

FINA 4103

Class Note 2: Market Structure and Trading
Mechanism

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Fall 2026

Market Microstructure

Garman (1976, JFE) coined the term “microstructure”



Journal of Financial Economics

Volume 3, Issue 3, June 1976, Pages 257-275



Market microstructure ☆

Mark B. Garman

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[https://doi.org/10.1016/0304-405X\(76\)90006-4](https://doi.org/10.1016/0304-405X(76)90006-4) ↗

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Abstract

It is assumed that a collection of market agents can be treated as a statistical ensemble. Their market activities are depicted as the stochastic generation of market orders according to a Poisson process. The objective is to effectively describe the 'temporal microstructure', or moment-to-moment trading activities in asset markets. Two basic models, 'dealership' vs. 'auction' markets (and their variants) are put forth. Implications are drawn from each model. The implications include several testable hypotheses regarding the aggregate behavior of markets and market-makers as well as some qualitative insight into the transaction-to-transaction nature of realistic exchange processes.

Market Microstructure

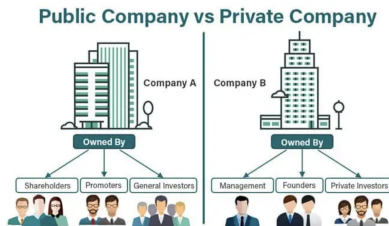
A few questions highlight needs for market structure knowledge

- ▶ Are all markets the same? —No
- ▶ Why not? How are they different?

Example: Private Stocks

Trading public stocks vs. private stocks

- ▶ Company XYZ issues pre-IPO stocks (equities)
 - ▶ Not publicly listed. Who hold them?
 - ▶ Traded by bilateral negotiation (brokers and company involved)
- ▶ Obviously different from trading publicly listed stocks
- ▶ How to compare the price efficiency of XYZ and AAPL?



Example: Bonds (Fixed Income Assets)

Bonds vs. stocks

Trading equities (stocks) vs. trading bonds

- ▶ Publicly listed stocks: traded on centralized LOB
- ▶ Bonds:
 - ▶ OTC trading in secondary market
 - ▶ Auctions for newly issued bonds in primary market
- ▶ Do auctions achieve higher market quality than centralized LOB?
How about OTC?

Example: Stocks

Different order execution protocols

Trading stocks at different venues using different methods

- ▶ Dealer markets vs double auction?

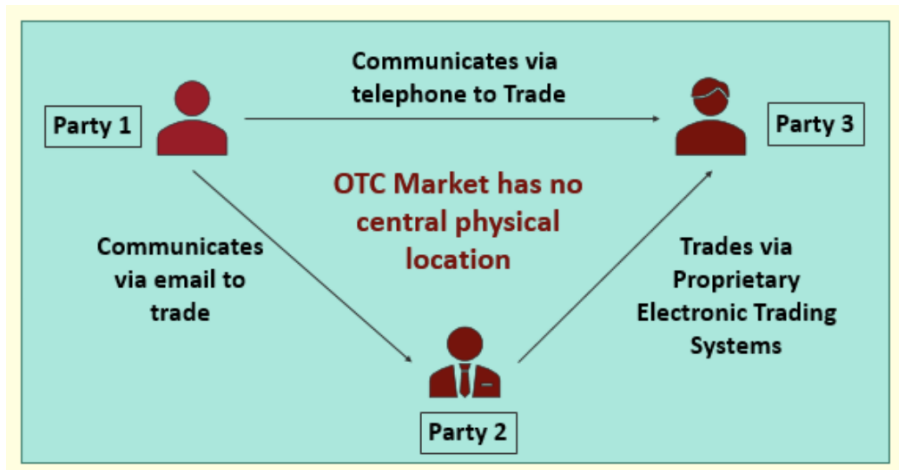


Market Structures

- ▶ Markets are all different in many aspects
 - ▶ Timing (speed), order matching and handling, flexibility, fungibility, liquidity, pricing, etc
- ▶ Several types of markets, broadly classified:
 - ▶ Over-the-Counter (OTC) markets
 - ▶ Fixing and Auctions
 - ▶ **Continuous Trading with CLOB**

Over-the-Counter Market

Over-the-Counter Market



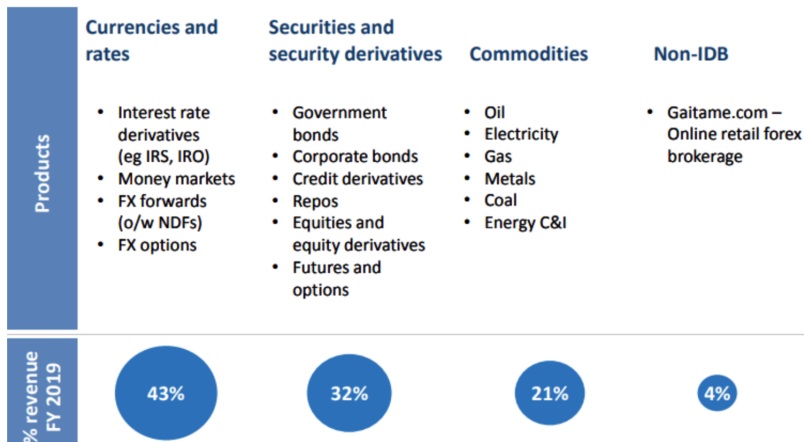
OTC: What Assets?

OTC markets typically trade non-standard (non-popular) securities

- ▶ Low liquidity: not many investors want to trade
 - ▶ Mortgages on housing
 - ▶ Tranches of CDO
 - ▶ Synthetic derivative securities
- ▶ But more flexible: contracts can be custom-tailored
- ▶ Foreign exchanges and (gov and corporate) bonds are also traded OTC

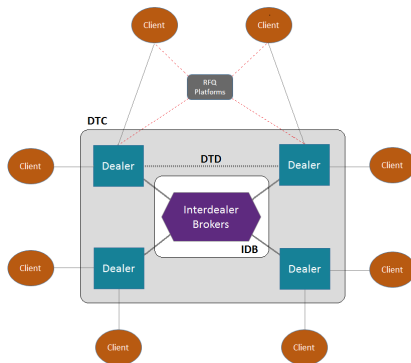
OTC: What Assets?

OTC-traded assets



Source: Tradition's Q4 '19 presentation

OTC: Who and How?



- ▶ **Dealer-customer** and **inter-dealer** markets
- ▶ Called “decentralized” market¹

¹Blockchain-based trading is also called decentralized; different meanings

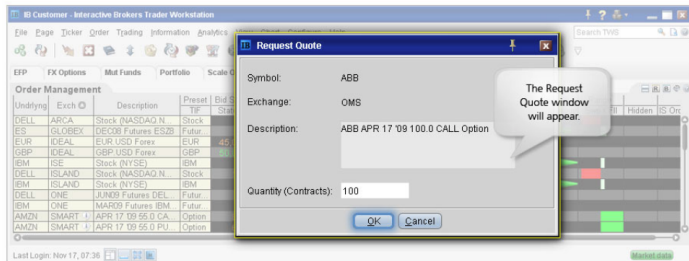
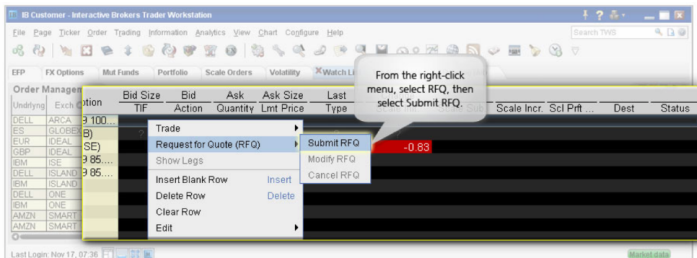
Dealer-Customer OTC

Dealer-customer markets:

- ▶ Clients (you and me) ask dealers (banks) for trading opportunities
 - ▶ Ask for availability of specific securities and prices (quotes)
- ▶ Traditionally, over the phone, email, f2f communication
- ▶ 2000's ~ electronic "Request for Quote (RFQ)" platforms
 - ▶ Contact multiple dealers to learn potential terms of trade

RFQ Platform

► Example from HKFE



Inter-Dealer OTC

Inter-dealer markets:

- ▶ Dealers also trade with each other (why?)
- ▶ Tends to be more stylized and liquid than customer-dealer
- ▶ It looks more like a centralized LOB

How exactly quotes are made/requested/executed?

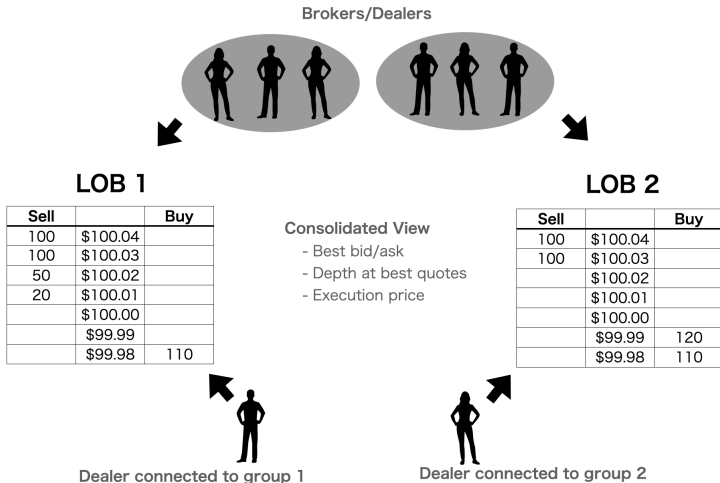
- ▶ Inter-dealer brokers (IDB)
- ▶ RFQ
- ▶ Electronic Communication Networks (ECNs)

Electronic Communication Network

Example from FX Market

- ▶ ECNs: networks connecting multiple market participants directly
- ▶ Each participant can post/observe quotes like LOB
 - ▶ Can place and execute orders
 - ▶ Anonymous
- ▶ Before 2000s, FX markets are plain-vanilla OTC
- ▶ Now, two major electronic brokers for inter-dealer spot trading
 - ▶ Reuters (Refinitiv) and Electronic Broking Services
 - ▶ Organize LOBs, dealers submit quotes, trade, and use as reference

Electronic Communication Network



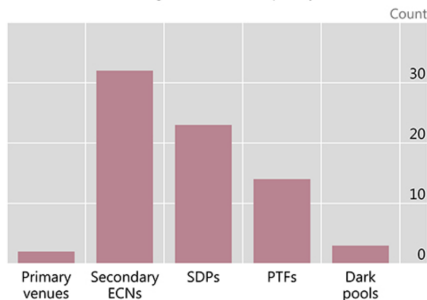
Electronic Communication Network and Others

- ▶ Customers:
 - ▶ More than 30 secondary ECNs
 - ▶ More than 20 dealers holding single-dealer proprietary platform (SDP)
 - ▶ Other primary trading firms (PTFs)
- ▶ More heterogeneous and opaque than inter-dealer

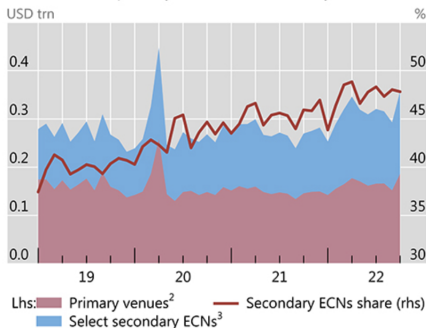
Evolution and Recent Changes

FX markets as an example

A. Number of trading venues and liquidity sources¹



B. Volumes on primary and select secondary venues



¹ Primary venues: CME/NEX EBS Market and Refinitiv/Reuters Matching; Secondary ECNs: a variety of anonymous and disclosed multi-dealer platforms; SDPs: proprietary single-dealer platforms of FX dealer banks; PTFs: principal trading firms. Dark pools: electronic venues where information about traders' orders is not revealed to other participants. ² CME/NEX EBS and Refinitiv spot turnover (a proxy for trading volumes on EBS Market and Refinitiv/Reuters CLOBs). ³ 360T, Cboe FX (Hotspot); Euronext FX (Fastmatch); FXSpotStream.

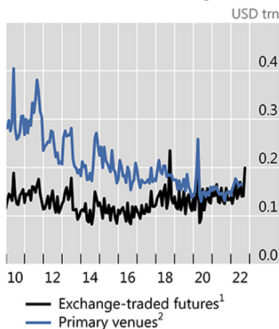
Sources: CBOE; CME; Deutsche Borse; Euronext; FXSpotStream; MarketFactory; Refinitiv; BIS.

Evolution and Recent Changes

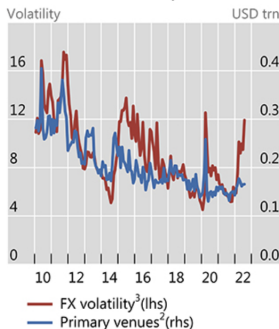
FX markets as an example

- ▶ Primary venues (LOBs, like Reuters) are losing volumes (why?)
- ▶ It co-moves with volatility measure (why?)

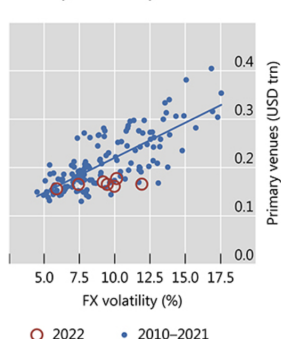
A. Trading volumes on primary venues and futures exchange



B. Trading volumes on primary venues and FX volatility



C. Trading on primary venues and FX volatility, historically and in 2022⁴



¹ Exchanged-traded currency futures turnover, all exchanges. ² CME/NEX EBS and Refinitiv spot turnover (a proxy for trading volumes on EBS Market and Refinitiv/Reuters CLOBs). ³ Deutsche Bank USD volatility index (DBCX) average mid-price. ⁴ R-squared = 0.6.

Sources: Refinitiv; BIS exchange-traded derivatives statistics; BIS.

Potential Explanations for Recent Trend

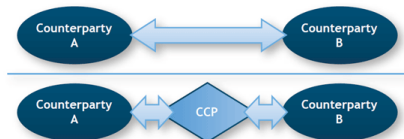
- ▶ Recall that inter-dealer markets are to unwind dealers' off-the-target positions
 - ▶ Related to the # of dealers?
 - ▶ Other systems than primary platforms?
 - ▶ Market volatility?

Risk and Costs in OTC Markets

- ▶ Heterogeneous trading mechanisms (including LOB) coexist
 - ▶ Different mechanisms offer different price and execution quality
 - ▶ The whole market structure/quality is often opaque
- ▶ OTC vs centralized LOB?
 - ▶ Transparency?
 - ▶ Order execution mechanism?
- ▶ What risks and costs traders expect to incur by trading through OTC?
 - ▶ Ex-ante:
 - ▶ Ex-post:

Central Clearing to Mitigate the Risk

- ▶ Synthetic derivatives and securitized assets traded via OTC contributed GFC in late 2000
 - ▶ Huge counterparty risk but was ambiguous (or obscured)
- ▶ To make OTC robust, major countries introduced **Central Counterparty, CCP** (Basel CBS, 2013)
 - ▶ Intermediary to take inventory and margin
 - ▶ Default by a single player has only a limited impact



- ▶ Not fully applied: only interest-rate swap and CDS

Over-the-Counter Markets

- ▶ Overall, OTC is characterized by decentralized trading
 - ▶ Heterogeneous assets, each with low liquidity, but high flexibility
 - ▶ Search-matching frictions, counterparty risk
- ▶ Recent tech development leads to more fragmentation
 - ▶ LOB-like trading mechanism and secondary ECNs
 - ▶ Due to the lack of wholistic data, difficult to address its impact

Auction

Fixing and Auctions



- ▶ Fixing is a type of auctions, but different motivation
 - ▶ Fixing: determine a single reference price
 - ▶ Auctions: allocation of assets

Fixing and Auctions

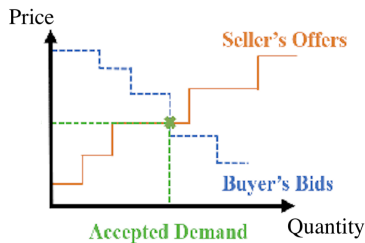
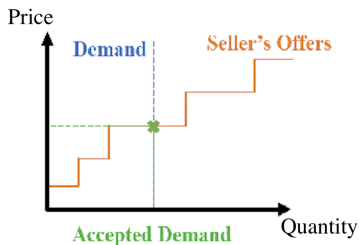
- ▶ Fixing:
 - ▶ Auction-type mechanism to set the price of a product
 - ▶ Limited participants submit buy and sell (on behalf of clients)
 - ▶ Could be collusive (illegal)
- ▶ Ex, London Fixing for precious metals
 - ▶ For gold, London Fixing Members solicit buy and sell
 - ▶ Set and announce the price twice a day (10:30 and 15:00), clearing demand/supply
 - ▶ Used as a reference price for gold trading

Fixing and Auctions

Auctions are typically held along with continuous markets

- ▶ Primary markets
 - ▶ US Government bonds
 - ▶ Arts, Commodities, Airport slots, etc
- ▶ Efficient way to handle high volume and volatility
 - ▶ Opening/Closing auctions, halting and resuming separated trading sessions
- ▶ In finance, typically single- and double-auctions
 - ▶ Microeconomics (game theory) makes it clear about specific structures

Single versus Double Auctions



Single-sided Auctions

Single-sided auctions:

- ▶ Demand or supply is solicited for each price; the other side is fixed
 - ▶ First-price auctions (“Dutch”)
 - ▶ Second-price auctions (“English”)
 - ▶ All-pay auctions, etc
 - ⇒ Revenue equivalence theorem

Leading example: primary market for US Treasury

- ▶ First-price one-sided auction (\$trillion/quarter)

Double Auctions

- ▶ Many traders both on the buy and sell sides, proposing prices and quantities
- ▶ Leon Walras proposed the clearing mechanism²
 1. The auctioneer announces a tentative price p_0
 2. Bidders and sellers announce how much they are willing to trade, $D(p_0)$ and $S(p_0)$
 3. Compare D and S :
 - ▶ If $D(p_0) > S(p_0)$, announce a new price $p_1 > p_0$; go to the first step
 - ▶ If $D(p_0) < S(p_0)$, announce a new price $p_1 < p_0$; go to the first step
 - ▶ If $D(p_0) = S(p_0)$, its done. Market clears at $p = p_0$
- ▶ Is this good?

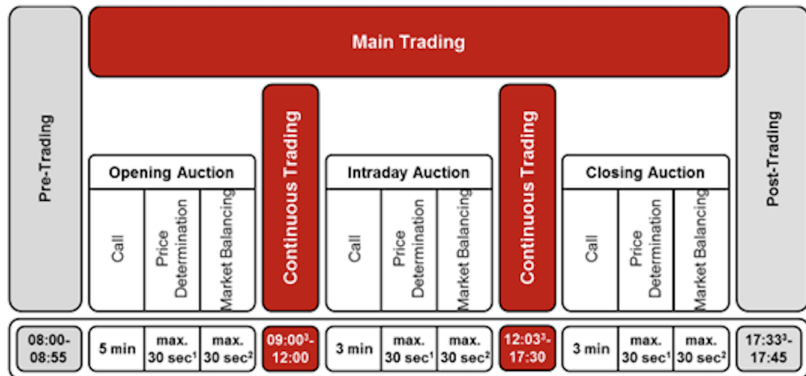
²Some jargons; Walrasian equilibrium, Walrasian auctioneers, etc

Double Auctions

- ▶ The algorithm is NP-hard if there is friction
 - ▶ Non-linear preference, trading costs, etc
- ▶ Possibly multiple equilibria (many p^* such that $D(p^*) = S(p^*)$)
- ▶ The real market does not work like this
 - ▶ Traders can deviate from algorithm by waiting (delaying)
 - ▶ Sealed bids and offers are available
 - ▶ Sequential auctions
- ▶ Mispricing may prevail (mechanism design question)
- ▶ Will see this in more detail in our LOB analyses

Auctions in Financial Markets

Stock exchanges hold auctions to start and close trading days



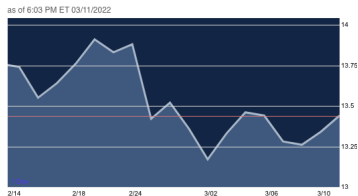
¹ random end | ² first 15 seconds being reserved for preferential access for Specialist and Market Maker | ³ earliest beginning

Opening and Closing Auctions

- ▶ Call auction phase:
 - ▶ traders submit quotes and quantities to the system
 - ▶ basically limit and market orders
 - ▶ the system displays only limited information
 - ▶ e.g., indicative execution price and quantity
 - ▶ not a full order book (depend on exchanges)
 - ▶ ends at random time period (why?)
- ▶ Price determination phase:
 - ▶ determines the price to maximize the volume of trade
- ▶ Market balancing phase:
 - ▶ market makers absorb excess demand/supply at the clearing price

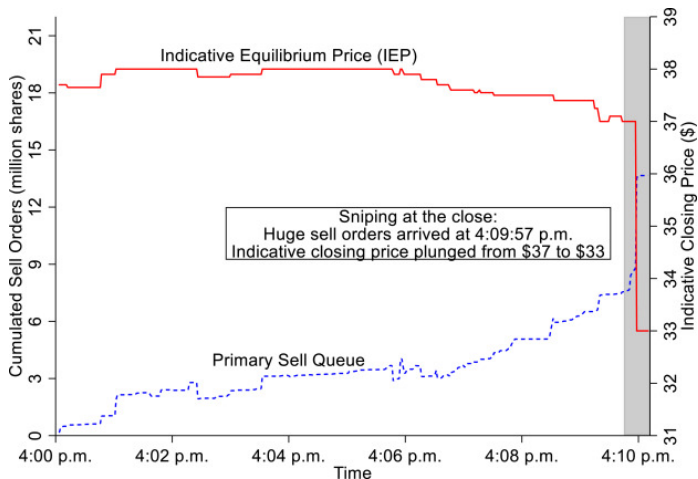
Opening and Closing Auctions

- ▶ Opening price: good reference point to start a trading session
- ▶ Closing prices are also informative; used to compute
 - ▶ Mutual funds NAVs
 - ▶ Margin requirement
 - ▶ Mark-to-market flow
 - ▶ Prices for index inclusion/exclusion
 - ▶ Derivative contracts' execution



Do they really work?

Gaming an auction



Source: Park et al., (2022, JFM)

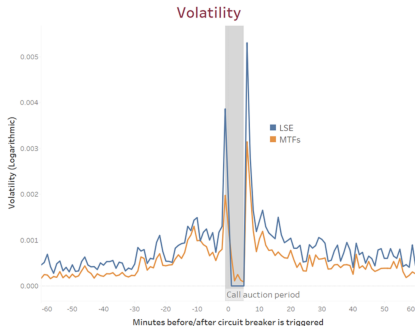
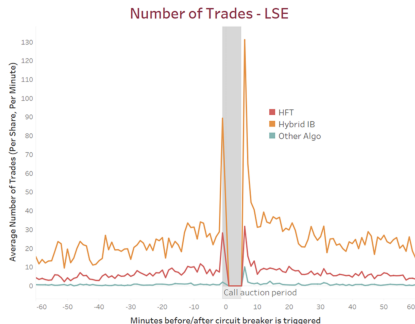
Do they really work?

Gaming an auction

- ▶ LSE's close auctions publish real-time indicative information
- ▶ Known end time for less liquid securities
 - ▶ Could post and cancel orders to “flush out” other traders (no penalty)
 - ▶ Before end time, the market was economically bogus
 - ▶ Resulted in some volatile closings and price inefficiency
- ▶ In 2003, random end time is introduced

Irregular Trading Pause: Circuit Breaker and Volatility Interruptions

- ▶ Equity markets halt trading when markets are super volatile
 - ▶ Significant news, severe order imbalances, etc



Circuit Breaker, Volatility Interruptions

- ▶ Before re-opening normal trading, they hold auctions
 - ▶ Re-opening time is published
 - ▶ Indicative price and order imbalance are published
 - ▶ Auction, and then re-open
- ▶ Good market structure?
 - ▶ Chen et al. (2024, JF) “The Dark Side of Circuit Breakers”
 - ▶ Trading halt makes market even more volatile and fragile

Centralized Stock Exchanges

Overview

Dealers Market and Specialists Market

- ▶ Exchanges (and trading mechanism therein) = intermediary
- ▶ Most modern exchanges use LOB (= double auction)
- ▶ But auctions are held in different manners at different exchanges
 - ▶ (i) automated order-matching tech; and
 - ▶ (ii) specialists
- ▶ NYSE and AMEX use specialist auctions
- ▶ NASDAQ uses dealer markets with automated LOB

NYSE: Specialist Markets (or Auction Market)

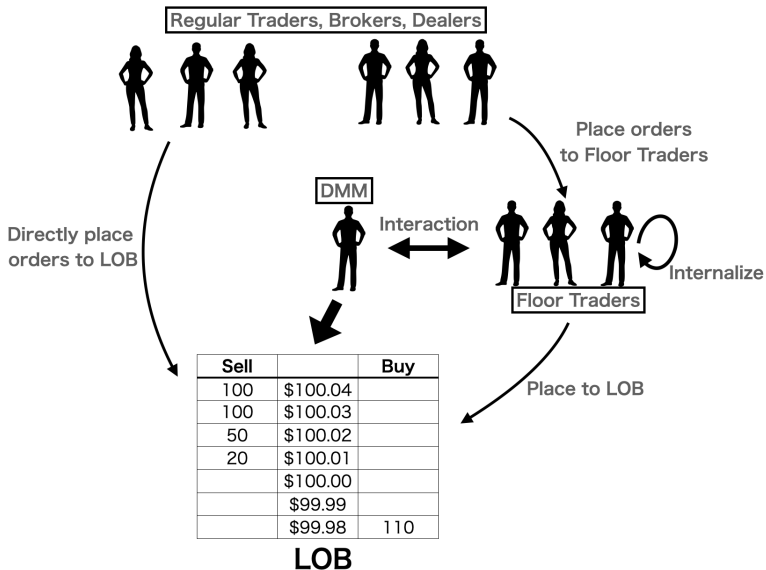
- ▶ They are specialists called **Designated Market Makers**. What do they do?



Specialist Markets

- ▶ A DMM is assigned a specific stock
 - ▶ Hold double-auctions as a market maker
 - ▶ They do not buy and sell *for profits*
 - ▶ Prohibited from outbid or offer floor traders for profits
- ▶ Their role is to “maintain a fair and orderly market” (NYSE, code 12a)
 - ▶ Receive orders from traders and execute as auctioneers
- ▶ If market faces disturbance, intervene by actively buying/selling

Specialist Markets

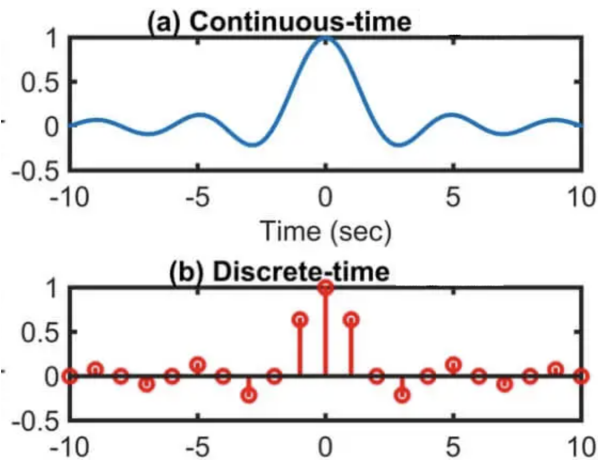


NASDAQ: Pure-Electronic Market

- ▶ Auctions can be held via automated matching algorithm
- ▶ NASDAQ and others do not have floor trading (and DMMs)
 - ▶ traders submit quotes, LOB displays them
 - ▶ other incoming orders are matched at best available prices on LOB
- ▶ Replicate human specialists
 - ▶ limit orders stand ready to accept/offer incoming traders
- ▶ **Registered market makers** play a role similar to DMM
 - ▶ They are dealers, allowed to trade *for profits*
 - ▶ But competition ensures fair liquidity provision

Continuous Trading

- ▶ Continuous vs. discrete trading (time)

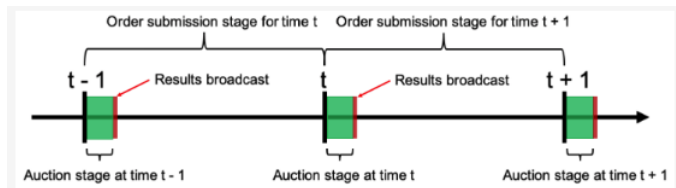


Continuous Trading

- ▶ Continuous trading (or continuous limit-order market)
 - ▶ Incoming orders are handled/executed in continuous manner
 - ▶ If your order arrives at time t , it is handled at time t (with potential latency)
- ▶ The price-time priority on the limit-order book protocol
 - ▶ Orders with better prices are executed first
 - ▶ First come, first served if offering the same price
- ▶ Actual trades happen in discrete manner (from data POV)

Discrete Trading

- ▶ Discrete market?
 - ▶ Referred to as “batch trading (auction)” or “periodic trading”
- ▶ Ex., opening auctions, trading on blockchain
 - ▶ Collect orders for a certain time interval and execute them as batch



- ▶ Frequent batch auction (FBA)
 - ▶ [Budish et al, \(2016, QJE\)](#) as a solution to HFT arms race
 - ▶ Does it work? Is it implemented?

Pros and Cons of Continuous Trading

Pros: the faster, the better(?)

- ▶ Price efficiency:
 - ▶ Market reflects new information in timely manner
- ▶ Liquidity:
 - ▶ Market makers provide liquidity in continuous manner
 - ▶ Investors can fulfill trading needs immediately
 - ▶ Ambiguous impact on bid-ask spread

Pros and Cons of Continuous Trading

Cons: facilitates special-purpose investment (can be wasteful)

- ▶ Additional dimension of information acquisition—speed
 - ▶ Speed of information acquisition, processing, reaction, etc
 - ▶ Causing HFT arms race and “phantom liquidity”
- ▶ You and your rival receive the same news at the same time
 - ▶ But you can trade on it faster than your rival
- ▶ Ex., \$300 Billion to connect NY and Chicago

Our Focus

- ▶ We will (mostly) focus on the market structures of continuous markets
- ▶ Not on periodic auctions nor OTC
 - ▶ They are often illiquid
 - ▶ Too heterogeneous to capture
- ▶ Also not analyze trading outside of trading hours

Our Plan

- ▶ More on microstructures
- ▶ Basics:
 - ▶ Orders, quotes, trades, traders
 - ▶ Trading rules (in the US)
- ▶ Continuous markets
 - ▶ How does the market handle and execute orders
 - ▶ How is the price determined?
- ▶ Metrics/models of liquidity and price efficiency