Market Rules—double auction

1. Buyer period profit = Value - Price.
   Seller period profit = Price - Cost.

2. All buyers and sellers will be paid for one randomly chosen trading period.

3. Each trading period will last for 3 minutes (initially; auctioneer can make adjustments as required 😊).

4. Sellers can make asks or accept bids after being recognized by the auctioneer. Sellers must state their seller number and price asked or accepted.

5. Buyers can make bids or accept offers after being recognized by the auctioneer. Buyers must state their buyer number and price offered or accepted.

6. Only the lowest offer and highest bid will be active. New offers and bids must be improvements on active offers and bids.

7. No losses are allowed (you can’t sell at below cost or buy at above your value).

8. When an offer or bid is accepted, active offers and bids are erased and any new offers or bids are accepted.
A long and important line of research was initiated by Chamberlin, Edward H. [1948], An experimental imperfect market,” Journal of Political Economy, 56, 95-108, which introduced the design of laboratory markets with controlled supply and demand.

He investigated a decentralized market in which subjects walk around the room and bargain in pairs or groups. Once a pair reaches an agreement, they leave the market.

Chamberlin introduced the idea of inducing supply and demand: here, equilibrium price = 56-58, quantity=15

<table>
<thead>
<tr>
<th>Transactions</th>
<th>Market Schedules</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>S</td>
</tr>
<tr>
<td>56</td>
<td>18</td>
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<tr>
<td>54</td>
<td>26</td>
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<td>72</td>
<td>30</td>
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<td>84</td>
<td>34</td>
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<td>104</td>
<td>54</td>
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<td>50</td>
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<td>86</td>
<td>64</td>
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<tr>
<td>74</td>
<td>62</td>
</tr>
</tbody>
</table>

Some “normally” excluded buyers may make bargains. For instance, the seller
Chamberlin found “No tendency for prices to move toward equilibrium during the course of the market.”

Of course, after each trade, the remaining supply and demand curves shift as traders leave the market, so he graphed the “moving equilibrium.”

It may be recalled that prices were sometimes written upon the blackboard as deals were completed and sometimes

![Diagram of price fluctuations over transactions](image)

prices to move toward equilibrium during the course of the market or for the last price to be closer to equilibrium than earlier ones is discernible in the data of our experiment.

In Figure 3 the successive prices are plotted in relation to the equilibrium figure of 36 (also in relation to the average price $10$); and it might be thought that a tendency toward equilibrium could be expected only when this information (analogous to the stock-market ticker tape) were provided for the remaining buyers and sellers in the market (as it was in the case before us). This view,
One very influential substream of this work began with Smith’s demonstration of competitive equilibrium outcomes in repeated double auctions:


“The design of my experiments differs from that of Chamberlin in several ways. In Chamberlin's experiment the buyers and sellers simply circulate and engage in bilateral higgling and bargaining until they make a contract or the trading period ends. As contracts are made the transaction price is recorded on the blackboard... Each trader's attention is directed to the one person with whom he is bargaining, whereas in my experiments each trader's quotation is addressed to the entire trading group one quotation at a time. Also Chamberlin's experiment constitutes a pure exchange market operated for a single trading period. There is, therefore, less opportunity for traders to gain experience and to modify their subsequent behavior in the light of such experience. It is only through some learning mechanism of this kind that I can imagine the possibility of equilibrium being approached in any real market."

About this latter difference Smith further notes (p115):

"One important condition operating in our experimental markets is not likely to prevail in real markets. The experimental conditions of supply and demand are held constant over several successive trading periods in order to give any equilibrating mechanisms an opportunity to establish an equilibrium over time. Real markets are likely to be continually subjected to changing conditions of supply and demand."
Smith and his colleagues showed that for a wide range of supply and demand schedules, the double auction tended to quickly converge in repeated markets to the competitive equilibrium price and quantity.

Smith and his colleagues (notable among them Charlie Plott) showed this to be a robustly reproducible result.
One followup line of research was to explain these observations. (from the point of view, e.g., of “if people in other experiments aren’t so smart, why do they do so well in markets?”)


“Zero intelligence” traders randomly generate bids or asks, with a transaction resulting if their bids cross (at the mean price in that case). Transactions cancel all previous bids, and traders leave the market after transacting for one unit.

ZI traders “with a budget constraint” are not allowed to generate bids or asks that would cause them to take a loss; i.e. buyers must bid below their value, and sellers must ask above their cost.
Fig. 1.—Demand and supply functions and transaction price time series (market 1)

market 2 to 170 in market 4) and volumes (from 6 in market 3 to 24 in market 1). In all cases a unique equilibrium price existed. In mar-

5 The human trader sessions had an extra buyer in markets 1 and 2 and an extra seller in markets 3 and 4. As a result, the demand schedule for the human trader sessions of markets 1 and 2 and the supply schedules for the human trader sessions for markets 3 and 4 are slightly different from the supply schedules for the other sessions, as can be seen from figs. 1–4.
Another followup line of research has been to see when double auctions and related markets don’t converge to competitive equilibrium (even in repeated markets).

Holt, Charles A., Lorin Langan, and Anne Villamil [1986], “Market power in oral double auctions,” Economic Inquiry, 24, 107-123.

The paper begins by quoting Plott ’82 to the effect that convergence of double auction markets to competitive equilibrium is independent of market conditions. “The only exception to this observation is that competitive price levels do not always occur in monopoly markets.”

Holt et al. quote Cournot and others as predicting that competition will be limited when sellers have "market power” which, in these experiments, mean that a player can profitably withhold a unit of supply (or demand) and make a profit from the resulting price move. (So, traders who trade only a single unit can never have market power, and Holt et al. observe that no trader in any of the experiments reported by Smith et al. ever had market power.)

Holt et al. observe that experienced traders can learn to withhold supply (or demand) when it is profitable, keeping the price persistently above (or below) the competitive price.

This experiment used active sellers but simulated buyers…

Each design has the same aggregate supply and demand, but in design 1 no seller has more than three units, while in designs 2 (and 3) each of sellers 1 and 2 has 4 units, and could profitably withhold 3 of them so that the price would rise to $r$…

Figure 1. Supply and Demand Arrays
Figure 2. Price Series for a Power/No-Power Sequence (Key: The box represents S1’s price, the cross represents S2’s price. Other prices are indicated by dots.)
Figure 3. Average price sequences for 6 sessions using designs 1 and 2

(they look at a posted price market, contrast their results with the competitive market results in the Roth et al. 4-country study, which also has an imbalance between supply and demand. The object here is to show that “market forces” don’t necessarily eliminate “preference anomalies” found in non-market environments.

(1991), for example, the outcomes of ultimatum game experiments and competitive market experiments are compared across several countries (Israel, Japan, Slovenia, the United States). There are significant differences in the bargaining outcomes across countries that the authors, tentatively, attribute to cultural factors. Despite these differences, in all countries the modal offer in the final period gave responders,—the “weak” party—between 40% and 50% of the available bargaining surplus. This outcome changes dramatically if one side of the market has to compete for getting a share of the surplus. In the presence of competition the weak party—those who have to compete—receive less than 5% of the available surplus in the final period.

The fact that competitive market experiments quickly converge to the competitive equilibrium under a wide variety of conditions renders such experiments particularly useful for an investigation of the role of social norms. We can regard the case that norms exert a permanent nonnegligible effect in competitive experimental markets as a strong indication for their importance.3
A number of their experimental papers report results that robustly stay away from equilibrium, both with posted price and double auction markets.

The three experimental conditions are:

Bilateral Gift Exchange: for a worker firm pair, the firm first sets a wage, and then the worker chooses an effort level. (Anonymous matching).

Gift Exchange Market: stage 1: firms offer wages to the market, and workers accept or wait (firms may revise offers). Stage 2: workers choose effort. (excess supply of workers, so competitive wage is reservation wage…)

Complete Contracts Market: just stage 1: effort is automatically equal to 1 (maximum effort)
Table 1
Experimental Design

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Bilateral Gift Exchange (BGE)</th>
<th>Gift Exchange Market (GEM)</th>
<th>Complete Contracts Market (CCM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasible effort levels</td>
<td>$v = 120$, $c_0 = 20$</td>
<td>$v = 120$, $c_0 = 20$</td>
<td>$v = 120$, $c_0 = 20$</td>
</tr>
<tr>
<td>Feasible wages</td>
<td>$v \geq w \geq c_0$</td>
<td>$v \geq w \geq c_0$</td>
<td>$v = w = c_0$</td>
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<tr>
<td>Wage determination</td>
<td>Firms commit themselves to a</td>
<td>One-sided oral</td>
<td>One-sided oral auction;</td>
</tr>
<tr>
<td></td>
<td>wage level</td>
<td>auction; firms are</td>
<td>firms are wage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wage setters</td>
<td>setters</td>
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<tr>
<td>Matching process</td>
<td>Exogenous</td>
<td>Via acceptance of</td>
<td>Via acceptance of wage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wage offers</td>
<td>offers</td>
</tr>
<tr>
<td>No. of firms $(N)$</td>
<td>$N = L$</td>
<td>$6-8$ firms; exogenous excess supply of labor of at least 50%</td>
<td>$6-8$ firms; exogenous excess supply of labor of exactly 50%</td>
</tr>
<tr>
<td>No. of workers $(L)$</td>
<td></td>
<td>$v$, $c(e)$, $c_0$, $N$, $L$ are common knowledge; identity of trading partner is unknown</td>
<td>$v$, $c(e)$, $c_0$, $N$, $L$ are common knowledge; identity of trading partner is unknown</td>
</tr>
<tr>
<td>Information conditions</td>
<td></td>
<td>$v$, $c(e)$, $c_0$, $N$, $L$ are common knowledge; identity of trading partner is unknown</td>
<td>$v$, $c(e)$, $c_0$, $N$, $L$ are common knowledge; identity of trading partner is unknown</td>
</tr>
<tr>
<td>Predictions with</td>
<td>Convergence toward $w = 20$;</td>
<td>Convergence toward $w = 20$;</td>
<td>Convergence toward $w = 20$</td>
</tr>
<tr>
<td>rational money maximizers</td>
<td>$e = 0.1$</td>
<td>$e = 0.1$</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 1.—Effort-wage relation in BGE and GEM and percentage of trades
Fig. 2a. — Average wages over time
Fig. 2b. — Evolution of average wages over time for different subject pools
Here are some results from a *posted price* market reported in Fehr, Ernst, Simon Gachter, and Georg Kirchsteiger (1996), “Reciprocal Fairness and Noncompensating Wage Differentials,” Journal of Institutional and Theoretical Economics, 152, 608-640.

**Figure 1:** Intertemporally stable wage differentials in the Fair Wage-Effort Model: firms’ wage payments increase in the redemption value because workers’ effort levels depend positively on the rent share.

Workers' reciprocal effort choices induce firms to actually pay wages in posted-bid markets that increase in the profitability of a worker for them, i.e., there are fairness-induced wage differentials. Data are from 4 sessions with 8 workers and 6 firms in each session.

Overall moral from these series of market experiments: figuring out the robust generalizations of your results is a lot tougher than getting reproducible results; experimental design is meant to help

Some understudied topics:

nonstationary demand and supply; either through random shocks, or nonstationary demand and supply induced by previous period trades…Chamberlin’s “moving equilibrium”

Why are some markets organized some ways and not others?

How far can we get with low intelligence models—if not zero intelligence, then reinforcement learning and its relatives?

Market power

Anomalous preferences and bounded rationality: when do market forces discipline these (or arbitrage them away) and when not?

Speed and reliability of convergence to equilibrium, and, what happens before convergence?
Convergence of auction prices for a new commodity: “Iraq most wanted” cards on eBay
By Axel Ockenfels and Alvin E. Roth

x-axis: time in days $x = 1$ is April 14, 2003, the date on which the first auction transaction was completed. (the pictures were distributed in Iraq on Friday April 11)

Left y-axis: daily average prices (red line)

Right y-axis: Daily number of card decks sold on eBay auctions (blue bars)

Blue line: retail price $5.95$