Sorry, No CODs: An Experimental Investigation of Sequential Trade

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Abstract: The trust game is used as a model of sequential trade. In this game it is the seller who must trust the buyer, but many naturally occurring transactions are structured such that buyers must trust sellers to complete trades upon receipt of payment. This subtle difference is significant as the experimental evidence presented in this paper indicates that sellers are more likely to complete the transaction. Surprisingly, buyers are substantially less trusting, but additional experiments indicate this lack of trust is due to buyer concern that sellers will accept a payoff that is smaller than the buyer’s payoff when the price divides the gains from trade equally.

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As evidenced by the fact that virtually every principles book begins with a discussion of comparative advantage and exchange, economics holds that trade improves the welfare of both parties. But trading requires each party to forego something of value and therefore if the trade is not completed at least one party is made worse. Trade is typically organized as follows. Person 1 gives item A to person 2. Upon receipt of item A, person 2 gives item B to person 1. When agents decide to enter a trade, they are weighing the gain from a successful trade against the loss from an unsuccessful trade. This is true even after the price (or relative amounts of what is to be traded) has been determined, although the price clearly impacts both the size of the gain or loss and may affect the likelihood that a trade is ultimately successful. The risk for person 1, is that upon receipt of item A, person 2 does not provide item B.

1 The author wishes to thank Mary Rigdon for helpful comments. Support from the Center for Retailing Excellence at the Sam M. Walton College of Business is greatly acknowledged.
Institutions such as the legal system and escrow accounts are designed to guard against such failures. Online auction houses, where one might expect fraud and failed trades among anonymous parties to be prevalent, use reputation mechanisms in an attempt to increase the likelihood that trades are successful. But in many situations such institutions are not available or are impractical. For example, the cost of legal fees makes it unlikely that an unhappy buyer would take a dispute over a $5 item to court. In cases where there is no external enforcement, the first party must trust the second party or else there will not be trade and a socially sub-optimal outcome is realized. Disappointingly, the standard self-interested model would suggest that the second mover would not complete the trade and, anticipating this, the first mover should not attempt to trade. Fortunately, casual observation of the naturally occurring world and controlled laboratory experiments do not support that conclusion.

Most laboratory experiments on trading and markets have external enforcement. That is, once the parties agree to a trade, the contract is enforced by the experimenter. An exception to this is the trust game of McCabe and Smith (2000), McCabe, Rigdon and Smith (2003) and Cox and Deck (2005). While not framed to subjects as a trade, as described by Coricelli, McCabe and Smith (2000) this game represents a basic model of personal exchange. In this stylized game, it is the seller that initiates trade and has to bear the risk. However, casual observation of the naturally occurring world suggests that it is often the buyer who is exposed to a risk as sellers typically demand payment before delivery. While trade can be initiated be either party, the difference in initiator is potentially very important. This paper reports experiments that examine how the role of the first mover (either buyer or seller) impacts the likelihood that a trade is attempted and ultimately completed in the absence of external enforcement.

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2 Brown, Falk and Fehr (2004) examine how enforceable contracts affect behavior experimental labor markets that have a structure similar to the trust game (see also Falk, Gächter and Kovács 1999 and Rigdon 2002). Another exception is Crockett, Smith and Wilson (2006) who examine how markets, specialization, and trade arise endogenously.

3 As described by McCabe and Smith (2000), the trust game is based on the investment game of Berg, Dickhaut and McCabe (1995).
The next section describes in detail the extensive form game as a model of trade. Another section provides details of the experimental design and the results. As a prelude to the results, conditional on a trade being initiated, a seller is more likely than a buyer to complete a trade; however, buyers are less likely to initiate trades. The second statement is surprising when compared to previous results. An additional series of experiments designed to reconcile this discrepancy is reported in a separate section and a final section contains concluding remarks.

The Model of Trade

The left panel of Figure 1 shows the trust game of McCabe and Smith (2000) and Cox and Deck (2005).4 The first mover has the option to not engage the second mover in which case the first mover receives $10 and the second mover receives $10. Alternatively, the first mover can trust the second mover and allow her to select the outcome. In this case the second mover can select to keep all of the larger surplus of $40 and leave $0 for the first mover or the second mover can share by giving $15 to the first mover and keeping $25 for herself. Both the cited studies of this game found that approximately half of the first movers trusted and about three fourths of second movers shared the larger surplus when subjects received payments directly from the experimenters. A key feature of this game is that once the first mover trusts, all of the gains are realized. The second mover’s decision is simply a transfer payment from the second mover to the first mover.

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4 McCabe, Rigdon and Smith (2003) use a different game that is better described as trading two goods rather than trading one good for money.
For a trade, both the buyer and the seller have some initial endowment, denoted $\omega_B$ and $\omega_S$ respectively.\textsuperscript{5} If neither party attempts to trade, then the final payoffs would equal the endowments. If a trade is completed the seller’s payoff is $\omega_S - c + p$ where $c$ denotes the cost of producing the good and $p$ is the price of the good. The buyer’s payoff from a successful trade would be $\omega_B - p + v$, where $v$ is the value of the good. The gains from the trade would thus be $[(\omega_S - c + p) + (\omega_B - p + v)] - (\omega_B + \omega_S) = v - c$. For both parties to be willing to trade it must be that $p - c > 0$ and $v - p > 0$, which implies that the gains from trade are positive. A failed trade can occur in one of two ways. If a buyer initiates a trade but the seller does not send the good, the payoff to the buyer is $\omega_B - p$ and the payoff to the seller is $\omega_S + p$. In this case the total surplus is identical to the no trade outcome, $[(\omega_B - p) + (\omega_S + p)] = (\omega_B + \omega_S)$. However, if it is the seller that initiates a failed trade then the buyer’s payoff is $\omega_B + v$ and the seller’s payoff is $\omega_S - c$. The total surplus in this case is identical to the surplus in a successful trade $[(\omega_B + v) + (\omega_S - c)] = v - c$. Figure 2 presents the extensive form representation of these two games.

For convenience, the games are identified by the role of the first mover. Therefore, the buyer game refers to a game in which the buyer sends money before the seller sends the good.

\textsuperscript{5} If the parties did not have an endowment, they would not have anything to offer in trade.
As stated previously, in the trust game the second mover decision only affects the allocation of the payoffs and not the level of the combined payoffs, just as in the seller game. In fact, comparing Figures 1 and 2, it is clear that the trust game is a seller game with the following parameter values: $\omega_S = 10$, $\omega_B = 10$, $c = 10$, $v = 30$, and $p = 15$. If the order was reversed so that it was a buyer game, the game would appear as in the right panel of Figure 1.

That gains are made only when the seller sends the good means that the decision faced by a buyer in the seller game and a seller in the buyer game are very different. A second mover buyer gives up $p$ to increase the other player’s payoff by $p$. That is, it costs the buyer $1$ to give the other person $1$. But in the buyer game, it costs the seller $c$ to give the buyer $v$. That is, it costs the seller $1$ to give the buyer $v/c > 1$. Recent dictator game experiments by Andreoni and Vesterlund (2001) highlight the significance of this difference.

In the standard dictator game, the dictator is endowed with some amount of money. The dictator can then determine how much of the money to keep and how much to give to the recipient. In dictator games as well as the regular trust game, it is not uncommon to observe people willing to forego their own payoff to increase someone else’s payoff. Andreoni and Vesterlund (2001) conducted a series of dictator game experiments in
which the dictator and the recipient had differential exchange rates. At one extreme, when the dictator reduced her payoff by $1, the recipient received $0.33. At the other extreme, when the dictator reduced her payoff by $1 the recipient received $3. What Andreoni and Vesterlund (2001) found was that dictators gave more the more recipients received per foregone dollar. An alternative way to state this result is that as the cost of giving the recipient $1 decreased, dictator gave more. These results suggest that sellers would be more likely than buyers to complete a trade since a buyer’s payment is a transfer whereas a seller’s delivery of the good actually creates value. This could explain why we observe many naturally occurring markets organized in such a way that buyers move first. This also suggests that for modeling trade, it may be more appropriate to use the buyer game instead of the seller game.6

Experimental Design and Results

Groups of between eight and fourteen subjects were recruited for a one hour experiment from undergraduate business and economics courses. In each session, the subjects were seated at individual computer terminals which were separated by privacy dividers. After reading computerized directions each subject completed a brief comprehension handout. While the subjects were reading the directions, the experimenter handed each participant the $5 show-up fee that was promised during the recruiting process. After all subjects completed the handout, an additional set of paper directions was distributed explaining the double-blind payoff procedure that would be used for maintaining the anonymity of the decision-makers. While these additional directions were being read aloud, the subjects were able to select one of several identical sealed envelopes containing mailbox keys with which the subjects would later be able to retrieve their payoff with privacy.7 After the experimenter left the room, subjects opened their envelopes, entered their secret identification codes, and were shown the “decision-tree.”8 Subjects played one one-shot game in only one role. Second movers only made decisions if the first mover attempted

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6 This is not to suggest that the seller / trust game are uninformative or inappropriate for certain uses.
7 The computerized directions, comprehension handout, and double blind procedures are identical to those used by Cox and Deck (2005, 2006a, 2006b). Copies are available upon request.
to trade. That is, the game was sequential and did not use the strategy method. After all of the payoffs had been determined, cash was placed in plain white envelopes which were then inserted into the mailboxes that were in a separate room just down the hallway from the laboratory. The entire experiment lasted approximately 30 minutes.

While McCabe and Smith (2005) and Cox and Deck (2005) report trust game experiments in which 75% of second movers, the buyers, cooperate, those experiments utilize single blind payoff procedures where subjects collect their payments in person from the experimenter. However, Cox and Deck (2005) also demonstrate that with the same payoffs, only about 25% of second movers, the buyers, cooperate when payoffs are double blind. The numbers beside each branch of the trust game in Figure 1 are from the double blind experiments of Cox and Deck (2005). Naturally occurring markets vary with respect to the anonymity of the participants and thus the appropriate payoff procedures are not clear. But given that the purpose of this research is to determine if having buyers move first increases the percentage of trades that are successfully completed, double blind procedures provide a more stringent test. It should be noted that the dictator games of Andreoni and Vesterlund (2001) use single blind payoff procedures. Hoffman, McCabe, Shachat and Smith (1994) examine dictator games with double blind payoff procedures and find greater material self-interest than when single blind procedures are implemented. Therefore it is not clear if the result of Andreoni and Vesterlund (2001) is applicable in a double blind environment. For example, it could be that subjects do not want to appear to the experimenter as being so selfish that they would not pay $1 to give someone else $3.

A natural place to begin examining the effect of trader order is to reverse the order of the original trust game. This is presented in the right hand panel of Figure 1. An obvious problem arises in that the possibility that the first mover loses money is present in this game. If the experimenter cannot extract a loss from a subject, then the experimenter loses control over the incentives. In particular, the $5 loss is no better or worse than a

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Neutral terms were used throughout the experiment. Extensive form games were referred to as decision-trees. No mention was made of buyers, sellers, trade, etc.
payoff of $0 or a loss of $1 million. The typical method of handling the possibility of losses is to endow subjects with a positive balance from which losses are deducted. Creating such a balance essentially adds some constant term to all of the subject’s payoffs. But doing this to the reversed trust game would necessitate doing the same to the trust game as well, which would make the game different from what is presented in the left hand panel of Figure 1. Hence, one cannot simply reverse the order of players and compare the results to previous work.

There are two interesting features of the trust game. One is that the two endowments are identical; if no trade is attempted both parties receive $10. Another interesting feature is that trusting exposes the first mover to the possibility of receiving a $0 payoff. Unfortunately, it is not possible to maintain both of these features in the seller and buyer games in such a way that provides the seller an incentive to trade. The payoff to a seller that attempts an unsuccessful trade is \( \omega_S - c \), while the payoff to a buyer who attempts an unsuccessful trade is \( \omega_B - p \). Assuming identical endowments, theses two payoffs are equal only if \( p = c \), which would mean that the seller gains nothing from a successful trade. As the focus of this research is on second mover behavior, the buyer and seller games both retain the possibility of the second mover leaving the first mover $0.

The following parameters were chosen for the experiments: \( \omega_S = 5, \omega_B = 10, c = 5, v = 15 \), and \( p = 10 \). The seller and buyer games with these values are shown in Figure 3. The parameters are based in part on the half payoff treatments of Cox and Deck (2005, 2006b). The value and cost numbers are exactly half of the original trust game. The endowments were set such that the first mover was exposed to the possibility of earning $0, which for the seller meant halving the endowment from the original trust game. But this necessitates that the buyer’s endowment equals the price. The price of $10 divides the gains from trade evenly between the buyer and seller whereas the price of $15 in the original trust game allocated 75% of the gains to the second mover buyer. In each
laboratory session, some subjects were making decisions in the seller game and some were making decisions in the buyer game.\footnote{In the initial sessions, approximately half of the participants were playing each game. But difference in the trusting rate made it such that very little data were being collected on second movers in the buyer game. To enable more observations of second mover sellers, relatively more buyer games were run in later sessions. The next section describes a third game that was used in later sessions to explore why observed behavior in the buyer game differed so dramatically from previous experiments.}

![Experimental Seller (left) and Buyer (right) games](image)

Figure 3. Experimental Seller (left) and Buyer (right) games

The results are based upon 102 subject pairs playing one of the games of interest, collected from 24 distinct experimental sessions. The number of subjects making each decision is reported beside that branch in Figure 3.

In the seller game, 55\% percent of sellers attempted to trade. In response, 30\% of the buyers opted to complete the trade. These numbers are statistically similar to the 52\% trust rate and 29\% cooperation rate reported by Cox and Deck (2005) for double blind payoffs (p-values of 0.7704 and 0.9283 based upon the 2-sample proportion test for equal proportions against the two sided alternative).

In the buyer game, 53\% of sellers completed a trade when given the opportunity. This is in the direction expected based upon the results of Andreoni and Vesterlund (2001) and is marginally statistically significant (p-value of 0.0783 based upon the 2-sample proportion test for equal proportions against the one sided alternative that cooperation is greater in
the buyer game). This increase in cooperation from switching the order occurs despite the fact that payoffs are double-blind. What is perplexing regarding the buyer game is that buyers are statistically less likely to attempt to engage in trade than sellers are when making the first move, 26% versus 56% (p-value of 0.0028 based upon the 2-sample proportion test for equal proportions against the two sided alternative).

Given the observed likelihood of a trade being completed, first mover buyers expect to receive $7.95 from trusting ($15 \times 0.53 + $0 \times 0.47$) as opposed to $10 from not trusting, so their choice to not trust is justified. But first mover sellers expect to receive $3 from trusting ($10 \times 0.3 + $0 \times 0.7$) as compared to $5 from not trusting and trust anyway. Unfounded trust was also noted by Cox and Deck (2005), who reported approximately half of first movers trusted in a variety of treatments.\textsuperscript{10}

**Further Exploration of Behavior in the Buyer Game**

In comparing the buyer game with the trust game one notices that the payoffs to the first mover are identical. The games differ only in the payoffs of to second mover. Despite this fact, first mover behavior is significantly different between the two games (p-value of 0.0154 based upon the 2-sample proportion test for equal proportions against the two sided alternative). Clearly the first movers are responding to the payoffs of the second mover. How do the payoffs of the second move differ? First, the endowments favor the first mover in the buyer game, but not in the trust game. Secondly, the mutually beneficial outcome favors the first mover in buyer game but favors the second mover in the trust game. This suggests two possible explanations for the first mover behavior, one is a desire to beat the other person and the other is a fear that the other player will not be willing to lose.

\textsuperscript{10}Cox and Deck (2006a) introduce a treatment in which there is a random chance that the first mover’s decision in the trust game will be reversed. They find that this lowers the level of trust observed and conclude that this is due to first mover’s not anticipating that second movers will give them the benefit of the doubt.
Some researchers have argued that people exhibit inequality averse preferences (see Fehr and Schmidt 1999 and Bolton and Ockenfels 2000), but the experimental evidence is mixed at best (see Deck 2001 and Engleman and Strobel 2004). Here the prediction of such models would depend on the specific form of the model and the value of its parameters. But for a buyer to trust, the buyer must believe that the seller is sufficiently likely to accept an unequal split that favors the buyer.\textsuperscript{11} Experiments on mini-ultimatum games by Güth, Huck, and Müller (2001) provide some insight on this issue. The ultimatum game is similar to a dictator game except that the recipient has the option to reject the proposed allocation in which case both parties receive $0. In a mini-ultimatum game, the first mover has only two possible divisions from which to choose. In Güth et al. (2001), first movers always had the lopsided proposal to keep an 85% share, but the more equitable proposal varied among keeping 55%, 50%, and 45% shares. They observed that even these small deviation from an equal split changed first mover behavior. When the equal split was possible, 44% of first movers asked for 85% share but when the more equitable option retained only a 45% share, 67% of first movers asked for the 85% share. These results would suggest that sellers would be less likely to cooperate. Anticipating this behavior, first mover buyers would be less likely to trade. But, as reported in the previous sections sellers are actually more likely to complete the trade due to both the relative cost of generosity and the fact that the seller’s decision is not made in isolation but rather in response to the first mover’s action.

To determine what accounts for the dramatic decrease in trust observed in the buyer game, additional experiments were conducted with game x; so named because it is constructed from the buyer game and the original trust game and is not based upon some underlying story. The first mover has the same outside option as in the buyer game, but trusting gives the second mover the same choice as in the trust game. Game x is presented in Figure 4. Notice that all three games have the identical payoffs for the first mover and only differ in the second mover’s payoffs. The only difference between game x and the trust game is that the second mover’s no interaction outcome is smaller in game

\textsuperscript{11} A buyer could have an extreme form of other regarding preferences or a desire to reach the highest social payoff. However, the dictator control treatment of Cox and Deck (2005) indicates that this is unlikely.
Therefore, a trusting action in game x appears to be at least as nice as in the trust game. The difference between the buyer game and game x is that the jointly beneficial outcome has increased by 15 for the second mover while the selfish outcome has increased by 25. Based upon the previous results, one would expect this to make second movers more likely to defect in game x relative to the buyer game.

Figure 4. Comparison of Trust (left), X (center), and Buyer (right) games

The numbers beside each branch of Figure 4 indicate the number of subjects making each choice. The 26 subject pairs in this treatment were part of the groups of 8 to 14 subjects in the lab starting with session 14. Behavior in game x is very similar to the seller game and the results of Cox and Deck (2005). There is no statistical difference for first movers or second movers between the trust game and game x (p-values of 0.6783 and 0.8378 respectively based upon the 2-sample proportion test for equal proportions against the two sided alternative). It is interesting to note that second movers nominally defect more often in game x in which the first mover’s decision to trust is at least as nice, a similar pattern to what is reported in Deck (2001). However, first mover behavior in game x is different from what was observed in the buyer game (p-value of 0.0580 based upon the 2-sample proportion test for equal proportions against the two sided alternative). Consistent with the previous results, second movers were more likely to defect in game x relative to the buyer game (p-values of 0.0662 based upon the 2-sample proportion test for equal proportions against the one sided alternative).
The results of the game x experiments indicate that is not the desire to have the larger share of the total payoff that is influencing first mover buyers, but rather a fear that second mover sellers will be unwilling to accept a smaller share.

Conclusions

In the absence of perfect contract enforcement, trade is a risky endeavor. The first mover gives up something of value anticipating that the second mover will complete the trade by returning something of greater value. While this general pattern is true regardless of which party goes first, the ordering has a subtle effect on the game. When the seller moves first all of the gains from trade are realized whether or not the buyer comes through with payment. However, when the buyer moves first gains are not realized until the trade is completed. It is second movers that have the ability to defect. A second mover buyer is making a one for one transfer while a second mover seller is making a one for more than one transfer. Consistent with previous experimental work, the relative cost of giving matters. Sellers are more likely to complete a trade than buyers are. Therefore, one would except to see naturally occurring markets in which buyers are told “Sorry, no CODs.”

Surprisingly, even though sellers were more likely to complete trades, completed trades occurred in 17% of the pairings in which sellers moved first and only 14% of pairings in which buyers moved first. This is due to the unwillingness of first mover buyers to attempt a trade. This aversion by buyers is caused by their fear that sellers will be unwilling to accept receiving a smaller payoff than the buyers and thus will defect on the trade. In these experiments the market price is set so that the gains from trade are shared equally between the buyer and seller. In naturally occurring markets the price is endogenous and in part reflects the risk assumed by the first mover. A lower price might induce more buyers to trade, but at the same time a higher price gives more surplus to the seller which could alleviate a buyer’s concerns about the likelihood of seller defection. But that is beyond the scope of the current paper.
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