Designing Strategic Market Games with Incomplete Information and Many Traders

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Abstract

The usual general equilibrium model of price determination fails to consider a key problem of devising an institutional framework, in the form of a strategic market game, that provides incentives for individual agents to honor the supply contracts that are associated with a Walrasian equilibrium allocation. This is fairly straightforward for one-period spot markets in the absence of adverse selection. But extensions to many periods or to markets with asymmetric information suggest a significant role for regulation in ensuring that the resulting “institutional general equilibrium” allocations are Pareto efficient subjective to appropriate incentive constraints.

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1 Extended Abstract

General equilibrium theory is a multi-market extension of a standard demand and supply framework for price discovery pioneered by Cournot. There is a corresponding strategic game with a continuum of traders who announce net demand correspondences, depending on the price vector, to a Walrasian auctioneer. This auctioneer is statutorily obliged to determine a market clearing price vector and a corresponding selection from each agent’s announced net demand set at that price vector which achieves market balance. In this game, each agent has a weakly dominant strategy of announcing its true net demand correspondence. The resulting focal equilibrium is a Walrasian allocation and associated price vector, as determined by the auctioneer. The construction even works in an economy with incomplete information.

The game is easily extended to multiple discrete time periods and a commonly known event tree along the lines pioneered by Arrow and, more precisely, Debreu. The equilibrium allocation is of irrevocable contingent contracts for the delivery of physical goods, dependent on each date–event pair corresponding to a node of the event tree.

Even in simple one-period spot markets, however, this framework neglects the important issue of how the relevant contracts are enforced. The general equilibrium framework will fail even as a model of price formation if it is not accompanied by some institutional mechanism for enforcing the contracts associated with the equilibrium allocation.

Consider first the case of simple one-period spot markets. Suppose too that, if agents are endowed with production sets, they use only their own resources to produce any output that they intend to sell. In fact, we should probably model agents as being endowed with two production sets: the first describing what they can do before undertaking any trade; then a second describing how they can convert stored or purchased inputs into final consumption outputs. Then there is a six-stage game with the property that, given any Walrasian equilibrium of the economy, there is a particular focal subgame perfect Bayesian equilibrium in weakly dominant strategies that implements the Walrasian equilibrium. A key feature of the game is that traders are required to deposit all their supplies in a central warehouse, and receive credit for them from the auctioneer/principal, before being allowed to take delivery of any goods they have demanded. Without such a provision, there is always a risk of default in supply contracts leading to a “market run”
(rather than a bank run) because some agents know that the system cannot afford to fulfil their demand contracts.

1. Agents announce ordinary net demand correspondences, but also contingent “effective” demand correspondences that depend on any revised price vector the auctioneer/principal may be forced to announce if some agents default on their supply contracts. This effective demand correspondence must have values that are subsets of the nonnegative cone of the commodity space, because it will be too late to allow any additional sales.

2. The auctioneer/principal announces a price vector along with a market balancing allocation selected from each agent’s net demand set at that price vector. This allocation is used to determine what supply and demand contracts are issued to each trader, placing for each good both an upper bound on the quantity they can supply, and another on what they can demand.

3. Agents with supply contracts deposit any goods they intend to sell in a central warehouse, up to the limits imposed by their contracts.

4. In case not every (or almost every) agent has delivered the expected supply, the auctioneer/principal chooses a revised price vector in order to match a mean demand vector in the traders’ aggregate effective demand correspondence to the mean supply of goods actually deposited in the warehouse. Otherwise the original price vector is maintained.

5. In case not every (or almost every) agent has delivered the expected supply, the auctioneer/principal also specifies a revised allocation of these supplies between different purchasers such that each agent is allowed a demand vector selected from the value of their announced effective demand correspondence. This allocation is used to issue revised demand contracts to each trader, placing for each good an upper bound on the quantity they can demand. Otherwise the original contracts specified in stage 2 are maintained.

6. Finally, agents are allowed to collect their goods from the warehouse, up to the limits specified in their demand contracts. Any uncollected goods are thrown away.
Another feature of the game is the use of credit, perhaps in the form of fiat money issued by the auctioneer/principal. This, however, is the only traded asset in this one-period setting.

It is also worth noting that it is hard to see any scope here for labor contracts, or for any form of traded labor (other than slaves, I suppose). Traders can convert their own labor into produce before supplying the market, and they can also apply their own labor to convert the goods they have purchased from the market into a more useful consumer product. But the economy is reduced to “labour autarky.”

The preceding has been a detailed sketch of how one might be able to design a spot market where many commodities are traded simultaneously in an orderly manner that, in equilibrium, generates a Walrasian allocation. The design has minimal informational requirements in the ideal case considered with a continuum of traders. It creates incentives for traders to fulfil all their contracts. Having a central warehouse for all physical commodities would clearly be impractical in reality; there is some scope instead for a network of local warehouses able to exchange information freely with a central market organizer.

In future work, it is intended to extend this basic framework in several directions. A move to two trading periods would allow significantly enriched markets, including some rudimentary financial assets and insurance contracts. A serious concern then would be with moral hazard and, perhaps even more seriously, with adverse selection. Preliminary work on the latter suggests that well designed markets would have to depart in major ways from the usual Walrasian ideal in order to achieve constrained Pareto efficient outcomes.