TIYF! Market Model

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Markets

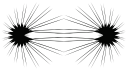
On a typical market, on which an arbitrary good is exchanged, buyers and sellers interact face to face, check the offers, negotiate prices and finally, if agreement is reached, trade X for Y making both parties better off. In many instances, this unstructured way of finding mutually beneficial opportunities to trade may, however, either not be feasible or not efficient. The reasons for such shortcomings are numerous, such as narrowly constrained time and/or space, a large number of buyers and sellers, standardized products, transaction costs etc.. In such cases, markets have been given certain well-defined structures in terms of codified rules or informal norms of how and when bid and ask prices can be made, and how buyers and sellers are matched and prices determined. Stock exchanges and auctions, for example, are highly organized and institutionalized markets. Concerning the latter, from the well-known ascending first price auction to highly complex formats used to auction off spectrum licenses, there is a wide range of formats with certain common and differing properties. For economists, auctions are not only of importance because they are actually used to allocate goods, but also because they are proxies for the processes driving conventional, unstructured markets that are easily accessible for analysis due to their well-defined format.

Double Auction Markets

The double auction is a very simple, but highly competitive auction format that when a commodity is traded, exhibits stable and rapid price formation towards the market clearing level, even if traders have only a little information about the other market participants' reservation prices. It was made popular to simulate markets by 2002 Nobel Laureate Vernon Smith in the 1960s. In the auction, buyers and sellers simultaneously post bids resp. ask prices which are displayed in such a way that every trader is informed about all the other traders' bids. Each buyer is free to choose to accept any of the ask prices at any time just as each seller is free to accept any of the bid prices at any time. Traders are also free to alter their bids, albeit only in the direction more favourable to the other market side. If a posted price is accepted by either buyer or seller, the trade is executed and the buyer gets the offered good while the seller gets the price. This simple framework is used extensively as a basic institution in the experimental economic analysis of markets that can easily be extended and modified to study a wider set of market environments.

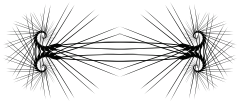
TIYF! Market

With the double auction protocol, commodities as well as assets can be traded. For the *TIYF!* installation, we have adopted the double auction framework to have differ-



ent assets traded simultaneously by a number of robot traders and anyone interested in doing so. Thus, interaction in TIYF is between a possibly quickly varying set of persons, and thus the focus is not on personal interaction and negotiating, but on fast paced anonymous trading.
The world in which our market exists knows three states and three assets, each of which representing one of the states of the world. The assets are also connected to the three visuals displayed on screens around the traders. In the world, there is a numeraire good (money) that can be used to buy units of the assets. The wealth accumulated by the traders is also measured in units of the numeraire good. Time in the *TIYF!* world flows in periods. Depending on the state of the world, which is randomly determined in each period, each unit of an asset pays a certain dividend which is added to the account of the traders multiplied by the number of units of the asset the trader holds in this period. The dividend payments are measured in units of the numeraire good and information about the amount of the dividend payments and how the states of the world are determined is public. Initially the market starts with a certain number of shares for each asset allocated asymmetrically across the traders. The same is true for the numeraire good.

Trading in the periods takes place as follows:
Buyers and sellers specify the asset they want to trade and post the maximum price they are prepared to pay (bid) resp. the minimum price they are prepared to accept (ask) for a unit. Given that a seller actually owns the asset she or he wants to sell and a buyer owns at least as much of the numeraire good as she or he is bidding, each asset can be bought resp. sold in each period. The trade volume is restricted to one unit for each asset and period per trader.
In the three submarkets, the bids and asks are ranked from high to low resp. low to high. The highest bid is then matched with the lowest ask, the second highest bid with the second lowest ask etc.. Trading occurs for each matched pair of buyer and seller given the bid is not lower than the ask at the price of the arithmetic mean of bid and ask. This procedure produces a stable matching and maximizes gains from trading.
After the trades are processed the traders' portfolios and numeraire good accounts are updated. The state of the world is then determined randomly, dividends paid accordingly and the accounts updated again.
The average of the prices of all shares of an asset sold in a period are taken as the asset's overall price in that period and the change of the asset price influences the progress of the visualisations related to the assets. The data of the TIYF market (bids, asks, transactions, asset prices etc.) is, of course, logged by the software and accessible for scientific analysis.



Bubbles and crashes

In the experimental economics literature, double auction markets for assets yielding stochastic dividend payments traded for real money have been shown to typically exhibit a cyclical pattern of bubbles and crashes. A bubble is defined as high volume trading of the asset with prices detached from the underlying fundamental value. A crash is a rapid decrease in price following the boom phase on the market. Typically a bubble takes a couple of trading periods to build up from one period to the next. The price follows an upward trend that reinforces itself until a peak is reached. In the same way, these trends go the other way after a peak has been reached. Prices start to fall with increasing intensity in a downward trend that comes to a halt, mostly with a hard crash landing.

Asset trading experiments have been conducted with various modifications and variations. Among those were, for example, variations in the variance of the dividend payments, allowing short selling, ruling out the resale of acquired shares, the introduction of transaction fees or the participation of subjects with varying degrees of experience and knowledge in financial matters. Nevertheless, the boom-bust pattern has been shown to be extremely persistent, with actual experience in such trading experiments being the only reliable manipulation to eliminate it.

From a theoretical perspective, it is puzzling why trading and thus bubbles as the consequence of excessive trading happen at all in such markets. Different risk attitudes of the traders and suitable initial endowments can, of course, lead to welfare improving transactions as risk taking and risk adverse subjects can both improve their portfolios through exchange that leaves the risk takers with the more risky assets and the risk adverse subjects with the less risky ones. Apart from these transactions, trading can't possibly improve both parties involved as the asset has to be valued equally by all (rational) agents and thus there are no possible gains from trade. Nevertheless, participants in experimental double auction markets do trade and generate bubbles. A possible explanation is that trading is the only activity the experiment's participants can pursue and thus fighting boredom could outweigh the fear of a potential monetary loss incurred by irrational trading. Apart from the fighting boredom argument, two potential reasons can be found for trading: the first is that the participants are not rational and they just don't see that there can't be any gain from speculative trading. The second is that if they are rational, the necessary requirement of common knowledge of rationality may fail and traders believe that they can outsmart the others and gain on their expenses.

In contrast to standard economic laboratory experiments in which the participants are paid according to their actual performance and consequently are assumed to act to maximize their pay-offs, trading in *TIYF!* is embedded in a very different context.

It's not monetary incentives the traders face, but the ability to influence the *TIYF!* world that surrounds the person involved. Changing the prices for the assets by trading feeds back into the progress of the visualisations and, of course, it also influences the numeraire good account of the traders. The numeraire good accounts are displayed and used to rank the traders. Although no money is paid out in the end, a competitive notion of the persons involved might induce them to show off their trading skills represented by the score. Thus, a interdependence between the motives of trading to influence the visual dimension of TIYF and trading for one's own ego is likely to arise creating a world which is driven by one of the most important ways of interaction between people, selling and buying on a market.

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