Notes on Koeppl, Monnet, Temzelides,
"Optimal clearing arrangements for financial trades"
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What economic services do clearing houses perform? How should their services be priced? What happens if traders have the option of using the services of the clearing house or not?

Clearing houses are the mechanisms for clearing and settling trades on organized financial markets. They are thus, like payment systems, part of the infrastructure that makes financial transactions feasible.

In this paper the activities of clearing houses are not clearly distinguished from the activities of net payment systems. In fact the model might better be interpreted as a model of a net payment system competing with a gross payment system. (And I will do so in these notes). Thus one important question to be asked is whether this captures all that clearing houses do, or is there additional effect from the use of clearing houses in handling financial transactions rather than simply handling payments.

The model simplified

Traders are infinitely lived, and have a common discount factor β over periods in which they trade. In each period they have a probability γ of being a buyer matched with a seller, a probability γ of being a seller matched with a buyer and a probability $1-2\gamma$ of not being matched with a counterparty for a trade.

In addition this meeting can occur randomly in one of two venues—either at an organized exchange (with probability α) or off the exchange ("over the counter").

If a trade takes place, the buyer will receive utility u, and the seller will incur cost c, where $u > c$. Payment will be made in a numeraire good. (The authors consider that the size of the trade could be variable, but this only comes in very late in the analysis).

Trade that takes place at an organized exchange *must* settle at the exchange clearing house, according to the rules of the exchange. Trade that takes place over the counter can either settle bilaterally or be taken by the pair of traders to the exchange clearing house and settled there. Settlement occurs in a numeraire good.

Breaching the rules of the clearing house leads to banishment from the exchange so that from that point onward only over the counter trade with bilateral settlement is available to the agent ("autarky.")

Bilateral Settlement

When two agents meet off-exchange and elect to settle bilaterally, it is assumed that there is a cost τ to the transaction. Thus the surplus from the transaction is $u-c-\tau$ (assumed positive) and this surplus is divided between the two agents according to their bargaining power. It is assumed that buyers always receive a fraction η of the surplus. This determines the price for the trade p (for accounting purposes it matters whether the transaction cost is paid by the buyer or seller, but for economic purposes it doesn't—we just adjust the price accordingly).

From this we can conclude that the expected payoff to autarky is

$$V_0 = \frac{(1-\alpha)\gamma[u-c-\tau]}{1-\beta}$$

Clearing House Rules

The authors focus on the following rules for a clearing house: Each agent who participates in the clearing house starts off with a "balance" (which with no real loss of generality is assumed to be zero). The balance is then adjusted each period according to whether he has bought or sold on the exchange (assumed observable) or whether he has reported buying or selling off the exchange. While it is assumed that the charges can vary for on-exchange or off-exchange trades, it is assumed for simplicity that the charges are otherwise constant over time, and that positive and negative balances accrue interest at a rate consistent with agents' rate of

time preference. (What the exchange can observe about OTC trades is a little delicate; results will probably vary somewhat with the details of this).

Then, after n periods, these balances are *settled* by having agents pay numeraire into the exchange or withdraw numeraire from the exchange, and the procedure repeats. Thus, as we see the exchange/clearing house system is essentially a system for net settlement of payments. (Note that modeling is simplified by assuming that the prices at which trades are made on the exchange are effectively determined as part of the settlement system. It will be interesting to see to what extent this matters).

It is assumed that there is a fixed cost of running the settlement round, and that the net of payments in and out by particpants at the time of settlement just equals this cost. That is, the system runs as a utility. This cost can perhaps be thought of as related to the need to acquir and handle the money that is used in the settlement.

Incentives

Traders always have the option at any point of leaving the exchange and reverting to autarky. In particular, then, on a settlement date, an agent must be willing to pay in the required amount according to the negative balance accumulated. Furthermore at each date where he is supposed to supply goods in a trade, he must prefer doing so (and getting a more favorable balance) to not doing so. The assumption is that if an agent doesn't want to participate in a trade, the exchange cannot tell it that the trade should have happened, however if the agent does participate in a trade on the exchange the exchange can tell that the trade did occur. (The reduction in balance from buying the good in a period never turns out to be a binding constraint; after all the agent could always receive the good and wait until settlement to renege). Finally, if agents are trading over the counter, then they will only bring the trade to the exchange for settlement if doing so is preferable to bilateral settlement. (As noted below, this may be a little delicate).

It is assumed that the payment in numeraire is equal to the balance; and since agents have linear utility in the numeraire this means that the value function of the position at settlement depends linearly on the balance.

Given the invariance of the arrangements over time and the interest rate equaling the rate of discount, the incentives need only be checked for the period immediately before settlement; if they hold then, they will hold for all earlier periods as well. (This is because a reduction of the settlement balance by one dollar has the same effect on value at any time and no matter what the current balance of the agent is). Similarly, willingness to participate only needs to be checked for the agent with the lowest possible balance at the settlement stage.

The incentive requirements simply boil down to: the charge for purchase has to be less than the value of purchasing, the improvement in balance for selling has to be greater than the cost of selling on the exchange, and for the OTC trades these have to be reduced further for the outside option of trade bilaterally. (In each case "charge" and "payment" means "relative to no trading"; it might be that non participants are expected to pay (or in principle receive) amounts each period.

Conditions for feasible exchange

Only exchange trading

Suppose that there is only exchange trading. Under what conditions will a simple clearing house arrangement of the form described satisfy the requirements for trade?

The surplus from staying with the exchange must exceed the cost of the worst balance that an individual can accrue on the exchange. (That is the balance when he owes for a purchase every period). This is the following equation:

$$\frac{\beta\gamma(u-c)}{1-\beta} - \frac{\delta}{1-\beta^n} - \gamma c\frac{\beta(1-\beta^n)}{\beta^n(1-\beta)} \geq 0$$

The first term is the lifetime benefit of being in the exchange. The second term is the cost per person of maintaining the exchange (note that we only have to pay it every nth period becuase it is only the settlement that is costly.) The third term is the amount that will have to be extracted from an individual who has bought in every period. It is clear why the c appears in the term, but why is the γ there? It turns out that it is useful to put some of the charges on the individuals who do no trading, to ensure that the costs

to the buyers are not pushed too high. Now the sellers have to have a better deal, in order to induce them to sell—in fact the deal has to be better by precisely c. (It must therefore be implicitly assumed that we can't force individuals who turn out to be sellers to supply the good; we can identify that they have made the sale, but not that they were supposed to make the sale). In order to keep the settlement burden as low as possible on any indivdual, we then spread the charges over all other individuals equally. That is, both buyers and non traders have their accounts charged each period, but that means that the burden for the chronic non-producers is as low as possible.

Only over the counter

If there is no organized exchange and the clearing house attempting to service over the counter trades, the situation is a little more delicate. First, the cost of running the exchange, namely δ every n periods, must be less than the expected cost of all the period by period transactions over the counter. This is the following inequality:

$$\frac{\beta\gamma\tau}{1-\beta} - \frac{\delta}{1-\beta^n} > 0$$

(Note, among other things, the more frequently agents trade—γ high—the greater the advantage of netting). Next the savings accrued in this way must also be large enough to tempt an individual who is in the worst possible situation at settlement to pay up; the amount he will have to pay is

$$\gamma p \frac{\beta(1-\beta^n)}{\beta^n(1-\beta)}$$

where p is the payment he incurs each time, and the fraction adjusts for the accumulation of interest across the periods until settlement.

As in the previous case, all participants in the market "pay" a fixed amount every time (that is, balances are reduced by a fixed amount); this amount is enough to handle the funding of the clearing house, plus the amount needed to offset the receipts by sellers, which are assumed to be equal to what they would receive in an OTC arrangement. In other words, individuals who sell must be identifiable so that they can be rewarded by the clearing house; everybody else pays an equal amount (whether they are buyers or not) and so it must be impossible for individuals to hide in any period from the clearing house (that is, individuals who do not pay the fixed amount every period are identifiable).

Joint Clearing House and Cross Subsidization

Now the authors allow for α between 0 and 1, and the clearing house operates across both markets. The main result of this section is that it may be necessary to use the payments in the organized market to subsidize the payments in the over the counter market, in order for the over the counter clearing to be viable. Feasibility simply requires that the weighted average of the two equations from before (weighted by the share of the trades in the population) be satisfied. But that allows that the payments represent a subsidy in either direction.

In fact what happens is this: to minimize the threat of default, the burden of financing the exchange is shared equally among all individuals. But then suppliers over the counter and suppliers on exchanges must each get the premium above this as described before: for exchange trades this equals cost; for over the counter trades this equals what they would get in the bilateral bargain.

The authors argue that this cross subsidization is necessary to internalize the externalities that the agents do not take into account the reduction in clearing costs provided by the viability of the exchange. However the equation which demonstrates this depends on the price from the Nash bargaining solution; thus it would be interesting to determine whether the problem is reduced in more competitive over the counter environments.

Liquidity and Incentives

Note that this structure implies that there is a limit to how long settlement can wait; if it is delayed too long then there is a chance that an agent has been unproductive so long that his required payment induces him

to default. On the other hand, the longer we can delay it, the lower the effective charge to the operations. (This phenomenon is also explored in greater detail in their earlier paper on the topic).

The authors also consider the possibility that the trade size can vary; then the ability to make a larger trade becomes a consideration in design of the system. They explore a simple extension (cutting back on other aspects of the problem) in which they consider what happens as it becomes more expensive to run the exchange. Their initial explanation of the intuitions at this point is a little confusing to me, I think their final explanation is the more useful one: As the exchange must be financed by payments and these payments increase, the threat of a default by an unproductive individual must be met—this is done by both increasing the settlement frequency and reducing the size of the trades, so as to reduce the required payments to the productive individuals.

Questions

Does the threat point work if it is necessary to have mutuality in the choice of whether to settle on or off exchange? This is an important question in payments systems when there are a number of options for making the payment.

Natural extensions—meetings may be easier on exchange than off.

In real exchanges the value of the position changes during the course of the time; is this captured by the model and if not can it be?