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An Experimental Inquiry of Gender Differences in Negotiation Strategy and Outcomes: Agricultural Market Implications

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The number of women in agricultural management positions and as business owners is increasing. A critical part of agricultural managers' success is negotiating profitable sales, which depends on negotiation strategy. We use laboratory market experiments to measure gender differences in negotiation strategy and related outcomes in three market contexts common to agricultural product sales. Results show that women tend to choose a negotiation strategy that focuses on trading a higher quantity but at a lower per trade profit than men. Our results further show that women will be disproportionately hurt as agricultural markets move away from traditional market environments toward privately negotiated contracts.

Key words: bargaining, delivery method, market institution, market role


Introduction

There is a growing recognition—stemming from an increase in the number of women managing agricultural operations—that policies and education designed to help agricultural managers need to address potential gender differences (Henehan et al., 2011; Sureshwaran and Ritchie, 2011; Inwood, 2013; Plastina, Leibold, and Stockton, 2019; Taylor and Zhang, 2019). In the United States, the prevalence of women as principal operators has increased from 5.2% in 1978 to 13.7% in 2012 (Hoppe and Korb, 2013; U.S. Department of Agriculture, 2014). In 2012, the 969,672 U.S. female farmers represented 30% of all farm operators and sold \$6 billion in crops and \$6.9 billion in livestock (U.S. Department of Agriculture, 2014). Nearly half of U.S. agricultural land is owned by women (Bigelow, Borchers, and Hubbs, 2016).

Despite the growth in the number of women agricultural managers and the need to understand potential gender differences, relatively little is known about women's success and business practices in agricultural endeavors. Generally, women as principal operators have lower sales than men (Hoppe and Korb, 2013). Further, the rate of return on equity is smaller for women than for men operators (Hoppe and Korb, 2013). Many questions remain as to why these differences exist.

One key area that impacts agricultural business success is marketing and sales. How agricultural products are marketed is changing from traditional outlets such as auctions to privately negotiated contract sales. Nearly 40% of the value of all agricultural commodities in 2011 was sold via privately negotiated contracts, as compared to 11% in 1969 (MacDonald, 2015). As agricultural marketing

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evolves to more privately negotiated sales, differences in individual negotiation styles may impact agricultural profits.

Previous studies have primarily focused on how gender differences in negotiation influence gender disparities in the labor market (e.g., Gerhart and Rynes, 1991; Wade, 2001; Bowles, Babcock, and Lai, 2007; Azmat and Petrongolo, 2014; Dittrich, Knabe, and Leipold, 2014; Leibbrandt and List, 2015). This research generally concludes that women are especially disadvantaged when negotiating economic outcomes (Gerhart and Rynes, 1991; Stuhlmacher and Walters, 1999). In reaction to competition, women's performance is found to decline, while men are found to increase their performance (Gneezy, Niederle, and Rustichini, 2003; Niederle and Vesterlund, 2007; Günther et al., 2010). The literature suggests possible gender differences when negotiating product prices. Yet little research specifically addresses the buying and selling of goods.

Many studies analyzing gender differences in labor contexts have been unable to control for personal identifying characteristics (e.g., gender of other participants), preventing researchers from fully isolating outcomes across genders. Research that isolates gender, negotiation styles, and outcomes in a relevant market context could improve our knowledge and ability to help managers be more successful and provide meaningful insights into policy creation. Our research objective is to evaluate potential differences in market outcomes and negotiation behavior for men versus women in three market environments commonly found in the agricultural supply chain across both buyer and seller roles.

Available agricultural sales data generally do not contain information on gender or on bids and offers of the parties involved. Due to the increase in private negotiation, transaction information is private as well. Given these data constraints, traditional methods such as econometric analyses will not yield results that isolate gender and negotiation strategies. Given a lack of available data specific to gender, behavior, and outcomes, we use market experiments to understand how gender influences transaction outcomes when individuals negotiate and trade a homogeneous product in three market environments common to agricultural products.¹

The first market context is an English auction, a common institution in agribusiness, specifically in livestock, hay, and some specialty products such as wine. In an English auction, buyers compete among themselves to purchase a product (through competing bids) from a passive seller. The other two market environments involve private negotiation, a growing market institution in the agricultural market chain for products such as livestock, grains, and specialty crops (MacDonald, 2015). In the second market environment, referred to as advance-production or spot delivery, a buyer and a seller negotiate privately over a product the seller has *already produced* (and therefore already incurred the costs of production). In the third and last market environment, known as production-to-demand or forward delivery, a buyer and a seller negotiate privately to trade a product *prior to production*. Women-owned operations are found in all of these product and market environments (Hoppe and Korb, 2013).

A further contribution of our research stems from our experimental design. Our laboratory market experiments are conducted over computer networks and record relevant individual data for each participant, including number of trades, surplus per trade, and overall profit. This approach also ensures that participants do not know the identity of the participants against whom they are negotiating. Preventing identification allows us to isolate the influence of gender on behavior and outcomes. Previous literature suggests that men and women behave differently in negotiations based on societal expectations and the fear of negative backlash from behavior outside of traditional gender roles (Bowles, Babcock, and Lai, 2007; Rudman and Phelan, 2008; Amanatullah and Morris, 2010; Günther et al., 2010; Stuhlmacher and Linnabery, 2013; Mazei et al., 2015). When gender is made more salient, gender differences in outcomes are more pronounced (e.g., Stuhlmacher, Citera, and Willis, 2007; Boschini, Muren, and Persson, 2012). Therefore, when gender is unknown, the threat of backlash from gender role incongruity is controlled for, allowing the underlying personal behavior

¹ We use the term negotiations to refer to the general price determination process, through private negotiation or auction, by the exchange of bids or offers to reach an agreed-on price.

to prevail. Yet these expectations of gender differences have never been tested in negotiations specific to relevant agricultural market institutions.

We find that women tend to perform worse than men in private negotiation markets and as buyers in English auction markets. However, women outperform men as sellers in auction markets, where their role in negotiations is passive. These gender differences may be partially driven by the negotiation strategy used. Across all market types, women generally produce and sell more than men and are willing to accept a lower surplus per trade (measured as the difference between value and cost of a trade) across trades than men. This behavior of focusing on increasing quantity traded over surplus per trade is not observed for men. Unlike women, men tend to focus more on maximizing surplus per trade at a potential cost of reduced quantity traded. Outside of the role of a seller in English auction, this behavior resulted in higher total profit.

We add to the literature by studying the role of gender in product negotiations. As previously mentioned, our experimental setup does not allow subjects to know the identity of other participants and controls for gender backlash from role incongruency. Hence, this study uncovers those differences most ingrained between men and women in market environments. This research allows for a broader understanding of the influence of gender differences in economic outcomes beyond the labor market and provides a deeper understanding of underlying gender differences in negotiation behavior, which may impact agricultural business success. Moreover, as agricultural markets evolve to more private negotiation, this research offers insights into the gender disparities this transition is likely to create.

Theory Overview

In markets where products are traded through negotiations, Rubinstein (1982), Muthoo (1999), and Krishna (2010) show that surplus from a successful trade of unit i , S_i , can be represented as

$$(1) \quad S_i = BS_i + SS_i,$$

where BS_i and SS_i represent the surplus to buyers and sellers of a successful trade of unit i , respectively. Thus,

$$(2) \quad BS_i = V_i - P_i \text{ and}$$

$$(3) \quad SS_i = P_i - C_i,$$

where V_i is the value to the buyer of unit i , P_i is the agreed-on price of unit i , and C_i is the cost of production of unit i to the seller. After trading n products, the total surplus or profit for buyers, π_B , is

$$(4) \quad \pi_B = \sum_{i=1}^n BS_i = \sum_{i=1}^n (V_i - P_i)$$

and the total surplus or profit for sellers, π_S , is

$$(5) \quad \pi_S = \sum_{i=1}^n SS_i = \sum_{i=1}^n (P_i - C_i).$$

Assuming that both V_i and C_i are exogenously determined, negotiation behavior influences P_i and n , determining profits.

In private negotiation markets, negotiation can be contextualized in an alternating-offers model in which one player makes an offer (or bid) to trade unit i and the other player can either accept the offer or make a counteroffer. The player who makes a counteroffer incurs a cost, represented as the time waiting to complete a trade (Muthoo, 1999). During negotiations, a patient strategy will lead to

an individual making slower counteroffers in an attempt to move the negotiation in their favor, while an impatient strategy will lead to quicker counteroffers in an effort to move the trade along (Phillips et al., 2014). Phillips et al. further define negotiation strategies based on generosity. An individual using a generous strategy will make a nonaggressive opening bid or offer while an individual using a greedy strategy will make an aggressive opening bid or offer. The levels of patience and generosity are found to usually support each other (Phillips et al., 2014). An impatient individual will tend to be generous to move the trade along and will therefore be identified as generous and impatient. Similarly, a patient individual will generally begin with a greedy opening bid or offer to increase their surplus per trade and will be labeled as patient and greedy. As a player becomes more patient or greedier and their discount rate decreases, the cost of making a counteroffer decreases, leading to increased bargaining power. As a result, the player with the lower discount rate (and who is thus more patient and greedier) tends to negotiate a greater amount of surplus per trade than the player who is less patient and generous (Muthoo, 1999; Phillips et al., 2014).

Yet there is a potential upside to an impatient and generous strategy. Since an individual practicing this strategy is motivated to move the trade along, an impatient and generous strategy results in more total trades, n , during repeated negotiations than a patient and greedy strategy. Based on equations (4) and (5), the effect of the level of individual patience and generosity on individual profit is unknown *a priori*. A more patient and greedy strategy in private negotiations increases surplus per unit, but with fewer units traded, whereas a relatively impatient and generous strategy increases the number of units traded, but with a lower surplus per trade.

Following Krishna (2010), in an English auction market, a group of buyers bid against each other to trade a unit with a seller. The buyer with the highest accepted bid shares the surplus of unit i with the seller. Equations (1)–(5) hold for an English auction. Yet in this market, buyers compete against each other, affecting P_i . Sellers are passive and have no direct influence on P_i . Their only role during negotiations is to determine the number of units to sell, n . As a result, negotiation strategies can lead to different outcomes in English auction markets than in private negotiation markets.

Impatient and generous buyers in English auctions desire to increase the number of units purchased and thus increase their bids in order to increase their probability of having the highest bid in order to purchase a unit. Similar to private negotiation markets, impatient and generous buyers in English auction will negotiate higher prices, resulting in less surplus per trade, BS_i , but with a higher quantity traded, n . More patient and greedier buyers are motivated to increase their surplus per unit and will risk maintaining a low bid that may result in not trading a unit. Patient and greedy buyers will see a reduction in the number of units they trade, n , but with a higher surplus per successful trade, BS_i . Based on equations (4) and (5), the effect a buyer's level of patience has on profit is unknown *a priori*. Since sellers have no influence over price, P_i , in English auction markets, their bargaining strategy only influences the number of units they are willing to sell. Consistent with expectations from patience and generosity in private negotiations and for buyers in English auction, we expect a patient and greedy strategy to lead to a lower n in equation (4). The relationship between n and P_i will determine the relationship between patience and profit.

Review of Negotiation Outcomes in Experimental Markets and by Gender

The influence of negotiation on market outcomes has been tested using laboratory market experiments. The use of economic experiments to understand market outcomes is well established and has been used in a number of studies (Menkhaus et al., 1999, 2000; Menkhaus, Phillips, and Bastian, 2003; Bastian et al., 2008; Menkhaus, Phillips, and Yakunina, 2009; Nagler et al., 2013; Phillips et al., 2014). Market institution, delivery method, and participant role have been found to influence individual negotiation behavior and resulting outcomes (e.g., Menkhaus et al., 2000; Menkhaus, Phillips, and Bastian, 2003).

In an English auction market, sellers, on average, have higher earnings than buyers (Menkhaus, Phillips, and Bastian, 2003; Krishna, 2010). Research concludes that this is largely a result of buyers

bidding against one another, driving the price of the product up, while sellers are passive and only decide on the number of units to produce. In private negotiation markets, prices tend to be lower, generally resulting in lower earnings for sellers than buyers (Menkhaus, Phillips, and Bastian, 2003; Menkhaus et al., 2007). Within private negotiation, two market delivery methods prevail: production-to-demand (production of product occurs after negotiation) and advance-production (production occurs prior to negotiation) (see Menkhaus, Phillips, and Bastian, 2003). In private negotiations with advance-production, sellers have even lower earnings than in production-to-demand markets because the risk of loss associated with sunk production costs puts sellers in a weaker bargaining position (Menkhaus, Phillips, and Bastian, 2003). As a result, both role and market environment affect agent outcomes.

In addition to negotiation affecting product market outcomes, previous research shows that negotiation leads to divergent outcomes across genders in other contexts. Women have been found to negotiate less often and, as a result, tend to achieve worse outcomes than men (Gerhart and Rynes, 1991; Stuhlmacher and Walters, 1999; Kulik and Olekalns, 2012; Mazei et al., 2015), potentially due to women's attitudes toward competition. A growing body of literature suggests that women's performance decreases as the level of competition increases in an environment (e.g., Gneezy, Niederle, and Rustichini, 2003; Günther et al., 2010; Niederle and Vesterlund, 2011). In addition, women tend to shy away from competition, while men seek it out (e.g., Gneezy and Rustichini, 2004; Niederle and Vesterlund, 2007).² This shyness toward competition has been found to be most prevalent when the task is considered masculine and is assumed to favor men (Croson and Gneezy, 2009; Günther et al., 2010). Günther et al. find that when performing a masculine task (solving maze games), women respond less strongly than men to competitive incentives. As a result, men increase their performance in reaction to competition, while women do not. However, while performing a feminine task (pattern matching and memory performance), women increase their performance in response to increased competition, while men do not. Although these results have been found in experimental labor market and competition studies, they have never been tested in product market negotiations.

Further, Kray, Galinsky, and Thompson (2002) find that men outperform women when negotiation is associated with stereotypically masculine skills and that women outperform men when negotiations are associated with stereotypically feminine skills. Negotiation in general has been viewed as a masculine role, as it is commonly modeled as a competitive game with winners and losers (Kray and Thompson, 2004). As a result, women have been found to shy away from negotiations; when they do enter into them, they behave less aggressively, resulting in worse economic outcomes than men (see Mazei et al., 2015). During negotiations, women have been found to be more cooperative than men (see Walters, Stuhlmacher, and Meyer, 1998). In trust and dictator games, women have displayed a greater propensity for reciprocity and generosity while men have been more egoistic and greedier (e.g., Eckel and Grossman, 2001; Buchan, Croson, and Solnick, 2008; Aguiar et al., 2009). Although never previously tested, these findings may extend to negotiations over the sale of agricultural products since, culturally, women have been viewed as "farmwives," not as agricultural decision makers (Trauger et al., 2008).

Role and context have also been found to influence women and men differently in negotiations. Dittrich, Knabe, and Leipold (2014) find that role in the labor market, as either an employee or employer, is interrelated with gender in negotiation outcomes. Female employees were found to achieve worse market outcomes than male employees, but this difference is not present between male and female employers. In investment and trust games, women are generally found to send less of their endowment to a respondent, but women responders returned more of their wealth (Croson and Buchan, 1999; Chaudhuri and Gangadharn, 2003; Buchan, Croson, and Solnick, 2008). In the

² Recent research suggests this gap in competition preference may decline over age (Flory et al., 2018). Experimental research in Malawi found that women over 50 are just as likely to enter a tournament-like competition as men. Similar results for a smaller U.S. sample were found, but the authors suggest caution before drawing "definitive conclusions" (Flory et al., 2018, p.261).

role of a sender, women are less trusting than men, and in the role of responder, women are more likely to reciprocate than men. The gender disparities in role may extend into market transactions, potentially leading to an interaction between gender and buyer/seller role.

While the literature suggests that women generally achieve worse negotiation outcomes than men in other contexts, such as in labor market or competition studies, the interaction of relevant agricultural market environments and gender has not been studied. Moreover, previous literature has generally not controlled for identification of gender during negotiation. Our research addresses both of these shortcomings in the literature.

Testable Propositions

We use laboratory market experiments to consider three propositions that will guide our thinking. Since women are found to be less willing to engage in negotiations and leave negotiations earlier than men (Gerhart and Rynes, 1991; Stuhlmacher and Walters, 1999; Hogarth, Karelaia, and Trujillo, 2012; Kulik and Olekalns, 2012; Mazei et al., 2015), together with findings that women are cooperative during negotiations (see Walters, Stuhlmacher, and Meyer, 1998) and less greedy (e.g., Eckel and Grossman, 2001; Buchan, Croson, and Solnick, 2008; Aguiar et al., 2009) in other, nonagricultural market contexts, we suggest the following:

PROPOSITION 1. *Across market contexts, women will be more impatient and generous during negotiations than men.*

The relationship between patience, generosity, and total profit is indeterminate *a priori*, yet a patient and greedy strategy is expected to garner higher overall profit since there may be limited opportunities to negotiate with others in such markets. Thus, we test a second proposition:

PROPOSITION 2. *A more patient and greedier negotiation strategy will increase overall profit.*

In the absence of active negotiation, women have been found to indirectly receive a lower price for grain than men (Cunningham et al., 2008). Given a similar volume of sales and production costs, this would lead to lower profit overall for women compared to men. Further, since men are found to increase their performance in reaction to competition, while women generally do not, we would expect men to outperform women in the market environments modeled here (Gneezy, Niederle, and Rustichini, 2003; Niederle and Vesterlund, 2007; Günther et al., 2010). Following this, we consider a third proposition:

PROPOSITION 3. *Men will outperform women in all market contexts.*

Experiments

To test our propositions, we use laboratory market experiments that follow standard practices (Menkhaus et al., 1999, 2000; Menkhaus, Phillips, and Bastian, 2003; Bastian et al., 2008; Menkhaus, Phillips, and Yakunina, 2009; Nagler et al., 2013; Phillips et al., 2014). Our experiments are guided by induced-value theory and are designed to provide the proper reward such that the conditions of monotonicity, dominance, and salience are met (Davis and Holt, 1993; Friedman and Sunder, 1994).

Design

Experiments were held in computer labs at a large Intermountain West university using software that simulated these different types of markets. Participants logged into computers and were randomly assigned a role as a buyer or seller for the entirety of the experiment. Participants were told that they

Table 1. Buyer Redemption Value and Seller Production Cost Schedules per Unit (in US\$)

Unit	Redemption Value	Production Cost
1	1.3	0.3
2	1.2	0.4
3	1.1	0.5
4	1.0	0.6
5	0.9	0.7
6	0.8	0.8
7	0.7	0.9
8	0.6	1.0

would receive either a redemption value schedule (buyers) or production cost schedule (sellers) and that their earnings in the experiment depended on the negotiated price of a unit and the number of units successfully traded. Buyers earned money by trading units at prices lower than their respective redemption values; sellers earned money by trading units at prices higher than their unit costs. Participant earnings accumulated over numerous periods. At the end of a session, participants received a base fee plus the aggregate profit from their trades. In order to keep trading partner identity anonymous, participants were unaware of others' roles. Participants sat at a table with partitions in order to maintain this anonymity.

Given their role as a buyer or seller, each subject participated in up to three practice trading periods, allowing all questions to be answered until participants unanimously indicated a readiness to begin the experiment. Participants were then informed that the experiment would begin and were given new redemption values and cost schedules showing the resale value or cost of production for each unit (Table 1). These schedules were consistent over sessions and treatments. Individuals only knew their own schedule values as per their role as buyer or seller.

In order to limit altered behavior in the final period, participants were informed that after period 15 (English auction) or 20 (private negotiation) there was a one-in-five chance of an additional period (Menkhaus et al., 2007). Three market treatments were conducted: (i) English auction, (ii) private negotiation with production-to-demand delivery, and (iii) private negotiation with advance-production delivery.

Each English auction session began with the experiment director giving participants experimental instructions (verbally and in writing) and answering any questions. Specifically, participants were told that randomly assigned buyers bid against each other to purchase units of a homogeneous commodity produced by passive sellers. A trading period began with each seller selecting the number of units they wanted to produce (up to eight), while the buyer waited. Then, trading began with the buyers bidding on one produced unit at a time. The particular seller whose unit was bid on was randomly selected, with the lowest cost units selected first, until all produced units were sold. The buyer with the highest bid purchased the unit. Participants were also told how profits were made and earnings accumulated.

The private negotiation production-to-demand treatment followed the same procedure as the English auction treatment, except that each trading period was divided into three 1-minute bargaining rounds. In each round, buyers and sellers were randomly matched and negotiated trades one-on-one. Buyers made bids and sellers made offers until they reached an agreed-on price and a trade was made, after which they began negotiating the next unit, until the end of each round, when buyers and sellers were randomly rematched. At the end of the three 1-minute bargaining rounds, a new period began. Given potential variability in negotiated outcomes, participants traded in 20 or more periods to allow for convergence toward stable outcomes.

The private negotiation treatment with advance-production delivery differed from procedures in the private negotiation production-to-demand treatment in that sellers made a production decision prior to trading. Having made this advance-production decision, sellers lost their production cost

Table 2. Total Number of Men and Women Participants by Treatment

	English Auction	Private Negotiation Production-to-Demand	Private Negotiation Advance-Production
Total	40	40	40
Men	19	19	20
Women	21	21	20

for any units produced that were not traded during the three 1-minute rounds that followed. No carryover of unsold inventory to the next trading period was allowed.

Participants

A total of 120 participants were recruited from the student body and surrounding community at an Intermountain West university to take part in the laboratory market experiments.³ Each participant took part in one of the three treatments. Average total earnings over the periods were generally between \$20 and \$40. We recruited a nearly equal sample of women and men across market environment and agent role (consistent sampling standard with much of the gender research literature). Of the 40 participants in the English auction treatment, 47.5% were men and 52.5% were women; of the 40 participants in the private negotiation production-to-demand treatment, 47.5% were men and 52.5% women; and of the 40 participants in the private negotiation advance-production treatment, 50% were men and 50% were women (Table 2).

Analysis

To test our propositions and estimate equilibrium market outcomes while allowing for participant learning in the experiment, we use a convergence model based on those of Ashenfelter et al. (1992) and Noussair, Plott, and Riezman (1995):

$$(6) \quad Z_{it} = B_0 \left[\frac{(t-1)}{t} \right] + B_1 \left(\frac{1}{t} \right) + \sum_{j=1}^{i-1} \alpha_j D_j \left[\frac{(t-1)}{t} \right] + \sum_{j=1}^{i-1} \beta_j D_j \left(\frac{1}{t} \right) + u_{it},$$

where Z_{it} represents market outcomes of interest such as surplus per trade, total profit, and units traded for our analysis for each of t periods (1, ..., 15 in English auction, or 1, ..., 20 in private negotiation) in cross-section j (where the number of treatments is equal to i); B_0 is the predicted asymptote and B_1 is the starting level of the dependent variable for the base treatment; α and β are adjustments to the asymptote and starting level for each treatment's relation to the base, respectively; D_j is a dummy variable separating j treatments; and u_{it} is an error term. The model provides estimates of beginning (B_1) and asymptote (B_0) outcomes and thus explains the path of the variable of interest. As we are focused on market outcomes representative of observed equilibria, we report estimates for asymptotes and test for differences across market role by gender for each of the market environments to achieve our research objective.

The panel data collected from these market experiments can suffer from serial correlation, heteroskedasticity, and contemporaneous correlation. We use the Parks (1967) method to correct for these issues through the PANEL procedure in SAS, as in previous research (e.g., Menkhaus, Phillips, and Bastian, 2003; Phillips et al., 2014). We use t -tests to test differences between groups when the data were normally distributed or at least not severely skewed (see Brown, 1997). For data

³ Some have criticized the use of students or nonagricultural managers in laboratory experiments. Nagler et al. (2013) found no difference in policy treatment effects between college students and agricultural professionals in an induced-value laboratory market. A review of the literature concludes that results across subject pools are generally consistent (Fréchet, 2017), supporting the use of students or nonagriculturalists in induced-value experiments.

Table 3. Average Number of Trades, Surplus per Trade, and Total Profit by Gender and Treatment (US\$)

	English Auction	Private Negotiation Production-to-Demand	Private Negotiation Advance-Production
Number of trades			
Male buyers	1.56 ^a	2.16	1.49
Female buyers	1.65 ^a	1.95	1.66
Male sellers	1.55 ^{*a}	1.74*	1.31*
Female sellers	1.64 ^{*a}	2.31*	1.88*
Surplus per trade			
Male buyers	0.14*	0.44*	0.46
Female buyers	0.03*	0.50*	0.43
Male sellers	0.39*	0.38*	0.50*
Female sellers	0.35*	0.32*	0.38*
Total profit			
Male buyers	17.82*	25.81	27.32*
Female buyers	15.76*	26.46	26.46*
Male sellers	29.86*	21.98*	24.01*
Female sellers	32.83*	20.57*	21.37*

Notes: A single asterisk (*) indicates a 5% level of significance or smaller. Only data from round 1 were used for private negotiation treatments. For comparison with English auction, we calculate average trades per minute of trading. We test differences of asymptotes to evaluate statistical differences between genders for a given role.

^a Indicates statistical differences using the Wilcoxon signed-rank sum test.

that were not normally distributed and were severely skewed, we use the Wilcoxon signed-rank sum test.

During trading periods in the private negotiation treatments, participants are randomly rematched when they move from bargaining round 1 to bargaining round 2. Thus, in bargaining rounds 2 and 3, participants could be trading with partners who are on different units in their respective cost or redemption schedules, creating a matching risk that impacts potential success (Menkhaus et al., 2007). For our purpose of isolating negotiation behavior, not complicated by matching risk, we analyze average number of units traded and average surplus per trade after the 1 minute of trading in round 1 for the private negotiation treatments. We compare this to average trades and surplus per unit per minute in the English auction treatment. We use these data as an indicator of patience and generosity, as discussed previously.

Results

Result 1: Men Tend to Be More Patient and Greedier during Negotiations than Women

As expected, women make more trades on average in the first minute of trading than men in each treatment and role except as buyers in the private negotiation production-to-demand treatment (Table 3). On average across treatment and role, women trade 1.85 units per minute while men trade 1.64 units (13% more trades than men). In the private negotiation treatments, women sellers transact 51% of their total trades in round 1, compared to men sellers transacting 40% of their total trades in round 1. Although not always statistically significant, this difference in number of trades suggests women tend to be more impatient than men.

Further, results from Table 3 show the trade-off between generosity (negotiating less surplus per trade) and patience (trading more units). Being greedier and negotiating more surplus per trade come at the expense of trading fewer units—a more patient outcome. Therefore, women negotiate

less surplus per trade than men, except in the role of a buyer in the private negotiation production-to-demand treatment. On average across all market contexts, men negotiate (whether as a buyer or a seller) a surplus of \$0.39 per trade, 15% more than women, who average \$0.34 per trade. In five of the six market context and role situations, women exhibit more impatient and generous behavior during negotiations, supporting Proposition 1.

Result 2: A More Patient and Greedier Negotiation Strategy Leads to More Overall Profit Except for Sellers in English Auction

The inherent trade-off between the number of trades and surplus per trade makes it unclear *a priori* how the level of individual patience and generosity affects total profit. Yet we expect that a patient and greedy strategy will lead to a large enough increase in surplus per trade to offset the impact of a reduction in quantity traded, resulting in higher overall profit.

Results from Table 3 show that, in the private negotiation market treatments, the group that is more patient and greedier has higher total profits than the impatient and generous group (although not statistically significant for buyers in the production-to-demand treatment). The same relationship is found between strategy and total profit for buyers in the English auction treatment. These results provide support for Proposition 2.

Interestingly, an unexpected relationship is found for sellers in English auctions. Sellers behaving as more impatient and generous (evidenced by more trades and lower surplus per trade) have higher total profits. This may highlight the passive nature of the seller, who has no effect on the negotiated per unit price in an English auction market. Thus, a greedy strategy focused on increased surplus per trade is not effective since this is not within the seller's control.

Our results show the relationship between strategy and resulting profit depends on the market context. But as markets move away from more competitive auction-based institutions and toward private negotiation, we expect that more patient and greedier negotiation strategies will be rewarded more than impatient and generous strategies.

Result 3: Men Generally Outperform Women in Privately Negotiated Markets

As predicted, men tend to have higher total profit than women in the context of private negotiation markets (Table 3). Our results provide support for Proposition 3. Men earn significantly more than women in privately negotiated markets except in the role of buyers in the production-to-demand treatment, where no significant difference is found.

In privately negotiated markets, level of risk varies depending on the timing of negotiation relative to production. In advance-production markets, units are produced prior to negotiations, while in production-to-demand markets, units are produced after negotiations are complete. Consequentially, there is the added risk for sellers in advance-production markets of not successfully negotiating the sale of a product already produced, resulting in the loss of production costs. Buyers may be able to take advantage of the increased risk for sellers in their negotiations, resulting in increased profit (e.g., Menkhous et al., 2000). Male buyers seem able to leverage the increased risk to sellers and expand their negotiation power, thereby increasing their total profit by \$1.51 in advance-production versus production-to-demand delivery in private negotiation. Women, on the other hand, do not fare as well and have the same earnings regardless of delivery method (\$26.46). This difference between men and women as buyers suggests that the increased risk in privately negotiated advance-production markets may disproportionately benefit men relative to women.

The finding that women generally are outperformed by men in private negotiation is mainly driven by the gender difference between high and low profit earners. As seen in Figure 1, men were nearly three times more likely than women to have the highest level of total profit. On the other hand, women were the only ones to have the lowest level of total profit.

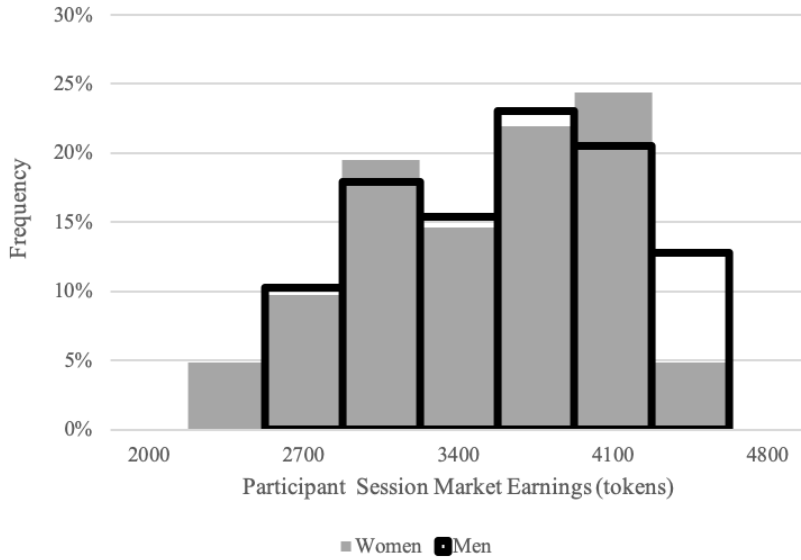


Figure 1. Distribution of Total Profit by Gender in the Private Negotiation Treatments

Result 4: An English Auction Market Context Improves the Earnings of Women as Sellers

Our results show that women have higher profits than men as sellers in the English auction treatment (Table 3). The finding that women using the more “feminine” strategy of impatience reap higher profit as sellers in the English auction treatment is supported by previous literature, which suggests that women’s performance decreases as the level of competition increases in an environment (e.g., Gneezy, Niederle, and Rustichini, 2003; Niederle and Vesterlund, 2007; Günther et al., 2010). In market contexts with high levels of competition and need for active negotiations, men are expected to outperform women; our results support this finding. Conversely, women should outperform men in market contexts with limited competition. When buyers only compete with each other for units and sellers are passive, previous literature suggests that women sellers will outperform men in such institutions (e.g., Kray, Galinsky, and Thompson, 2002; Günther et al., 2010), which is supported by our results.

Figure 2 shows that men as buyers in the English auction treatment were considerably more likely to be in the top half of total profit earners, while women were more likely to be in the lower half of total profit earners. Yet as sellers in the English auction treatment, women were much more likely to be in the top half of profit earners, while men dominated the lower half.

Further, our results are consistent with previous market experiments. Laboratory studies consistently find that sellers outperform buyers in English auction markets, while buyers perform better in private negotiation markets (Menkhaus, Phillips, and Bastian, 2003; Menkhaus, Phillips, and Yakunina, 2009; Nagler et al., 2013; Phillips et al., 2014). Across all market treatments, our results support these previous findings (Table 3). In the English auction treatment, sellers have higher profit than buyers for both genders. In both private negotiation treatments, buyers have higher average profit than sellers across genders.

In all market environments, similar to Dittrich, Knabe, and Leipold (2014), we find an interaction between gender and role. Therefore, neither gender nor role alone can explain differences in earnings. Any analysis to understand gender differences in negotiation outcomes must also include role to accurately capture differences.

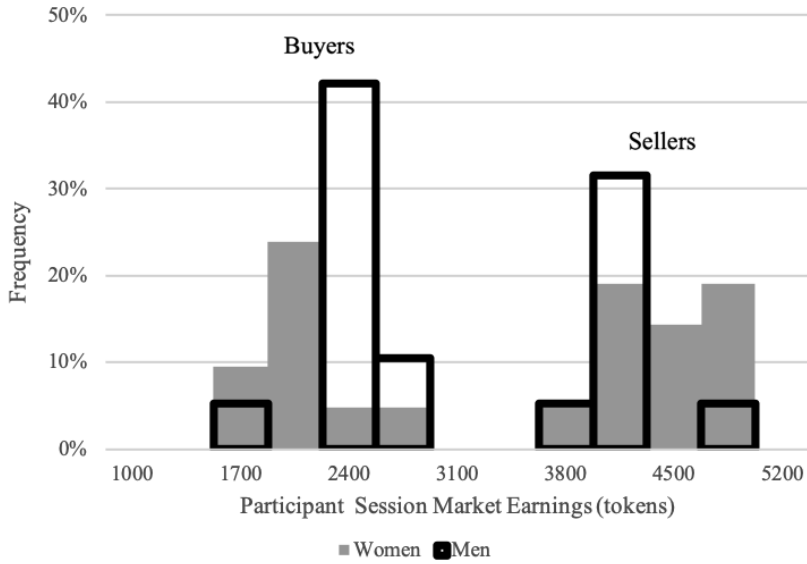


Figure 2. Distribution of Total Profit by Gender in the English Auction Treatment

Discussion

Given the increasing number of women agricultural operators, gender differences in economic outcomes pertaining to trading products are of utmost importance. Previous literature suggests that men will outperform women in other negotiation contexts considered more masculine and that the opposite is true when the negotiation contexts are considered more feminine. Using economic laboratory market experiments, we find that behavior and outcomes in markets are generally consistent with previous literature.

Our results show that women tend to choose a market negotiation strategy that is more impatient and generous than men. This behavior leads to women generally negotiating more trades, but with lower surplus per trade. Although the relationship between patience, generosity, and total profit is not known *a priori*, results show that in private negotiation markets, a more patient and greedier strategy leads to higher profit, regardless of role. As a result, women are found more frequently among traders that earned lower total profits, while men more often earned the highest level of total profit. In English auction markets, the same relationship holds between patience, generosity, and profit for buyers. On the other hand, a more patient and greedier strategy (resulting in the production of fewer units for sale) leads to lower profits due to the passive nature of sellers in English auction markets. Given the competitive nature of buyer bidding, the marginal effect of an additional unit produced on price is lower in English auction than in private negotiation (Menkhous, Phillips, and Bastian, 2003). Any influence of increasing units traded on price will likely not outweigh the additional profit earned by sellers trading more units. Thus, for a seller in an English auction, a more impatient strategy (resulting in increased production of units for trade) will lead to more overall profit. As a result, the more “feminine” strategy of impatience and generosity generally leads to lower profits for women in private negotiation and as buyers in English auction. When examining the distribution of earnings, women are found to make up the majority of those in the lower half of profit earners, while men make up the majority of the top half of profit earners. The only market situation in which women choosing this strategy is beneficial occurs when the agent is in a passive role, such as a seller in an English auction market.

In addition to negotiation strategies, risk aversion is theorized to affect negotiation outcomes in all market contexts (Muthoo, 1999; Klemperer, 2004; Krishna, 2010). Muthoo (1999) shows that in private negotiations, the party that is more risk averse—regardless of market role—will negotiate

a smaller surplus per unit. With no assumed effect on the quantity of trades negotiated, a more risk-averse player will negotiate a lower overall profit in privately negotiated markets.

There is a vast literature consisting of findings that women are more risk averse than men over a broad range of environments (e.g., Jianakoplos and Bernasek, 1998; Bernasek and Shwiff, 2001; Eckel and Grossman, 2008; Brick, Visser, and Burns, 2012; Charness and Gneezy, 2012; García-Gallego, Georgantzís, and Jaramillo-Gutiérrez, 2012). In negotiations, women may receive less lucrative offers and face more aggressive bargaining when viewed as more risk averse (Eckel and Grossman, 2008). As a result, women may be willing to accept a less lucrative offer in order to ensure that level of payoff and avoid the risk of not reaching a mutually agreed upon outcome with no payoff, resulting in worse outcomes than men (Muthoo, 1999). Our results may therefore be partially explained by women being more risk averse than men on average. Further, the increased risk in the advance-production treatment may amplify the surplus differences by levels of risk aversion, further explaining the cause of women being outperformed in both roles in the private negotiation advance-production treatment.

In an English auction market, increased risk aversion among buyers will increase bids and therefore prices (Krishna, 2010). For a risk-averse buyer, the impact of a slightly lower bid has a smaller effect on utility than the possibility of loss from being outbid. Compared to a less risk-averse buyer, a more risk-averse buyer will bid a higher amount to increase the chance of securing a trade (Krishna, 2010, p. 39). As a result, a risk-averse buyer will be more generous in bidding and will likely have more trades than less risk-averse buyers, but at a lower surplus per trade (Klemperer, 2004). Since sellers are not active in the English auction negotiation process, risk aversion can only impact the number of units that sellers trade. A more risk-averse seller may be inclined to sell more units in order to minimize the risk of an unfavorable negotiation over one unit (especially in the English auction context, where the potential for unsold units is reduced, Menkhous, Phillips, and Bastian, 2003). As a result, a more risk-averse seller in English auction markets may actually have higher overall profit than a less risk-averse seller. This rationale lends further support to our finding that women sellers in English auctions outperform men while using an impatient and generous strategy. Future research should identify the link between risk aversion, negotiation strategy, and outcomes.

There has been a move away from English auction-type markets to privately negotiated sales in agribusiness. Our results indicate that this move toward private negotiations will disproportionately hurt women operators, whose economic outcomes are generally lower than men's in this type of market. Our results, together with the transition of agricultural markets toward more private negotiation, may partially explain why women producers have lower sales and a smaller rate of return on equity than men producers (Hoppe and Korb, 2013).

Our experiments did not measure the influence of market experience on gender differences in outcomes or behavior, which may influence participant decisions. Future research can determine whether such experience decreases or exacerbates the gender differences found here. Additionally, future research relating risk, expectations, and bargaining outcomes across genders and market role could add further insights.

Fear of backlash from behaving outside of expected gender roles has been suggested as one main cause of women behaving differently from men in negotiations (Bowles, Babcock, and Lai, 2007; Rudman and Phelan, 2008; Amanatullah and Morris, 2010; Günther et al., 2010; Stuhlmacher and Linnabery, 2013; Mazei et al., 2015). By making the identity of the participants unknown to one another, we eliminate potential backlash or retaliation for acting outside of gender norms in our experiments. As a result, behavior in our experiments should not be biased from such backlash and should give insights into underlying personal behavior. Even without the threat of backlash, participants still behave in accordance with gender norms: Men behave in a more patient and greedier manner than women. The more aggressive behavior of being patient and greedy leads to men generally outperforming women in privately negotiated markets. The gender differences in these underlying behaviors influence economic outcomes. In a setting in which the identity of others

is known, and the fear of backlash is present, these gender differences may be more pronounced. Future research should expand the study of gender differences in market negotiation behavior and outcomes when the fear of gender nonconformity backlash is potentially present.

Our results suggest that policies to increase the economic outcomes of women in agricultural contract sales should include education to encourage women to be more patient and greedier in their negotiation styles, in the hope of reducing their prevalence in low sales categories. While discussion of the effectiveness of education on negotiation style seems absent in the literature, education has been shown to reduce the gender gap in willingness to compete and performance as it relates to school-aged children (e.g., Alan and Ertac, 2019). Moreover, research suggests that education related to negotiation in interpersonal and problem-solving domains can improve business outcomes (Movius, 2008). It should also be noted that educating women to change their negotiation styles has the potential to increase the likelihood of backlash from acting outside of gender norms. Thus, effective policy should not only educate women on how to be more patient and greedier during negotiations but should also educate both men and women to challenge gender stereotypes in negotiations. Effective education on both of these topics is necessary if women truly hope to successfully compete against men in private negotiation markets.

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Online Supplement: An Experimental Inquiry of Gender Differences in Negotiation Strategy and Outcomes: Agricultural Market Implications

**Chian Jones Ritten, Christopher T. Bastian, Selena Gerace,
Owen R. Phillips, and Amy Nagler**

Instructions: English Auction (This line not part of instructions).

Introduction

Thank you for agreeing to participate in this experiment in the economics of market decision making. In this experiment, we will set up an auction market in which some of you will be BUYERS and others will be SELLERS. These instructions provide you with an overview of the experiment, the specific instructions for buyers and sellers, and trading rules for the auction. After reading the instructions, you will be shown pictures of the “point and click” computer screens and there will be a discussion of operational details associated with them. We will not start the actual experiment until everyone is comfortable with the mechanics of the experiment. Your overall objective is to make as much money as you can.

The commodity you are trading is referred to as a “unit.” Buyers earn money by purchasing units and then redeeming (or reselling) these units to the experimenter during each trading period. Sellers earn money by producing units at a cost and selling these units to buyers. Earnings are recorded in a fictitious currency called tokens. Tokens are exchanged for cash at the rate of **100 tokens = \$1.00**. Your earnings will be paid to you in CASH at the end of the experiment. To begin, every buyer and seller will be given an initial balance of **700 tokens (\$7.00)**. You may keep this money PLUS any you earn.

Each trading period consists of a production decision and an auction. During the production period, the sellers will decide how many units to produce for the trading period. Any units produced are then available to sell in the auction. Meanwhile, during the production decision buyers are waiting for the auction to begin. The auction, therefore, occurs after the sellers have produced units. During the auction, buyers bid for the units produced by the sellers in the production phase.

Specific Instructions to Buyers

Profits for buyers will depend on the unit (or resale) value and purchase price. The unit value for each buyer will be displayed on the computer screen. The highest bid price in the auction is the purchase price. Buyer profits are, therefore, determined by out bidding other buyers for the purchase price. Buyers will receive actual unit values for the experiment. During each trading period buyers are free to purchase up to 8 units in the auction. For the first unit bought, a buyer will receive the amount listed under unit VALUE for Unit 1. For the second unit bought a buyer will receive the amount listed under unit VALUE for Unit 2. The unit values for subsequent units also will be displayed on the computer screen. The earnings from each unit purchased are computed by taking the difference between the unit value and purchase price of the unit bought. That is,

Buyer Earnings = Unit Value – Purchase Price.

Suppose that a buyer purchases 2 units in a trading period. If 60 tokens are paid for the first unit, 65 tokens for the second unit, buyer earnings are:

$$\text{Buyer Earnings for Unit 1} = 80 - 60 = 20$$

$$\text{Buyer Earnings for Unit 2} = 70 - 65 = 5$$

$$\text{Total Buyer Earnings} = 20 + 5 = 25 \text{ tokens.}$$

The unit values, purchase prices and profits will be displayed on the computer screen during the experiment, as well as in an end-of-period report provided by the computer. Obviously, if a buyer does not purchase units, profits will be zero.

Specific Instructions to Sellers

During each trading period you are free to produce and sell up to 8 units. Remember, you must decide on the number of units you wish to produce and then sell in the production period. Because you must decide on the number of units to produce before you sell them in the production period, you will incur production costs for all units you produce.

The first unit that you produce during a trading period will cost you the amount listed under UNIT COST for Unit 1. In this example, this cost is 15 tokens. Unit 1's unit cost is 15 tokens. The second unit that you produce will cost you the amount listed under UNIT COST for Unit 2, which is 20 tokens and Unit 3 is 25 tokens.

The earnings from each unit that you sell (which are yours to keep) are computed by taking the difference between the sale price and unit cost of the unit sold. That is,

$$\text{Your Earnings} = \text{Sale Price} - \text{Unit Cost}$$

Let's suppose that in the trading period you sell Unit 1 for 45 tokens, Unit 2 for 40 tokens and Unit 3 for 35 tokens. Your earnings would then be:

$$\text{earnings for Unit 1} = 45 - 15 = 30$$

$$\text{earnings for Unit 2} = 40 - 20 = 20$$

$$\text{earnings for Unit 3} = 35 - 25 = 10$$

During the experiment this trading information will be summarized on the computer screen at the end of each trading period. Sellers also should be aware that they will not be allowed to incur a production cost greater than the amount in their beginning token balance in any one period.

Trading Rules for the Auction

Each unit produced by sellers is auctioned in order of least cost to highest cost one at a time. Sellers' units are randomly selected for sale by the computer starting with the lowest cost units. Once all units are sold from this cost level, the computer then moves to the next higher cost units, and so on until all units are sold. Buyers purchase units in the order shown by their individual unit value schedules. Sellers watch while units are sold during the auction.

During the auction, buyers submit bids. The computer serves as the auctioneer in this experiment. The auctioneer will begin by setting a token amount at which bidding begins. The computer might start at 30 tokens, for example. If this initial bid is too high for buyers, the auctioneer will lower the start bid until a buyer clicks on the BID box and enters a bid.

If a buyer wants to bid higher, he/she simply clicks on the "Place Bid" or "Enter Bid" box displayed on the screen. If you click "Place Bid" the bid amount will go up by 1 token. The "Enter Bid" box allows you to type in bids greater than one token. Buyers keep bidding in order to buy the unit at the highest bid. If the bidding slows, the computer will flash the message: going once, going twice. If there are no additional bids the unit is awarded to the highest bidder and the screen will flash Sold!! The sale price is then displayed in the listing of trade prices.

The winning bidder moves down to the next unit on the unit value schedule. For example, if the second unit is bought by a buyer, he or she moves to the third unit, when the bidding begins again. If

the person was not the winning bidder, he or she stays at the unit value of the first unpurchased unit. It will be highlighted on the screen.

You need to pay close attention to your screen and your value for the unit. Buyers will not be allowed to purchase units for more than the resale value.

Once all units that have been produced for sale have been sold, the trading period will end. A period recap screen indicating an individual’s earnings will be displayed. The next trading period will start with sellers producing units for sale.

The experiment will go at least 15 auction periods. After the fifteenth period, the computer will randomly generate a number between 1 and 100. If the number falls between 1 and 20 the experiment will end. If the number is bigger than 20 it will continue. Hence the probability of stopping after period 10 is 1 in 5 and the probability of continuing is 4 in 5.

Your Name and Student ID Number

Before beginning the experiment, the computer will ask for your name and student ID number. This information is kept confidential, but it is important to the funding agency as proof of your participation. The bids and earnings of people in the experiment are confidential. Please do not look at someone else’s screen and do not speak to another participant once the experiment begins. You may ask the experimenter questions at any time during the experiment. Are there any questions before we begin the practice period?

Private Negotiation – Advance Production. (This line not part of the instructions).

INSTRUCTIONS

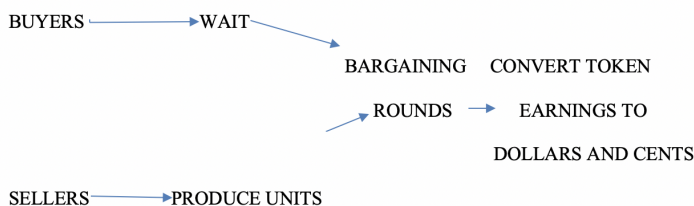
Introduction

This is an experiment in the economics of market decision making. In this experiment, we will set up a market in which some of you will be BUYERS and some of you will be SELLERS.

The commodity you are trading is referred to as a “unit”. Sellers make earnings by producing units at a cost and selling these units to buyers. Buyers make earnings by purchasing units from sellers and then redeeming (or reselling) these units to the experimenter. Earnings are recorded in a fictitious currency called tokens. Tokens have a cash value of **100 tokens = \$1.00**. Your earnings will be paid to you in CASH at the end of the experiment. To begin, every seller and buyer will be given an initial balance of **700 tokens (\$7.00)**. You may keep this money PLUS any you earn.

Buyers and sellers will be randomly paired and will exchange units for tokens in computerized markets over a sequence of trading periods. Each trading period consists of three one-minute trading rounds during which pairs of buyers and sellers negotiate trading prices.

All trading is conducted over the computer network. Each trading period will consist of a production period followed by random pairings of buyers and sellers and negotiations for trade prices. During the production period, the sellers determine the number of units to produce and the buyers wait. After the sellers have produced the units, buyers and sellers are randomly paired in each of the three one-minute bargaining rounds during which each buyer and seller pair negotiate for trade prices. See the figure below



For the units produced, the cost of production is deducted from the seller's token balance. In addition, the computer will automatically account for sales or purchases that you have made and adjust your token balance accordingly. A listing of sales or purchases you have made and your adjusted token balance will be displayed on the computer screen at the end of every trading period.

After you have viewed this information and clicked on OK, a new trading period with three trading rounds will begin. This experiment will consist of several trading periods. We will conduct a practice trading period to familiarize you with the mechanics of the computerized market before the actual experiment begins. During the practice trading period the information you see will be different than that in the actual experiment.

Specific Instructions to Buyers

During each trading period you are free to purchase up to 8 units. For the first unit that you buy during a trading period, you will receive the amount listed under UNIT VALUE for Unit 1. In this example, this amount is 55 tokens. For the second unit that you buy you will receive the amount listed under UNIT VALUE for Unit 2, which is 50 tokens. The redemption values for these and subsequent units will be displayed on your computer screen.

The earnings from each unit that you purchase (which are yours to keep) are computed by taking the difference between the redemption value and purchase price of the unit bought. That is,

$$\text{Your Earnings} = \text{Redemption Value} - \text{Purchase Price}$$

Suppose, for example, that you buy 2 units in a trading period. If you pay 40 tokens for the first unit and 30 tokens for the second unit your earnings are:

$$\text{earnings for Unit 1} = 55 - 40 = 15$$

$$\text{earnings for Unit 2} = 50 - 30 = 20$$

Your total earnings are:

$$\text{total earnings} = 15 + 20 = 35 \text{ tokens}$$

During the experiment this trading information will be summarized on the computer screen at the end of each trading period. Tokens will be converted to cash at the conversion rate of 100 tokens = \$1.00. Buyers also should be aware that they will not be allowed to spend more tokens buying units than what they have in their beginning balance in any one period.

Specific Instructions to Sellers

You must decide on the number of units you wish to produce and then sell in the production period. During each trading period you are free to sell up to 8 units. If a trade is not completed, you incur production costs but do not sell the unit or receive the sale price. Because you must decide on the number of units to produce before you sell them in the production period, you will also incur production costs for all units you produce, even the ones you do not sell in the trading period. The first unit that you sell during a trading period will cost you the amount listed under UNIT COST for Unit 1. In this example, this cost is 15 tokens. Unit 1's unit cost is 15 tokens. The second unit that you sell will cost you the amount listed under UNIT COST for Unit 2, which is 20 tokens and Unit 3 is 25 tokens. The unit costs for these and subsequent units will be displayed on your computer screens.

The earnings from each unit that you sell (which are yours to keep) are computed by taking the difference between the sale price and unit cost of the unit sold. That is,

$$\text{Your Earnings} = \text{Sale Price} - \text{Unit Cost}$$

Let's suppose that in the trading period you sell Unit 1 for 45 tokens, Unit 2 for 40 tokens and Unit 3 for 35 tokens. Your earnings would then be:

$$\text{earnings for Unit 1} = 45 - 15 = 30$$

$$\text{earnings for Unit 2} = 40 - 20 = 20$$

$$\text{earnings for Unit 3} = 35 - 25 = 10$$

Your total earnings are:

total earnings = 30 + 20 + 10 = 60 tokens

During the experiment this trading information will be summarized on the computer screen at the end of each trading period. Sellers also should be aware that they will not be allowed to incur a production cost greater than the amount in their beginning token balance in any one period.

Trading Rules for the Market

Only one unit may be bought and sold at a time. A buyer makes bids to the seller to purchase a unit. A “bid” is a proposed price at which a buyer is willing to purchase a unit. Bids must become progressively higher. In other words, if the first bid for a unit is 50 tokens, then the second bid must be higher than 50. Suppose the second bid is 55 tokens, then the third bid must be higher than 55, and so on.

A seller makes offers to the buyer to sell a unit. An “offer” is a proposed price at which a seller is willing to sell a unit. Offers must become progressively lower. In other words, if the first offer to sell a unit is for 60 tokens, then the second offer must be lower than 60. Suppose the second offer is 55 tokens, then the third offer must be less than 55, and so on.

There is one further set of restrictions on bids and offers. The reason for these restrictions is just common sense. A buyer’s bid cannot be higher than what is labeled on the computer screen as the BEST OFFER. In other words, a buyer cannot attempt to pay a price that is higher than that for which the seller is willing to sell. Similarly, a seller’s offer cannot be lower than what is labeled as the BEST BID. In other words, a seller cannot attempt to sell at a price below that which the buyer is willing to pay. In fact, the computer will not allow such bids and offers.

A bid is made by typing the bid and pressing the ENTER key. Similarly, an offer is made by typing the offer, and pressing the ENTER key. During a market, a buyer will be making bids at the same time that a seller is making offers.

It should be apparent that the difference between the BEST BID and the BEST OFFER gradually decreases. A trade is made when the BEST BID equals the BEST OFFER. Suppose the BEST BID is 55 tokens and the BEST OFFER is 60 tokens. If a buyer decided that he or she was willing to purchase the unit for 60 tokens, he or she could type the number 60 and then press ENTER. There is, however, a quicker method to do this. As soon as the buyer saw the BEST OFFER was 60, he or she could simply click on “Accept.” Whenever a buyer “Accepts”, he or she automatically makes a bid which equals the BEST OFFER or, in other words, “accepts” the BEST OFFER.

As another example for sellers, suppose again that the BEST BID is 55 and the BEST OFFER is 60. If a seller decided that he or she was willing to sell the unit for 55 tokens, he or she could type the number 55 and then press ENTER. Again, there is a quicker method to do this. As soon as the seller saw the BEST BID was 55, he or she could click on “Accept.” Whenever a seller “Accepts”, he or she automatically makes an offer which equals the BEST BID or, in other words, “accepts” the BEST BID.

After a seller and buyer have made a trade, the trading price will be listed on both the buyer’s and seller’s screens. After a trade has been made, bid and offer values are cleared from the screen. A buyer and seller pair may then resume entering bids and offers for additional units. Trades are made between buyer and seller pairs for one minute. After a minute has elapsed, buyers and sellers are again randomly paired and the next trading round begins.

Each trading period has a maximum time limit of 3 minutes or three one-minute trading rounds. A trading period will be terminated automatically if profitable trades cannot be made by randomly matched buyers and sellers.

Each trading period has a maximum time limit of 3 minutes or three one-minute trading rounds. A trading period will be terminated automatically if profitable trades cannot be made by the randomly matched buyer and seller. Because buyers incur a purchase price for units and sellers incur costs to produce units for sale, it is possible to reach a token balance of 0. If a player reaches

a 0 token balance, they cannot continue to buy or produce units in the market and the experimental session will end. There will be at least 20 periods in the experiment. After the twentieth period, the computer will randomly generate a number between 1 and 100. If the number falls between 1 and 20 the experiment will end. If the number is bigger than 20 it will continue. Hence the probability of stopping after period 10 is 1 in 5 and the probability of continuing is 4 in 5.

Your Name and Student ID Number

Before the practice trading period, the computer will ask for your name and student ID number. This information is kept confidential, but it is important to the funding agency as proof of your participation. The bids and earnings of people in the experiment are confidential. Please do not look at someone else's screen and do not speak to another participant once the experiment begins. You may ask the experimenter questions at any time during the experiment. Are there any questions before we conduct the practice trading period?

Instructions Private Negotiation – Production-to-Demand (This line not part of the instructions).

INSTRUCTIONS

Introduction

Thank you for agreeing to participate in this experiment. This is an experiment in the economics of market decision making. In this experiment, we will set up a market in which some of you will be BUYERS and some of you will be SELLERS.

The commodity you are trading is referred to as a "unit". Sellers make earnings by producing units at a cost and selling these units to buyers. Buyers make earnings by purchasing units from sellers and then redeeming (or reselling) these units to the experimenter. Earnings are recorded in a fictitious currency called tokens. Tokens are exchanged for cash at the rate of **100 tokens = \$1.00**. Your earnings will be paid to you in CASH at the end of the experiment. To begin, every seller and buyer will be given an initial balance of **700 tokens (\$7.00)**. You may keep this money PLUS any you earn.

Buyers and sellers will be randomly paired and will exchange units for tokens in computerized markets over a sequence of trading periods. Each trading period or cycle consists of three trading rounds during which pairs of buyers and sellers negotiate trading prices. Each trading period consists of what is commonly referred to as a forward market. The forward market occurs before sellers have produced units. A trade in the forward market is a binding agreement between buyer and seller. In other words, the seller agrees to produce a unit for the buyer and the buyer agrees to pay the seller for that unit.

All trading is conducted over the computer network. At the end of each trading period, any unit sold is automatically produced, and the cost of production is deducted from the seller's token balance. In addition, the computer will automatically account for sales or purchases that you have made and adjust your token balance accordingly. A listing of sales or purchases you have made and your adjusted token balance will be displayed on the computer screen at the end of every trading period. After you have viewed this information and clicked on OK, a new trading period with three trading rounds will begin. This experiment will consist of at least 20 trading periods. We will conduct a practice period to familiarize you with the mechanics of the computerized market before the actual experiment begins. During the practice period the information you see will be different than that in the actual experiment.

Specific Instructions to Buyers

During each trading period you are free to purchase up to 8 units. For the first unit that you buy during a trading cycle, you will receive the amount listed under UNIT VALUE for Unit 1. In this example, this amount is 55 tokens. For the second unit that you buy you will receive the amount listed under UNIT VALUE for Unit 2, which is 50 tokens. The redemption values for these and subsequent units will be displayed on your computer screen.

The earnings from each unit that you purchase (which are yours to keep) are computed by taking the difference between the redemption value and purchase price of the unit bought. That is,

$$\text{Your Earnings} = \text{Redemption Value} - \text{Purchase Price}$$

Suppose, for example, that you buy 2 units in a trading period. If you pay 40 tokens for the first unit and 30 tokens for the second unit your earnings are:

$$\text{earnings for Unit 1} = 55 - 40 = 15$$

$$\text{earnings for Unit 2} = 50 - 30 = 20$$

Your total earnings are:

$$\text{total earnings} = 15 + 20 = 35 \text{ tokens}$$

During the experiment this trading information will be summarized on the computer screen at the end of each trading cycle. Buyers also should be aware that they will not be allowed to spend more tokens buying units than what they have in their beginning balance in any one period.

Specific Instructions to Sellers

During each trading period you are free to sell up to 8 units. Remember, any units that you sell will automatically be produced once trading in the forward market is complete. The first unit that you sell during a trading cycle will cost you the amount listed under UNIT COST for Unit 1. In this example, this cost is 20 tokens. Unit 1's unit cost is 20 tokens. The second unit that you sell will cost you the amount listed under UNIT COST for Unit 2, which is 30 tokens an unit 3 is 40 tokens. The unit costs for these and subsequent units will be displayed on your computer screens.

The earnings from each unit that you sell (which are yours to keep) are computed by taking the difference between the sale price and unit cost of the unit sold. That is,

$$\text{Your Earnings} = \text{Sale Price} - \text{Unit Cost}$$

Let's suppose that in the forward market you sell Unit 1 for 50 tokens, Unit 2 for 45 tokens and Unit 3 for 45 tokens. Your earnings would then be:

$$\text{earnings for Unit 1} = 50 - 20 = 30$$

$$\text{earnings for Unit 2} = 45 - 30 = 15$$

$$\text{earnings for Unit 3} = 45 - 40 = 5$$

$$\text{total earnings} = 30 + 15 + 5 = 50 \text{ tokens}$$

During the experiment this trading information will be summarized on the computer screen at the end of each trading period. Sellers also should be aware that they will not be allowed to incur a production cost greater than the amount in their beginning token balance in any one period.

Trading Rules for the Forward Market

Only one unit may be bought and sold at a time. A buyer makes bids to the seller to purchase a unit. A "bid" is a proposed price at which a buyer is willing to purchase a unit. Bids must become progressively higher. In other words, if the first bid for a unit is 50 tokens, then the second bid must be higher than 50. Suppose the second bid is 55 tokens, then the third bid must be higher than 55, and so on.

A seller makes offers to the buyer to sell a unit. An "offer" is a proposed price at which a seller is willing to sell a unit. Offers must become progressively lower. In other words, if the first offer to

sell a unit is for 60 tokens, then the second offer must be lower than 60. Suppose the second offer is 55 tokens, then the third offer must be less than 55, and so on.

There is one further set of restrictions on bids and offers. The reason for these restrictions is just common sense. A buyer's bid cannot be higher than what is labeled on the computer screen as the BEST OFFER. In other words, a buyer cannot attempt to pay a price that is higher than that for which the seller is willing to sell. Similarly, a seller's offer cannot be lower than what is labeled as the BEST BID. In other words, a seller cannot attempt to sell at a price below that which the buyer is willing to pay. In fact, the computer will not allow such bids and offers.

A bid is made by typing the bid and pressing the ENTER key. Similarly, an offer is made by typing the offer, and pressing the ENTER key. During a market, a buyer will be making bids at the same time that a seller is making offers.

It should be apparent that the difference between the BEST BID and the BEST OFFER gradually decreases. A trade is made when the BEST BID equals the BEST OFFER. Suppose the BEST BID is 55 tokens and the BEST OFFER is 60 tokens. If a buyer decided that he or she was willing to purchase the unit for 60 tokens, he or she could type the number 60 and then press ENTER. There is, however, a quicker method to do this. As soon as the buyer saw the BEST OFFER was 60, he or she could simply click on "Accept." Whenever a buyer "Accepts", he or she automatically makes a bid which equals the BEST OFFER or, in other words, "accepts" the BEST OFFER.

As another example for sellers, suppose again that the BEST BID is 55 and the BEST OFFER is 60. If a seller decided that he or she was willing to sell the unit for 55 tokens, he or she could type the number 55 and then press ENTER. Again, there is a quicker method to do this. As soon as the seller saw the BEST BID was 55, he or she could click on "Accept." Whenever a seller "Accepts", he or she automatically makes an offer which equals the BEST BID or, in other words, "accepts" the BEST BID.

After a seller and buyer have made a trade, the trading price will be listed on both the buyer's and seller's screens. After a trade has been made, bid and offer values are cleared from the screen. A buyer and seller pair may then resume entering bids and offers for additional units. Trades are made between buyer and seller pairs for one minute. After a minute has elapsed, buyers and sellers are again randomly paired and the next trading round begins.

Each trading period has a maximum time limit of 3 minutes or three one-minute trading rounds. A trading period will be terminated automatically if profitable trades cannot be made by randomly matched buyers and sellers.

The experiment will go at least 20 trading periods. After the twentieth period, the computer will randomly generate a number between 1 and 100. If the number falls between 1 and 20 the experiment will end. If the number is bigger than 20 it will continue. Hence the probability of stopping after period 10 is 1 in 5 and the probability of continuing is 4 in 5.

Your Name and Student ID Number

Before the practice session, the computer will ask for your name and student ID number. This information is kept confidential, but it is important to the funding agency as proof of your participation. The bids and earnings of people in the experiment are confidential. Please do not look at someone else's screen and do not speak to another participant once the experiment begins. You may ask the experimenter questions at any time during the experiment. Are there any questions before we conduct the practice session?

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