Chapter 35

CALL AUCTION TRADING[1]

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Abstract

A call auction is an order driven facility which, in contrast with continuous trading, batches multiple orders together for simultaneous execution in a multilateral trade, at a single price, at a predetermined point in time, by a predetermined matching algorithm. The chapter describes how orders are handled and clearing prices set in call auction trading, contrasts call auctions with continuous trading, and identifies different types of call auctions (including price scan auctions, sealed bid auctions, and open limit order book auctions). Attention is given to the use of information technology in call market design, the integration of an auction in a market's microstructure, and to the facility's ability to deal with market quality issues such as containing intra-day price volatility, sharpening price discovery, and catering to participant demands for immediacy. To produce robust results, a call auction must attract sufficient critical mass order flow; the paper concludes by noting that, because large traders in particular are reluctant to enter their orders early in the auction process, book building cannot be taken for granted.

Keywords: book building; continuous trading; critical mass order flow; hybrid markets; information technology; intra-day price volatility; order driven facility; open limit order book auction; price and time priority; price discovery; price improvement; price scan auction; sealed bid auction

A call auction is an order driven facility that batches multiple orders together for simultaneous execution in a multilateral trade, at a single price, at a predetermined point in time. This contrasts with continuous trading where a trade can occur whenever a buy and a sell order cross in price. Our discussion of call auction trading is implicitly in the context of equity trading, but the concepts involved apply to a far greater array of financial instruments and nonfinancial resources.

The call auction form of trading died out in the precomputer age but has made its re-entrance today as an electronic marketplace. An electronic call auction has been incorporated in recent years in a number of market centers around the world, most notably Deutsche Börse, Euronext (the Paris, Amsterdam, Brussels and Lisbon, exchanges), the London Stock Exchange, and the NASDAQ Stock Market. These electronic calls are not being used as standalone systems, but have been combined with continuous trading to create hybrid markets. When it comes to trading, one size does not fit all. With a hybrid system, an investor can select among alternative trading venues depending on the size of the order, the liquidity of the stock being traded, and the investor's own motive for trading.

A pure "order driven" market is a trading environment where all of the participants are investors seeking to buy or to sell shares for their own portfolio purposes. The environment is called "order driven" because limit orders that are placed by some participants set the prices at which others

can trade by market order. Most order driven markets are not "pure," but allow for market making. Even without imposing specific obligations or offering incentives, large market participants often choose to make markets as a specific business line. There is a need for market making services, and these services get paid for.

An order driven market can be structured in two fundamentally different ways. With a "continuous" market, a trade can be made at any moment in continuous time that a buy order and a sell order meet in price. In the continuous market, trading is generally a sequence of bilateral matches. Alternatively, in a "call auction," orders are batched together for a simultaneous execution. At the time of a call, a market clearing price is determined, and buy orders at this price and higher execute, as do sell orders at this price and lower.

Call auctions and continuous trading both have their advantages and their shortcomings. In most exchanges, both methods are combined, as are order driven and quote driven facilities[2] so as to form an optimum structure for all kinds of users. In principle, an auction appears to be the ideal way of defining the equilibrium market price at a specific point in time. Continuous trading is more apt to resemble a never ending crawl around a dynamically evolving equilibrium price.

Many retail customers are accustomed to trading with immediacy. Nevertheless, if there were only retail orders, periodic calls would probably be the better way to provide fair and equitable treatment to every investor. However, markets must also cope with the problem of handling big block orders. A lot of interaction with the market is needed to trade large orders. That is where some see the advantage of continuous trading. It offers a special kind of interaction between the market participants, opportunities to test the market, and to get information from the market. For big orders, periodic calls may not provide the kind of flexibility that some participants want.

On both sides of the Atlantic, this has led to combinations of both call and continuous systems. Call auctions are typically used at the beginning of each trading session to open their continuous order driven markets. The opening price has special importance because orders that have come in during the overnight trading halt are normally considered to have an equal right to get filled, at least partly, at the opening price. Setting the opening price should, therefore, be done carefully – be it by a well-structured auction or through a less formalized process. Calls can also be used to close the market. The major European equity markets and NASDAQ in the United States do this to sharpen the accuracy of price determination at this critical time of the trading day, and in recognition of the multiplicity of uses to which the closing prices are put (at index rebalancings and derivative expirations, as well as for marking-to-market in derivative markets, share valuations for various other legal purposes, etc.). Some exchanges also run periodic calls during a trading session (Deutsche Börse's market model includes one intra-day call). The intra-day calls are important particularly for securities with low trading volume.

35.1. Order Handling

Orders are handled differently in call auctions than in continuous trading, and the time clock is used differently. With a call auction, trades are made at specific points in time rather than whenever, in continuous time, a buy and a sell order cross. To accomplish this, orders submitted to a call auction that could otherwise have been matched and executed are batched together for a multilateral clearing. The clearings are generally held at predetermined points in time (at the open, at the close, and/or at set times during the trading day).

As noted, at the time of a call, the batched orders are matched, and a single clearing price is established. The single clearing price reflects the full set of orders submitted to the call. Buy orders at this value and higher execute, as do sell orders at this value and lower. Because all executed orders clear at the same price, there is no bid–ask spread in call auction trading. Further, with single price clearing, buy orders priced above the single clear-

ing value and sell orders priced below it receive price improvement.

35.2. Alternative Call Auction Designs

Many variations in auction design exist. Calls can be held "on request" instead of at predetermined regular intervals. Multiple (discriminatory) pricing in a call is possible. The amount of precall pricing information to reveal is a decision variable. Traders may be free to change their orders/quotes quotes until the last moment, or there may be restrictions of various kinds. And so forth.

Taking an aerial view, we identify four basic types of call auctions (with several variations in between).

35.2.1. Price Scan Auctions

In a price scan auction, a sequence of prices is "called out" until a value is found that best balances the buy and sell orders. The NYSE call auction opening best fits into this category. The exchange specialists periodically announce indicated opening price ranges, traders respond with their orders, and as they do, the specialists adjust their indicated opening prices.[3]

35.2.2. Sealed Bid Auctions

In a sealed bid auction, participants submit their orders in sealed envelopes that are not opened until the time of the auction. These auctions are totally "closed book" (nontransparent) during the preopen phase, and consequently no participant knows what orders the others are submitting. The term may also be applied more broadly when orders are submitted electronically or by other means if pretrade orders and indicated clearing prices are not revealed to participants. The U.S. Treasury's new issues market is a good example of the sealed bid auction.

In an electronic trading environment, the auction can be set up with various degrees of preauction transparency that allows traders to react to an indicated clearing price that is continuously displayed as the market forms. This functionality characterizes the third category of call auctions:

35.2.3. Open Limit Order Book

With an open limit order book, posted orders are displayed to the public in the precall order entry period. As the time of the call approaches, the procedure also identifies and updates an indicated clearing price, which at each instant, is the value that would be set in the call if the call were to be held at that instant. At the time of the call, the book is frozen and the indicated clearing price becomes the actual clearing price. The open limit order book call is used in most electronic order driven trading platforms around the world.

The fourth category is not, strictly speaking, a call because it does not undertake price discovery. However, because it is based on the principle of order batching, we include it here:

35.2.4. Crossing Networks

A crossing network does not discover price. Rather, buy and sell orders are matched in a multilateral trade at a price that is set elsewhere. Generally, the value used at a cross is either the last transaction price or the midpoint of the bid–ask spread set in a major market center. In the United States, ITG's Posit crosses and Instinet's cross are good examples of this facility.

35.3. Order Batching and Price Determination

Figures 35.1–35.4 describe order batching and price determination in a call. In each of these figures, share price is shown on the vertical axis, and the number of orders is shown on the horizontal axis. The number of shares sought for purchase or offered for sale is conventionally displayed on the horizontal axis, but the exposition is simplified by assuming that all orders are for the same number of shares (e.g. one round lot). The following legend is used in the diagrams:

• Individual buy order

● Cumulative buy orders at the price or better

○ Individual sell order

O Cumulative sell order at the price or better

Figure 35.1 displays the individual buy and sell orders. The horizontal axis gives the total number of orders (buys plus sells) that have been placed at each price. At each price, the orders are arrayed according to the sequence in which they have arrived. At the price of 52, just one sell order has been placed. At 51, a sell order arrived first, and then a buy order. At 50, two buy orders arrived followed by one sell order. And so on.

Figures 35.2 and 35.3 show how the individual buy and sell orders are aggregated. The buy orders only (both individual and aggregated) are shown in Figure 35.2. Because the price limit on a buy order

Figure 35.1. Batching of customer orders

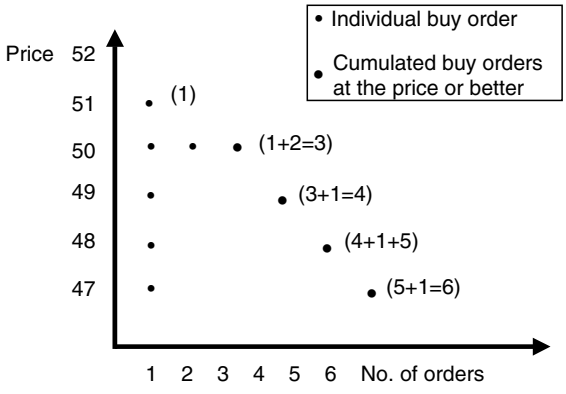

Figure 35.2. Cumulation of the buy orders

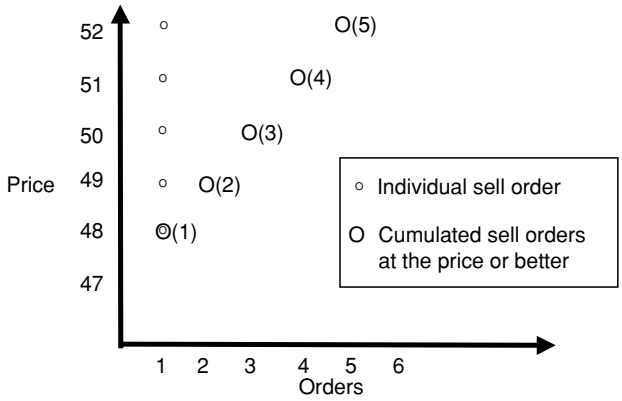

Figure 35.3. Cumulation of the sell orders

is the highest price at which the order is to be executed, the buy orders are cumulated from the highest price (in this case 51) down to the lowest (47). At 51, there is just one order to buy. Two additional buy orders have been entered at 50, and thus at 50, there is a total of three buy orders. At yet lower prices, one order has been placed at each of the prices, 49, 48, and 47. Thus, the cumulative number of orders at these prices is four, five, and six, respectively.

The sell orders only (both individual and aggregated) are shown in Figure 35.3, and they are also cumulated. Because the price limit on a sell order is the lowest price at which the order is to be executed, the sell orders are cumulated from the lowest price (48) up to the highest price (52). There is only one sell order at each of the prices, and the cumulative number of sell orders increases by one order as we move from the single order at 48 to the five orders at 52.

The cumulative buy and sell orders are matched together in Figure 4 to determine the clearing price at which they execute and the specific orders that execute. At the intersection of the two curves, price is 50 and the number of orders is three. Thus, three buy orders execute (the one placed at 51 and the two at 50) and three sell orders execute (the one placed at 48, the one at 49, and the one at 50). Note that three is the maximum number of orders that can execute: at the higher price of 51 there is only one buy order, and at the lower price

of 49 there are only two sell orders. For this reason, the clearing price in a call auction is typically identified as the value that maximizes the number of shares that execute (and, in the special case presented here, the number of orders that execute).

Note that the most aggressive buy orders are matched with the most aggressive sell orders. This is because orders receive price priority. Namely, the most aggressive orders (on either side) are executed first. As we discuss below, if several orders have the same price limits, the order that was input first gets executed first (time priority). In the example depicted in Figure 4, three of the executed orders receive price improvement (the buy at 51, the sell at 49, and the sell at 48). The less aggressive orders (the buys at 49, 48, and 47, and the sells at 51 and 52) remain unexecuted. These orders may be rolled into the continuous market, held for the next call, or cancelled, depending on the wishes of the investor.

In Figure 4, at the market-clearing price of 50, the cumulated sell orders match the cumulated buy orders exactly. What if no price exists that gives an exact match? For instance, what would happen if, everything else constant, three buy orders rather than two were entered at 50? The decision rule would still pick 50 to be the price (this value would still maximize the number of orders that execute), but with a cumulative of only three sell orders at 50, only three of the four buy orders can be executed.

A further decision rule is needed to specify which three of the four orders to pick. The rule commonly used is the ''time priority rule:'' orders execute according to the sequence in which they were placed, with the first to arrive being the first to execute. Time priority is valuable in call auction trading as it gives participants an incentive to place their orders earlier in the precall, order entry period.[4]

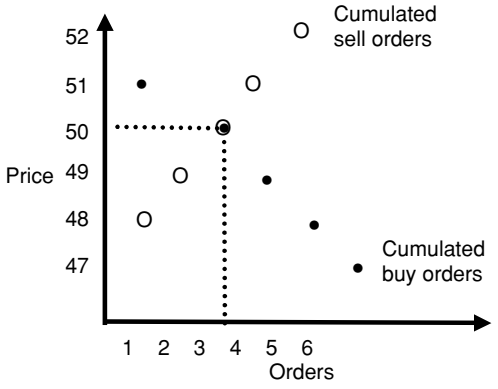

Figure 35.4. Matching of the cumulated buy &sell orders

35.4. Relationship Between Limit and Market Orders

Limit orders and market orders are very different order types in continuous trading, but are virtually the same in call auction trading. For continuous markets, limit orders set the prices at which market orders execute, and limit orders sitting on the book provide immediacy to the market orders (i.e. the market orders execute upon arrival). Limit order traders are willing to wait patiently for an execution and they are the liquidity providers. In a continuous market, market order traders demand immediate liquidity.

In contrast, market orders in the call environment are nothing more than extremely aggressively priced limit orders. Specifically, a market order to buy has an effective price limit of infinity and a market order to sell has an effective price limit of zero. Participants in a call auction all wait until the next call for their orders to execute, and thus market orders in a call auction do not receive immediacy as they do in continuous trading. The distinction in continuous trading that limit order placers supply liquidity while market order placers demand liquidity, does not apply to call auction trading. In a call auction, all participants supply liquidity to each other. However, with an open book call, those participants who place their orders early in the precall order entry period are key to the book building process. As we discuss further below, early order placers are the catalysts for liquidity supply.

35.5. The Electronic Call Auction

Over 100 years ago, the New York Stock Exchange was a call market (nonelectronic, of course). In some respects, the nonelectronic call was a fine system for participants on the exchange floor but it had deficiencies for anybody away from the floor. Investors not physically present had little knowledge of what was happening (the calls offered no transparency), and access to trading was limited because shares of a stock could be exchanged only periodically (when the market for the stock was called). On May 8, 1869, the call procedure was abandoned when the NYSE merged with a competing exchange, the Open Board of Brokers, and became a continuous trading environment.

The Tel-Aviv Stock Exchange through the 1970s and the Paris Bourse before the 1986 introduction of its electronic market, CAC (the acronym stands for "*Cotation Assistée en Continu*"), were also nonelectronic call auctions that did not survive.

Call auction trading had been very popular with continental European exchanges in the earlier days when they still had floor trading. But with growing competition among exchanges, continuous trading became increasingly popular. This went hand-in-hand with extended trading hours. Both developments meant that the volume at the opening call got thinner and its importance was reduced. The widespread trend to fully automated trading of most European exchanges, however, has allowed for new solutions and combinations.

In recent years, tremendous advances in information technology and a slew of other developments in the industry have paved the way for the call's reentry. With an electronic open limit order book, participants anywhere around the globe are able to see the auction as it forms, and can enter their own orders with electronic speed. Compared to traditional floor trading, electronic trading offers new flexibilities for fine-tuning market architecture. Automated order book trading usually starts with an opening call and uses a call to resume trading after any halt. As noted, the major European exchanges and NASDAQ have also introduced closing electronic calls, particularly to provide "better" closing prices. For securities with little liquidity and less frequent trading, one or two calls per day may suffice.

While information technology (IT) can be used advantageously in continuous trading, it is essential for efficient call auction trading. Moreover, the call auction is an extremely good environment for the application of IT. In a continuous market, IT speeds up the rate at which orders can be submitted, displayed, and turned into trades, and in so doing, it accentuates the importance of nanoseconds. In an electronic call auction environment, on the other hand, IT is used to sort and cumulate orders, and to find the clearing prices. In a call auction, the computer is used to do one thing in particular that it was created to do, namely, to compute.

The electronic call auction is appealing for small and mid-cap stocks because order batching augments the efficiency of liquidity provision by focusing liquidity at specific points in time. The procedure also has particular appeal for the large cap stocks, because it caters to the needs of institutional participants whose portfolios are mostly comprised of these issues. Market impact is reduced for the institutional investor because the call is a point in time meeting place, and as noted, batching orders in a multilateral trade focuses liquidity. For all stocks, commissions may be lower due to the greater ease of handling orders and clearing trades in the call auction environment.

For the broad market, electronic call auctions can reduce short-period (e.g. intra-day) price volatility, unreliable pricing, unequal access to the market, and various forms of manipulation and abuse.[5] Further, the electronic call auction is an explicit price discovery facility. That is, batching many orders together for simultaneous execution at a single price produces a consensus value that

better reflects the broad market's desire to hold shares. Consequently, the electronic call auction is a good opening facility for the continuous order driven market. Moreover, because it is an explicit price discovery facility, call auction trading can be used to dampen short-period (e.g. intraday) price volatility.

One feature of call auction trading that has been thought by some to be a drawback is that it does not provide transactional immediacy (participants have to wait for a call). With call and continuous trading combined in a hybrid market structure, this limitation ceases to be a deficiency. And, in any event, immediacy involves a cost (bid–ask spreads and market impact costs) that not all investors wish to pay. Retail and institutional customers who place limit orders are not looking for immediate executions and many institutional customers are more concerned with anonymity and keeping trading costs low than with obtaining immediate executions.

To deliver its promise of being a highly efficient trading environment, a call auction must attract sufficient volume. To accomplish this, some order placers must be incented to enter their orders early in the precall order entry period. The early stages of book building cannot be taken for granted, however, especially for an auction that opens the market at the start of a trading day. Some participants, particularly big institutional customers, are reluctant to post orders, an act that may reveal their trading intentions when the book is thin. Nevertheless, early order placers, the catalysts for liquidity supply, are needed. Two incentives for early order placement are (1) the use of time priorities and (2) reduced commission rates for early order entry. The inclusion of retail customers who are less concerned that their small orders will have any meaningful impact on the clearing price also helps. Lastly, a market maker could play an important role in animating book building during the precall order entry period.

NOTES

1. Adapted from Robert A. Schwartz and Reto Francioni (2004), *Equity Markets in Action: The Fundamentals of Market Structure and Trading,* John Wiley (Copyright © 2004 Robert A. Schwartz and Reto Francioni; This material is used by permission of John Wiley); and Robert A. Schwartz, (2003) "The Call Auction Alternative," In Robert A. Schwartz, John Aidan Byrne and Antoinette Colaninno (eds.) *Call Auction Trading: New Answers to Old Questions*, Kluwer Academic Publishers (Springer).
2. In a quote driven market, the quotes of a dealer or market maker establish the prices at which others can trade by market order.
3. The Paris Stock Exchange's market, before the Bourse introduced electronic trading in 1986, was a classic price scan call auction. When the market for a stock was called, an auctioneer would cry out one price after another, scanning the range of possibilities, until an acceptable balance was found between the buy and sell orders.
4. Further situations can be described that require more complex rules of order execution. As is typically the case, the set of decision rules required for an actual operating system is far more complicated than those we need consider to achieve a basic understanding of a system.
5. For further discussion of the properties of call auction trading, see Cohen and Schwartz (1989), Economides and Schwartz (1995), and Schwartz, Francioni and Weber (2006), Chapter 4.

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