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Suggested versus Extended Gifts: How Alternative Market Institutions Mitigate Moral Hazard

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Comments

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Abstract

Gift exchange can partially mitigate supply-side moral hazard, even in anonymous market interactions. In a market where quality is not fully contractable, the amount that a price exceeds the market-clearing price for the lowest quality is a gift from the buyer. We show that the gift formation process, inextricably linked with a market institution's price formation process, greatly influences the size and effectiveness of the gift. When the market institution dictates that prices are formed by bids posted by buyers, the gift is extended to the seller. When the market institution dictates that prices are formed by offers posted by sellers, the gift is suggested by the seller. We conjecture that extended gifts do not instill as strong a concern for the material welfare of the other party as suggested gifts. We show in experiments that this effect is quite profound in both monopsonist and thick markets. Posted offer markets generate higher prices, in turn larger gifts, and higher levels of product quality than posted bid ones. In addition, the posted offer institution generates a higher quality given the price, rather than simply generating higher prices. Both sides of the market obtain higher payoffs under posted offer institutions.

JEL classifications: C90; D47; L14

Keywords: market institution; moral hazard; gift-exchange game; other-regarding preference

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1 Introduction

Market exchange is the cornerstone of any capitalist economy. It empowers the division of labor to create efficiencies, often through complex and coordinated production processes. The realities of such production processes often give rise to bilateral exchange in which financial terms are set in advance of production and delivery. In the post-contractual production process, a moral hazard often arises as the seller determines the actual attributes of a good inferior to the specification of the contract, or that are not specified in the contract. Gift exchange is one of the ways researchers have considered to ameliorate this moral hazard (Akerlof, 1982; Fehr et al., 1993, 1998b).

Gift exchange, the practice of voluntary transfer of goods or services while renouncing the right to require a transfer in return[1], strengthens the social bonds between community members. These social bonds foster collectivist sentiments that facilitate the care of community members' individual welfare and concern for broader community-wide standards. In market exchange, people habitually seek for social bonds to reduce uncertainty and undesirable outcomes. Gifting brings a sentiment of social connection between the transacting parties. When there is a potential moral hazard, these collectivist concerns can lead producers to forgo some personal enrichment to enhance the welfare of buyers who bear gifts.

In market exchange, gifts can be sent within the context of a transaction. Price may consist not only of compensation for a good or service but also a potential gift from the buyer to the seller. For example, the amount a wage offer exceeds the minimum wage level has been interpreted as a gift offered by the employer. In turn, after accepting the gift, the worker reciprocates with more than minimal effort (Akerlof, 1982; Fehr et al., 1993, 1998b).

The process determining prices in a market institution may also embody the formation of the gift from the buyer. Consequently, when there is a potential moral hazard, different market institutions can lead to differing gifts, sensitivities of social bond formation, and welfare impacts. In market institutions where the price-determining actions are taken by buyers, e.g. posted bid markets, the gift is extended by the buyers and accepted by sellers. In institutions where price-determining actions are taken by sellers, e.g. posted offer markets, the gift is suggested by sellers and then fulfilled by the buyers. We conjecture that the later process fosters a stronger collectivist sentiment in the transacting seller, as it gives the seller higher decision power over the gift size. Analogously to participating in the policy-making process, which leads to more prosocial behavior during the policy implementation (Bó et al.,

[1]Testart (2013) gives a more precise definition of a gift, which is "a transfer of a good that 1) implies the renunciation of any right over this good and of any right that might arise from this transfer, in particular that of requiring anything by way of counterpart; and 2)that is not itself required". See Elder-Vass (2020) for another discussion of the definition.

2010; Sausgruber et al., 2021), empowering sellers in the price-determination process can also make sellers more considerate of the buyers' well-being during production.

We compare the performance of the two institutions in a laboratory experiment in an archetypal procurement scenario. A buyer wishes to acquire a single object from a set of possible sellers. Her valuation of the object depends on the delivered quality as well as the price. The buyer can form a contract with one of the sellers, which specifies the price of the object but not the quality. After signing a contract, the seller determines the quality level. Sellers are all capable of producing one unit of the object, and have the same cost scheme for quality delivered. As quality is increasingly costly, a profit-maximizing seller chooses the lowest quality.

Under the posted bid institution, the buyer proposes a price to all sellers. A contract is formed between the buyer and a seller who accepts the proposal. Under the posted offer institution, each seller proposes a price to the buyer. The buyer then chooses one offer to accept, which does not need to be the lowest offer, and forms a contract with the seller who proposes it.

Our experimental design purposefully creates settings encouraging moral hazard, and thus presenting challenges to effective gift exchange or rendering it as the only plausible explanation for mitigation. One of our chief concerns is that gift exchange, as it stems from interpersonal bond, can be more effective in a smaller group than in a large competitive one. To address this concern, our design includes the treatment variable market thickness. We consider two market thickness conditions. One market thickness category is monopsony or 'thin' market, in which one buyer faces two sellers. Another category is competitive or 'thick' market, in which six buyers face twelve sellers.[2] The market thickness treatment allows for an evaluation as one moves from more strategic environments to more competitive ones in which individuals have less price-setting power. In the latter, we expect moral hazard to be more prevailing.

Our second fortification of the moral hazard outcome is the anonymity and random matching protocols adopted in the experiment. We run the experiment without unique player identifiers, and subjects can only see their own market outcomes. This makes interactions anonymous, eliminating reputation building or incumbencies as building blocks for reciprocal behavior. Additionally, in our thin treatment, we randomize matching across periods of

[2]The monopsony market coincides with much of the research on procurement auctions (Brosig-Koch and Heinrich, 2014; Fugger et al., 2019; Walker et al., 2023) which typically consider a buyer determined auction in which sellers submit offers but the buyer is not bounded to choose the lowest price, in other words, a posted offer institution. The thick market corresponds to much of the experimental labor market literature (Fehr et al., 1993, 1998a; Brandts and Charness, 2004) which considers competitive markets with excess supply and is implemented with posted bid institutions. Our 2×2 experimental design, with the institution and market thickness treatment variables, provides a bridge between these two strands of literature.

the buyers and sellers eliminating the ability to utilize repeated game strategies to foster reciprocity.

Our third fortification of the moral hazard outcome is the excess supply, which plays a few roles. First, the excess supply exerts downward pressure on the price, which suppresses the size of the gift from the buyer. This makes it more difficult to observe the gift-exchange behavior. Second, compared to a setting with an equal number of buyers and sellers, it draws a more clear distinction between the gift and non-gift part of the price. The market-clearing price for the lowest quality is the non-gift part of it. Any part of the price that exceeds this amount is a gift from the buyer: the buyer gives the additional money and cannot require any higher quality in return for it. With excess supply, the non-gift part of the price equals the seller's cost for the lowest quality. Therefore, any part of the price that exceeds the seller's cost for the lowest quality is a gift from the buyer. Third, compared to a setting with excess demand, it allows the gift to be a relatively larger component of the price. The non-gift part of the price is the lowest under excess supply and the highest under excess demand.

We model the strategic interaction in these scenarios by identifying their subgame perfect Nash equilibrium solutions. The consideration for the well-being of the buyer in the transaction gives rise to the seller's gifting behavior, which is a common observation in the literature. To accommodate this stylised fact, we use the other-regarding utility function introduced by Fehr and Schmidt (1999). Applied to our setting, when the seller cares more for the buyer's well-being, represented as a higher weight on the buyer's monetary payoff in the utility function, the quality they choose at each price weakly increases. Given the sellers' choice of quality at each price, the excess supply pushes the equilibrium to be at the buyer's most preferred price under both institutions. Therefore, by holding the traders' preferences constant, the two institutions have the same equilibrium price and quality. Higher equilibrium price and quality imply that the sellers are more other-regarding.

The posted offer institution outperforms the posted bid institution in the experiment. We observe significantly higher prices and quality in the posted offer institution. This is consistent with the equilibrium outcome when sellers have a higher concern over the buyer's monetary payoff. In addition, both the buyer and the seller obtain higher monetary payoffs under the posted offer institution. The market thickness does not have a significant effect in our experiment. The different outcomes under the two institutions are driven by different quality-price relationships. At a given price, the quality is higher under posted offer institution regardless of the market thickness.

A closely related paper is Charness et al. (2012), which shows in a laboratory experiment that delegating the wage choice to the worker increases the payoffs for both the firm and

the worker. In Charness et al. (2012), there is no competition or market process–one firm is matched with one worker beforehand, and different treatments determine how the two parties decide wage. The gift to the worker in Charness et al. (2012) is either a high wage chosen by the firm or the authority to decide the wage. In this paper, we focus on the role of the gift-formation process in the market institution. In both procedures we compare, the gift from the buyer is a part of the price.

In both Charness et al. (2012) and this paper, the moral hazard lies on the sellers' side. Both papers confirm the welfare improvement of using the institution that invites sellers to choose the price. Similarly, participating in the policy making process, such as voting, makes participants more prosocial in the resulting stage (Bó et al., 2010; Sausgruber et al., 2021). Participation in the decision process may make a player feel more responsible for the social outcome or more belonging to a group, hence exhibits a higher level of other-regardingness.

Other closely related papers are Fehr et al. (1993, 1998b) (FKR hereafter) and Fugger et al. (2019). These studies show the welfare improvements resulted from the flexibility to accept offers/bids that are not the lowest/highest in the market when facing potential moral hazard problem. Their experiments prove the existence of the gift-exchange behavior in two different settings. FKR uses a thick posted bid market to study behavior in the labor market; Fugger et al. (2019) uses a monopsonist posted offer institution to study the procurement of goods, a mechanism known as buyer-determined auction in procurement studies. This paper compares the two institutions from these two studies, and shows that the outcomes of the posted offer institution Pareto dominates the outcomes of posted bid institution regardless of the market thickness.

Our results from the comparison between the different market thicknesses is consistent with Brandts et al. (2010). In Brandts et al. (2010), tripling the size of the market does not have a statistically significant effect on the gift-exchange relationship. Contracts in Brandts et al. (2010) are formed by double auction or decentralised bilateral negotiation. We use different trading institutions, and our comparison is more extreme: the smallest monopsonistic market versus its sextuple.

The rest of the paper is organized as follows. Section 2 gives a formal description of the procurement and the game-theoretical prediction. Section 3 states the hypotheses. Section 4 and 5 present the experimental design and findings from the experiment. Section 6 concludes.

2 The game-theoretic model

We study a procurement scenario in which each buyer attempts to form a contract with one of multiple potential sellers to produce a single object. The quality of the object, denoted by q, is determined by the amount of costly effort exerted by the seller. Further, the contract

terms cannot be conditioned on the quality. The contract is characterized by the naming of a seller and the price of the object, p, prior to production. After the awarding of the contract, the named seller chooses the quality of the object.

Each seller can produce no more than one unit, and there is excess supply in the market. The market may be thin, where the buyer is a monopsony, or thick, where there are multiple buyers. We keep the buyer-seller ratio the same, which maintains the level of the demand-supply imbalance.

We use the payoff structure of the classic studies of FKR. The quality of the object is an integer between 1 and 10, inclusive. Sellers' cost for producing the object, $c(q) \approx aq^2+bq+d$, where $a = 0.11$, $b = 0.83$ and $d = 28.93$, is an increasing function of quality in the range.

A seller's payoff if sells is

$$\Pi_S = p - c(q).$$

If a seller does not sell, her payoff equals 0.

The buyer's payoff if she buys is

$$\Pi_B = (126 - p) \times \frac{q}{10}.$$

Also, we have $p \in [30, 126]$ to guarantee non-negative payoffs for buyers involved in trades.

We consider two institutions to award the contract: a posted bid institution, and a posted offer institution. The posted bid institution is the one-sided double auction used in FKR, where each buyer makes a price offer to all sellers, and contract with one of the sellers who are willing to accept the offer. The posted offer institution is referred to as buyer-determined auction in the literature, where each seller makes a price offer and each buyer picks one of them to trade with.

Table 1 illustrates the procedure used in the two institutions in the monopsony market. Both the monopsony buyer and the sellers take part in deciding the transaction price in both institutions: one party proposes a price, the other party approves. Once the contract is formed, the contracted seller chooses the quality level to provide.

In a thick market, all bids are visible to all sellers under the posted bid institution, and sellers choose which bid to accept from the list of available bids; all offers are visible to all buyers under the posted offer institution, and buyers take turns to choose the offers.

	Posted Bid	Posted Offer
Stage 1: Send price messages	The buyer proposes a price to all sellers.	Each seller proposes a price to the buyer.
Stage 2: Form contract	The seller who accepts the proposal forms a contract with the buyer.	The buyer picks one sellers to form the contract with.
	The two parties contract at the proposed price.	
Stage 3: Production	The contracted seller chooses the quality level of the product.	

Table 1: Sequence of tasks in the posted bid and posted offer institutions

2.1 The subgame perfect Nash equilibrium

We solve for a subgame-perfect Nash equilibrium. Here we introduce the other-regarding preference into the setting. Commonly observed in the literature, upon receiving a gift of a high price from the buyer, a seller reciprocates with a gift of a high quality. This cannot happen if the seller only maximizes her own profit. With other-regarding preference, which includes the other party's monetary payoff in the utility function, the seller may choose a quality level higher than the minimum, and the gift-exchange behavior can be sustained in the equilibrium.

We use the outcome-based other-regarding utility function introduced by Fehr and Schmidt (1999) for tractability. This utility function is based on inequity aversion. However, in each of its inequity regime, it is equivalent to a weighted function of own payoffs and the other party's payoff. [3]

Denote by B and S the buyer and the seller involved in the transaction. The utility for a buyer who buys is

$$U_B = \Pi_B - \alpha_B \max\{\Pi_S - \Pi_B, 0\} - \beta_B \max\{\Pi_B - \Pi_S, 0\}.$$

[3]Another class of other-regarding preference models incorporates an intention component into the utility representation (for example, Cox et al., 2007; Rabin, 1993; Levine, 1998; Gul and Pesendorfer, 2016), to capture the fact that the perceived kindness affects a player's choice. These models differ in the way the intention is inferred. In both Fehr and Schmidt (1999) and Levine (1998), the utilities are weighted functions of the two parties' payoffs. By applying the outcome-based utility function of Fehr and Schmidt (1999), we use the parameters α and β as reduced forms of the factors that may affect the buyer-seller relationship, be it the different interaction or different perceived intention.

The utility for a seller who sells is

$$U_S = \Pi_S - \alpha_S \max\{\Pi_B - \Pi_S, 0\} - \beta_S \max\{\Pi_S - \Pi_B, 0\}.$$

The parameters, α and β, reflect the levels of aversion an agent has towards unequal payoffs, when the agent is in disadvantageous and advantageous inequity respectively. Following Fehr and Schmidt (1999), we assume that $\beta_S, \beta_B \in [0, 1)$, $\beta_B \leq \alpha_B$ and $\beta_S \leq \alpha_S$. In words, both buyers and sellers care about equality, but not as much as her payoff, and traders prefer advantageous inequity over a disadvantageous one.

In each of the inequity regime, the utility function is a weighted function of own payoff and other's payoff.

$$U_i = \begin{cases} (1+\alpha)\Pi_i - \alpha\Pi_j; & \text{if } \Pi_i < \Pi_j \\ (1-\beta)\Pi_i + \beta\Pi_j; & \text{if } \Pi_i \geq \Pi_j \end{cases}$$

When the other party gets more payoff, one get disutility from the other's earning. Otherwise both own and other's payoff take positive weights in the utility. In our setting, most of the choices take place in the second regime. Players' choices are affected by the value of β, the weight they put on the other party's payoff, but not α.

We assume all sellers have the same preference and always prefer to trade than not[4]. Knowing the seller's best response in the last stage, we can find the buyer's globally preferred price p^*. It is easy to see that p^* is the subgame perfect Nash equilibrium price for both institutions.

In the Nash equilibrium in posted bid market, the buyer offers p^* to sellers, and forms the contract with a random one of them; The sellers accept the proposal from the buyer, and the contracted one offers the quality that maximizes her utility. This holds in both thick and thin markets. Since sellers prefer to trade than not, they accept any bid. Given the excess of supply, no buyer has the incentive to choose a price different from p^*.

In the Nash equilibrium in the posted offer market, all sellers offer p^*, each buyer contracts with a random one of them, and the contracted seller chooses the quality level that maximizes her utility given p^*. With excess supply, deviating from offering p^* reduces the seller's opportunity of trade to zero, which the seller would refrain from doing. If sellers offer different prices, an unchosen seller can be better off deviating to a chosen price, which increases the probability of trade. If sellers offer the same price $p' \neq p^*$, a seller can make a small deviation towards p^*, and increases the probability of trade to 1.

[4]The preference to trade always holds when sellers are profit-maximizing. If sellers are other-regarding, the threshold depends on their parameter α and the additional assumption on the utility they get if not trade. The latter can be arbitrary.

Therefore, given participants' preference, p^* and the corresponding optimal quality for sellers are the same under the two institutions in different market thickness. The Nash equilibrium outcome are the same under both institutions and market thickness: the price equals p^*, and the quality equals the seller's optimal quality at p^*.

If agents are own-profit-maximizing, $\alpha = \beta = 0$. In the last stage of the game, the seller chooses $q^* = 1$. Knowing this, the buyer obtains the highest profit at price $p^* = 30$. The Nash equilibrium outcome is $p^* = 30$ and $q^* = 1$ under both institutions.

Seller's choice of quality

The quality-price space can be divided into two parts, shown as the area with and without shade in Figure 1. When $\Pi_S < \Pi_B$, the seller has disutility from obtaining lower payoff than the buyer. In this range, a seller would choose a quality as low as possible. Given a price, decreasing the quality increases seller's utility in two ways: it decreases the disutility from unequal payoffs, and it increases the seller's payoff. The value of α_S does not affect the seller's choice of quality as long as it is positive.

When $\Pi_S > \Pi_B$, the seller has disutility from obtaining higher payoff than the buyer. Given a price, increasing the quality decreases the distutility from unequal payoff, but decreases the seller's payoff as well. The trade-off between these two factors determines the quality level. In summary, we have the following proposition.

Proposition 1. *The seller chooses $q = 1$ at all prices if $\beta_S < 0.11$. At each price, the seller's choice of quality is weakly increasing in β_S.*

The proof of the proposition is in the appendix. Figure 1 depicts the optimal quality choices at each price. Each color indicates a value of β_S. The $\Pi_S < \Pi_B$ area is shaded. At the boundary of the shaded area, the payoffs are equal for both buyer and seller.

If β_S is smaller than 0.11, as shown by the yellow line, the seller chooses $q = 1$ at all price levels. When β_S is larger than 0.11, the seller may choose a quality higher than 1 at some prices. As shown in Figure 1, when the price is low, the quality chosen by the seller equals 1; As the price goes higher, the optimal quality starts to increase, and then decreases after the price reaches a certain level. The the highest quality choice on the equal-payoff curve is the point that the seller's marginal utility from increasing own payoff equals the marginal utility from decreasing the inequality. The same goes to the points on the decreasing segments of the quality. Even though the seller values equality, the quality level is decreasing in price in these segments. This feature comes from the structure of the payoff functions. As the price goes higher, the marginal effect of quality on buyer's payoff drops, while its effect on seller's payoff is constant. Therefore, high quality is not necessarily efficient in our settings.

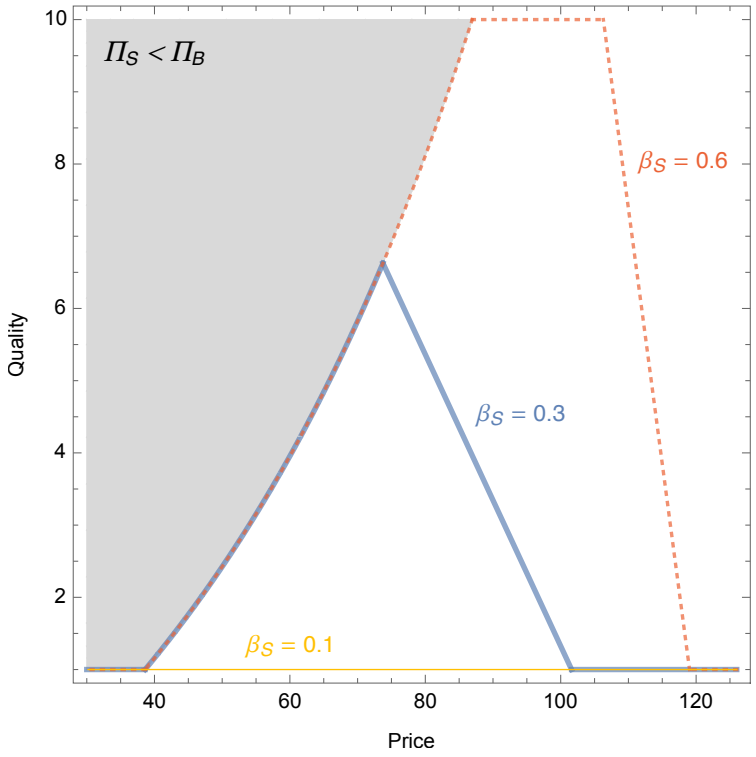


Figure 1: Quality choice by the seller

When price goes high enough, by lowering the quality, the increase in the seller's own payoff exceeds the increasing disutility from inequality. The higher β_S is, the higher the price and quality are at the turning point. When $\beta_S > 0.43$, the preferred quality level is bounded by 10 in certain price ranges.

Buyer's preferred price

Denote by P_1 the price at which the buyer and the seller have equal payoffs when $q = 1$. Given the seller's quality choice, denote by $\hat{P}(\beta_S)$ the highest price at which the buyer and the seller have equal payoff. From proposition 1, $\hat{P}(\cdot)$ is a non-decreasing function.

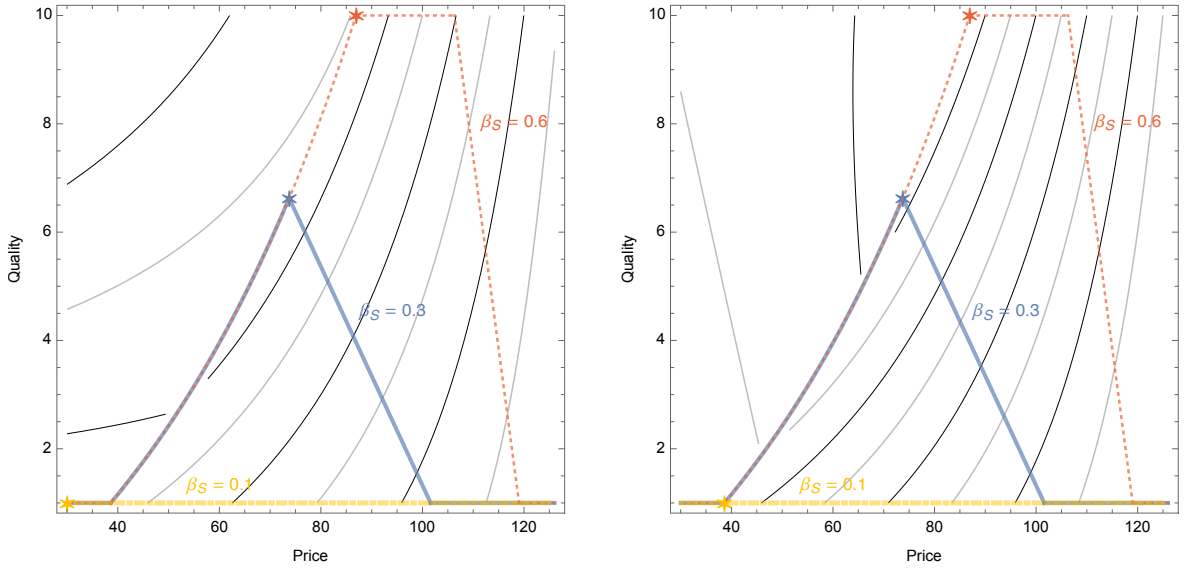
We have the following proposition for buyer's globally preferred price.

Proposition 2. *A buyer's globally preferred price is 30 if $\beta_B < 0.09$ and $\beta_S < 0.11$. Otherwise the preferred price is $\hat{P}(\beta_S)$. A buyer's globally preferred price is weakly increasing in β_S.*

The proof is in the appendix. Intuitively, when the price exceeds $\hat{P}(\beta_S)$, the quality chosen by the seller is not increasing in p, and the buyer has lower payoff than the seller. Therefore, the buyer prefers $\hat{P}(\beta_S)$ to all prices higher than it. In the price range between p_1 and $\hat{P}(\beta_S)$, the buyer prefers $\hat{P}(\beta_S)$ because it gives the highest payoff, while there is no

disutility from inequality in the range. In the range of price between 30 and p_1, the buyer prefers p_1 if she has strong enough preference for equality, i.e. $\beta_B > 0.09$, and prefers 30 if $\beta_B < 0.09$. Hence, if β_S is high so that $\hat{P}(\beta_S)$ generates higher utility than when $p = 30$, or if $\beta_B > 0.09$, the buyer's globally preferred price is $\hat{P}(\beta_S)$.

In Figure 2, the asterisks indicate the Nash equilibrium at different levels of β_S. Lines in colors are the best responses by sellers of different β_Ss, same as the ones in Figure 1. In a subgame-perfect Nash equilibrium, the buyer chooses a point on the seller's best response curve that yields the highest utility. The black lines in the background are the buyer's indifference curves. Like in panel (a), when $\beta_B \leq 0.09$, the buyer's utility increases in the direction of northwest. Depending on the slope of indifference curves, when β_S is low, i.e. $\beta_S \leq 0.11$, the Nash equilibrium price can be between 30 and 39.59. When $\beta_S > 0.11$, as shown in proposition 2, the Nash equilibrium price is $\hat{P}(\beta_S)$, which is non-decreasing in β_S. Like in panel (b), when $\beta_B > 0.09$, the buyer obtains highest utility at the highest kink of the indifference curves.



(a) $\alpha_B = 1$, $\beta_B = 0.08$ (b) $\alpha_B = 1$, $\beta_B = 0.7$

Figure 2: Nash equilibrium with Fehr-Schmidt utility

Overall, with Fehr and Schmidt (1999) type of other-regarding preference, the Nash equilibrium price and quality can be higher than the minimum level and are weakly increasing in β_S. For $\beta_B > 0.09$ or $\beta_S > 0.11$, the Nash equilibrium lies on the equal-payoff curve. When $\beta_S \in [0.11, 0.43]$, the Nash equilibrium outcome is strictly increasing in β_S.

3 Hypotheses

Our first hypothesis relates to the existence of gift-exchange behavior. When sellers have sufficiently strong other-regarding preferences, the equilibrium price and quality are above the minimum level, as was observed in FKR and others studies. We expect to see the same in our experiment.

Hypothesis 1. *The price and quality are above the minimal levels.*

From the Nash equilbrium prediction, all treatments have the same subgame-perfect Nash equilibrium outcome if the different trading environments do not affect the seller's preference.

Hypothesis 2. *The market institution does not have an effect on the price and quality.*

Hypothesis 3. *The market thickness does not have an effect on the price and quality.*

In our setting, the moral hazard lies on the sellers' side. Hence how the transacting seller perceives the buyer-seller relationship matters for the severity of it. The different market process involve different gift-exchange interaction between the two parties in the contract, and the market thickness changes the environment they interact in. There is no direct evidence from the literature on how Hypothesis 2 and 3 would hold. There are a few conjectures on why they may not.

Regarding hypothesis 2, the posted offer institution may foster higher other-regarding level in the transacting sellers in a few ways. Firstly, as discussed in the introduction, the posted offer institution involves sellers at a higher level in the price formation process. The seller is the one who suggests the price under the posted offer institution, but does not have a say on the price level under the posted bid institution. In other studies, the higher level of involvement in the decision process has led to more prosocial behavior in the resulted state. It may do the same in our setting.

Secondly, compared to the posted bid institution, the posted offer institution may foster a stronger bond between the transacting parties, hence increases the collectivist sentiment the seller has towards the buyer. The posted offer institution better satisfies the two needs people seek for when identifying with others: "a sense of belonging and a sense of distinctiveness" (Brewer, 1991, p. 475). The posted offer institution satisfies the inclusiveness better as the buyer indicates approval of the seller's request, which is an action of acceptance. In terms of the distinctiveness from people outside of the transaction, the posted offer institution better advantages the transacting seller from others. The buyer accepts the request from the transacting seller and rejects request(s) from other(s) under the posted offer institution. Under the posted bid institution, the buyer extends the gift to all sellers indiscriminately.

A stronger bond between the contracted parties can lead to the seller's putting more weight on the buyer's welfare, which is captured by the parameters in the Fehr and Schmidt (1999) model. More other-regarding sellers can lead to higher price and quality in the market.

Regarding hypothesis 3, although the market thickness in Brandts et al. (2010) does not have a significant effect over the outcome, traders interact under different institutions in our setting. Our comparison between the monopsony market with one that is six times as large is more extreme. The thicker market broadens the set of traders and price information each participant has access to, which may facilitate price discovery.

4 Experimental design and procedures

We adopt a 2×2 full factorial experimental design. One treatment variable is Market Thickness. The two levels of of this treatment variable are Monopsonist (one buyer and two sellers, 1:2 hereafter) and Competitive (six buyers and 12 sellers, 6:12 hereafter). The other treatment variable is market institution: either posted bid or posted offer. Before providing a detailed description of the institution we note the following. For all treatments, a period begins with a market to form contract(s), which determines the buyer and seller pair(s) and transaction price(s). However, a contract is incomplete, as the seller chooses the quality after the market closes.

In the initial stage of the posted offer institution, each seller submits a sealed offer to sell a unit of the good. In the posted offer 1:2 treatment, the procedures are the same as the buyer-determined auction in Fugger et al. (2019). The buyer is presented the two offers without labels identifying the associated seller. The buyer chooses one of the offers, without obligation to accept the lowest one, establishing a contract at the price equal to the accepted offer. In the posted offer 6:12 treatment, we replicate the procedures of the posted offer institution in Ketcham et al. (1984). The sellers' offers, without identifying labels, are presented to the buyers. Then buyers, randomly placed in a queue, take turns to select an offer, again without obligation to price priority, which sets the contract price and seller.

The posted bid institution replicates the procedures in Fehr et al. (1993, 1998b). Prior to the market opening, buyers submit opening bids. The market opens with the buyers' bids posted, without buyer labels, to the sellers. The market is open for 30 seconds in the 1:2 setting and 120 seconds in the 6:12 setting. A contract is formed when a seller accepts a bid, leading to the withdrawal of the bid, the buyer, and the seller from the market. A seller in the market can accept any available bid. A buyer whose bid remains unaccepted can revise her bid, but only upwards.

In all four treatments, once the market closes, each successful seller chooses the quality of the sold unit. All choices are anonymous in the experiment. A seller's quality choice is

only revealed to her buyer.

In the experiment, prices (p) are integers from 30 to 126, and quality levels (q) are integers from 1 to 10. The cost scheme for sellers follows Fehr et al. (1993) and is listed in Table 2.

Quality q	1	2	3	4	5	6	7	8	9	10
Cost $c(q)$	30	31	32	34	36	38	40	42	45	48

Table 2: Sellers' quality cost schedule

All levels of quality are feasible options for all sellers. The cost scheme is common knowledge to all participants and is displayed on the interface. We provide a table containing the cost scheme and corresponding payoffs onscreen. Participants can enter a price to check its corresponding payoffs at each quality.

Four sessions were conducted for each treatment. There were 18 participants in each session. Each participant was either a buyer or a seller throughout the session. There were 30 periods in each session. In the monopsonist environment, subjects were randomly assigned into groups of 1 buyer and 2 sellers, and were randomly matched after each period.

The experiment was conducted at the Finance and Economics Experimental Laboratory in Xiamen University. Subjects were undergraduate or master students in the university, recruited via ORSEE (Greiner, 2015). The experiment was programmed in z-Tree (Fischbacher, 2007).

Instructions [5] were read out loud to guarantee the public information known to all subjects. The experiment began after every subject indicated understanding of the instructions and familiarized themselves with the potential payoffs under different prices. Each session lasted for no more than 90 minutes. The Average payoff was 63.2 CNY which including a show-up fee of 10 CNY.[6]

The exchange rates was private information for subjects. To give similar payoffs to both roles, the exchange rate was 16 experimental dollars=1 CNY for buyers and 8 experimental dollars = 1 CNY for sellers.

5 Results

5.1 Overview

Average prices are substantially lower and average quality levels are higher in posted offer treatments than in posted bid treatments, and market thickness has little impact. These key results are readily seen in Figure 3 which shows the times series of the average price and

[5] English translations of the instructions are provided in appendix B.

[6] The exchange rate ranged between 6.1-6.2 CNY = 1 USD at the time of the experiment. The average payoff was more than 150% of the typically wage for a student job on campus

quality for each of the four treatments. A blue line denotes a posted offer institution and a red line denotes a posted bid institution. Three inferences can be drawn in combination with Table 3, which provides the average and standard deviation of price and quality in each treatment. First, in favor of Hypothesis 1, the price and quality are higher than the minimum levels. Average prices in the four treatments range from 58.35 to 79.09, and are significantly higher than 30 (t-test p-value < 0.01 for each treatment). Average qualities are higher than one (t-test p-value < 0.01 for each treatment). Second, contrasting Hypothesis 2, in both 1:2 and 6:12 markets, price and quality are higher in the posted offer institution (t-test p-value< 0.01 for both 1:2 market and 6:12 market). Third, the support for Hypothesis 3 is largely against. The thickness of market does not have a significant effect on the price (t-test p-values> 0.1 for both institutions). Only under the posted bid institution, the thicker market affects the quality level, reducing it by only 0.27 (two-sided t-test p-value> 0.1 for posted offer treatments, and p-value< 0.01 for posted bid treatments).

Consistent with previous literature, behavior of subjects in our experiment is closer to the predictions made with other-regarding preference. Both price and quality deviate from the profit-maximizing Nash equilibrium of $(p, q) = (30, 1)$. The correlations between quality and price are positive and significant in all treatments (Spearman's rank correlations are > 0 and p-values < 0.01).

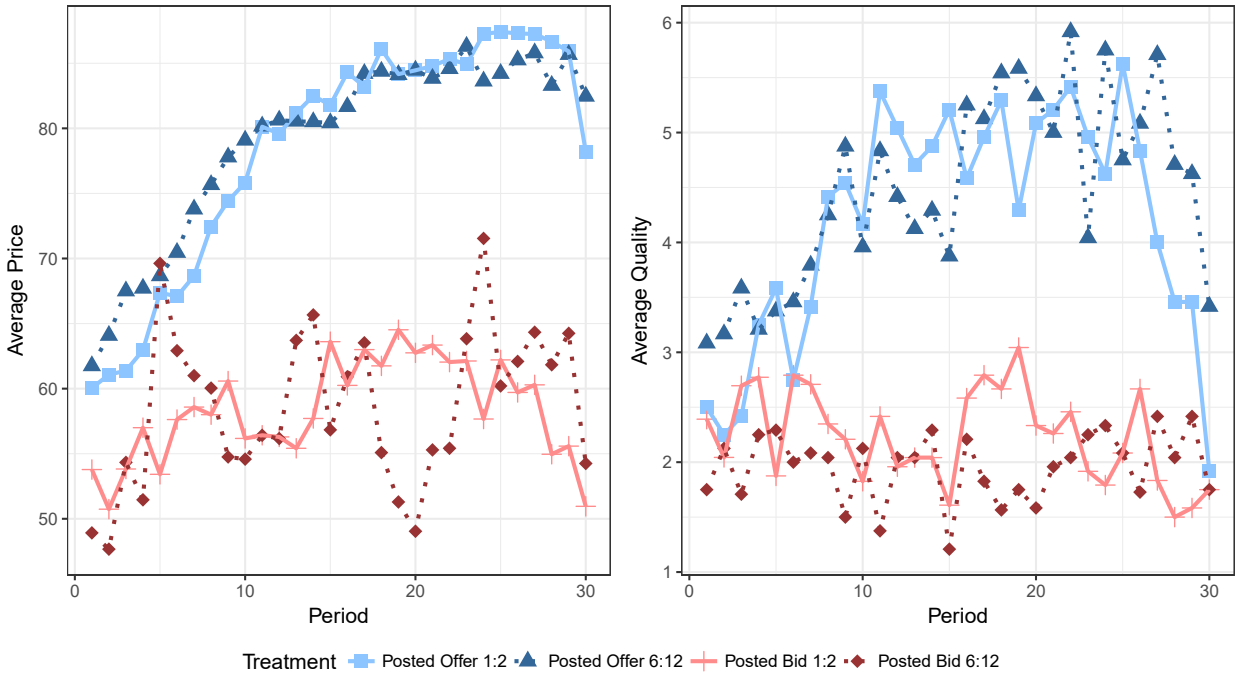


Figure 3: Average prices and quality over time

institution	Posted Offer		Posted Bid	
Number of Buyers: Number of Sellers	1:2	6:12	1:2	6:12
Number of trades [a]	720	720	710	716
Price	78.46	79.09	58.35	58.55
	(13.03)	(13.99)	(20.53)	(21.1)
Quality	4.21	4.47	2.23	1.96
	(3.37)	(3.44)	(1.89)	(1.82)
Spearman's rank correlation (p, q)	0.33	0.37	0.52	0.48

Note: standard deviations in parentheses.

[a] There are 720 potential trades in each treatment, which were all achieved in posted offer treatments. In posted bid treatments, several trades were not made because no seller accepted the bid or the buyer did not submit a bid during the auction. One trade was deleted in posted bid 6:12 treatment due to a error in the program that allowed price to be zero. Both subjects involved in this trade noticed the problem and informed the experimenter. Due to simultaneous clicks by sellers in posted bid 6:12, two sellers were accidentally involved in two transactions. The analysis provided in this paper excludes the extra sellers. No distinguishable change happens if they are included.

Table 3: Mean prices, mean quality and price-quality correlations by treatment

With respect to material welfare, the posted offer treatments generate higher payoffs for both buyers and sellers. As depicted in Figure 4, average payoffs from transactions are higher in the posted offer treatments for both the buyer and the seller (one-sided t tests p-values < 0.01 for both 1:2 and 6:12 markets).

Table 4 contains the average social surplus and payoffs in transactions. The average social surpluses are around 60 in the treatments that sellers offer bids, and around 40 in the treatments that buyers offer bids. At the same thickness of the market, using the institution in which sellers offer bids generates a significantly higher social surplus (one-sided t test p-value< 0.01 for both 1:2 and 6:12 markets).

The thickness of market does not have an effect on the social surplus (two-sided t test p-value > 0.1 for posted offer treatments, 0.36 for posted bid treatments) or seller's payoff (two-sided t test p-value > 0.1 for posted offer treatments, 0.58 for posted bid treatments). When the institution in which sellers offer bids is used, the thickness of the market does not have an effect on the buyer's payoff (two-sided t test p-value > 0.1). Only under the posted bid institution, a thicker market reduces the payoffs for the buyers (one-sided t test p-value < 0.01).

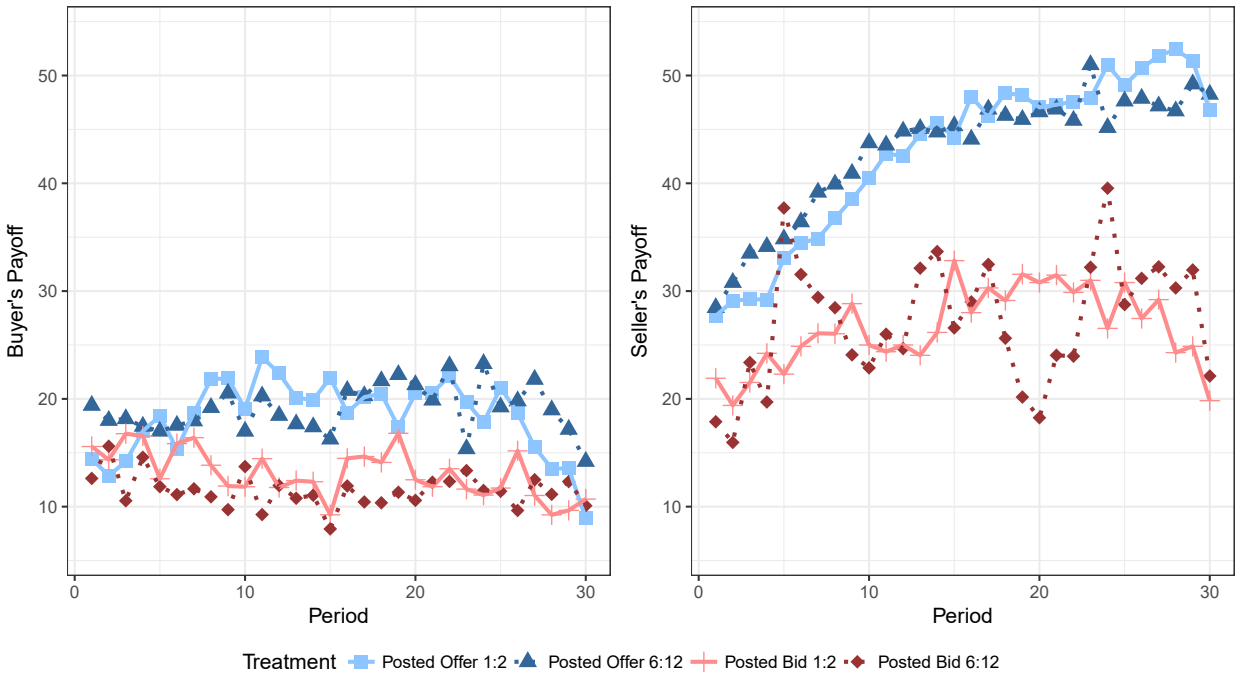


Figure 4: Buyer's and seller's payoff over time

Treatment	Posted Offer		Posted Bid	
	1:2	6:12	1:2	6:12
Social surplus in a period	61.25	62.07	39.72	38.66
	(14.95)	(14.67)	(21.85)	(21.60)
Buyer's payoff in a period	18.36	19.04	13.12	11.50
	(13.32)	(13.38)	(8.51)	(7.94)
Seller's payoff in a period	42.90	43.03	26.60	27.17
	(12.15)	(12.67)	(19.24)	(20.03)

Note: The values are in experimental dollars. Standard deviations are in the parentheses. Only data for successful transactions are included.

Table 4: Average buyer, seller and total period experimental payoffs

5.2 Price dynamics

Figure 3 revealed that average prices in the posted bid and posted offer markets are similar in the initial rounds, but do not exhibit the same increasing trend afterward. Figure 5 shows individual transaction prices over time. The top and bottom panels are for thin and thick markets respectively. The blue triangles are offers accepted in the posted offer markets, and the red dots are bids accepted in the posted bid markets. The two panels exhibit similar

patterns. Two inferences can be drawn from Figure 5. Firstly, prices in the posted offer and posted bid markets exhibit different patterns. Prices in the posted offer markets become more concentrated over time, and cluster at the higher range. Prices in the posted bid markets cover a wider range, and the dispersion persists over time. Secondly, buyers in the posted bid markets have experience with high prices. Lacking information on the outcomes of high prices can lead to a persistently low price level in the market, as in a self-confirming equilibrium Fudenberg and Levine (1993). The constant existence of high prices in the posted bid markets suggests that this is not the cause for the lower price in posted bid markets.

The rest of this section shows how traders experiment and adjust prices in the markets. Since the two institutions differ in their price formation process, we investigate their price adjustment processes separately.

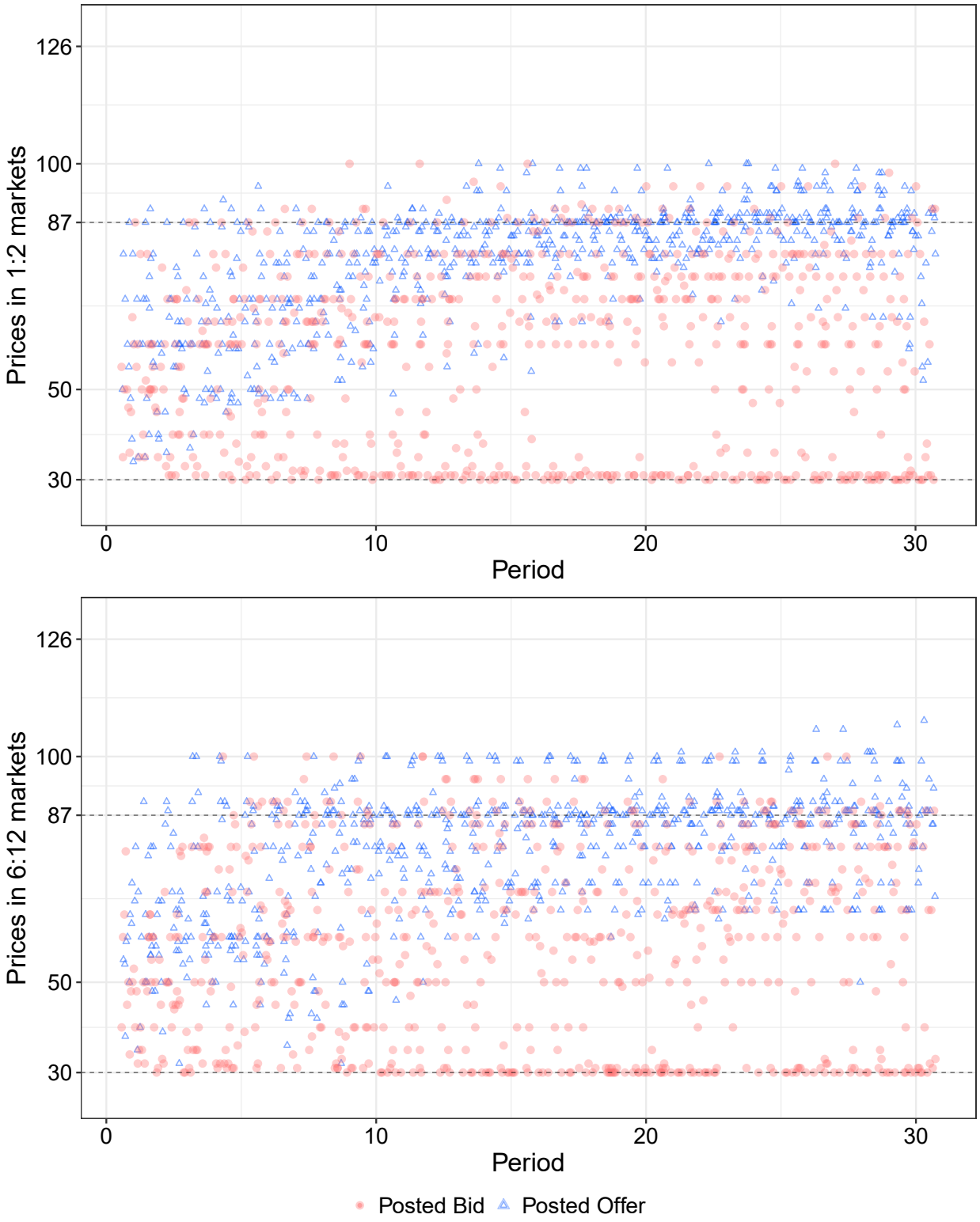


Figure 5: Prices in thin and thick markets over time

5.2.1 Posted bid market prices

In posted bid treatments, buyers adjust their bids according to the information and results in the previous period. From regression Models (1) and (2) in Table 5, when the quality of the previous period was high, the buyer increases the bid. In the thick market, as shown in regression (2), buyers adjust their bids toward the average of bids in the previous period, without knowing the realized quality of each price.

Dependent Variable: $\text{Bid}_{i,t} - \text{Bid}_{i,t-1}$		
	(1)	(2)
	Posted Bid 1:2	Posted Bid 6:12
Constant	26.32^{***}	28.67^{***}
	(3.49)	(4.50)
$\text{Bid}_{i,t-1}$	-0.54^{***}	-0.60^{***}
	(0.06)	(0.08)
$\text{Quality}_{i,t-1}$	2.40^{***}	3.37^{***}
	(0.29)	(0.43)
$\text{Bid}_{i,t-1} - \text{Average bid}_{t-1}$		-0.32^{***}
		(0.10)
Number of Observations	1386	695

Note: GLS regression with random effects. Robust standard errors in parentheses. Standard errors clustered by individual. Significance at 1%, 5% and 10% are denoted by *** , **,* respectively. The Im-Pesaran-Shin for unit root tests for all variables reject the null hypotheses that the panels contain unit roots.

Table 5: Buyers' bid adjustment in posted bid markets

Although the overall distribution of prices are similar in both thin and thick markets, buyers bid in different patterns. There is less variance in the bids a single buyer submits in the thin markets. The lowest prices in thin markets come from a small set of buyers who constantly bid the lowest price. The thicker market provides more information, as buyers can observe others' bids, and a repeated bid may signal a high payoff associated with it. More buyers have tried the lowest price in the thick markets, but none stays there.

5.2.2 Posted offer market prices

Under homogeneous good setting, the posted offer institution tends to sustain prices higher than the competitive level when sellers possess certain market power (Ketcham et al., 1984; Davis and Holt, 1994). However, we find it unlikely that the higher price in our posted offer treatment is caused by sellers' tacit collusion as in the literature.

Regressions in Table 6 shows that sellers adjust their offers towards the accepted offer in the previous period, even when the groups are randomly rematched in every period. The coefficients for ($\text{Offer}_{i,t-1}$−Average accepted offer_{t-1}) are negative and significant: if the offer was higher than the average accepted offer, which is always the case when a strictly higher offer is accepted in the thin market, sellers lower their offers in the next period. Hence, if a lower price is preferred, a buyer can thwart tacit collusion by choosing a lower than average price. However, price priority does not prevail; buyers choose a higher than average offer 49.72% of the time in thin markets and 42.64% of the time in thick markets.

Dependent Variable: $\text{Offer}_{i,t}-\text{Offer}_{i,t-1}$		
	(1)	(2)
	Posted Offer 1:2	Posted Offer 6:12
Constant	9.12^{***}	8.65^{***}
	(2.48)	(2.90)
$\text{Offer}_{i,t-1}$	-0.12^{***}	-0.09^{**}
	(0.03)	(0.04)
$\text{Offer}_{i,t-1}-\text{Average accepted offer}_{i,t-1}$	-0.66^{***}	-0.58^{***}
	(0.04)	(0.06)
$\text{Offer accepted}_{i,t-1}$	1.11^{**}	0.00
	(0.48)	(0.53)
Number of Observations	1392	1392

Note: GLS regression with random effects. Robust standard errors in parentheses. Standard errors clustered by individual. Significance at 1%, 5% and 10% are denoted by *** , **,* respectively. The Im-Pesaran-Shin for unit root tests for all variables reject the null hypotheses that the panels contain unit roots.

Table 6: Sellers' offer adjustments in posted offer markets

When deciding whether to select an offer higher than average, the buyer leans more on previous experience according to the Logit regression results presented in Table 7. The dependent variable "High $\text{offer}_{i,t}$" equals 1 if buyer i accepts an offer higher than the average offer in her market in period t, and 0 otherwise. Model (1) shows that the distribution of offers, captured by the mean and the standard deviation, does not have a significant effect on the choice. As suggested by Model (2), getting a high quality reinforces the buyer's choice of offer: when a buyer accepts a high offer, getting a high quality would increase the probability she continues doing so in the next period (the sum of coefficients for Quality and Quality × High offer is positive when High offer=1); when a lower offer is accepted, getting a high quality reduces the probability she chooses a high offer in the next period (the sum

of coefficients for Quality and Quality × High offer is negative when High offer=0).

Dependent Variable: High offer$_{i,t-1}$		
	(1)	(2)
Constant	−0.07	0.11
	(0.57)	(0.58)
Average offer$_{i,t}$	0.00	−0.01
	(0.01)	(0.01)
Standard deviation offer$_{i,t}$	−0.01	0.00
	(0.01)	(0.01)
High offer$_{i,t-1}$		−0.02
		(0.21)
Quality$_{i,t-1}$		−0.09***
		(0.03)
Quality$_{i,t-1}$× High offer$_{i,t-1}$		0.25***
		(0.04)
Number of observations	1440	1392

Notes: Logit regression on panel data of buyers' choices over time. Only posted offer treatments are included. Standard errors in parentheses. Significance at 1%, 5% and 10% are denoted by *** , **,* respectively. The Im-Pesaran-Shin for unit root tests for all variables reject the null hypotheses that the panels contain unit roots.

Table 7: Determinants of high-offer acceptance by buyer: Logit regresssions

5.3 The price-quality relationship

Our next analysis demonstrates that the quality-price relationships are different in the posted offer and posted bid markets. Overall, given price, the quality is higher in the posted offer markets.

Figure 6 shows the counts of price-quality transactions using a heat map. The redder color corresponds to a higher frequency of a price-quality combination. In the posted bid treatments, traders cluster at the low quality levels, mostly at the lowest price and quality combination. In the posted offer treatments, trades happen most often in the price range of 80 to 90, with the corresponding quality ranging from 1 to 10 at these prices. Overall, the trades in the posted offer treatments cluster more on the upper right part of the graphs than the trades in the posted bid treatments.

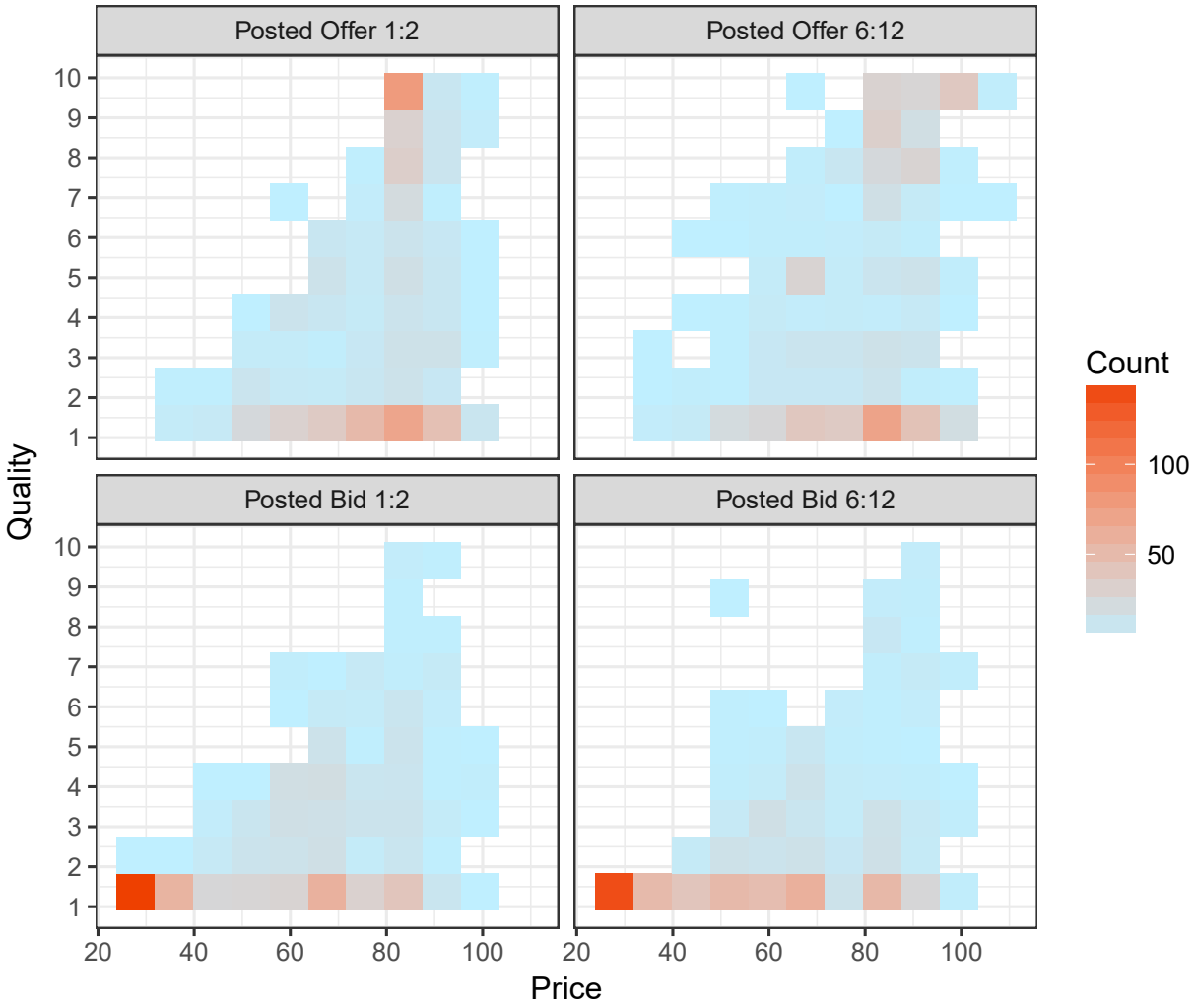


Figure 6: Price and quality joint histograms by treatment

We run several Tobit regressions to check whether there is a statistically significant difference between the quality-price relationship in the treatments. Results are shown in Table 8. Consistent with FKR, from regression (1), quality increases with price in our experiment. Shown in regression (2), given the transaction price, the quality the seller chooses is lower in the posted bid markets, and the market thickness does not have a significant effect on seller's quality choice. From regression (3), the two market institutions do not react differently to the change in market thickness (coefficient for the interaction term not significant at 5% level).

Dependent Variable: Quality			
	(1)	(2)	(3)
Constant	-11.64^{***}	-9.37^{***}	-9.09^{***}
	(1.32)	(1.24)	(1.23)
Price	0.18^{***}	0.16^{***}	0.16^{***}
	(0.02)	(0.01)	(0.01)
Posted-bid		-1.71^{***}	-2.41^{***}
		(0.46)	(0.65)
Thin market		0.26	-0.32
		(0.45)	(0.55)
Posted-bid $\times$ Thin market			1.37
			(0.85)
Num. of Obs.	2868	2868	2868
Pseudo R^2	0.09	0.10	0.10

Note: Robust standard errors in parentheses. Standard errors clustered by session. Significance at 1%, 5% and 10% are denoted by *** , **,* respectively.

Table 8: Tobit regression: Treatment effects on quality

The higher quality at given prices is consistent with the theoretical prediction when sellers have stronger other-regarding preferences, which results in an equilibrium price and quality which are also higher. These results confirm that posted offer markets produce higher quality because it not only generates higher prices on averge, but, in fact, higher quality at all prices. In other words, suggested gifts induce greater positive reciprocity than extended gifts unconditional upon price.

5.4 Alternative conjectures

We evaluate alternative conjectures to explain the differences in quality-price relationships between the two institutions, but do not find strong support in our data.

An alternative way to model the scenario is to to allow for heterogeneity in sellers' other regarding levels and incorporate incomplete information. In Janssen and Roy (2010) where the quality is determined for each seller ex ante, prices in the posted offer markets can be indicators of the qualities. Our setting is more complicated as the quality is determined by both the endogenous transaction prices and the seller's preference.

Each seller i has private information on her type β_i. From section 2.1 we can see that

the quality seller i chooses if contracted, $q(p, \beta_i)$ is determined by the price level and β_i.

Under the posted bid institution, the buyer posts the bid b to all sellers. A Bayesian Nash equilibrium bid b^* yields the highest expected utility for the buyer given the distribution of sellers' types and the quality choice each type makes at each price. Denoted by $b^* = \arg\max_b EU_B(b, q(b, \beta_i))$.

Under the posted offer institution, for every price there exists a pooling equilibrium to support it. Each seller submits offer p. The buyer accepts a random one of them, and gets $EU_B(p, q(p, \beta_i))$. There are different beliefs the buyer can hold, some supported by further refinement. Nevertheless, in a pooling equilibrium under the posted offer institution, the buyer does not get as high expected utility as in the equilibrium under the posted bid institution. For a buyer who maximizes her own profit, this implies that her payoff would be higher in the posted bid markets, contradicting the results from the experiment. A pooling equilibrium under the posted offer institution may lead to both higher price and quality than the equilibrium under the posted bid institution, but it cannot explain the different quality-price relationship the two institutions induce.

In a separating equilibrium under the posted offer institution, since sellers can signal their types, the more other-regarding sellers may be selected more often than in the posted bid markets, which leads to a higher quality level given price. However, this conjecture is not supported by the data. Figure 7 depicts the bids and offers over time in the thin and thick markets. Same as the price trend in Figure 5, offers converge in posted offer markets over time, regardless of the market thickness. Under the posted offer institution, there is no statistically significant difference between the chosen and unchosen offers in the thin market (two-sided t-test p-value= 0.98), but chosen offers are significantly lower than the unchosen ones in the thick market (one-sided t-test p-value= 0.00). The cause of the different patterns between the thin and thick market remains unclear. However, as shown in previous sections, the market thickness does not lead to a difference in the price and quality, or the quality-price relationship in posted offer markets.

Therefore, in order to explain the observation from our experiment, we have to rely on the difference in the seller's preference between the two institutions. Neither the separating equilibrium or pooling equilibrium alone can explain the results.

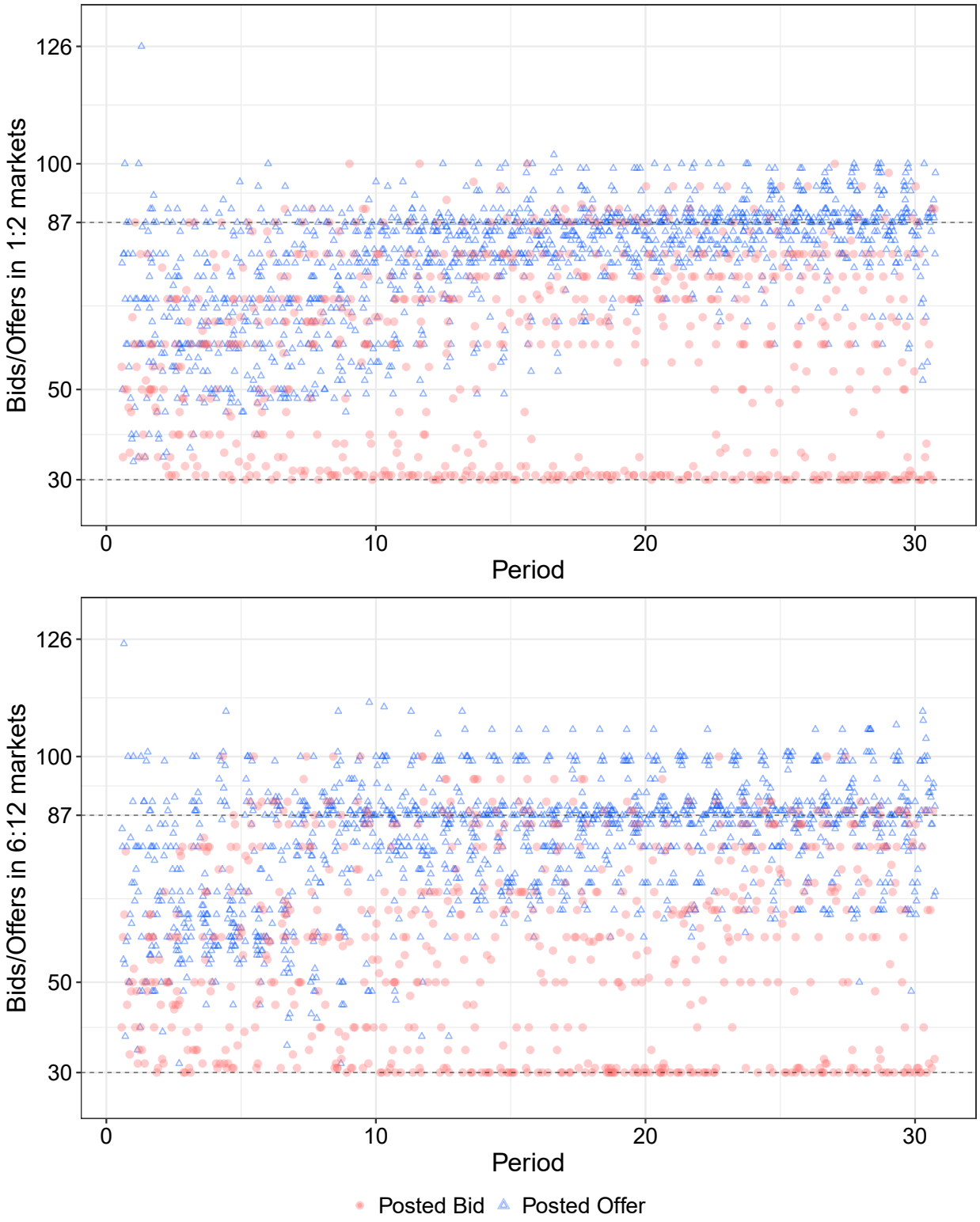


Figure 7: Bids and offers over time

6 Conclusion

In this paper, we compare two institutions for procurement, the posted bid and the posted offer institution, in a setting featuring moral hazard. A contract is formed through a posted bid or posted offer institution that specifies the price but not the quality, which the seller chooses afterwards. Holding preference constant, these two institutions have the same subgame-perfect Nash equilibrium outcome under different market thicknesses. The two institutions differ in their gift-formation process: the gift is extended to the seller in the posted bid institution, and suggested by the seller in the posted offer institution.

In the experiment, gift-exchange behavior is observed under both institutions, and is stronger in posted offer markets, at a given price, the quality is higher when the posted offer institution is used. The posted offer institution results in higher quality and price in the market, generating higher surpluses for both buyer and sellers. The market thickness does not have a significant effect on the gift-exchange relationship. The different quality-price relationships are the key factor driving the varying performance under the two institutions. These results are consistent with the equilibrium outcome from more other-regarding sellers. The most likely explanation for this difference is that the interaction in the posted offer institution builds a stronger buyer-seller relationship, for which the seller cares more for the buyer's pecuniary payoff.

A few reasons can contribute to the stronger sentiment the seller has in the posted offer markets. One explanation is that the seller feels more responsible for the social outcome since she has a higher decision power in the pricing process. Similar phenomena have been observed in other settings in the literature, where a higher level of participation in group decision makes players more prosocial. Another explanation could be that the interaction in posted offer treatment fosters a stronger bond between the buyer and the seller, as the buyer explicitly favors and approves the seller's offer. In this paper, we do not identify which of these factors is the main driving force of behavior.

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Appendices

Appendix A: Proofs

Proof of Proposition 1

Proof. Given price p, the seller's optimization problem is

$$\max_q \Pi_S(p,q) - \alpha_S \max\{\Pi_B(p,q) - \Pi_S(p,q), 0\} - \beta_S \max\{\Pi_S(p,q) - \Pi_B(p,q), 0\}$$

For each β_S, denote by $\hat{P}$ the highest price at which the seller's optimal quality equalizes buyer's and seller's profits. We can show that $\hat{P} \in [P_1, P_2]$, where $P_1 = 38.61$, $P_2 = 86.94$, and $\hat{P}$ is a function of β_S.

The blue lines in figure 8 are examples of the quality choices at different β_Ss.

1. If $\Pi_S \leq \Pi_B$, we have

$$U_S(p,q) = \Pi_S(p,q) - \alpha_S(\Pi_B(p,q) - \Pi_S(p,q)).$$

   In this range, $\frac{\partial U_S}{\partial q} < 0$, the seller obtains the highest utility at the lowest quality level that satisfies $\Pi_S \leq \Pi_B$ and $q \geq 1$.

   When the price is lower than P_1, the optimal quality level for a seller is 1 regardless of the value of β_S.

2. If $\Pi_S \geq \Pi_B$, we have

$$U_S(p,q) = \Pi_S(p,q) - \beta_S(\Pi_S(p,q) - \Pi_B(p,q)).$$

In this range, $\frac{\partial U_S}{\partial q} = -(1-\beta_S)(2aq+b) + \beta_S(126-p)/10$.

If $\beta_S \leq 0.11$, $\frac{\partial U_S}{\partial q} < 0$ when $\Pi_S \geq \Pi_B$. The optimal quality is 1 for all $p \in [30, 126]$.

As shown in panel (c) and (d) of figure 8, if $\beta_S > 0.11$, there can be several segments for the optimal quality.

When price is smaller than $\hat{P}$, $\frac{\partial U_S}{\partial q} > 0$ for (p,q) if $\Pi_S \geq \Pi_B$, the optimal quality is the highest quality in the range of $\Pi_S \geq \Pi_B$, which is the quality that makes $\Pi_S = \Pi_B$.

Denote by P_3 the price at which $\frac{\partial U_S}{\partial q}|_{q=1} = 0$, thus $P_3 = 126 - 10.455 \times \frac{1-\beta_S}{\beta_S}$. When $p \in [\hat{P}, P_3]$, we have $\frac{\partial U_S}{\partial q} = 0$ and $\Pi_S \geq \Pi_B$ for the optimal quality, as depicted by the downward sloping segment in panel (c) and (d) in figure 8.

When price is higher than P_3, we have $\frac{\partial U_S}{\partial q} < 0$ for $q \in [1, 10]$, the optimal quality equals 1.

Furthermore, if $\beta_S > 0.43$, as in panel (d) of figure 8, the constraint of $q \leq 10$ is binding for some quality choices. When price is between P_2 and $P_4 = 126 - 29.553 \times \frac{1-\beta_S}{\beta_S}$, we have $\frac{\partial U_S}{\partial q} > 0$ for $q \in [1, 10]$, the optimal quality in this range is 10.

Therefore, denote the quality choice by $q(p)$, we have

- $\beta_S \in [0, 0.11]$

$$q(p) = 1 \text{ for } p \in [30, 126]$$

- $\beta_S \in (0.11, 0.43]$

$$q(p) = \begin{cases} 1 & p \in [30, P_1] \cup [P_3, 126] \\ q^e(p) & p \in [P_1, \hat{P}] \\ q^0(p) & p \in [\hat{P}, P_3] \end{cases}$$

- $\beta_S \in (0.43, 1]$

$$q(p) = \begin{cases} 1 & p \in [30, P_1] \cup [P_3, 126] \\ q^e(p) & p \in [P_1, P_2] \\ 10 & p \in [P_2, P_4] \\ q^0(p) & p \in [P_4, P_3] \end{cases}$$

Here $q^e(p)$ is the quality level such that $\Pi_S = \Pi_B$ given price p. $q^e(p)$ is increasing in p when $p \in [30, 126]$, and is not a function of β_S. Also, $q^0(p) = 0.4713 \times \frac{\beta_S}{1-\beta_S}(126-p) - 3.9270$ is the quality level such that $\frac{\partial U_S}{\partial q}|_{\Pi_S \geq \Pi_B} = 0$, and is decreasing in p and increasing in β_S.

Note that $\hat{P}$, P_3 and P_4 are non-decreasing functions of β_S.

The following shows that $q(p; \beta_S)$ is increasing in β_S. Take $\beta_1, \beta_2 \in (0, 1]$, and suppose $\beta_1 \leq \beta_2$.

a) If $\beta_1 \leq 0.11$, we have $1 = q(p; \beta_1) \leq q(p; \beta_2)$ for all prices.

b) If $\beta_1, \beta_2 \in (0.11, 0.43]$,

   i) For $p \in [30, P_1]$, the quality is 1 for any β_S, $q(p; \beta_1) = q(p; \beta_2)$.

   ii) For $p \in [P_1, \hat{P}(\beta_2)]$, we have $q(p; \beta_2) = q^e(p)$, and $q(p; \beta_1) = \min\{q^e(p; \beta_1), q^0(p; \beta_1)\}$. Hence, $q(p; \beta_1) \leq q^e(p; \beta_1) \leq q^e(p; \beta_2) = q(p; \beta_2)$.

   iii) For $p \in [\hat{P}(\beta_2), P_3(\beta_2)]$, we have $q(p; \beta_2) = q^0(p; \beta_2)$, and $q(p; \beta_1) = \max\{q^0(p; \beta_1), 1\}$. Therefore, $q(p; \beta_1) \leq q^0(p; \beta_1) \leq q(p; \beta_2)$.

   iv) For $p \in [P_3(\beta_2), 126]$, we have $q(p; \beta_1) = q(p; \beta_2) = 1$.

   Therefore, $q(p; \beta_1) \leq q(p; \beta_2)$ if $\beta_1, \beta_2 \in (0.11, 0.43]$.

c) If $\beta_1 \in (0.11, 0.43]$, and $\beta_2 \in [0.43, 1]$,

   i) For $p \in [30, P_1]$, the quality is 1 for any β_S, $q(p; \beta_1) = q(p; \beta_2)$.

   ii) For $p \in [P_1, P_2]$, same as when $\beta_1, \beta_2 \in (0.11, 0.43]$, $q(p; \beta_1) \leq q^e(p; \beta_2) = q(p; \beta_2)$.

   iii) For $p \in [P_2, P_4(\beta_2)]$, $q(p; \beta_2) = 10 \geq q(p; \beta_1)$.

   iv) For $p \in [P_4(\beta_2), P_3(\beta_2)]$, same as when $\beta_1, \beta_2 \in (0.11, 0.43]$, we have $q(p; \beta_1) \leq q^0(p; \beta_1) \leq q^0(p; \beta_2) = q(p; \beta_2)$.

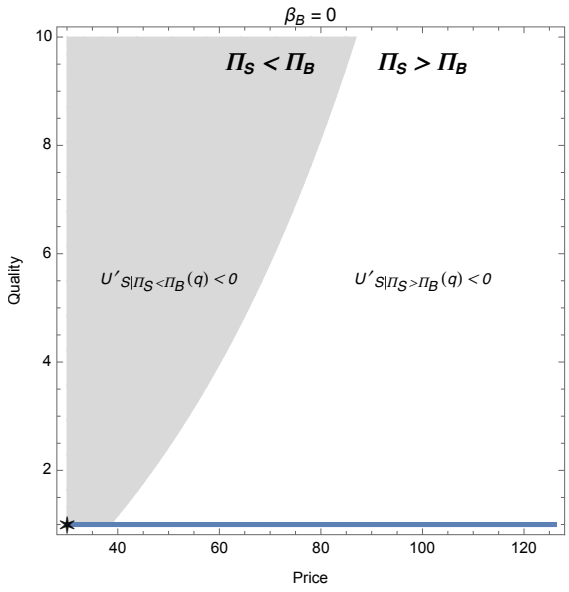
   v) For $p \in [P_3(\beta_2), 126]$, $q(p; \beta_1) = q(p; \beta_2) = 1$.

   Therefore, $q(p; \beta_1) \leq q(p; \beta_2)$ in this price range.

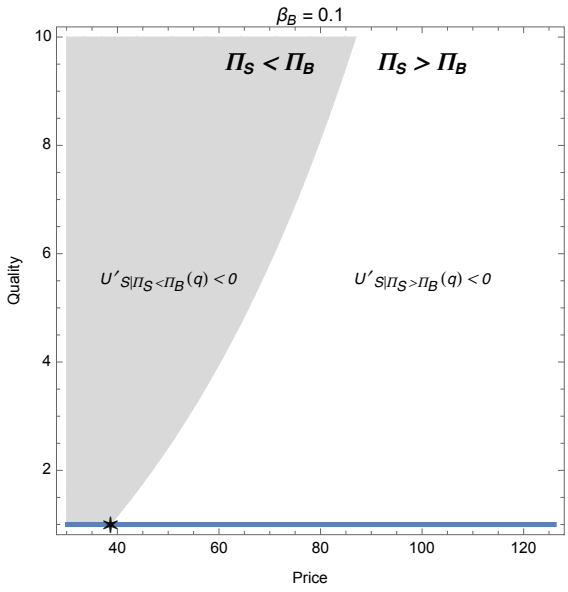
d) If $\beta_1 > 0.46$, we have $q(p; \beta_1) = q(p; \beta_2)$ for $p \in [30, P_4(\beta_1)]$. For $p \in [P_4(\beta_1), P_4(\beta_2)]$, $q(p; \beta_2) = 10 \geq q(p; \beta_1)$. For $p \in [P_4(\beta_2), P_3(\beta_2)]$, we have $q(p; \beta_2) = q^0(p; \beta_2) > \max\{q^0(p; \beta_1), 1\} = q(p; \beta_1)$. For $p \in [P_3(\beta_2), 126]$, we have $q(p; \beta_1) = q(p; \beta_2) = 1$.

   Therefore, $q(p; \beta_1) \leq q(p; \beta_2)$ in this price range.

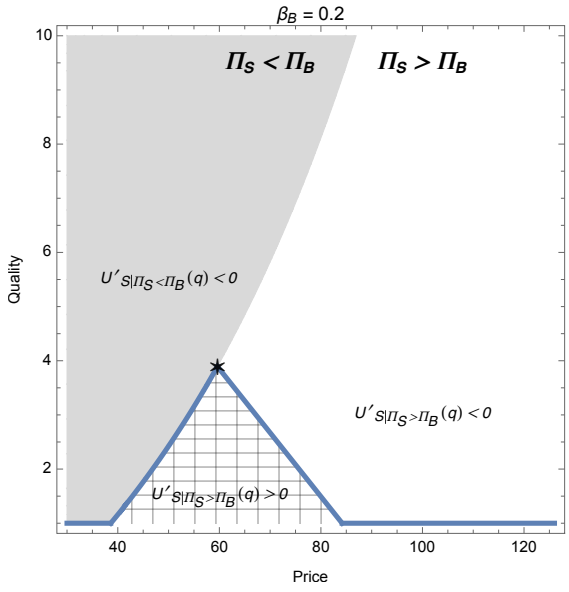
Hence, we have $q(p; \beta_1) \leq q(p; \beta_2)$, $q(p; \beta_S)$ is increasing in β_S. □



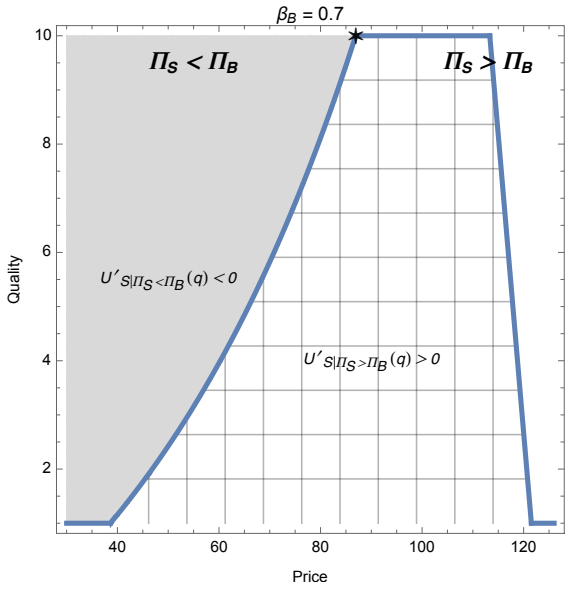
(a) $\beta_S \leq 0.11$



(b) $\beta_S \leq 0.11$



(c) $0.11 < \beta_S \leq 0.43$



(d) $0.43 < \beta_S < 1$

Figure 8: Optimal quality and prices

Proof of Proposition 2

Proof. Given the seller's quality choice in the last stage, we can find the price that maximizes the buyer's utility.

- If $p \leq P_1$, we have $\Pi_S \leq \Pi_B$ and $q(p) = 1$. In this range, the buyer's utility

$$U_B(p, q(p)) = (1 - \beta_B)(126 - p) \times 0.1 + \beta_B(p - c(1)).$$

  Therefore a buyer with $\beta_B < 0.09$ prefers $p = 30$ in this range, and a buyer with $\beta > 0.09$ prefers $p = P_1$ in this range.

- If $p \in [P_1, P^*]$, where $P^* = \min\{\hat{P}(\beta_S), P_2\}$, the seller chooses $q^e(p)$ that equalizes Π_S and Π_B. In this range, $U_B = \Pi_B = \Pi_S$. Since $q(p)$ is a bijective function in this range, write p as a function of q, such that $p(q) = q^{-1}(q)$, and from $\Pi_B = \Pi_S$ we have,

$$p'(q) = -\frac{-c'(q) - (126 - p)/10}{1 + q/10}.$$

  Therefore,

$$\begin{aligned}\frac{dU_B}{dq} =& p'(q) - c'(q) \\ =& \frac{1}{1 + q/10} \cdot [c'(q) + (126 - p)/10 - c'(q)(1 + q/10)] \\ =& \frac{1}{10 + q} \cdot [-c'(q) \cdot q + (126 - p)].\end{aligned}$$

  Hence when $p \in [P_1, P_2]$ and $q \in [1, 10]$, we have $\frac{dU_B}{dq} > 0$. In this range, the buyer prefers the highest price, $\min\{\hat{P}(\beta_S), P_2\}$, which leads to the highest quality. Note that $\hat{P}(\beta_S) \leq P_2$ when $\beta_S \leq 0.43$, and $\hat{P}(\beta_S) > P_2$ otherwise. Therefore the buyer's preferred price is increasing in β_S.

- If $p \in [P^*, 126]$, we have $\Pi_S > \Pi_B$, thus $U_B = \Pi_B - \alpha(\Pi_S - \Pi_B)$. In this range, $q(p)$ is a decreasing function of p, thus $\frac{dU_B}{dp} < 0$, and the buyer prefers P^*.

Therefore, the buyer prefers $P^* = \min\{\hat{P}(\beta_S), P_2\}$ to any other price in the range of $[P_1, 126]$, and if the buyer has $\beta \geq 0.09$, P^* is the buyer's globally preferred price.

If the buyer has $\beta_B < 0.09$, and the seller has $\beta_S < 0.11$, we have $U_B(q(30), 30) > U_B(q(\hat{P}(\beta_S)), \hat{P}(\beta_S))$, the buyer's globally preferred price is 30. If $\beta_S \geq 0.11$, then $U_B(q(30), 30) < U_B(q(P^*), P^*)$, the buyer prefers P^*.

The preferred prices are marked by asterisks in figure 8.

In summary, the globally preferred price is 30 if $\beta_B < 0.09$ and $\beta_S < 0.11$, and P^* otherwise. Since P^* is increasing in β_S, and $P^* > 30$, the buyer's globally preferred price is increasing in β_S.

□

Appendix B: Instructions

Posted Offer 1:2

Instructions

Today you are participating in an experiment that studies decision making in auctions. Your decisions will determine your earnings. Please read these instructions carefully.

Do not use mobile phones, laptop computers, or use the lab's desktop computer other than for the experiment. During the experiment, please refrain from talking or looking at the computer monitors of others. If at some point you have a question, please raise your hand and we will address it as soon as possible.

At the conclusion of the experiment, please sit quietly. We will call participants up one at a time to the sign-in counter. There you will privately receive your earnings. We will not reveal your earnings to any other subject, or any other subject's earnings to you. Nor will we provide any information about how your earnings compare to the earnings of others.

Introduction

Today you will participate in a series of 30 transactions. You will be either a buyer or seller for the entirety of this series. In each transaction, participants are randomly assigned to form groups, each consisting of one buyer and two sellers. The buyer purchases a good from one of the sellers in the group. After the purchase, this seller chooses the quality of the good he provides to the buyer.

Sellers have the same capacity to produce the good, and incur the same cost at the same quality. Each seller can produce at quality levels from 1 to 10, with 10 being the highest. After purchasing the good, the amount of profit buyer can get depends on both the price paid and the quality.

Each transaction has three phases. In the first phase, each seller submits a price to the buyer – called a bid. In the second phase, the two bids submitted in the group will be informed to the buyer and two sellers. The buyer chooses one seller to purchase at the seller's bid. In the third phase, the selected seller chooses the quality level of the good provided to the buyer.

Note the buyer is only shown the sellers' bids when he is selecting the seller, not the history of sellers' selected quality levels or participant ID.

Payoffs

All of your earnings are in experimental dollars. At the conclusion of the experiment, your experimental dollar earnings will be converted to Chinese Yuan at a certain rate. This rate will be shown on your screen interface. These earnings will be added to your show-up fee of ¥10 to determine your total earnings today.

In a transaction, participants' experimental dollar earnings are as follows.

The buyer's profit is,

Buyer's Profit = (126–Price Paid) × (Quality/10).

For the seller not selected, the profit is 0.

The selected seller's profit is

Seller's Profit = Bid – Cost of the Quality Provided.

A seller's cost for quality provided is provided in the following table.

Quality	1	2	3	4	5	6	7	8	9	10
Cost	30	31	32	34	36	38	40	42	45	48

How to use the software

When the experiment starts, please enter your participant ID, which is the number on the card you received when signing in. You will then be informed whether you are a buyer or seller.

Now please take a look at the accompanying screenshots handout.

In the first phase of a transaction, the sellers and buyer screens will appear as shown in the first two screenshot. As in the first screenshot, the seller screen has a single field where he can enter bids. If he clicks the grey "Show Profits" button after entering a price, the table below the button will show the his costs, his profits, and buyer's profits for the ten different quality levels. When the seller has settled on a bid amount to submit to the buyer, he enters the price and clicks the red "Submit" button. A seller may also review the history of his past transactions by examining the Table on the right side of the interface.

In this phase of the transaction, see the second screen shot, the buyer may enter prices and explore the corresponding profits for different quality levels. He may examine his previous transaction outcomes as well.

In the second phase of the transaction, the buyer's screen will appear as the third screenshots. The two prices submitted by the sellers are shown above their respective red "Choose" buttons. The buyer selects a seller by clicking the corresponding "Choose" button.

Meanwhile, sellers may check for the profits under each combination of price and quality on the interface similar with the second screen shot.

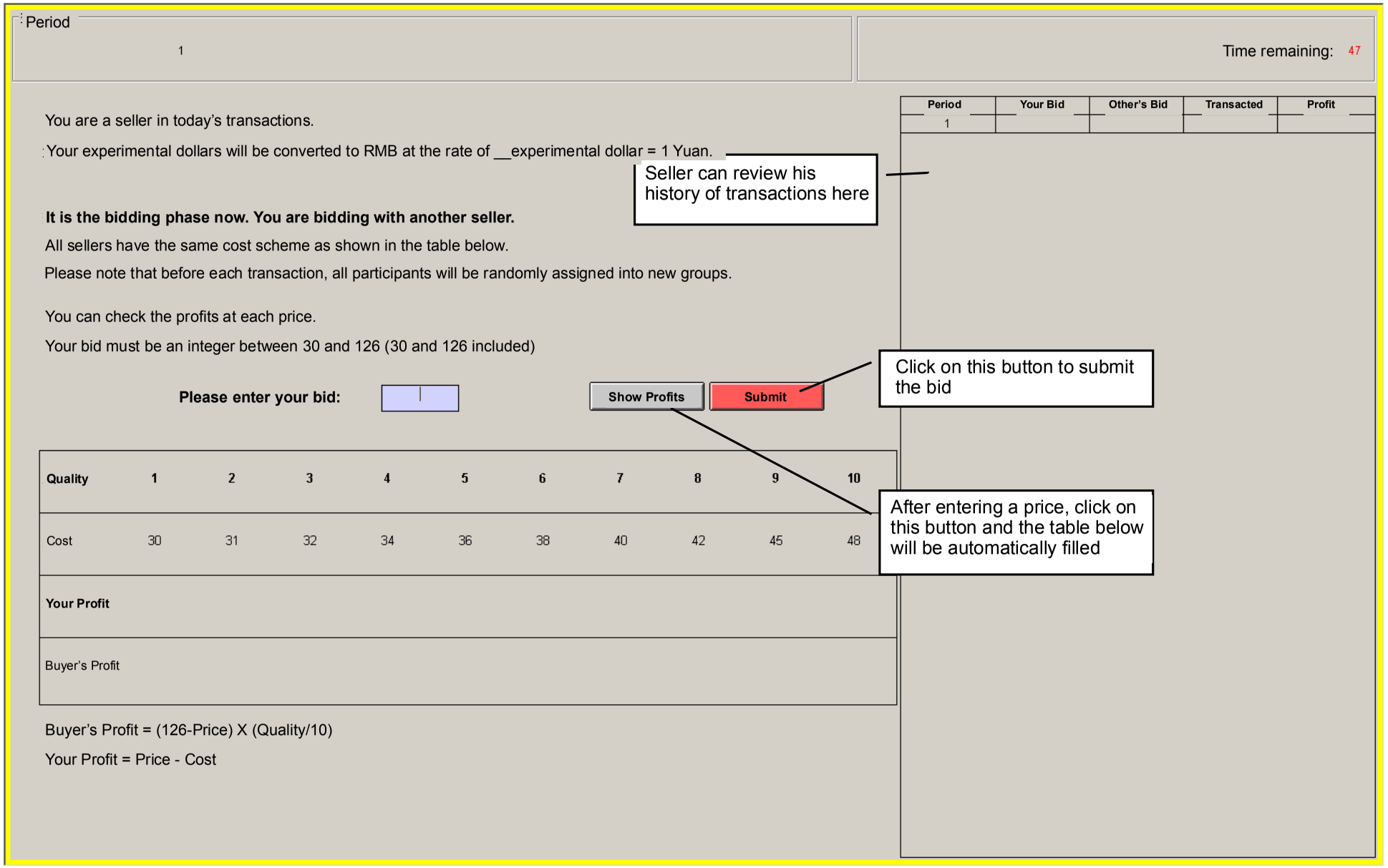
Afterwards in the third phase, on the sellers' screen, appear as the fourth screenshot, the chosen seller selects the quality he provides. The task is completed by entering the intended quality in the "Quality" field and then clicking the red "Submit" button.

At the same time, an interface similar with the second screen shot will appear as well for buyers and unchosen sellers.

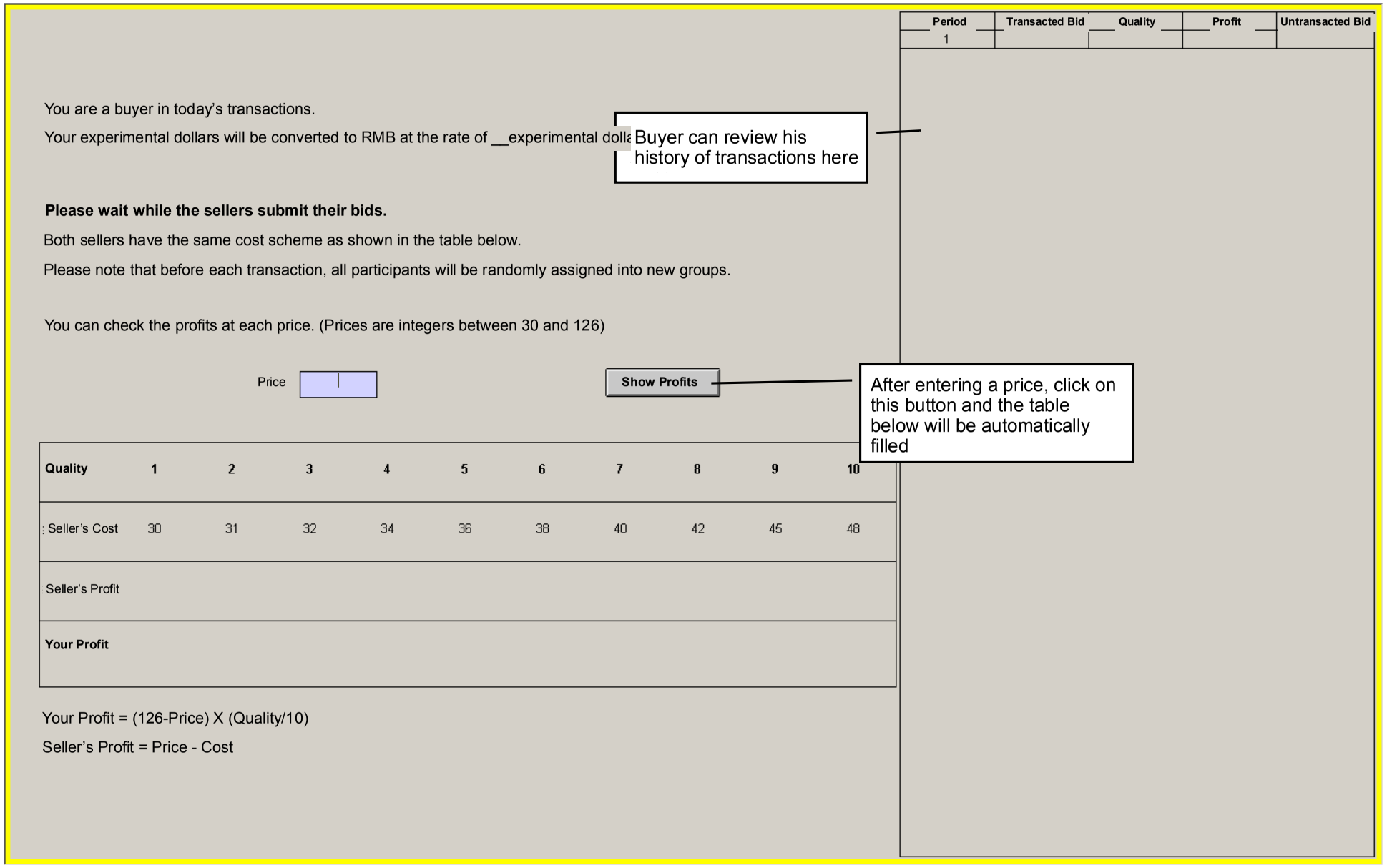
Once all groups have completed the transaction tasks, each buyer is privately informed of the quality level of his good and the corresponding profit. Sellers are informed of their resulting profits.

After completing all transactions you will complete a short questionnaire.

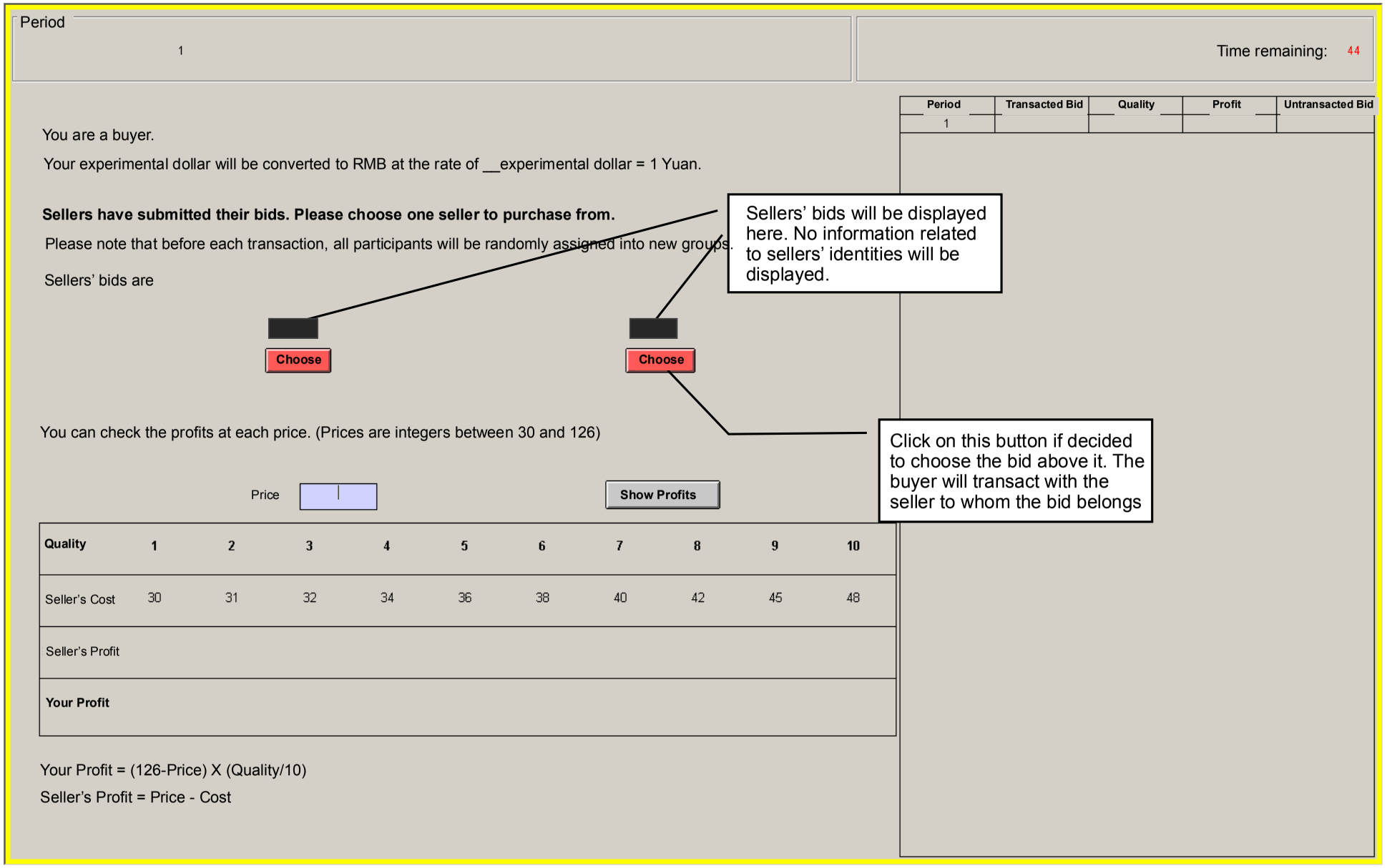
If there is any question now or any time during the experiment, please raise your hand, and someone will come to assist as soon as possible.



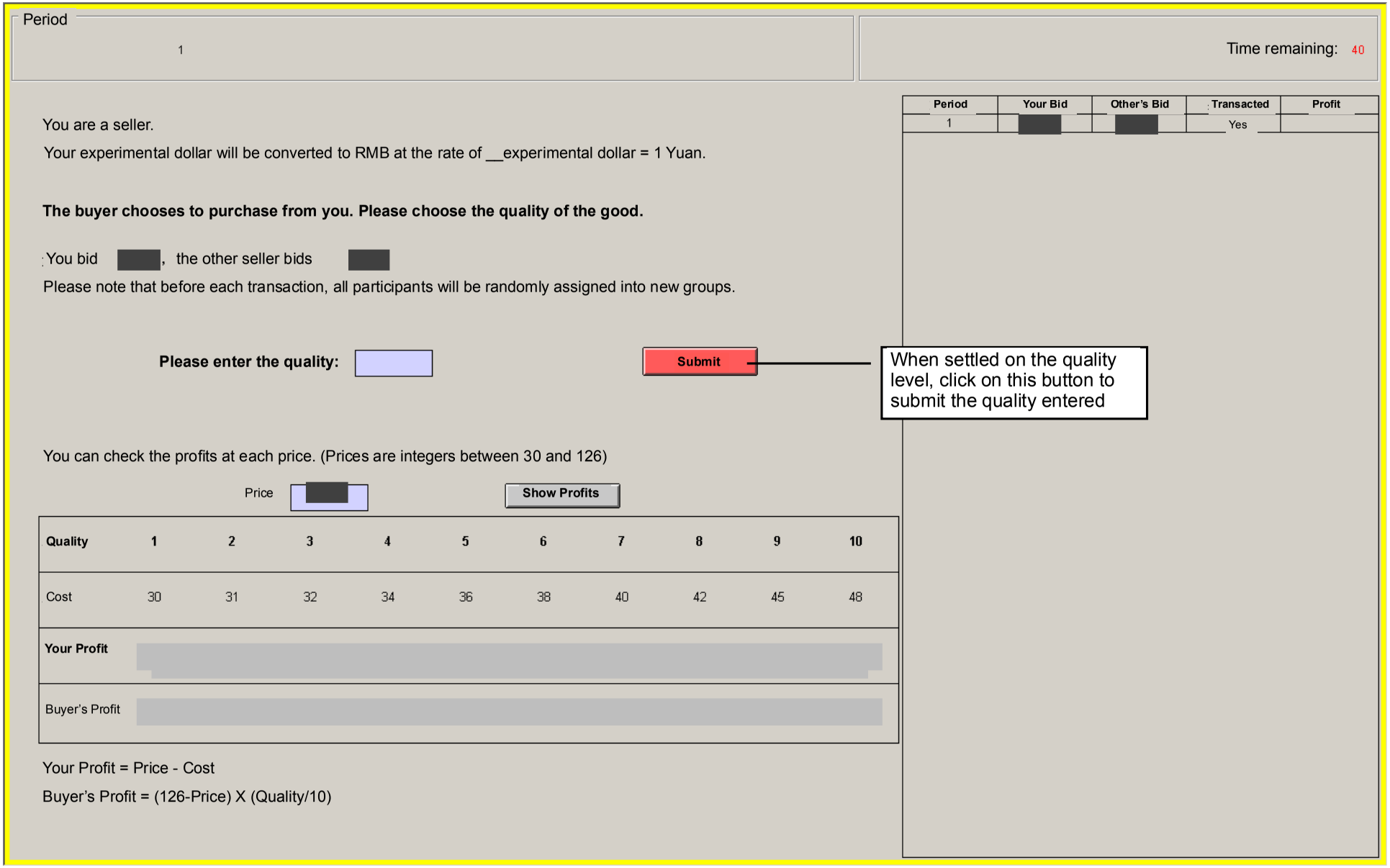
Screenshot 1 Seller's screenshot in the first phase: choosing a bid



Screenshot 2 Buyer's screenshot in the first phase: waiting



Screenshot 3 Buyer's screenshot in the second phase: choose a seller



Screenshot 4 Seller's screenshot in the third phase: choose the quality

Posted Offer 6:12

Instructions

Today you are participating in an experiment that studies decision making in auctions. Your decisions will determine your earnings. Please read these instructions carefully.

Do not use mobile phones, laptop computers, or use the lab's desktop computer other than for the experiment. During the experiment, please refrain from talking or looking at the computer monitors of others. If at some point you have a question, please raise your hand and we will address it as soon as possible.

At the conclusion of the experiment, please sit quietly. We will call participants up one at a time to the sign-in counter. There you will privately receive your earnings. We will not reveal your earnings to any other participant, or any other subject's earnings to you. Nor will we provide any information about how your earnings compare to the earnings of others.

Introduction

Today you will participate in a series of 30 transactions. You will be either a buyer or seller for the entirety of this series. In a transaction each seller may sell only one unit of a good, and each buyer will purchase only one unit. When the transaction begins, every seller selects a price of his unit. Then all of these prices are shown to all buyers and sellers. Buyers are then randomly placed in a queue to make purchases one at a time. Note the buyers' positions in this queue are randomly reassigned every transaction. Whenever a seller's unit is purchased, he must choose the quality of the good he provides.

Sellers have the same capacity to produce the good, and incur the same costs at the same quality. Each seller can produce quality levels from 1 to 10, with 10 being the highest. After purchasing the good, the amount of profit buyer can get depends on both the price paid and the quality.

Note the buyer is only shown the sellers' bids when making the purchase, not the sellers' participant ID's or previous selected quality levels. Also, the seller only chooses the quality after selling the good.

(The experimenter announces the number of buyers and sellers in the session)

Payoffs

All of your earnings are in experimental dollar. At the conclusion of the experiment, your experimental dollar earnings will be converted to Chinese Yuan at a certain exchange rate. Your exchange rate will appear on your computer screen once the experiment starts. These earnings will be added to your show-up fee of ¥10 to determine your total earnings today.

In a transaction, participants' experimental dollar earnings are as follows.

The buyer's profit is,

Buyer's Profit = (126–Price Paid) × (Quality/10).

For seller who does not get the contract, the profit is 0.

The selected seller's profit is

Seller's Profit = Bid – Cost of the Quality Provided.

A seller's cost for quality provided is provided in the following table.

Quality	1	2	3	4	5	6	7	8	9	10
Cost	30	31	32	34	36	38	40	42	45	48

How to use the software

When the experiment starts, please enter your participant ID, which is the number on the card you received when signing in. You will then be informed whether you are a buyer or seller.

Now please take a look at the accompanying screenshots handout.

In the first phase of a transaction the sellers and buyer screens will appear as shown in the first two screenshots. As in the first screenshot, the seller's screen has a single field where he can enter bids. If he clicks the grey "Show Profits" button after entering a price, the table below the button will show the his costs, his profits, and buyer's profits for the 10 different quality levels. When the seller has settled on a bid amount to submit to the buyer, he enters the price and clicks the red "Submit" button. A seller may also review the history of his past transactions by examining the Table on the right side of the interface.

In this phase of the transaction, see the second screenshot, the buyer may enter prices and explore the corresponding profits for different quality levels. He may examine his previous transaction outcomes as well.

In the second phase of the transaction, the buyer's screen will appear as the third screenshots. Prices are displayed from the highest to the lowest. Buyer can view profits under different prices by clicking on the price or entering the price and click on the "Show Profits" button. Buyers' orders are randomly reassigned in each period, and buyer can select a price by click on "Submit" button after click on the appropriate price. Prices selected will be crossed off.

On seller's screen, prices will be shown as well. Same as the buyer's interface, clicking on the bid button and the table below will automatically show its corresponding payoffs.

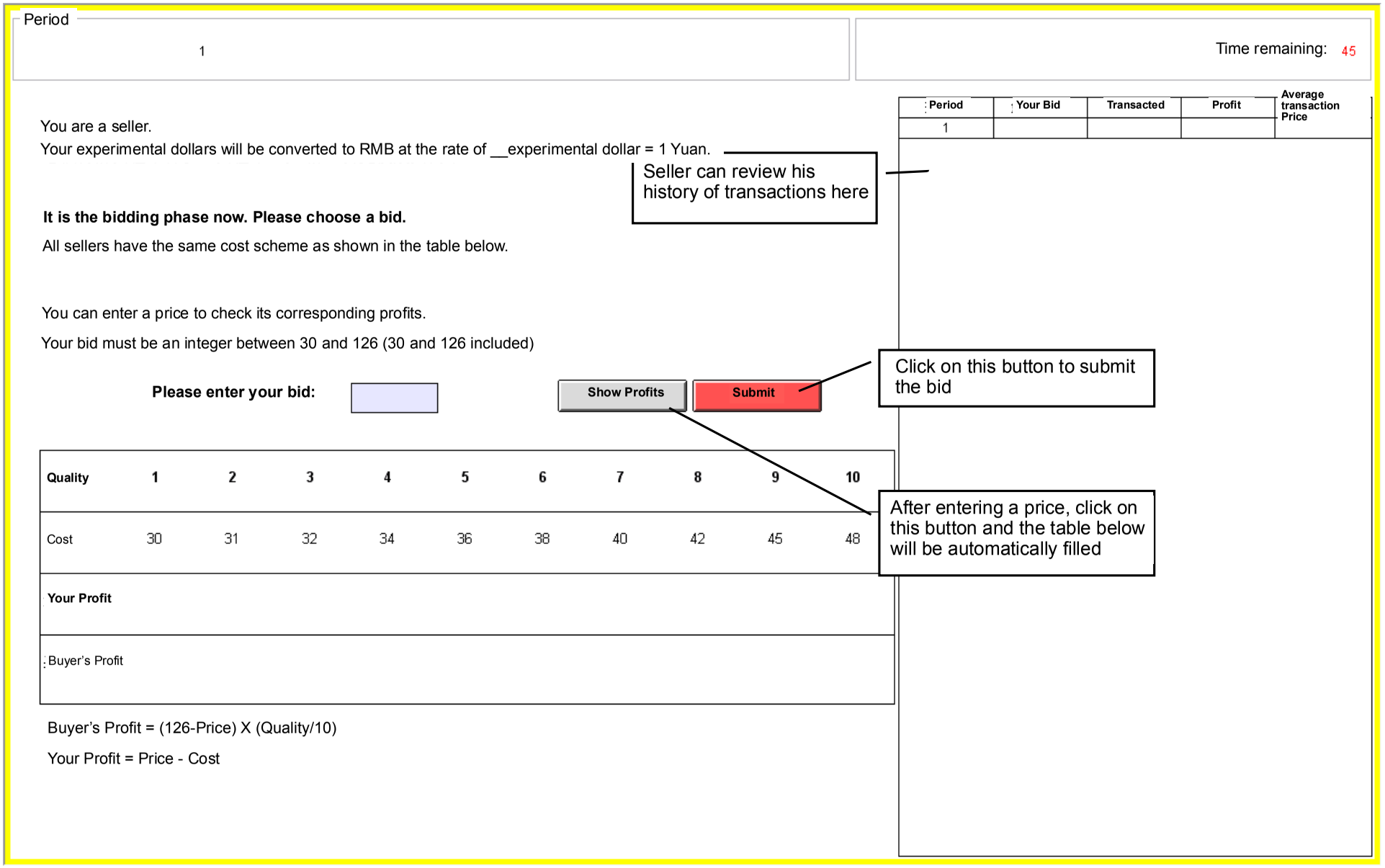
In the third phase, if the seller makes a sale, the sellers' screen appears as the fourth screenshot. This seller then selects the quality he provides. The task is completed by entering the intended quality in the "Quality" field and then clicking the red "Submit" button.

Meanwhile, buyers and participants who do not get a contract may check for the profits under each combination of price and quality.

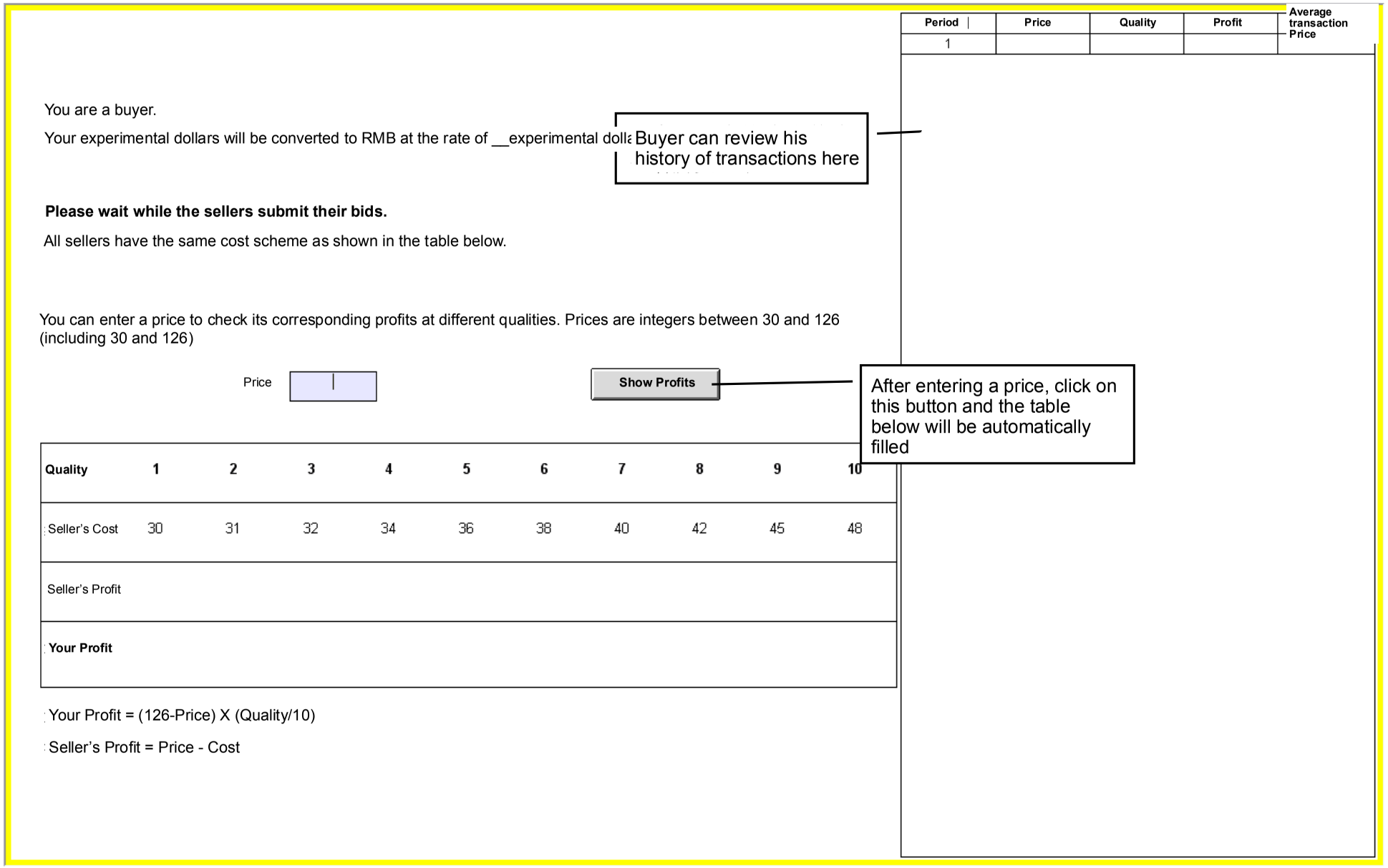
Once all groups have completed the transaction tasks, we privately inform each buyer of the quality level of his good and corresponding profit. Sellers are informed of their resulting profits.

After completing all transactions you will complete a short questionnaire.

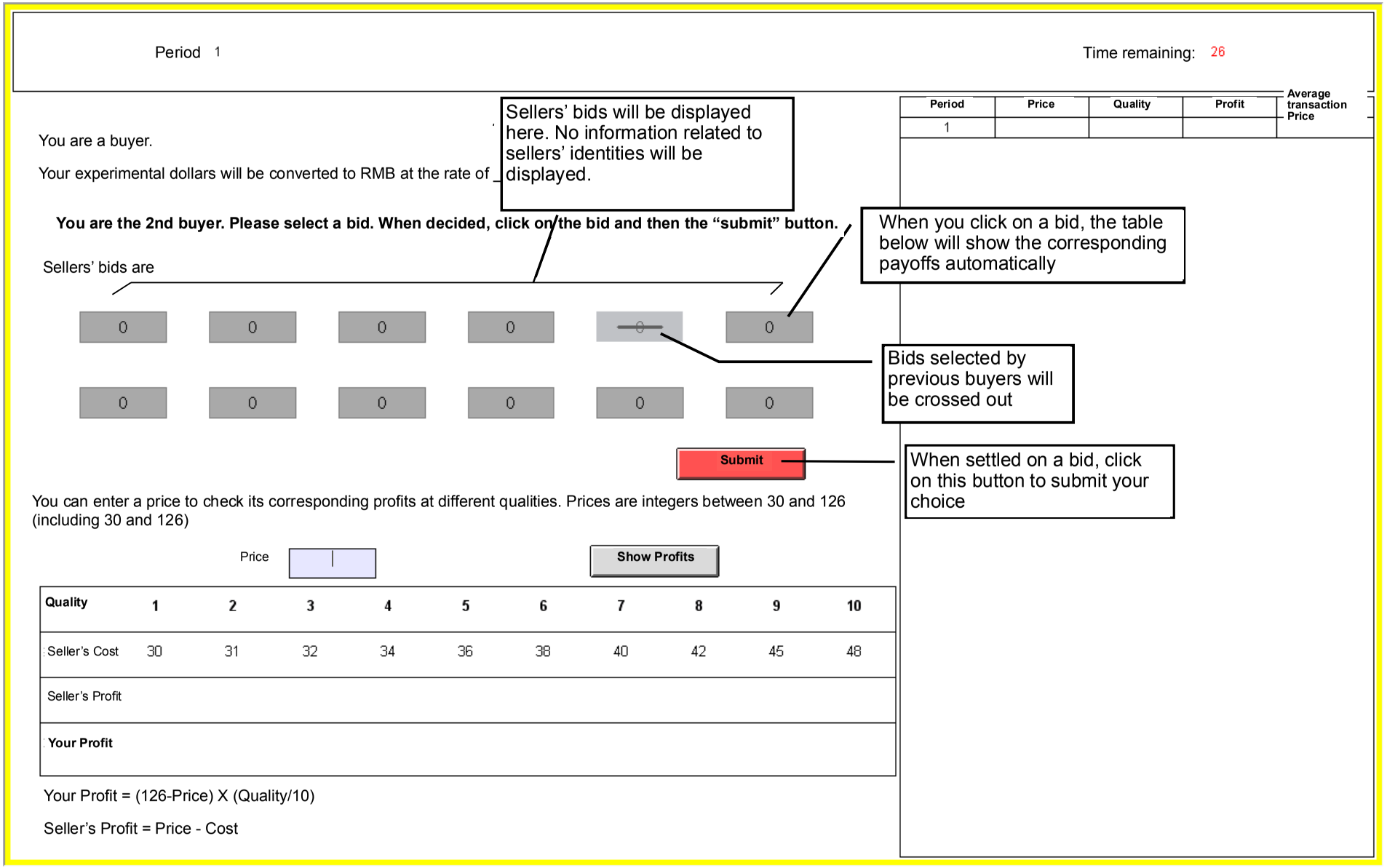
If there is any question now or any time during the experiment, please raise your hand, and someone will come to assist as soon as possible.



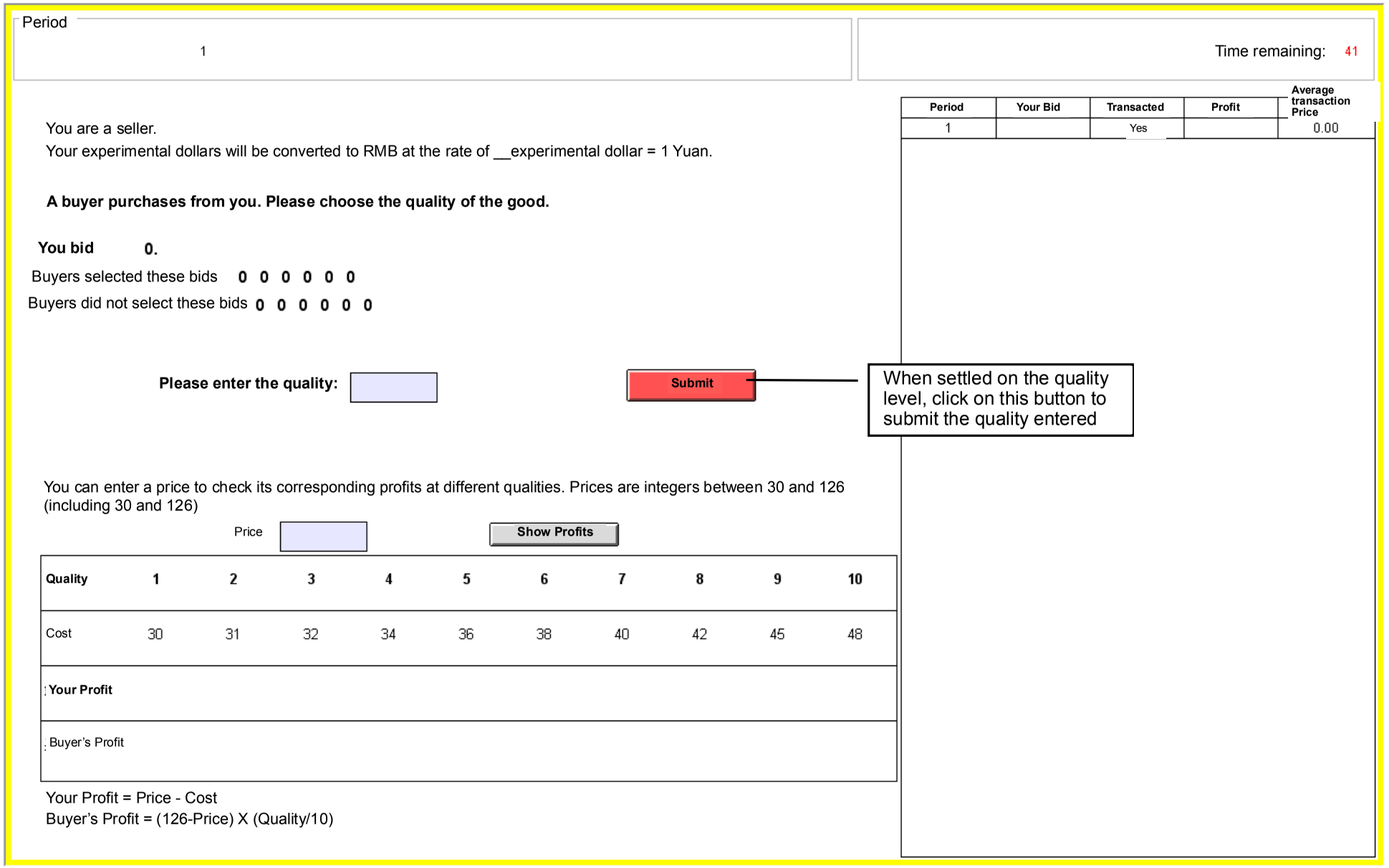
Screenshot 1 Seller's screenshot in the first phase: choosing a bid



Screenshot 2 Buyer's screenshot in the first phase: waiting



Screenshot 3 Buyer's screenshot in the second phase: choose a seller



Screenshot 4 Seller's screenshot in the third phase: choose the quality

Posted Bid 1:2

Instructions

Today you are participating in an experiment that studies decision making in auctions. Your decisions will determine your earnings. Please read these instructions carefully.

Do not use mobile phones, laptop computers, or use the lab's desktop computer other than for the experiment. During the experiment, please refrain from talking or looking at the computer monitors of others. If at some point you have a question, please raise your hand and we will address it as soon as possible.

At the conclusion of the experiment, please sit quietly. We will call participants up one at a time to the sign-in counter. There you will privately receive your earnings. We will not reveal your earnings to any other participant, or any other participant's earnings to you. Nor will we provide any information about how your earnings compare to the earnings of others.

Introduction

Today you will participate in a series of 30 transactions. You will be either a buyer or seller for the entirety of this series. In a transaction a buyer purchases a good from one of two sellers in the same group. After a purchase, the successful seller chooses the quality of the good he provides to the buyer. Note that in each transaction, buyers and sellers are randomly assigned to form new groups.

Sellers have the same capacity to produce the good, and incur the same costs at the same quality. Each seller can produce quality levels from 1 to 10, with 10 being the highest. After purchasing the good, the amount of profit buyer can get depends on both the price paid and the quality.

Each transaction has two phases. In the first phase, the buyer submits a price to sellers – called a bid. The buyer can revise the bid only by enhancing it. Meanwhile, both sellers will observe the bid at the same time, and the one who accepts the bid first gets the contract. All these must be done in a limited time period. In the second phase, seller who gets the contract chooses the quality level of the good provided to the buyer.

Note the seller is only shown the buyer's bid, never the buyer's participant ID.

Payoffs

All of your earnings are in experimental dollar. At the conclusion of the experiment, your experimental dollar earnings will be converted to Chinese Yuan at a certain exchange rate. Your exchange rate will appear on your computer screen once the experiment starts. These earnings will be added to your show-up fee of ¥10 to determine your total earnings today.

In a transaction, participants' experimental dollar earnings are as follows.

Quality	1	2	3	4	5	6	7	8	9	10
Cost	30	31	32	34	36	38	40	42	45	48

If a seller accepts the bid, the buyer's profit is,

Buyer's Profit = (126–Price Paid) × (Quality/10).

For seller who does not get the contract, the profit is 0.

Profit for the seller who gets the contract is

Seller's Profit = Bid – Cost of the Quality Provided.

If the buyer does not offer a bid, or neither of the sellers accepts it, profits for the buyer and both sellers are all 0.

A seller's cost for quality provided is provided in the following table.

How to use the software

When the experiment starts, please enter your participant ID, which is the number on the card you received when signing in. You will then be informed whether you are a buyer or seller in today's transactions.

Now please take a look at the accompanying screenshots handout.

Before the transactions start you will have two minutes to familiarize yourself with profits under alternative combinations of price and quality. Your screen interface will appear as screenshot 1. In this period you may enter a price and click on the "Show Profits" button to investigate profits under each quality at this price.

In the first phase of a transaction, a buyer's screen will appear as screenshots 2. The buyer's screen has a single field where he can enter bids. After entering a price, he may view the potential profits for himself and the seller by clicking the "Show Profits" button. If he wishes to submit this bid, he clicks on the red "Submit" button. A buyer may revise his bid by entering a new higher one. Also, a buyer may review the history of his past transactions by examining the table on the right of the interface.

In this phase of the transaction, the seller's screen will appear as screenshot 3. Buyer's bid will display on sellers' screens. Sellers can accept the bid by clicking on the "Accept" button. The first seller to accept a bid during the trading phase will complete a sale. During this phase, a seller may enter prices and explore the corresponding profits for different quality levels. Sellers can examine previous transaction outcomes as well.

The first phase lasts for 60 seconds. Only when the price is offered and also accepted within this time period will a trade be made. The time remaining in the phase is always displayed in the upper right hand corner of your screen.

In the second phase, if the seller made a sale, the sellers' screen appears as screenshot 4. This seller then selects the quality he provides. The task is completed by entering the

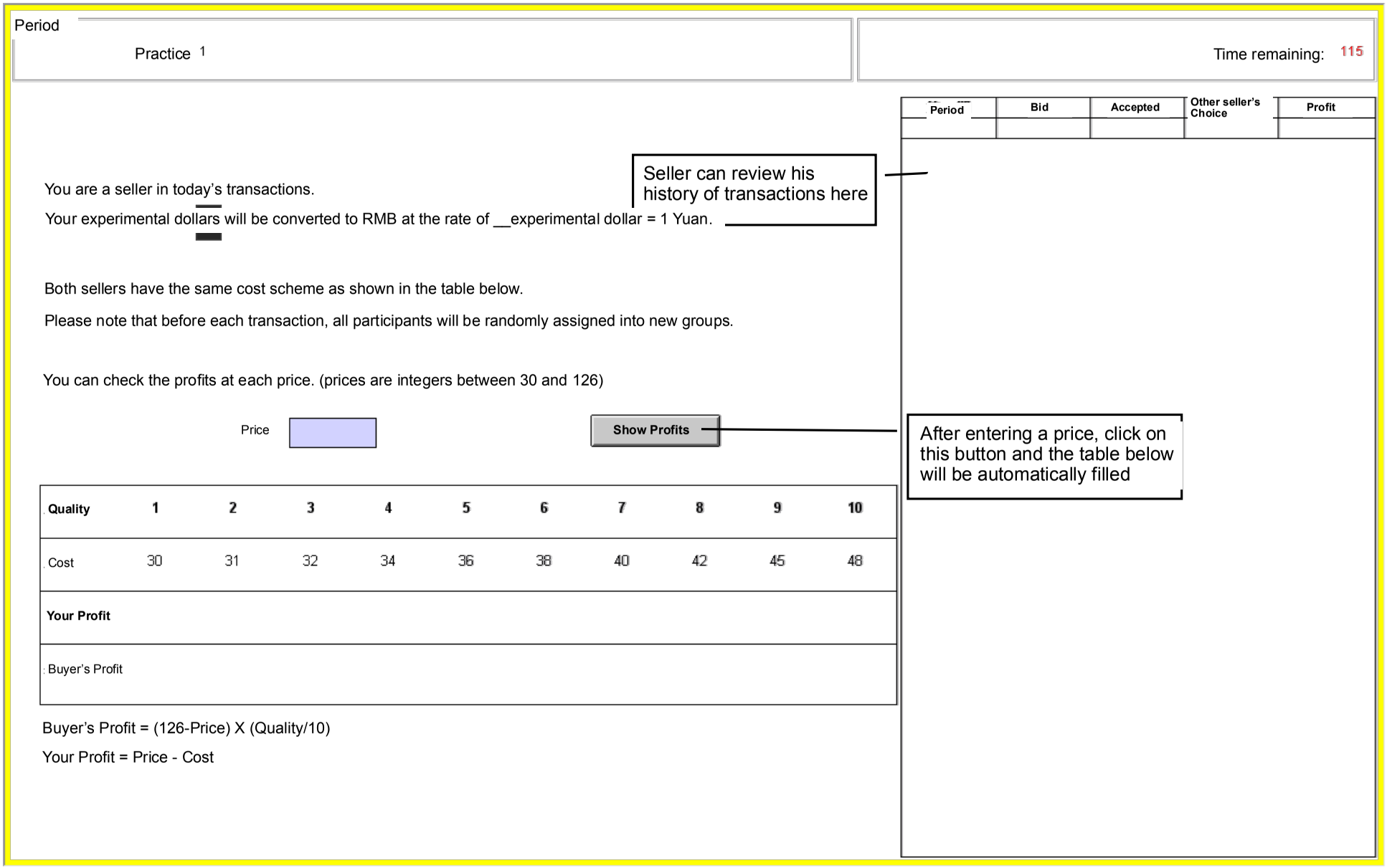
intended quality in the "Quality" field and then clicking the red "Submit" button.

Meanwhile, buyers and participants who do not get a contract may check for the profits under each combination of price and quality on the interface similar to screenshot 1.

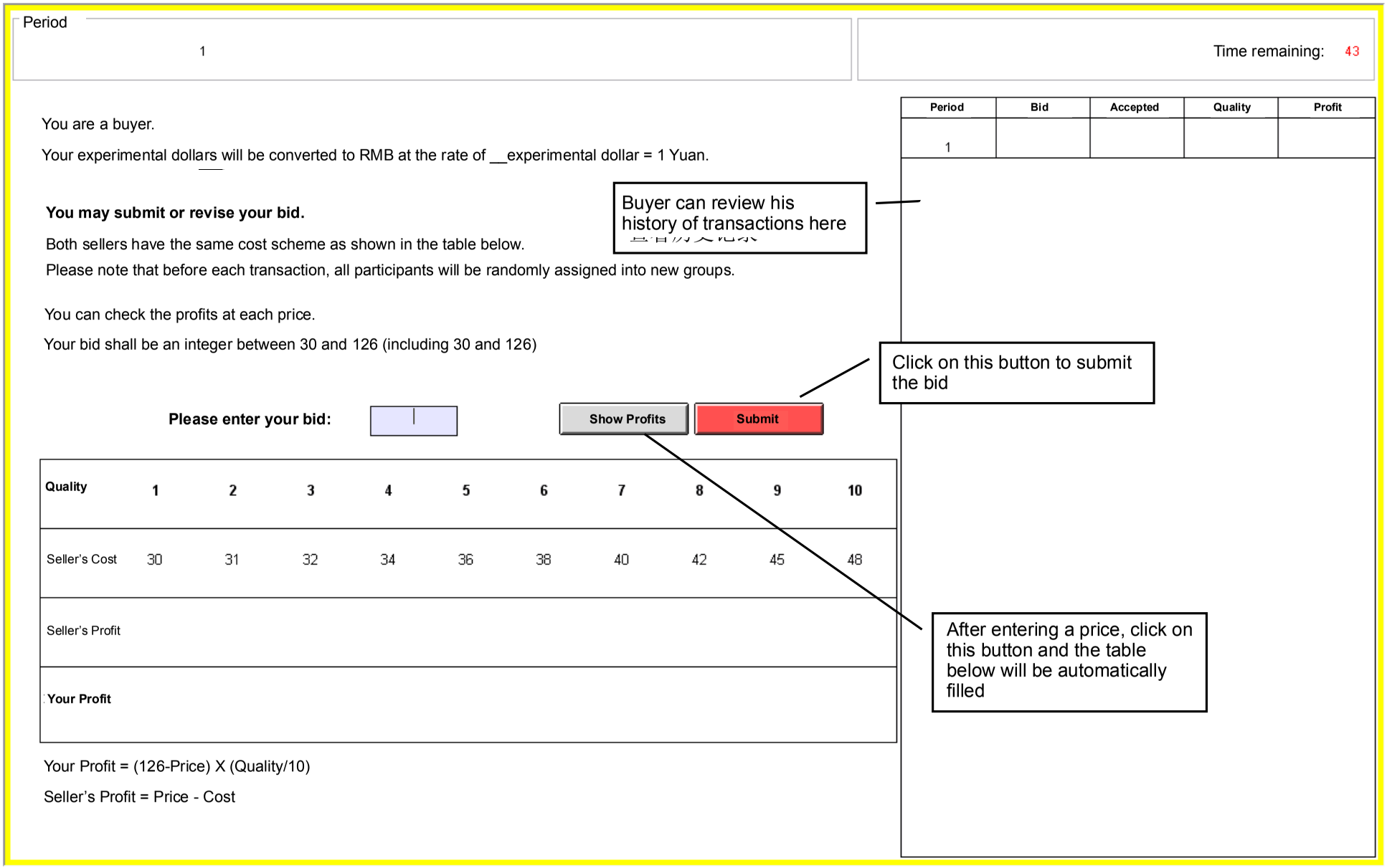
Once all groups have completed the transaction tasks, we privately inform each buyer of the quality level of his good and his profit. Sellers are informed of their own profits.

After completing all transactions you will complete a short questionnaire.

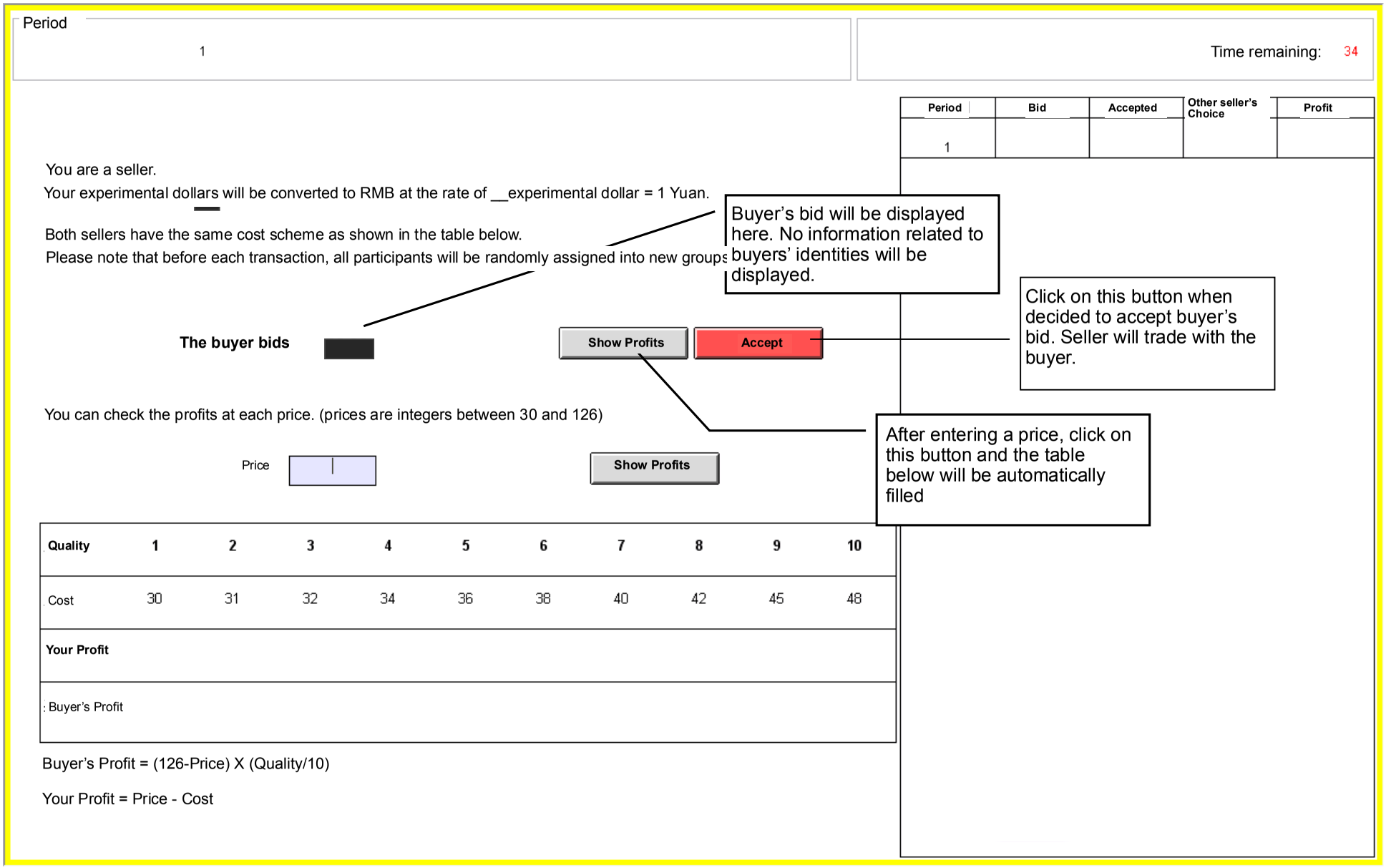
If there is any question now or any time during the experiment, please raise your hand, and someone will come to assist as soon as possible.



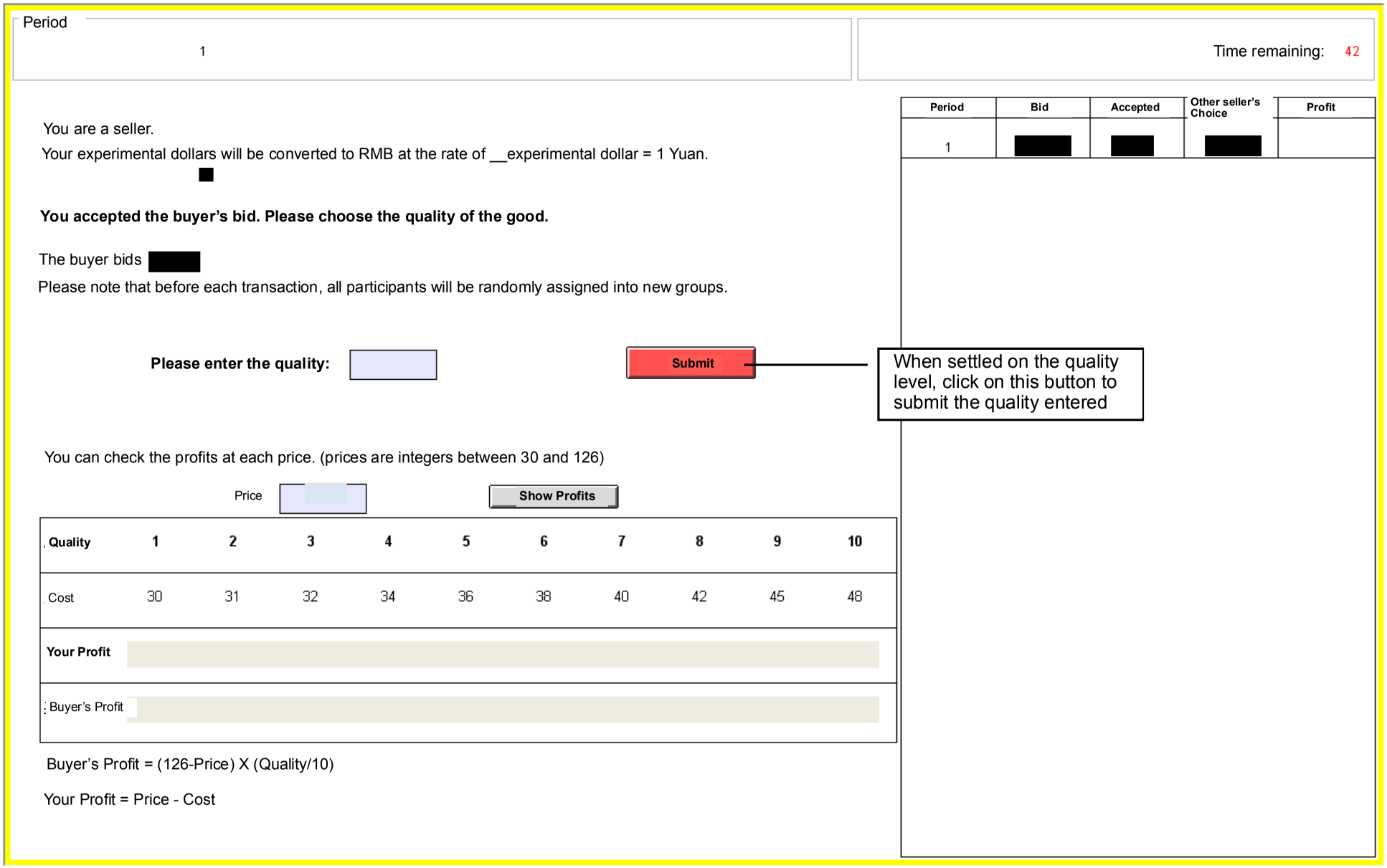
Screenshot 1 Seller's screenshot in the practice round



Screenshot 2 Buyer's screenshot in the first phase: bidding



Screenshot 3 Seller's screenshot in the first phase



Screenshot 4 Seller's screenshot in the second phase: choose the quality

Posted Bid 6:12

Instructions

Today you are participating in an experiment that studies decision making in auctions. Your decisions will determine your earnings. Please read these instructions carefully.

Do not use mobile phones, laptop computers, or use the lab's desktop computer other than for the experiment. During the experiment, please refrain from talking or looking at the computer monitors of others. If at some point you have a question, please raise your hand and we will address it as soon as possible.

At the conclusion of the experiment, please sit quietly. We will call participants up one at a time to the sign-in counter. There you will privately receive your earnings. We will not reveal your earnings to any other participant, or any other participant's earnings to you. Nor will we provide any information about how your earnings compare to the earnings of others.

Introduction

Today you will participate in a series of 30 transactions. You will be either a buyer or seller for the entirety of this series. In a transaction each seller may sell only one unit of a good, and each buyer will purchase only one unit.

In the market, the transactions between buyers and sellers go as follows. First, each buyer can submit a price, indicating his willingness to buy one unit of good at it. These prices are placed on a list that is shown to all buyers and sellers. Sellers can choose one of the available prices to sell his unit.

When the market closes, each seller who made a sale must choose the quality for the good he provides.

The amount of profit buyer earns from purchasing a good depends on both the price paid and the quality provided by the seller. Sellers have the same capacity to produce the good, and incur the same costs at the same quality. Each seller can produce quality levels from 1 to 10, with 10 being the highest.

Note the seller is only shown the buyer's bid, never the buyer's participant ID. Nor will the buyer be informed of the participant ID of the seller he purchases from.

Payoffs

All of your earnings are in experimental dollar. At the conclusion of the experiment, your experimental dollar earnings will be converted to Chinese Yuan at a certain exchange rate. Your exchange rate will appear on your computer screen once the experiment starts. These earnings will be added to your show-up fee of ¥10 to determine your total earnings today.

In a transaction, participants' experimental dollar earnings are as follows.

Quality	1	2	3	4	5	6	7	8	9	10
Cost	30	31	32	34	36	38	40	42	45	48

If a buyer buys a unit, his profit is,

Buyer's Profit = (126–Price Paid) × (Quality/10).

For seller who does not sell a unit and buyer who does not buy a unit, the profit is 0.

Profit for the seller sells his unit is

Seller's Profit = Bid – Cost of the Quality Provided.

A seller's cost for quality provided is provided in the following table.

How to use the software

When the experiment starts, please enter your participant ID, which is the number on the card you received when signing in. You will then be informed whether you are a buyer or seller in today's transactions.

Now please take a look at the accompanying screenshots handout.

Before the transactions begin, you will have two minutes to familiarize yourself with profits under alternative combinations of price and quality. Your screen interface will appear as screenshot 1. In this period you may enter a price, and click on the "Show Profits" button to investigate profits under each quality at this price.

In a transaction, when a market is open, a buyer's screen will appear as screenshot 2. The buyer's screen has a field where he can enter his price. If he wishes to submit this price, he clicks the red "Submit" button. On the price list, a buyer's own price is displayed in blue, and other buyers' prices are in black. A buyer can recognise his own price accordingly.

The first price a buyer submit can be any integer between 30 and 126, regardless of the current available prices. However, if a buyer wishes to revise his price, the new one must be higher than all of the current available prices. Also, a buyer may review the history of past transactions by examining the Table on the right of the interface.

In this phase of the transaction, sellers' screens will appear as screenshot 3. Prices buyers submit will be displayed on sellers' screens. A seller can accept a price by clicking on the "Accept" button after selecting the price. When a price is accepted by a seller, this trading price will be shown to all buyers and sellers, and it will be no longer available. During this phase, a seller may enter prices in the calculator and explore the corresponding profits for different quality levels. A seller may examine his previous transaction outcomes as well.

The market is open for 2 minutes. Only when the price is offered and also accepted within this time period will a purchase be made. The time remaining in this phase is always displayed in the upper right hand corner of your screen.

In the second phase, if the seller made a sale, the sellers' screen appears as screenshot

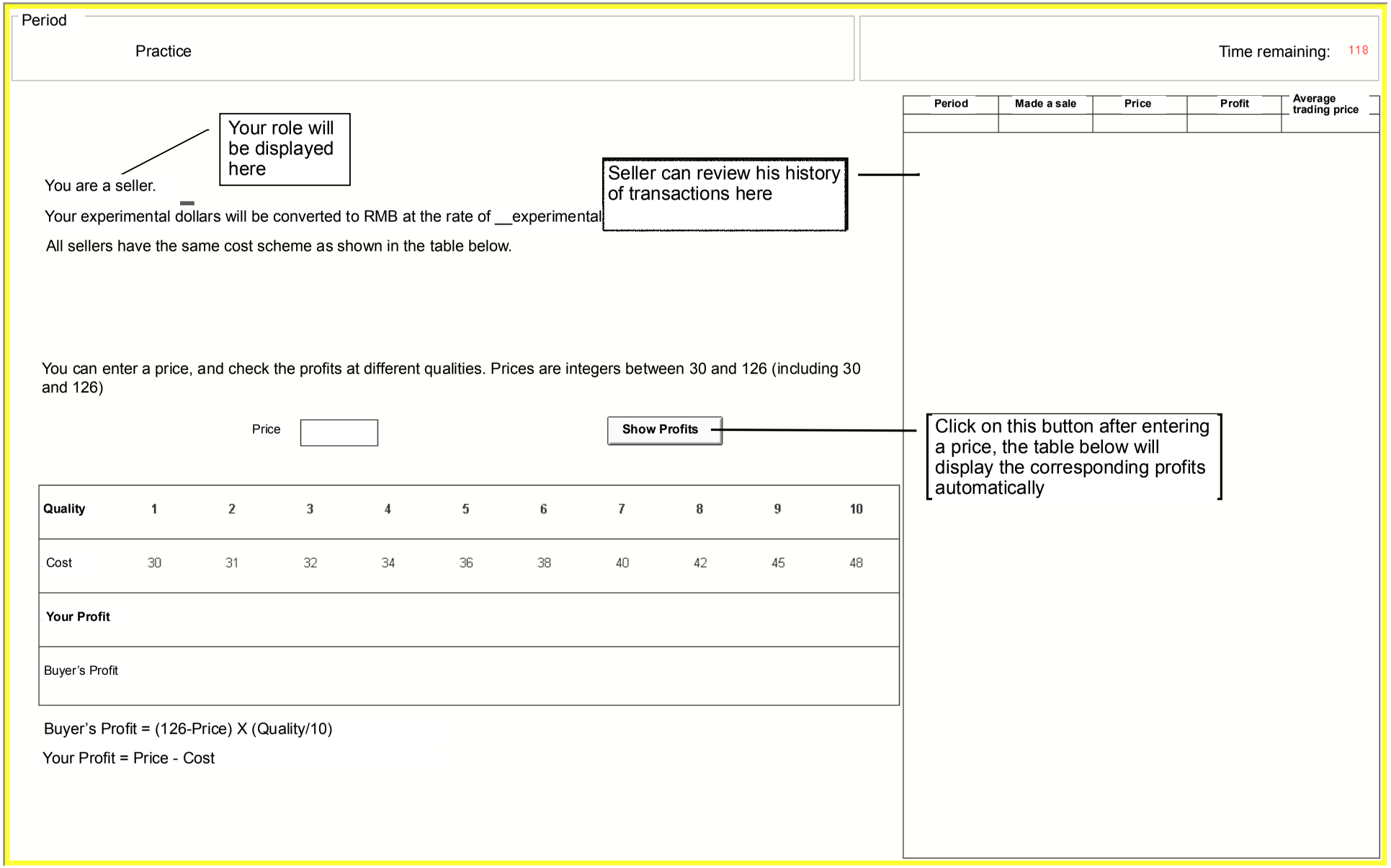
4. This seller then selects the quality for the good he provides. The task is completed by entering the intended quality in the "Quality" field and then clicking the red "Submit" button.

Meanwhile, buyers and participants who do not get a contract may check for the profits under each combination of price and quality on the interface similar to screenshot 1.

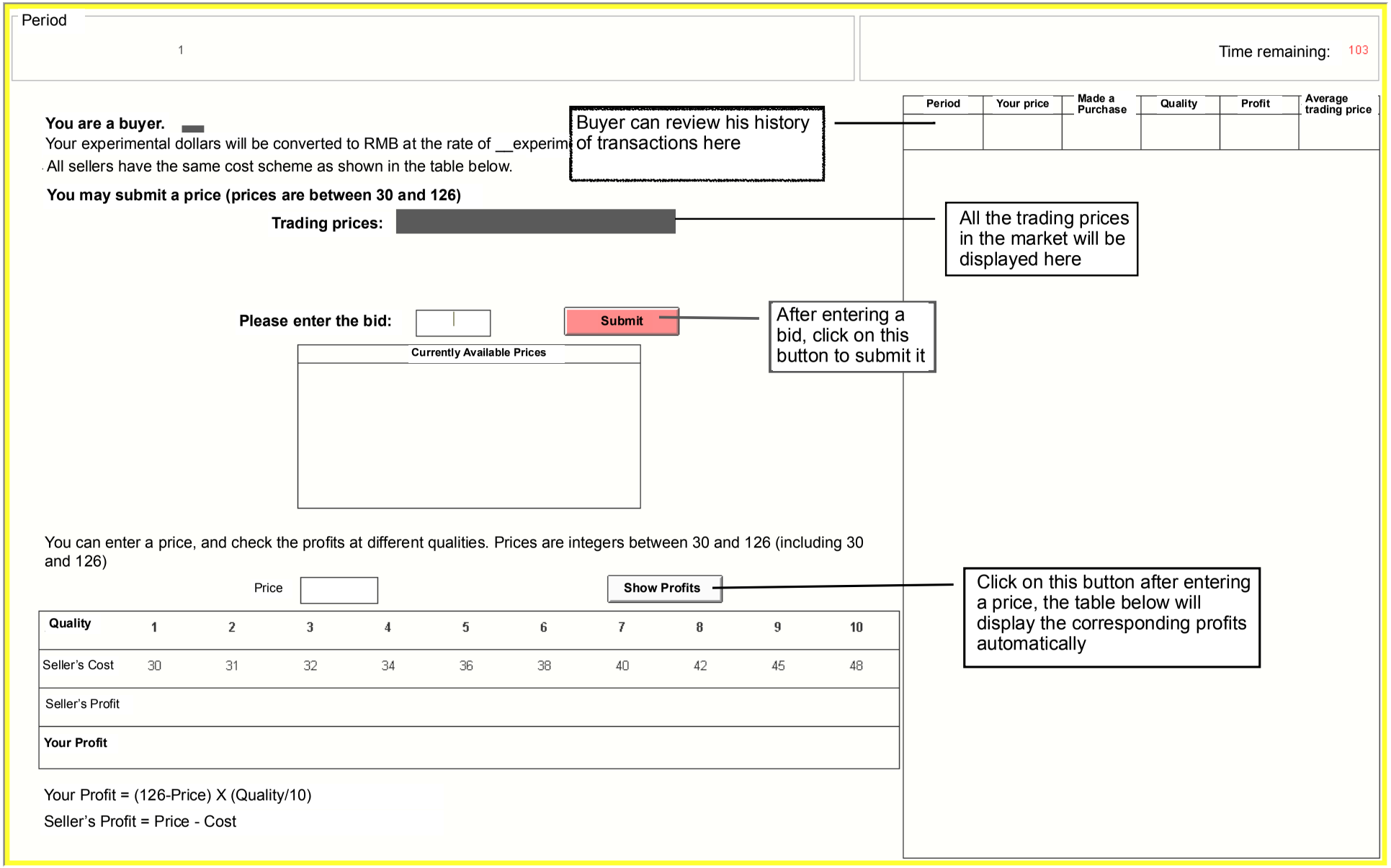
Once all sellers who sold a unit have finished choosing the quality, we privately inform each buyer of the quality level of his good and his profit. Sellers are informed of their own profits.

After completing all transactions you will complete a short questionnaire.

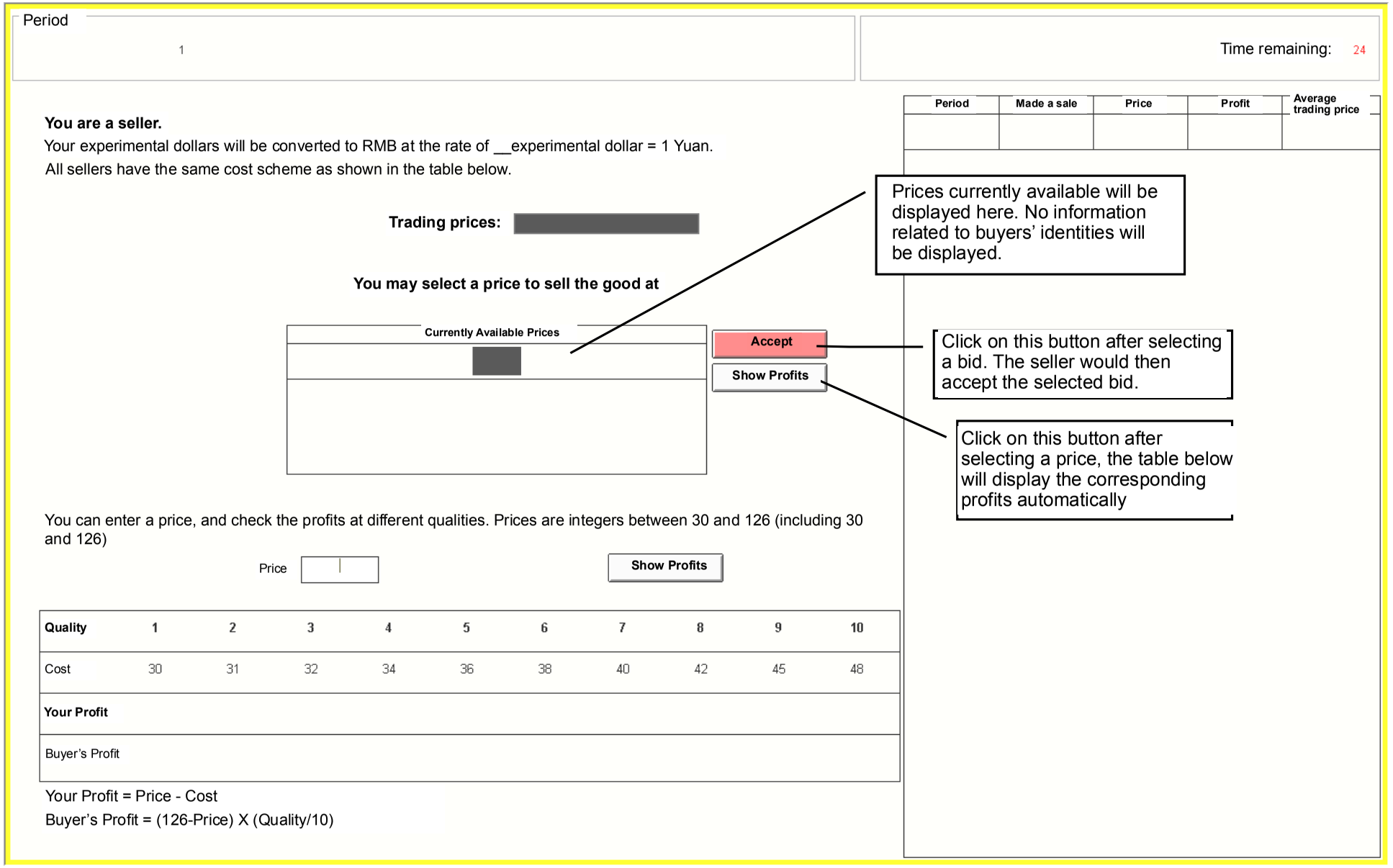
If there is any question now or any time during the experiment, please raise your hand, and someone will come to assist as soon as possible.



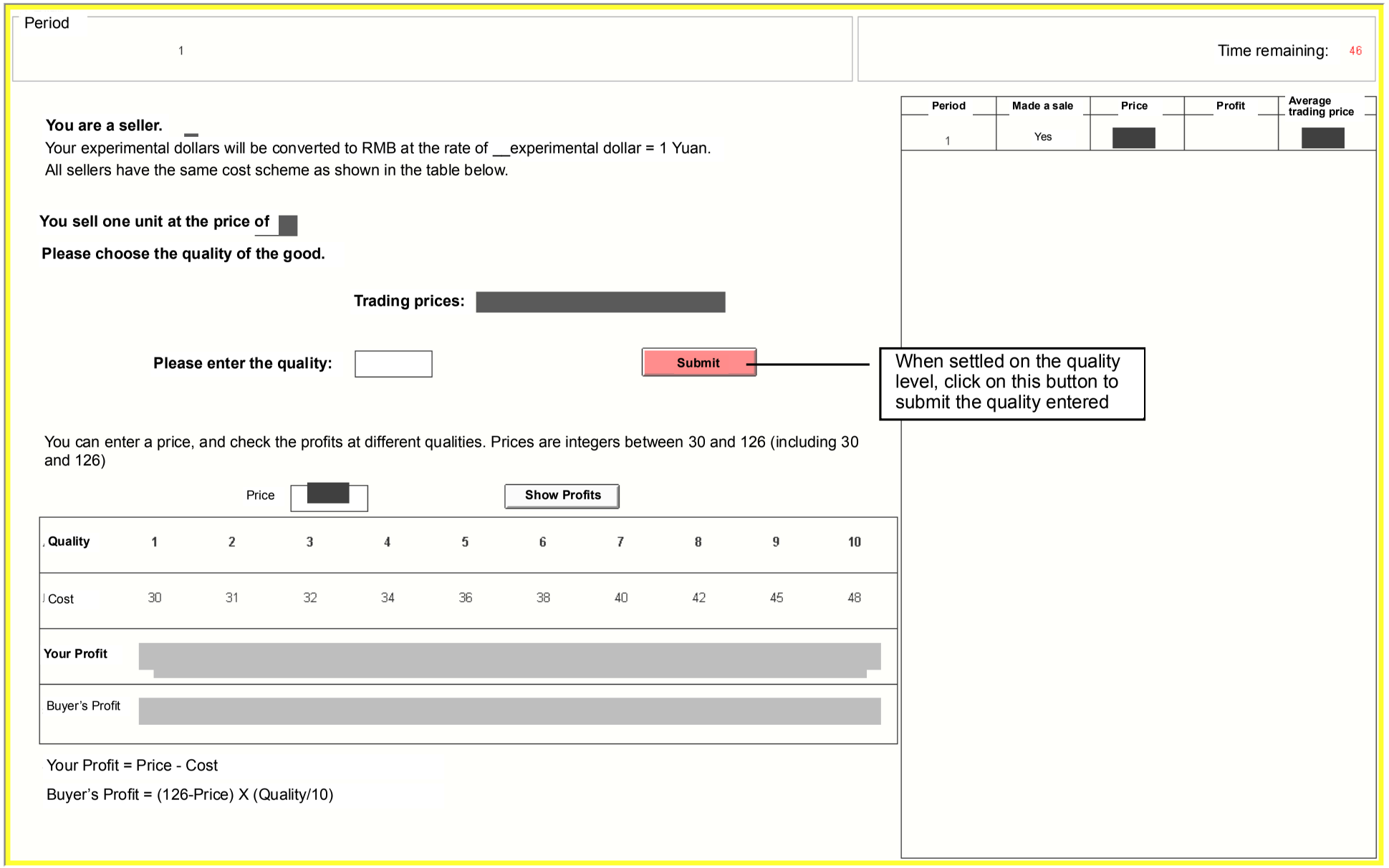
Screenshot 1 Practice round, seller's screenshot as an example



Screenshot 2 Buyer's screen when the market is open: submit bid



Screenshot 3 Seller's screen when the market is open: choose a bid



Screenshot 4 Seller's screen after the market closes if makes a sale: choose the quality