly in this data set, we use the auctioneer's publicly announced valuation for each lot, which has a close connection with the initial price at which the auction commences, and which is thus a reasonable proxy for the reserve price. We turn next to the regression results in Table 4, where the dependent variable is the publicly announced valuation. The tables suggest that the auctioneer announces a valuation for his affiliated lots that is, on average, higher by at least Tk. 2.77/Kg controlling for all auction characteristics. This further supports that the main mechanism behind the high price conditional on sale for auctioneers' affiliated lots is the costly action of reducing the probability of sale by keeping the reserve price high.

3.2 Additional Results

While the discussion thus far has focused on how an auctioneer's behavior differs between lots of tea with which he is or is not affiliated, here we discuss some of the other findings. These largely support our story that the auctioneer chooses the strategies based on how much flexibility he enjoys in choosing strategies regarding the lots of a particular seller. This flexibility arises from the how closely the objectives of the market maker and the seller are aligned. Specifically we look at the strategies for lots from major estates and vertically integrated estates.

Lots from major estates Recall that major estates own almost 42% of the lots listed in our data set. Thus, they may benefit quite a bit from interdependence of prices within an auction. Specifically, if there is some positive externality from high benchmark prices, they are likely to internalize that to some extent in their objective function unlike small sellers. Moreover, these estates have a very stable contractual relationship with their auctioneers, and they do not usually switch auctioneers. Hence, they may trust the auctioneer to take actions that are in their best interest than do smaller unaffiliated estates. These suggest that the reserve prices for lots from major estates is likely to be higher than that of lots from non-major unaffiliated estates, but lower than reserve prices of affiliated lots. We go back to columns (2) and (3) of Table 4 to test that. Indeed, the regression of publicly announced valuation, a close indicator of the reserve price, supports this hypothesis.

Tables 2 and 3 also show that the lots owned by the major estates have a higher price by more than Tk. 0.41/Kg relative to those of a lot by a non-major unaffiliated seller. The fact that these lots have a higher price conditional on sale is not surprising in the light of Proposition 1 and the above result that the reserve price for lots from major estates are higher than that for lots from smaller estates. If the lots are comparable other than the ownership, however, a higher reserve price will also mean a lower probability of sale. This implies that the probability of sale for lots by major estates should be lower than that for lots from non-major unaffiliated estates. However, the coefficients for major estates are positive in Tables 2 and 3. Thus, even after controlling for lot-specific heterogeneity such as the grade and quality of tea and the positioning of the lot, lots from major estates sold with a higher frequency while generating a higher price for sold lots.

These seemingly inconsistent results can easily be explained if lots from major estates enjoy a higher number of potential buyers compared to other lots. However, this cannot be directly tested in the data because we do not have any measure for the number of buyers across different lots of tea within a given auction day. Nevertheless, we have some indirect evidence that the smallest buyers buy significantly more frequently from major estates relative to other lots. It is indicative of that lots from major estates enjoy more bidders than other lots because of the greater participation of small buyers.[22] This, in turn, may underlie the results from Tables 2 and 3 that lots from major estates had both a higher probability of sale and a higher price conditional on sale. In Chittagong tea auctions, small buyers are more likely to purchase lots from larger sellers because they face an information asymmetry problem. This is because sample assessment varies between larger and smaller buyers. First, auctioneers send a sample of each lot to large buyers, i.e., those who bought relatively larger amounts of tea the previous year, which they can taste and view. Small buyers must visit the auctioneers' offices to only visually examine samples. Second, large tea buyers invest in tea tasters who can judge the quality of tea very well. On the other hand, for small buyers purchasing only a few lots, the benefit from learning the precise quality of tea may not be worth the fixed cost of doing so.[23] Hence, less informed buyers may depend on estate reputations rather then the quality of a specific lot on sale and prefer tea lots from estates with a greater reputation for tea quality and service. This is similar to the finding of Bronnenberg et al. (2013) that consumers with a greater knowledge of product quality buy generic brands more frequently over national brands for a broad set of health and food products than do regular consumers.

[22] The regression results are available from the authors but are not presented here as they are not concrete proofs of major estates enjoying higher number of bidders.

[23] Bergemann and Pesendorfer (2007) theoretically show that an auctioneer may prefer to provide information asymmetrically to bidders. In our setting, information asymmetry arise more from the institutional structure as is the case in Hendricks and Porter (1988), which is a classic empirical analysis of auctions with asymmetrically informed bidders.

Lots from vertically integrated estates As noted earlier, some of the large buyers are vertically integrated estates who can be both the seller and the buyer for a lot as they both produce tea and sell their own brands of tea. Tables 2 and 3 also allow us to investigate the prices of lots from estates owned by integrated buyers. The tables suggest that the prices for lots from these estates were no different from the prices of lots from unaffiliated non-major sellers. However, in Table 5, we decompose lots from these estates by those that were bought by the seller (integrated buyer and estate owner) herself and those that were bought by some other buyer. Interestingly, the lots bought by the seller herself had prices lower by at least Tk. 0.81/Kg, on average, compared to the lots bought by a different buyer. This suggests that if the price was not high enough, vertically integrated buyers would buy back their own tea as they had a use for them. That way, they could ensure that they do not let the acceptable price for their tea become too low. Being able to buy back their own tea created a virtual lower bound for prices from these lots. This illustrates another mechanism of keeping the auction prices relatively high by the vertically integrated estates.

This also means that the probability of sale is high for lots from vertically integrated estates as seen in Tables 2 and 3. Going back to Table 4, we find that the publicly announced valuations for lots from vertically integrated estates are, basically, as high as those for the lots from affiliated estates. As the vertically integrated estates buy back their own tea if the prices are low, they effectively create a floor below which they do not allow the price of their lots to fall. To take this into account, the auctioneers announce a high valuation for these lots.

4 Conclusions

Auctioneers such as eBay, Amazon.com, or stock exchanges, that administer large marketplaces, play a prominent role in the economy. There are numerous other auctioneers who run auction markets on a regular basis throughout the world. They are private market designers who receive a small share of the transaction prices, and their actions determine the efficiency of the markets they operate. And yet, the precise role of an auctioneer has not been well-documented in the auction literature. As they typically receive only a small fraction of the revenue, the environment is ripe for clients and market participants to have agency concerns. On the other hand, since the auctioneer represents multiple clients, externalities can also play a prominent role. Hence, successful auctioneers must aim to address agency concerns and manage externalities at the same time. Therefore, strategies that build trust and establish good reputation are likely to be key to the efficient running of auction markets.

In this paper, we have highlighted the role of auctioneers as effective managers of the marketplace they oversee. To allay agency concerns, auctioneers undertake costly actions on lots over which they enjoy greater trust in order to generate a positive externality for others. Using a unique data set of tea auctions in Bangladesh, we investigate the strategic behavior of auctioneers as market makers. We find that the auctioneers are able to obtain higher prices for lots that belong to sellers with whom they enjoy a greater level of trust as these sellers allow the auctioneer greater flexibility in choosing strategies. However, to achieve that, they sell these lots less frequently. This involves short run costs as lots that take longer to sell usually sell for a lower price and there are extra storage and financial costs as well. Nevertheless, the auctioneers take such costly actions because they lead to an increase in the overall auction price. By illustrating how interdependence among market offerings affect auction outcomes, our paper also suggests that data from auction markets should be analyzed using the point of view of a market and not a single auction. As a result, structural estimation of bidder characteristics while treating auctions within a market as independent auctions may lead to incorrect estimates.

While our analysis shows that administrators of large auction markets are better viewed as market makers, it is important to note that the market structure matters. In our setting, the auctioneer has market power and his strategies can affect all market transactions. Moreover, the auctioneer interacts with the same set of participants, buyers and sellers, repeatedly over a long period of time. As a result, gaining their trusts by managing market externalities well plays a prominent role in such a setting. On the other hand, if the facilitator of trade only administers a relatively small share of all market transactions in a non-repeated setting and does not have much power to influence other trades in the market, then strategies that promote trust or reputation are not likely to be useful in interpreting observed outcomes.

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Table 1: Summary Statistics - Auction Outcomes and Publicly Announced Valuations

	Pure Auctioneer	Integrated Auctioneer		
		All Lots	Affiliated Lots	Unaffiliated Lots
Number of Auction Days	16		16	
Total Number of Lots	11925	5704	1047	4657
Lot Size	751.31 Kg	521.17 Kg	499.38 Kg	526.07 Kg
	(314.28)	(120.49)	(129.87)	(117.73)
Publicly Announced Valuation	78.97 Tk./Kg	77.35 Tk./Kg	81.29 Tk./Kg	76.46 Tk./Kg
	(6.05)	(7.22)	(2.83)	(7.60)
Quality Rating	5.47	6.45	7.01	6.32
	(1.86)	(1.46)	(1.04)	(1.51)
Percentage of Lots Sold	91.71%	83.64%	80.04%	84.45%
	(0.28)	(0.37)	(0.40)	(0.36)
Price Conditional on Sale	78.29 Tk./Kg	77.55 Tk./Kg	80.80 Tk./Kg	76.86 Tk./Kg
	(5.73)	(6.49)	(3.13)	(6.80)
Number of Weeks Needed to Sell a Lot	1.079 Weeks	1.183 Weeks	1.226 Weeks	1.173 Weeks
	(0.341)	(0.536)	(0.560)	(0.530)

Note: Standard deviations are presented inside parentheses

Table 2: Heckman Two-step Regression of the Price

	Price	Sold	Price	Sold	Price	Sold
	(1)		(2)		(3)	
Publicly Announced Valuation	0.888***	0.023***	0.888***	0.021***	0.888***	0.021***
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Lot from an Affiliated Estate	0.543***	-0.316***	0.537***	-0.257***	0.422***	-0.276***
	(0.069)	(0.059)	(0.070)	(0.061)	(0.074)	(0.065)
Lot from a Major Estate			0.495***	0.234***	0.492***	0.234***
			(0.038)	(0.046)	(0.038)	(0.046)
Lot from a Vertically Integrated Estate			0.037	0.370***	0.031	0.368***
			(0.057)	(0.076)	(0.057)	(0.076)
Lots Auctioned off by the Pure Auctioneer	-0.675***	0.246***	-0.821***	0.205***	-0.823***	0.204***
	(0.039)	(0.039)	(0.041)	(0.042)	(0.041)	(0.042)
Prior Number of Auctions Where the Lot Was Up for Sale	-0.627***	-0.115***	-0.614***	-0.103***	-0.669***	-0.109***
	(0.037)	(0.028)	(0.036)	(0.028)	(0.038)	(0.029)
Prior Auctions × Affiliated Lot					0.505***	0.065
					(0.111)	(0.081)
Inverse Mills Ratio	-1.282***		-1.186***		-1.183***	
	(0.094)		(0.095)		(0.095)	
Observations	17564		17564		17564	
Wald Chi^2	138649.15		142009.76		142299.48	

Notes: We present Heckman two-step regressions of the price which is observed only when a lot sells. We control for tea type, tea quality, the auctioneer's position in the day's auctions, and other lot characteristics. A variable deonting theposition of the lot normalized by the total number of lots listed by the auctioneer, squared of this variable, and lagged variables indicating whether a previous lot was sold are excluded variables used as instruments in the selection regressions. Standard errors are presented inside parentheses. * represents significance at the 1% level.

Table 3: Impact of the Benchmark Price on the Price

	Price			Sold
	(1)	(2)	(3)	
Publicly Announced Valuation	0.819***	0.819***	0.810***	0.021***
	(0.004)	(0.004)	(0.004)	(0.004)
Lot from an Affiliated Estate	0.385***	0.381***	0.458***	-0.257***
	(0.067)	(0.067)	(0.073)	(0.061)
Lot from a Major Estate	0.453***	0.450***	0.406***	0.234***
	(0.037)	(0.037)	(0.041)	(0.046)
Lot from a Vertically Integrated Estate	-0.023	-0.025	-0.101	0.370***
	(0.055)	(0.055)	(0.062)	(0.076)
Lots Auctioned off by the Pure Auctioneer	-0.787***	-0.788***	-0.832***	0.205***
	(0.039)	(0.039)	(0.044)	(0.042)
Benchmark Price	0.107***	0.110***	0.114***	-0.007**
	(0.004)	(0.004)	(0.004)	(0.003)
Benchmark Price Lag 1		-0.011***		
		(0.004)		
Benchmark Price Lag 2		0.009**		
		(0.003)		
Previous Lot Went Unsold			2.510**	
			(0.485)	
Benchmark Price × Previous Lot Unsold			-0.025***	
			(0.006)	
Prior Number of Auctions Where the Lot Was Up for Sale	-0.473***	-0.468***	-0.423***	-0.103***
	(0.035)	(0.036)	(0.038)	(0.028)
Inverse Mills Ratio	-0.852***	-0.843***	-1.868***	
	(0.094)	(0.094)	(0.192)	
Observations	17564	17539	17564	
Wald Chi^2	154984.63	155000.21	131457.57	

Notes: We present Heckman two-step regressions of price, which is observed only when the auction results in a sale. Benchmark price equals the price of the previous lot if it sold and the reserve price of the previous lot if it did not sell. We control for tea type, tea quality, the auctioneer's position in the day's auctions, and other lot characteristics. A variable deonting theposition of the lot normalized by the total number of lots listed by the auctioneer, squared of this variable, and lagged variables indicating whether a previous lot was sold are excluded variables used as instruments in the selection regressions. Standard errors are presented inside parentheses. *, **, and *** represent significance at 10%, 5%, and 1% levels, respectively.

Table 4: Determinants of the Publicly Announced Valuation

	Publicly Announced Valuation		
	(1)	**(2)**	**(3)**
Lot from an Affiliated Estate	2.775***	3.507***	2.899***
	(0.164)	(0.165)	(0.177)
Lot from a Major Estate		0.691***	0.675***
		(0.098)	(0.098)
Lot from a Vertically Integrated Estate		3.162***	3.104***
		(0.144)	(0.144)
Lots Auctioned off by the Pure Auctioneer	3.087***	3.285***	3.255***
	(0.092)	(0.097)	(0.097)
Prior Number of Auctions Where the Lot Was Up for Sale	-2.616***	-2.505***	-2.730***
	(0.081)	(0.081)	(0.084)
Prior Auctions × Affiliated Lot			2.361***
			(0.251)
Observations	17629	17629	17629
R^2	0.4689	0.4833	0.4859

Notes: The table presents fixed effects panel regressions of the publicly announced valuation controlling for tea type, tea quality, the auctioneer's position in the day's auctions, and other lot characteristics. Standard errors are presented inside parentheses. * represents significance at the 1% level.

Table 5: Vertically Integrated Estates

	Price (1)	Price (2)	Sold
Publicly Announced Valuation	0.888***	0.810***	0.021***
	(0.003)	(0.004)	(0.004)
Lot from an Affiliated Estate	0.530***	0.452***	-0.257***
	(0.070)	(0.074)	(0.061)
Lot from a Major Estate	0.497***	0.407***	0.234***
	(0.038)	(0.042)	(0.046)
Vertically Integrated Lot Purchased by the Seller	-0.207**	-0.356***	
	(0.103)	(0.110)	
Vertically Integrated Lot Purchased by Another Buyer	0.106*	-0.030	
	(0.062)	(0.068)	
Lots Auctioned off by the Pure Auctioneer	-0.835***	-0.847***	0.205***
	(0.041)	(0.044)	(0.042)
Benchmark Price		0.114***	-0.007**
		(0.004)	(0.003)
Previous Lot Went Unsold		2.542**	
		(0.490)	
Benchmark Price × Previous Lot Unsold		-0.026**	
		(0.006)	
Prior Number of Auctions Where the Lot Was Up for Sale	-0.614***	-0.423***	-0.103***
	(0.036)	(0.039)	(0.028)
Inverse Mills Ratio	-1.194***	-1.889***	
	(0.095)	(0.195)	
Observations	17564	17564	
Wald Chi^2	141996.94	128610.33	

Notes: We present Heckman two-step regressions of price, which is observed only when the auction results in a sale. "Vertically Integrated Lot Purchased by the Seller" is a dummy variable indicating a lot which was purchased back buy the seller and "Vertically Integrated Lot Purchased by Another Buyer" is a dummy variable indicating a lot owned by a vertically integrated seller but purchased by a buyer who is not the seller. Benchmark price equals the price of the previous lot if it sold and the reserve price of the previous lot if it did not sell. We control for tea type, tea quality, the auctioneer's position in the day's auctions, and other lot characteristics. A variable deonting the position of the lot normalized by the total number of lots listed by the auctioneer, squared of that variable, and lagged variables indicating whether a previous lot was sold are excluded variables used as instruments in the selection regressions. Standard errors are presented inside parentheses. ** and *** represent significance at the 5% and 1% levels, respectively.