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EXPORTER COOPERATION IN THE  
INTERNATIONAL WHEAT MARKET:  
AN ANALYSIS INVOLVING EXPERIMENTAL ECONOMICS

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Wheat Trade

## EXPORTER COOPERATION IN THE INTERNATIONAL WHEAT MARKET:

### AN ANALYSIS INVOLVING EXPERIMENTAL ECONOMICS

#### THE INTERNATIONAL WHEAT MARKET

The international wheat market is one which is characterized by a few large sellers facing a few large buyers plus a competitive fringe. Five countries (United States, Canada, Australia, Argentina and France) account for 90 percent of world wheat exports while five trading blocs (EC-9, USSR, China, Eastern Europe and Japan) account for 40 percent of world imports.

The structure of this market has been described, at various times, as duopolistic, triopolistic, competitive or monopsonistic. For the period 1956-1965 the world wheat market was characterized as a duopoly [McCalla, 1966]. In this model Canada behaved as the price leader, with the United States acting as a price follower. The demand side was assumed to behave competitively. The price wars of 1965 and 1968 led McCalla [1970] to later argue that his duopoly model was no longer relevant. Australia had been growing in importance as an exporter during the 1960's and was cutting deeply into the duopolists' market shares. This precipitated the price wars and, as Alaouze, Watson and Sturgess (AWS) [1978] argue, Australia was forced to accept a new role as the third member of a triopoly.

Beginning in 1972, the world wheat market moved rapidly from a situation of glut to one of very short supplies and high prices. Exporters were no longer intent on propping up prices and according to AWS the market became essentially competitive. By 1976, AWS argued that the triopoly was showing signs of being re-established.

In a recent paper, Carter and Schmitz [1979] put forward a radically different view of the international wheat market. They argued that the world wheat market is a buyers' market and postulated that large importers exercised market power by the application of an optimum, or near optimum, tariff. Large importers like the European Community and Japan were represented as monopsony buyers.

In this brief review of past models of the world wheat trade we see a tradition of researchers attempting to explain market behavior primarily in terms of an oligopoly or a monopsony structure. These models appear to be a reflection of practical efforts made at exporter cooperation in the grain trade itself. The theoretical oligopoly models appear to have been attempts to explain the basis for exporter cooperation. On the other hand, the monopsony model appears to have been an attempt to justify exporter cooperation (i.e., to offset monopsony power).

The purpose of this paper is to explore the alternative forms of seller cooperation from the viewpoint of their ability to raise the negotiated price. We focus on two specific approaches to cooperation, construct a laboratory market, and test for significant differences in price outcomes between these two approaches and a control experiment in which no cooperation is permitted.

#### EXPORTER COOPERATION

Initially, four alternative forms of exporter cooperation were considered for analysis. The first form is the international commodity agreement. We have had considerable experience with such agreements in the case of wheat. The agreements from 1933 to 1971 went through a number of phases with the main emphasis on establishing maximum and

minimum prices, that is, stabilizing international prices. As such, they attempted not only to achieve cooperation among exporters but also to achieve cooperation between exporters and importers. The agreements worked well so long as the price limits were not tested. In 1968, as a result of the price limits being raised and the presence of very large world wheat stocks, the lower price limit was tested, and the agreement collapsed. The use of international agreements as a means to influence price outcomes for wheat has not been revived.

The second form of exporter cooperation is the tacit price-leading oligopoly. This was first proposed by McCalla [1966] as a duopoly between Canada and the United States and subsequently by Alaouze, Watson and Sturgess [1978] as a triopoly involving Canada, the United States and Australia. More recently, Carter and Schmitz [1979] have thrown some doubt on the ability of the exporters to exert the necessary market power suggested by this form of cooperation.

In 1972 a major event occurred in the international wheat market which raised the call for a third form of exporter cooperation, namely, the exchange of sales information among the major exporters. The event was the so-called "Great Grain Robbery" perpetrated by the U.S.S.R. A disastrous crop harvest in the U.S.S.R. coupled with a dramatic shift in Soviet trade policy to protect its domestic livestock industry resulted in the Soviets becoming a major wheat importer. The Soviet Union was able to negotiate large purchases at low prices by dealing with each major exporter in isolation. No seller was aware of the deals being struck with other sellers because the Soviet representatives had requested each seller not to reveal his sales. Most sellers were happy to comply since they were, at the time, in a short position and welcomed

secrecy to give them time to cover their positions. It has been suggested that exchanging sales information could have prevented the "Robbery".

Some economists have recommended a fourth type of exporter cooperation, namely, a grain export cartel. This form of cooperation has been promoted in a recent book by Schmitz et al. [1981]. The authors suggest that the world grain market is frequently a buyer's rather than a seller's market, and that importers have been able to exert monopsony (buying) power in trade, resulting in export instability. An export cartel could, in their view, provide large gains to the major exporting nations.

As we look to the future, the above discussion suggests a number of possible stances which wheat exporters may consider when facing a buyer's market. In this paper, we analyze three possible stances:

- (a) The major exporters continue to negotiate with the buyer in isolation.
- (b) The major exporters agree to exchange sales information with each other.
- (c) The major exporters form an export cartel.

Other stances are also possible. For example, the old idea of an international wheat agreement could be resurrected, although in a buyers' market it is difficult to see why importers would be willing to enter such an agreement. Even if such an agreement could be negotiated, past experience would suggest that it has little chance of significantly supporting world wheat prices. Using (a) as a benchmark we want to discover whether (b) and/or (c) can be successful in significantly raising prices.

## EXPERIMENTAL DESIGN

The research methodology used to conduct the analysis is experimental economics. A market with a predetermined structure is created in a laboratory experiment, using volunteers as market participants. The rules of the market are varied according to the three proposed seller stances in three separate trials. The impact of these rule changes on the price-quantity outcomes are then observed.

In constructing the market we wanted to incorporate the "essence", as we saw it, of the international wheat market (a buyer's market with few sellers). We were concerned to strip away details that would unnecessarily complicate the market. We discovered very early the desirability of keeping the market rules as simple and straightforward as possible. (See, for example Fouraker and Seigel [1960]). This tends to remove variation in the results which arises from confusion among participants.

The structure of the market is represented graphically in Figure 1. There are three sellers who have 10, 20 and 30 units, respectively, of a commodity to sell. We used different-sized sellers in order to test whether size led to significant difference in price outcomes between sellers. The aggregate supply curve is assumed to be horizontal at a price of \$20 per unit until the aggregate quantity of 60 units is attained. The aggregate supply curve is represented in Figure 1 as SCS'. The three sellers face a single buyer whose demand curve is DD'. Points A, B and C represent particular price-quantity outcomes that might be predicted by varying assumptions concerning buyer-seller behaviour. Thus, point A would be predicted in a market situation where the sellers behave collectively as a monopolist maximizing their joint

profits, while the buyer behaves passively as a price taker. Point C would be predicted in a market situation in which the sellers behaved as price takers while the buyer behaved as a monopsonist maximizing his surplus. Point B would be predicted in a market situation in which sellers and buyer all behaved as price takers (i.e. the competitive solution). Points along the line segment BC represent possible bilateral monopoly solutions in which buyer and sellers agree to maximize joint profits. When the market experiment is run, and allowing adequate opportunity for negotiation, we would expect price-quantity outcomes to lie along the line segment ABC.

To analyze the three different seller stances we ran the experiment under three different sets of rules. They were as follows:

- (1) The three sellers negotiate separately with the buyer. The sellers are unable to communicate with each other in any way; neither exchanging sales information, nor discussing collusion.
- (2) The three sellers negotiate separately with the buyer but sales information is exchanged. All offers and bids are made known to all sellers as soon as they are made. The buyer is not informed that such an exchange of information is taking place.
- (3) The three sellers sit together and have the opportunity to discuss the prospective offers to be made and the bids as they arrive. The buyer is not informed that such seller cooperation is permitted.

The mechanics of the market experiment are as follows. The above three sets of rules were incorporated in three separate trials. The experiment was conducted with the assistance of 84 University of Saskatchewan student volunteers from the Colleges of Arts and Science

and Agriculture. Each trial included 28 students in seven replicates. Each replicate required 4 students (3 sellers and 1 buyer). When the volunteers arrived they were randomly assigned to their positions as buyer or seller in a particular replicate of a particular trial. Each participant was given a set of materials (see Appendix) which included instructions and a record of offers, bids and trades. Each seller also had a sheet to record his sales and profits. Each buyer also had a profit table showing his net surplus for various price-quantity combinations based on the assumed demand curve. At the conclusion of the experiment the participants received a cash payment based on how much profit/surplus they accumulated during the experiment.

Each experiment involved five trading periods. Each trading period began with the seller making a price-quantity offer. The buyer responded with a price-quantity bid. The seller responded with a second offer and so on. This process of offer and bid continued until a bid (offer) exactly matched the preceding offer (bid). At this point a trade was made. If no trade was achieved by the end of four offers and bids, the trading period ended with no trade recorded. We assumed all unsold quantities were disposed of at cost (i.e. \$20 per unit) so there was no carryover. Each trading period was treated as a completely new game. Each seller had a new quantity to sell—the same quantity as at the start of the first trading period. The buyer had a new set of demands, with the same demand curve as at the start of the first trading period. The reason for having a number of trading periods is to allow for the learning process that necessarily occurs in such experiments.

Through the trading process the buyer and seller learn more about the specific structure and parameters of the market. The price trends



are indicated in Figure 2. In this figure, the prices for each trial in each trading period have been averaged over the three seller types. Prices for trials 1 and 2 appear to be levelling off while for trial 3 they appear to be climbing even after 5 trading periods. This suggests that more trading periods would have been desirable. However, given that we only have the five trading periods it also suggests that the analysis should be conducted only on prices in the 5th trading period.

One interesting result is already apparent from Figure 2. The trial permitting collusion leads to an average price higher than that of the control trial in which no cooperation is permitted. This is as expected. However, the trial involving an exchange of sales information leads to an average price lower than that of the control trial. This is not as expected. Whether or not these differences are significant, in the statistical sense, will depend on the analysis to which we now turn.

#### ANALYSIS

The analysis consists generally of analysis of variance. Average price (averaged over the 7 replicates) for each trial in trading period 5 is shown in the centre of Table 1. In addition, the final column of that table shows averages over seller types for each trial while the final row shows averages over trials for each seller type. Following the strategy for analyzing two-factor models, as outlined in Neter and Wasserman [1974, pp. 588-589], we first examine whether the two factors interact. An overall F test for the presence of any interaction effects yielded an F statistic of 0.28. This statistic may be compared with a critical F value ( $F_c$ ) for the F distribution with 4 and 54 degrees of freedom. At the 5% significance level,  $F_c = 2.5$  and hence we fail to

reject the null hypothesis of no interaction effects. We now test for main effects. There are two possible tests:

- (a) a test that different size sellers receive different prices, and
- (b) a test that sellers in different trials receive different prices.

The appropriate F statistics for the two tests are 1.28 and 3.86, respectively. These statistics may be compared with a critical F value ( $F_c$ ) for the distribution with 2 and 54 degrees of freedom. At the 5% significance level  $F_c = 3.16$ . Hence, we fail to reject the null hypothesis that different sized sellers receive the same price. However, we reject the null hypothesis that sellers in different trials receive the same price. Rejection of this null hypothesis leads us to now question which factor level means are significantly different.

For the purposes of this paper we are particularly interested in testing whether the mean prices for trials 2 and 3 are significantly different from that of the benchmark, trial 1. Hence, we tested only for differences in these means. The appropriate t tests yielded t statistics of -1.95 (trials 1 and 2) and 2.53 (trials 1 and 3). These statistics may be compared with a critical t value ( $t_c$ ) from a t distribution with 40 degrees of freedom. At the 5% significance level and using the two-tail test,  $t_c = 2.02$ . At this significance level the null hypothesis for the first test is accepted. However, at the 5.8% level it would be rejected. Hence, the test is borderline and further experimentation is warranted. If a 10% significance level is adopted one would conclude that sellers in trial 2 achieve a significantly lower price than sellers in trial 1. With regard to the second t test the null hypothesis is rejected at the 5% significance level. Sellers in trial 3 achieve a significantly higher price than sellers in trial 1.

### IMPLICATIONS OF THE RESULTS

The two t tests we have conducted have some interesting implications. The first t test tends to throw cold water on the idea that exchanging sales information may be helpful in raising prices. The test may, in fact, suggest that it had the opposite effect. One possible explanation is as follows. Fouraker and Seigel argued that sellers may behave cooperatively, rivalistically or competitively (i.e., seeking to maximize profits without regard to the impact of its decisions on the other sellers). We suggest that unless the cooperative potential is strong (as in the case of collusion) the latter two types of behaviour will predominate. Such is the case in trials 1 and 2. Considering rivalistic and competitive behaviour, the former may be the stronger tendency when there are few sellers. However, sales information on the other sellers is required for rivalistic behaviour just as much as it is required for cooperative behaviour. Hence the sellers in trial 2 may be behaving rivalistically. The sellers in trial 1 (the control) have no sales information related to the other sellers and so have little choice but to behave competitively.

Notwithstanding these explanations, we should bear in mind that our result is only really valid for the particular experiments conducted. Thus, for example a change in the type of information exchanged (e.g., only on buyer's bids) or in the type of market (e.g., a dynamic market rather than our static one) may lead to very different results.

The second t test establishes statistically that allowing the sellers to collude significantly increases prices. It is interesting to note that the average price in trial 3 in the 5th trading period is very

close to \$40 which is the maximum that the sellers could hope to achieve without restricting supplies. It is quite conceivable that prices would stabilize at this level, given more trading periods. This is because it still allows sellers to sell all they have and they need not be concerned about market share allocation.

#### SUMMARY AND CONCLUSIONS

Two alternative approaches to seller cooperation have been analyzed in this paper. These alternatives are the exchange of sales information among sellers and the formation of a cartel. An experimental market was used to test whether these two alternatives could be found to significantly increase prices. We tested them against a control group of sellers which did not have the benefit of either type of cooperation. We found that, while the formation of a cartel did significantly raise prices in the experimental market, the exchange of sales information did not. In fact, one may conclude (at the 10% significance level) that prices declined relative to those in the control group.

What do these results have to say about the international wheat market? It is important to keep the model and experimental method in perspective. The model is a very simple abstraction of the negotiations process we might expect in the international wheat market. The experiments involve student volunteers, a limited number of replicates, and perhaps an insufficient number of trading periods. We thus interpret the results as suggestive rather than definitive. Thus, as a means of raising prices, our results do not support the idea of exchanging sales information among major wheat exporters, as this may

induce rivalistic rather than cooperative behavior. Our results do support the idea of forming a cartel as a means of raising prices, provided that it does not result in a reduction of market share.

Table 1: Average Prices in 5th trading period, 3 trials

Trial	Seller			Average Over Sellers
	1 (10 units)	2 (20 units)	3 (30 units)	
1	28.14	30.43	36.21	31.59
2	25.57	28.64	28.00	27.40
3	39.18	39.46	41.61	40.08
Average over Trials	30.96	32.84	35.27	33.02

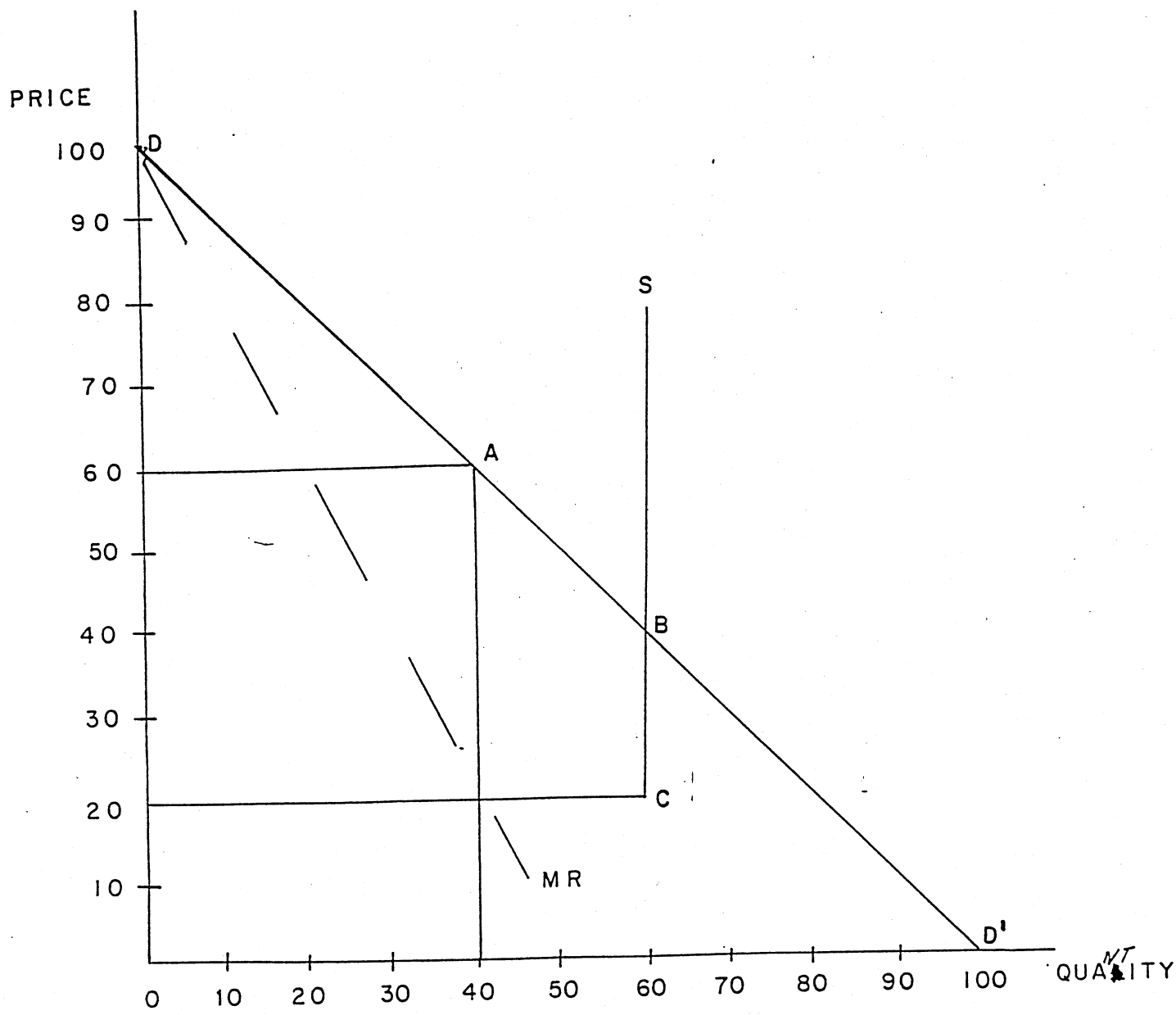


FIGURE 1 : ESTIMATABLE MONOPSONY-OLIGOPOLIST MODEL

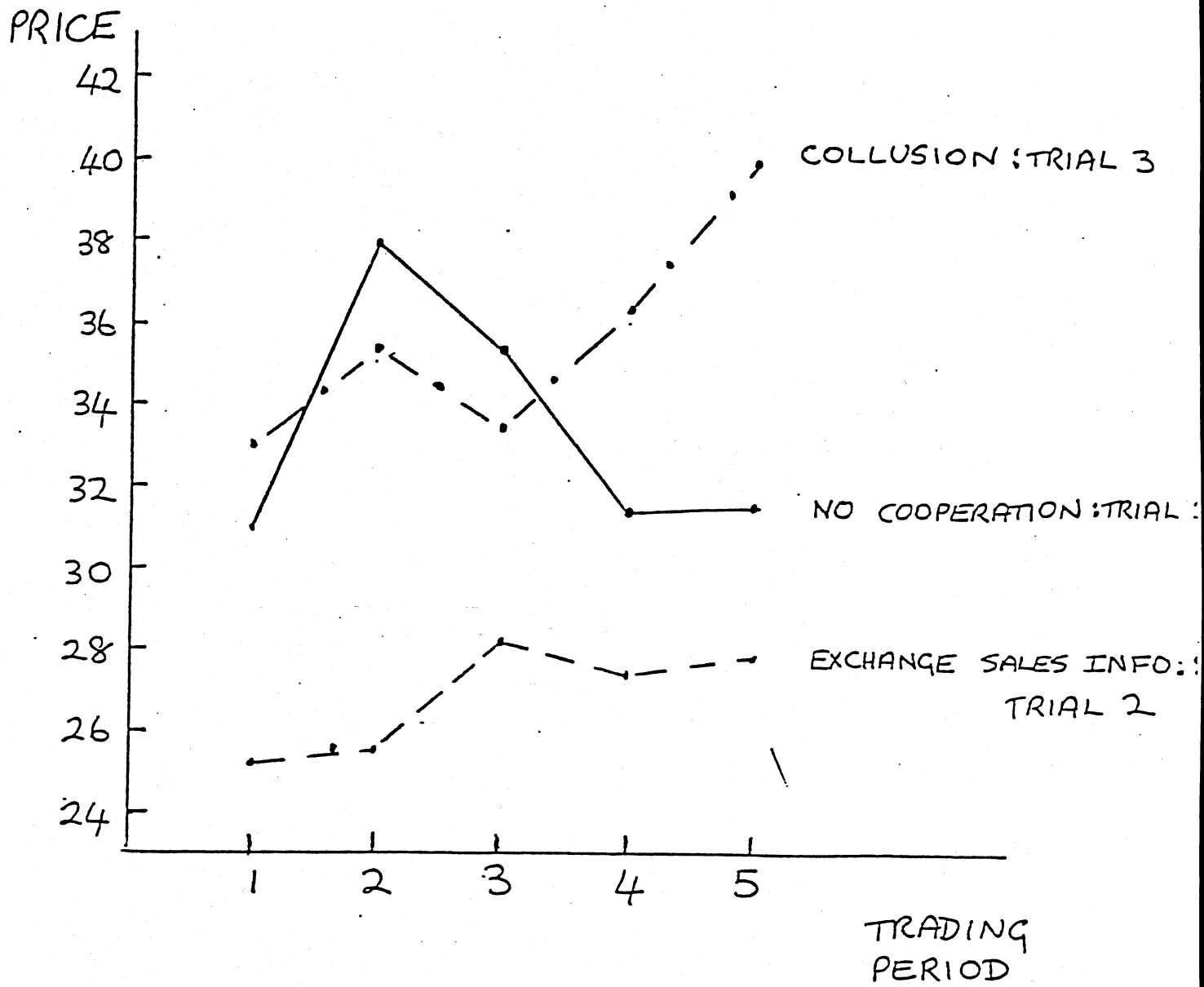


FIGURE 2 : AVERAGE PRICE FOR 5 TRADING PERIODS