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**Matching and Inventory Loss Risks as Facilitators of Market Power
in Private Negotiation Spot Trading**

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Abstract

This laboratory study investigates the extent to which matching and inventory loss risks contribute to market power in private negotiation trading. Asymmetry in the number of buyers and sellers increases matching risk when exchange is bilateral. The risk of inventory loss can occur from advance production and is common in markets for perishable products. In a buyer concentrated market with bilateral trading, prices are about 23% below the predicted competitive level and close to the monopsony price. These lower prices are the result of tacit coordination enjoyed by buyers resulting from matching and inventory loss risks faced by sellers.

Key words: matching risk, inventory loss risk, market power, laboratory markets

(JEL C78, C92, L13)

Matching and Inventory Loss Risks as Facilitators of Market Power in Private Negotiation Spot Trading

Exchange institutions are evolving from auctions to private negotiation trading for many transactions in the food supply chain. This institutional change and the market power exerted by firms in concentrated food industries have caused substantial debate (Barkema, Drabentstott and Novak; Combest; Hahn and Nelson; OMC; WORC).

Questions have emerged regarding the relative bargaining positions of buyers and sellers, as trading institutions and industry structures change.

Historical data, even if available, can be inadequate in addressing these issues, especially if aggregated to the industry level. Aggregate industry data can mask the effects of market power (Sexton) and the interaction it has with the trading institution. Shifts from open-auction trading to private negotiation, in which transaction data are proprietary, compounds the data problems. Firm level data, even if available, may not necessarily provide a means to assess the combined impacts of concentration and evolving market practices.

We believe more attention should be directed toward identifying practices that augment the market power by firms in concentrated industries. These practices are often labeled facilitating influences. Facilitating influences are factors that contribute to one firm's power over rivals or other firms in the vertical supply chain. Such influences may contribute to collusive behavior. The purpose of this study is to explore the extent to which two possible facilitating influences, matching risk and an inventory requirement

that precedes a bilateral agreement, contribute to market power in private negotiation trading in concentrated industries using laboratory markets.

The market environment, specifically the trading institution and method of delivery, in which agents participate is an important determinant of market efficiency (Menkhaus, Phillips and Bastian). The competitive model is typically set forth as a standard by which to measure relative efficiency, but purely competitive market outcomes are rarely observable in naturally occurring markets. They do, however, exist in a laboratory market. Outcomes from different laboratory market designs offer a way to begin evaluating alternative trading practices.

In the laboratory markets we conduct, attention is given to a firm's pricing decision. The prices set by firms aggregate to a specific and well defined market price. The focus is on market power of agents in a concentrated market, when private negotiation is the trading institution and the method of delivery is spot, i.e., sales are made once there is inventory on hand. Asymmetry in the number of buyers and sellers creates a matching risk when exchange is conducted via private negotiation. The side of the market for which there are relatively few traders controls access, which can increase the market power of either buyers or sellers. Advance production for spot delivery creates a risk of inventory loss, particularly for perishable commodities/products, because production costs are incurred prior to marketing. This creates risk for the seller, in that if units are not traded, all or a portion of the costs of production can be lost, and inventory loss risk is compounded by the matching risk. Laboratory markets provide the data for

the analyses by which to assess the impact of the matching problem and the inventory requirement on outcomes when the trading institution is private negotiation.

Matching and Inventory Loss Risks

In private negotiation a seller cannot trade unless granted access to a buyer and vice versa. Auction trading, as in a double auction, on the other hand, consists of all buyers and all sellers announcing prices. This creates open access between traders. The double auction is in this sense matching rich, as all buyers and all sellers simultaneously participate in the price discovery process. A lack of access and therefore, matching risk, can be especially restrictive in private negotiation trading when there are few bargaining rounds, during which buyers and sellers are matched.

There are two main sources of matching risk in private negotiation trading when there is an inventory requirement. First, matching risk arises with sellers (buyers) being matched with buyers (sellers) who have met their purchasing needs (who are out of inventory). Second, decreasing the number of matching opportunities, which can result from concentrated markets, increases the opportunity cost associated with any one match. Asymmetry in buyer and seller numbers potentially decreases the number of matches between buyers and sellers and increases matching risk. Further, even if matched, the willingness to pay may be strictly below the price at which sellers are willing to sell, or the willingness to sell price may be above willingness of buyers to pay. The relatively scarce trader has a bargaining advantage, particularly if inventories must be sold.

Holding perishable inventories in advance of the trading time is important to the matching problem in private negotiation. A comparison of results from laboratory double

auction and private negotiation trading, with and without advance production, reveals the relationship between matching risk and the trading institution (Menkhaus et al.; Menkhaus, Phillips and Bastian). Private negotiation by itself does not greatly affect market price, compared to auction trading. This can be seen by comparing results from a double auction to results from private negotiation, when there is no inventory requirement.

In earlier private negotiation experiments, buyers and sellers were randomly matched in three bargaining rounds per trading period. Prices in both double auction and private negotiation trading are near the predicted competitive price, as reported in Menkhaus et al. The quantity traded, however, is below the level predicted by the competitive model in private negotiation, reflecting some loss in total surplus. This loss in surplus provides a measure of the transaction cost associated with private negotiation and few bargaining rounds. As the number of bargaining rounds increases in private negotiation trading, matching risk diminishes and the results are near the competitive levels in both prices and trades. Private negotiation with many bargaining rounds resembles the matching rich double auction when there is no advance production.

Advance production introduces a risk of potential inventory loss. The inventory on hand puts sellers under increased pressure to sell, especially for perishable products. Sellers reduce this pressure by producing less. Earlier research has shown that double auction trading with advance production, when compared to double auction without this requirement, results in significantly higher prices and less quantity traded, although the latter is still within the predicted range from the competitive model (Phillips, Menkhaus

and Krogmeier). Also, a competitive English auction with spot delivery results in a price level above that predicted by the competitive model and favorable earnings to sellers, relative to buyers (Menkhaus, Phillips and Bastian). Auctions and advance production favors the seller.

Market outcomes reverse and favor the buyer when traders privately negotiate with few potential matches. In this case, results from laboratory markets indicate that private negotiation trading with spot delivery can reduce units traded by 25% and trade prices by 10%, relative to the predicted competitive equilibrium (Menkhaus et al.). Advance production and private negotiation trading with few bargaining rounds gives buyers monopsony power in the last rounds of the last trading cycle, and extends by backward induction into earlier bargaining rounds and trading cycles. Spot sellers lose their advantage in private negotiation trading, as compared to double and English auctions, and reduced production does not generate higher prices.

Theoretical Considerations

The inventory requirement from advance production in private negotiation trading throws market power to the buyer. Consider the case in which buyers and sellers are matched n bargaining rounds in a single trading or production cycle. Sellers have the opportunity to sell stock during the n matches with buyers in this cycle. Excess inventory becomes worthless at the end of the n th bargaining round. That is, it is assumed the commodity or product is perishable, as is common in the food sector. As a result, the buyer has the incentive to bid and pay virtually zero for remaining stock in the last bargaining round. This price paid in round n means zero should be paid in preceding rounds as well. The

predicted Nash equilibrium price, through backward induction, is therefore zero for a single production period – a one-shot game. Sellers in this scenario incur losses and will not produce in future production periods, and the market disappears.

In a multi-period game, the buyer seeks to maximize consumer surplus over several production cycles. Assuming no price discrimination and a uniform price, the equilibrium condition for the buyer is where marginal factor cost intersects the demand schedule, and price is from the supply schedule. This is the monopsony solution in the bilateral monopoly model and is the multi-period Nash equilibrium. Price and quantity traded are expected to be below competitive levels. This result hinges on the buyer having complete bargaining power relative to the seller, a condition that can exist due to the inventory loss risk faced by advance production sellers. This result also assumes no matching risk faced by buyers.

As trading moves toward the n th bargaining round in a trading cycle, both buyers and sellers face an increasing matching risk. The buyer is confronted with an increased probability that sellers will be out of inventory. If a seller waits until late bargaining rounds to trade, there is a risk that buyers have met their purchase requirements and are willing to trade only at low prices. Specific to the experiments conducted in this study, late random matches may pair a buyer with a seller in which one or the other may not gain from the trade, i.e., traders cannot find reasonably positive differences between marginal benefit (unit value) and marginal cost (unit cost). Buyers and sellers, as a result, have incentive to trade early, diluting some of the buyers' market power when there is advance production. Buyers, desiring to avoid a later mismatch, will move the price

above the monopsony level, closer to the competitive level. Quantity traded is predicted to be below competitive levels, given the leftward shift in both the marginal benefit and marginal cost schedules due to matching risk. As matching risk shifts to one side of the market or other, due to consolidation of buyers or sellers, the advantage is expected to go to the agents with less matching risk. Advance production risk may impact the sellers' bargaining position, even if they face lower matching risk, relative to buyers. Price is indeterminate and depends on the relative leftward shifts in supply and demand, along with the relative bargaining positions of buyers and sellers in bilateral trading.

Although not explicitly measured, matching risk arises from the absence of contact between buyers and sellers. A relatively small number of bargaining rounds in a trading cycle creates matching risk. Also, asymmetry between the number of buyers and sellers creates matching risk, if this asymmetry restricts contact between traders. Indeed any impediment to contact between traders causes matching risk.

Matching risk affects both buyers and sellers in private negotiation trading. Sellers face the additional risk from advance production. The relative impact of these two factors on buyers and sellers is an empirical issue. The following are testable propositions.

Proposition 1. Increased matching risk will reduce the number of units traded, relative to the predicted competitive level or other private negotiation environments with less matching risk.

Proposition 2. Advance production, combined with relatively few potential matches, gives buyers a advantage and moves prices toward the monopsony level. Buyers benefit from the risk of inventory loss faced by sellers.

Proposition 3. Matching risk resulting from buyer consolidation/concentration facilitates the market power of buyers in private negotiation trading with advance production.

Proposition 4. Matching risk resulting from seller consolidation/concentration facilitates the market power of sellers in private negotiation trading, but the risk of inventory loss faced by sellers continues to benefit buyers.

Experimental Design and Laboratory Procedures

The experimental design incorporates alternative sources of matching risk in laboratory private negotiation trading with advance production. We begin by allowing four buyers and four sellers to be matched during five bargaining rounds in a trading or production cycle. This provides a baseline treatment for comparison with market outcomes from treatments that introduce additional matching risk. Reducing the number of bargaining rounds from five to three in the experiments, as well as creating asymmetry in the number of buyers or sellers in the market and retaining five bargaining rounds, both increase matching risk. Reducing the relative number of buyers increases matching risk for the sellers, who also face inventory risk from advance production, while reducing the relative number of sellers increases matching risk for the buyers. The following four treatments make up the experimental design. Each consists of private negotiation trading with advance production and randomly matching buyers and sellers during each bargaining round of the trading/production cycle. Buyers and sellers were randomly matched, in order to avoid the formation of agreements and reputation building among agents and to provide a controlled market environment to identify the effects of matching risk.

Treatment 1 – Five matches with four buyers and four sellers (5M)

Treatment 2 – Three matches with four buyers and four sellers (3M)

Treatment 3 – Two buyers and four sellers with five matches (2B5M)

Treatment 4 – Two sellers and four buyers with five matches (2S5M)

Subjects were recruited primarily from undergraduate agricultural business and economics classes. The participants randomly drew a slip of paper corresponding to either a buyer or seller when they entered the computer laboratory where the experiments were conducted. The experimental instructions were then read followed by a practice session. Buyer and seller participants were randomly matched for three or five one-minute bargaining rounds in a trading period and traded “units” from a computer station through private, bilateral negotiation. Buyers were supplied with redemption values for each unit that could be traded in the laboratory market. Sellers were given production costs for units they could produce and then sell. An artificial currency called “tokens” was used, with an exchange value of one cent per token. The unit values and unit costs, which were the same for each of the four buyers and four sellers, respectively, are presented in table 1. Each of the four treatments was replicated three times and consisted of twenty trading periods. Participants were unaware that trading would terminate at the end of period twenty.

Prior to each trading period sellers were required to make a production decision, reflecting advance production. While the sellers made their decisions, buyers waited. Once all sellers completed a production decision the trading began. For each one-minute bargaining round, buyers and sellers traded as many units as they wished. The matched buyer/seller pairs made bids and offers, respectively, until bids and offers were equal, or until the buyer or seller accepted the existing bid or offer. Following each trading cycle an individual’s earnings were posted on their computer screen. Buyers earned the difference between what they paid and for a unit and the given redemption value for that

unit. Sellers earned the difference between what they sold a unit for and its unit cost. Participants could view only their own information and prices and profits of other participants were confidential.

The initial baseline treatment (5M) had four buyers and four sellers and contained five bargaining rounds during each of the 20 trading periods. In another treatment (3M), the number of bargaining sessions was reduced from five to three, again using four buyers and four sellers. This treatment reflects added matching risk resulting from fewer matches. A third treatment (2B5M) reduced the number of buyers to two, who were randomly matched with two of the four sellers during five bargaining rounds. Two sellers, therefore, did not trade during each of the bargaining rounds. Laboratory results are expected to indicate to what extent buyer concentration, and accompanying increased matching risk for sellers, alters the buyers' market power in private negotiation spot trading. The final treatment (2S5M) consisted of two sellers randomly matched with four buyers for five bargaining rounds per trading period. The 2S5M treatment is designed to provide insight into the amount of market power producers might gain by using a collective intermediary to market their commodities, and possibly overcoming matching and inventory loss risks.

Horizontally summing the unit values and unit costs for the four buyers and four sellers results in a predicted competitive equilibrium price of 80 tokens and quantity of 20 to 24 units. The cost schedule for sellers ranged from 30 tokens for the first unit produced to 100 for the eighth unit produced, as seen in table 1, for treatments 1 and 2. In treatment 3 (with two buyers), buyers were able to buy 16 units and the unit values

were 130 tokens for the first two units, 120 for the third and fourth units, etc. Similarly, in the fourth treatment (with two sellers), sellers can produce up to 16 units each. The unit cost schedule had two units costing 30 tokens, two units at 40 tokens, etc. The predicted competitive equilibrium price and quantity levels remain at 80 and between 20 and 24, respectively, for these latter two treatments. For comparison, the predicted monopoly and monopsony prices are 100 and 60 tokens, respectively, with 16 units traded.

Methods of Analysis and Results from Laboratory Markets

Data collected from the laboratory markets include quantities traded, trade prices, earnings for buyers and sellers, and total earnings. A description of the characteristics of each of these market outcomes over the 20 trading periods is provided by means of a convergence model (Noussair, Plott and Reizman). The following general convergence model is estimated for each market outcome, Z_{it} :

$$(1) \quad Z_{it} = B_0[(t-1)/t] + B_1(1/t) + \sum_{j=1}^{i-1} \alpha_j D_j [(t-1)/t] + \sum_{j=1}^{i-1} \Gamma_j D_j (1/t) + u_{it},$$

where Z_{it} = average sale price (or units traded or earnings) across the replications of the treatment and all trades for each of t trading periods in cross section (treatment) i ; B_0 = the predicted convergence level of the dependent variable for the base category (competitive prediction); B_1 = predicted starting level of the data for the base category; t = trading periods 1, ..., 20; D_j = dummy variable separating the j treatments (competitive prediction, 3M, 5M, 2B5M, and 2S5M) and u_{it} = error term. The convergence levels are of primary interest in this study, particularly how they differ across treatments.

This model provides a useful means to statistically test the effect of trading periods (t) or experience on outcome variables (prices, units traded, buyer and seller earnings, and total surpluses or earnings) for each treatment relative to the predicted competitive norms, as well as differences across treatments. The base treatment in this analysis was the competitive prediction, which has 80, 20, 1200 and 150 for price, units traded, total surplus and both buyer and seller earnings, respectively. The dummy variables (D_j) take on the value of one when the dependent variable is from the j^{th} treatment (3M, 5M, 2B5M, and 2S5M) and are otherwise zero. For the base, the convergence level of the dependent variable is given by B_0 while B_1 is the estimated origin (starting level) of the time series. The competitive model holds B_0 and B_1 fixed, but these values are adjusted by α_j and Γ_j , respectively, for other treatments.

Observations generated over several time periods may be serially correlated and heteroscedastic. Data also may be contemporaneously correlated between cross sections due to the same unit values/costs being used by subjects across alternative treatments. The Parks method was used to estimate equation (1). The use of the Parks method allowed us to take account of the unique statistical problems resulting from the panel data sets that consist of time series observations on each of the several cross-sectional units generated in our experiments. We focus on the convergence levels in the discussion that follows. The convergence levels describe the differences in treatment market outcomes, after experiment participants have adjusted their decisions to be consistent with the incentives inherent in the experiment design.

Quantities Traded

Units traded in each of the private negotiation spot delivery treatments under investigation in this study exhibit an estimated convergence level significantly less than the predicted competitive norm (table 2). This result can be attributed to the combined influences of advance production risk for the seller and matching risk for both the buyer and seller, which shift both the supply and demand schedules to the left. The estimated convergence levels for trades for the 5M and 3M treatments, between which the effects of matching risk can be isolated, are 17.20 and 14.61, respectively, and are significantly different, a result supporting Proposition 1. There are incentives for producers to produce and trade more when there are increased matching opportunities.

The greatest differences from the competitive model equilibrium level of 20 units are for the 2B5M and 2S5M treatments, with estimated convergence levels of 12.74 and 13.23. These levels are not significantly different from each other but are significantly lower than 5M and 3M levels and are below the bilateral monopoly level of 16 units. This result reflects the impact of increased matching risk resulting from concentrated markets on either the buyer side or seller side. Buyers and sellers appear equally capable of exploiting market power due to an asymmetry in the relative number of traders. These results support Propositions 3 and 4.

The highest percentage of trades in all bargaining environments (for periods 16 - 20, to allow for the effects of learning to subside) occurs in the first bargaining round (table 3), which may indicate the desire by both buyers and sellers to avoid matching risk that is potentially greater in later rounds. Sellers are particularly vulnerable in latter

rounds, due to inventory loss risk from advance production and matching risk. About 81% of all trades are executed in the first three rounds of the 5M treatment. When the number of buyers is reduced, 77.83% of trades occur in the first three rounds, as compared to 68.71% when the number of sellers is reduced. The market containing two sellers has 15.34% of the trades occurring in the fifth round, which is the highest among the treatments with five matches. This last result suggests that risk from holding inventory is not as severe for sellers in the case when buyers face greater matching risk resulting from increased concentration on the seller side of the market. Interestingly, sellers do not produce additional units in this environment (table 2). The two sellers may be in a position to exercise monopoly power facilitated by reduced matching risk. An analysis of prices may lend more insight into the issues of relative bargaining risk faced by buyers and sellers, as well as relative bargaining advantage.

Prices

Price increases by 4.70 tokens when the number of bargaining rounds increases from three to five and moves to within 2.36 tokens of the competitive equilibrium of 80 tokens (table 2). Price moves toward the competitive price level as matching risk decreases for both buyers and sellers. The risk associated with advance production also diminishes with more matches. A reduction in matching risk contributes to higher prices in private negotiation trading with spot delivery. Conversely, increased matching risk gives buyers a bargaining advantage, consistent with Proposition 2.

Prices are extremely depressed in the 2B5M treatment, exhibiting an estimated convergence level of 62.42 tokens, the lowest among all treatments and near the

monopsony level of 60 tokens. This occurs even at lower production/trades. The combined influences of reduced matching risk faced by buyers from a concentrated market and increased matching and inventory loss risks faced by sellers, put buyers in an advantageous bargaining position. They are able to exert monopsony power in price negotiation. This behavior is evidence supporting Proposition 3.

When matching risk shifts to the buyer, as in the 2S5M case, the estimated convergence level is not significantly different from that predicted by the competitive model. Nor is the price in this market environment significantly different from that in the 5M treatment. The estimated convergence price is not above the competitive prediction of 80 tokens. It appears that the risk of holding inventory, even with reduced matching risk, prevents sellers from negotiating price above the competitive level in private negotiation spot trading. Still, prices generally are higher than they are in the other treatments, and as noted below, seller earnings are robust. These results are consistent with Proposition 4.

Comparing average prices across bargaining rounds for periods 16 - 20 (table 3), treatments containing five bargaining rounds (5M, 2B5M, 2S5M) all have a tendency for higher prices in the first three rounds. The fourth round yields a modest price reduction. Prices are consistently lower in the fifth bargaining round. Buyers are aware that sellers cannot hold over units and learn sellers will accept lower bids to offset at least some production costs in the final round. These results suggest that in the last round sellers with unsold units are at the mercy of buyers in the market, even when there are two sellers. This is due to the risk of inventory loss associated with advance production.

These comparisons also illustrate matching risk for buyers. If a buyer does not make trades early in a period he or she could be matched with a seller in later rounds who does not have units in stock. There is support for the theoretical argument made earlier. That is, buyers and sellers have the incentive to trade early, diluting some of the buyers' market power associated with advance production. In later rounds, however, the buyer has the advantage when matched with a seller having inventory in stock and facing the risk of losing the sunk unit production costs. When the matching risk is reduced for the buyers, as in the 2B5M treatment, they gain a bargaining advantage and monopsony power. In the last bargaining round of this treatment, the price of 54 tokens is near the break-even level for sellers, considering the average units traded is between three and four units for each seller.

Trading in the 5M market, as compared to the 3M market, reduces the opportunity costs incurred by sellers not trading in the early bargaining rounds. Differences in opportunity costs for the seller associated with the first three bargaining rounds of the 3M and 5M markets are illustrated in table 3. The opportunity cost of not trading in round one of the 3M market is the difference between prices in the first and second rounds or 2.21 tokens. The opportunity cost of not trading in the second round is the difference between prices in round two and prices in round three – about 5 tokens. By comparison, in the 5M market, there is a positive change in prices from rounds one and two (1.79) and from rounds two to three (0.55). The opportunity costs to sellers of not trading in the earlier rounds, however, become quite high by the latter two rounds in the 5M, 2B5M and 2S5M treatments and the last round of the 3M treatment.

So, why do buyers trade during these earlier rounds? It is because they face matching risk and run the risk of losing gains from trade if they are matched with a seller out of inventory in latter rounds. But if buyers can reduce matching risk, for example through increased consolidation, they can gain market power, lending support for Proposition 3. On the other hand, spot sellers do not appear to gain market power through reduced matching risk in a seller concentrated market. Prices are no different in the 2S5M and 5M treatments, even with reduced production/trades in the concentrated seller market.

Earnings

Overall, buyers fare better than sellers in private negotiation trading with spot delivery (table 2). Buyer earnings are not significantly different from the predicted competitive level of 150 tokens in both the 5M and 3M treatments. Seller earnings are 22.55 and 52.27 tokens below the competitive level in these two treatments, respectively, but improve with additional matches and the concurrent reduction in matching risk. The buyer concentrated market yields earnings for buyers almost 2.33 times that of the competitive level and about 80% of the total monopsony surplus (440 tokens). Sellers earn about 53% more than the predicted level of 150 tokens in the seller concentrated 2S5M market and slightly more than 50% of the total monopoly surplus. Seller earnings are severely impacted in the 2B5M treatment, with earnings less than half that expected in the competitive market. Buyer earnings, in contrast, are about 33 tokens below the predicted competitive norm in the seller concentrated market. This result is due to increased matching risk faced by buyers in the seller concentrated market and its

influence on monopoly power. In the presence of advance production risk, consolidated sellers cannot achieve the earnings that are on par with those of buyers in a concentrated market. Matching risk resulting from consolidated buyers severely impacts seller earnings in private negotiation trading with advance production.

Total surplus is significantly below the competitive level for each of the treatments. The greatest losses in surplus (deadweight loss) are in the concentrated buyer and seller markets, followed by the 3M treatment. Increasing matching risk, whether for the buyer or seller, results in lower market efficiency, as measured by total surplus. Increased matching opportunities in private negotiation trading, as in the 5M treatment, moves total surplus closer to the competitive level.

Conclusions

This study investigates matching and inventory loss risks as potential facilitators of market power in private negotiation trading. A laboratory market approach is used, in order to create a controlled environment in which to study matching risk when sellers also face the risk of inventory loss from advance production. It is argued that the latter is common in food markets, due to the perishable characteristic of agricultural and food products, along with advance production. That is, production costs are sunk prior to negotiations for prices; sellers risk losing these costs if the product is not sold.

Both buyers and sellers can face matching risk in private negotiation trading, when the number of matches is limited. This risk is not present in auction or centralized trading, because all buyers and sellers make bids and offers simultaneously, as in a double auction. As the number of matching opportunities increases in private negotiation

trading, however, matching risk is reduced or eliminated; market outcomes move toward the predicted competitive results.

A market, such as the food market, that is evolving from public auctions toward more private negotiation can reduce the chances for buyers and sellers to match for exchange. Increased buyer or seller consolidation increases the potential for matching risk for sellers and buyers, respectively. Matching risk alone does not impact the bargaining advantage of one side of the market or other in negotiating prices (Menkhaus et al.). When sellers face both matching and advance production risks, however, the bargaining advantage and market power shifts to the buyer. The greater the matching risk faced by sellers in private negotiation spot markets, the greater the market power advantage to buyers. Further, spot delivery of a perishable product keeps buyers from losing bargaining power, even when they face increased matching risk in a seller concentrated market. Advance production risk, combined with matching risk, places the seller in a disadvantaged bargaining position relative to buyers.

While not the specific focus of this research, it is not surprising that sellers are eager to enter into vertical relations with buyers to avoid matching and advance production risks in private negotiation spot markets. These arrangements, of course, are often beneficial to both buyers and sellers in reducing transaction costs, such as searching costs. Nevertheless, the results of this study suggest the buyer has the advantage in specifying the terms of the vertical relations, when the seller faces matching and inventory loss risks.

The results of experiments conducted in this study suggest that buyers in a

concentrated market with private negotiation trading and spot delivery can exercise market power and extract monopsony rent. Prices are about 23% below the predicted competitive equilibrium and close to the monopsony price level. These lower prices are the result of tacit coordination enjoyed by buyers resulting from matching risk and inventory loss risk from advance production faced by sellers, rather than collusive activities. The seller in a seller concentrated market is not as successful in extracting monopoly rent, although the price level is higher than in a matching risk environment. Current policy does not forbid concentrated markets, as long as efficiencies are perceived and outright collusive behavior is not observed. Agricultural producers, under current regulations, can benefit by creating alliances or cooperatives to increase their bargaining position for price and reduce matching risk. Inventory loss risk, however, prevents consolidated sellers from taking full advantage of such structural arrangements.

Finally, in this study we have given added risk to the seller in the form of inventory loss risk. While we believe agricultural producers typically bear relatively more risk than processors of agricultural products, processors also can face related risks, such as filling plant capacities. In such cases, the bargaining advantage of the buyer/processor would be dampened, relative to those found and reported in this study. The relative risks faced by buyers and sellers is a strong facilitator of market power, particularly in concentrated markets.

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Table 1. Unit Buyer Redemption Values and Seller Costs (Tokens) Used in the Experiments

Unit	Redemption Value for Buyers	Cost for Sellers
1	130	30
2	120	40
3	110	50
4	100	60
5	90	70
6	80	80
7	70	90
8	60	100

Table 2. Estimated Coefficients (Standard Errors) – Convergence Models for Quantities Traded, Trade Prices, Buyer Earnings, Seller Earnings and Total Surpluses by Treatment

Treatment Asymptotes	Quantities Traded	Trade Prices	Buyer Earnings	Seller Earnings	Total Surpluses
Competitive Equilibrium	20	80	150	150	1200
5M	-2.72*a (0.29)	-2.36*a (0.77)	-2.30a (3.22)	-22.55*a (3.35)	-105.57*a (4.51)
3M	-5.39*b (0.20)	-7.06*b (0.72)	3.24a (2.15)	-52.27*b (3.54)	-191.35*b (12.91)
2B5M	-7.26*c (0.16)	-17.58*c (0.80)	198.93*b (4.47)	-86.64*c (1.89)	-253.42*c (7.75)
2S5M	-6.77*c (0.18)	-0.96a (1.24)	-33.38*c (4.28)	80.13*d (10.61)	-270.04*c (9.25)
Treatment Starting Levels	Quantities Traded	Trade Prices	Buyer Earnings	Seller Earnings	Total Surpluses
Competitive Equilibrium	20	80	150	150	1200
5M	-1.07a (0.86)	-16.47*c (2.03)	67.64*a (9.65)	-84.27*a (9.11)	-77.24*a (14.75)
3M	-4.98*b (0.62)	-9.98*b (1.41)	22.25*b (6.07)	-73.26*a (9.53)	-231.54*b (37.97)
2B5M	-6.27*b (0.53)	-9.16*b (1.80)	191.66*c (14.16)	-71.21*a (4.51)	-214.18*b (25.65)
2S5M	-4.99*b (0.53)	-11.39*ab (3.13)	19.85b (11.22)	32.45b (23.20)	-203.25*b (26.83)
R ²	0.99	0.99	0.99	0.99	0.99

*Estimated Convergence/Starting Level significantly different from the competitive equilibrium or base value, $\alpha = 0.01$.

a, b, c, d – Same letter indicates no significant difference between estimated convergence or starting levels in the respective equations. Different letters indicate a significant difference between estimated asymptotes or starting levels, $\alpha = 0.01$.

Table 3. Percentage of Trades and Average Prices for Each Bargaining Round by Treatment – Periods 16 -20

Treatment 5M					
	Round 1	Round 2	Round 3	Round 4	Round 5
Percentage of Trades	37.98%	22.87%	20.54%	7.75%	10.85%
Average Price	78.58	80.37	80.92	77.20	66.75
Treatment 3M					
	Round 1	Round 2	Round 3		
Percentage of Trades	38.18%	35.45%	26.36%		
Average Price	76.58	74.37	69.36		
Treatment 2B5M					
	Round 1	Round 2	Round 3	Round 4	Round 5
Percentage of Trades	31.27%	28.57%	17.99%	13.76%	8.47%
Average Price	66.02	65.30	65.82	63.46	54.13
Treatment 2S5M					
	Round 1	Round 2	Round 3	Round 4	Round 5
Percentage of Trades	27.61%	25.15%	15.95%	15.95%	15.34%
Average Price	78.51	82.51	85.12	80.46	70.28