Market Microstructure

Equity/Stock markets in US:

- NYSE 15% (New York Stock Exchange)
- NASD 15%
- ARCA
- BATS ---> BZX (direct), BYX (reverse)
- EDGE ---> EDGX (direct), EDGY (reverse)

Limit order books, closing and opening auctions

- Dark pools/Crossing Engines: GS, MS, JPM, CS

Order types:

Limit orders for continuous trading:

Buy N-shares of stock XYZ at LimitPrice

Market orders:

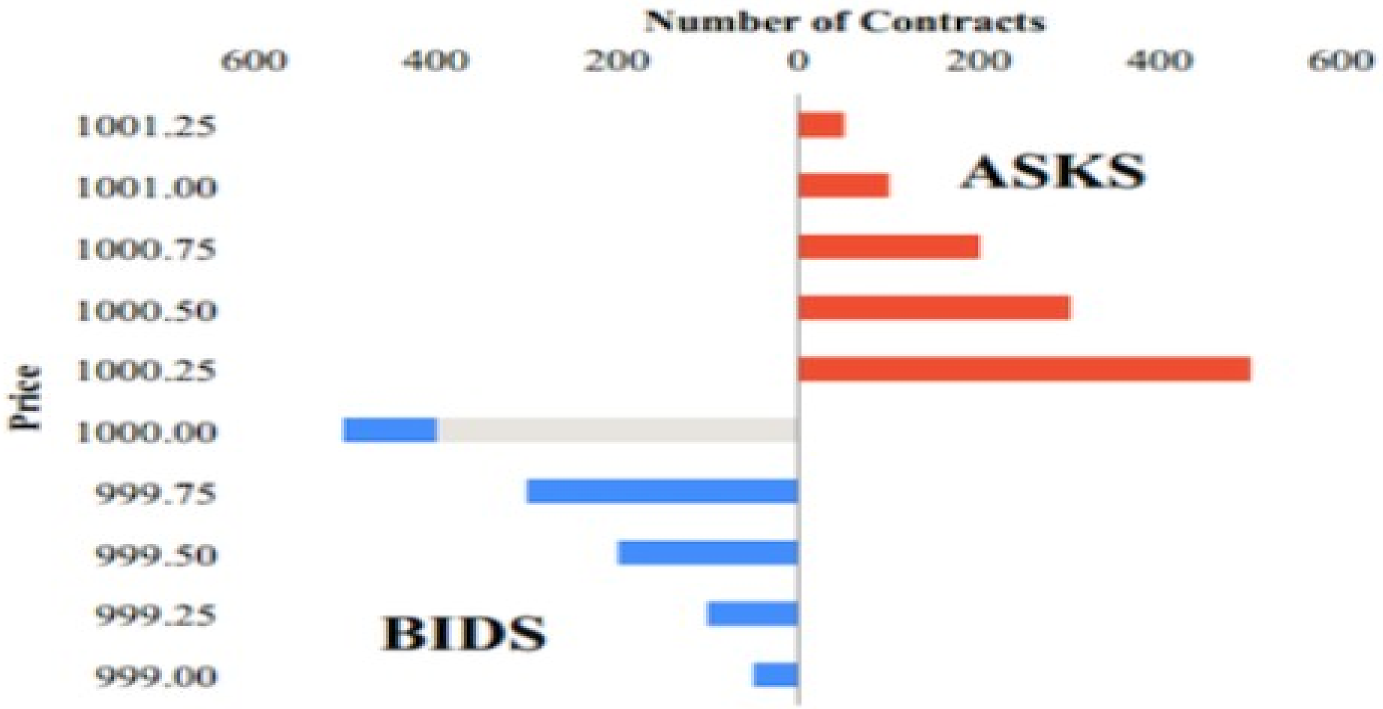
Buy N-shares of stock XYZ at any price (marketable order)

For orders participating in the Opening and Closing auctions eg. NYSE:

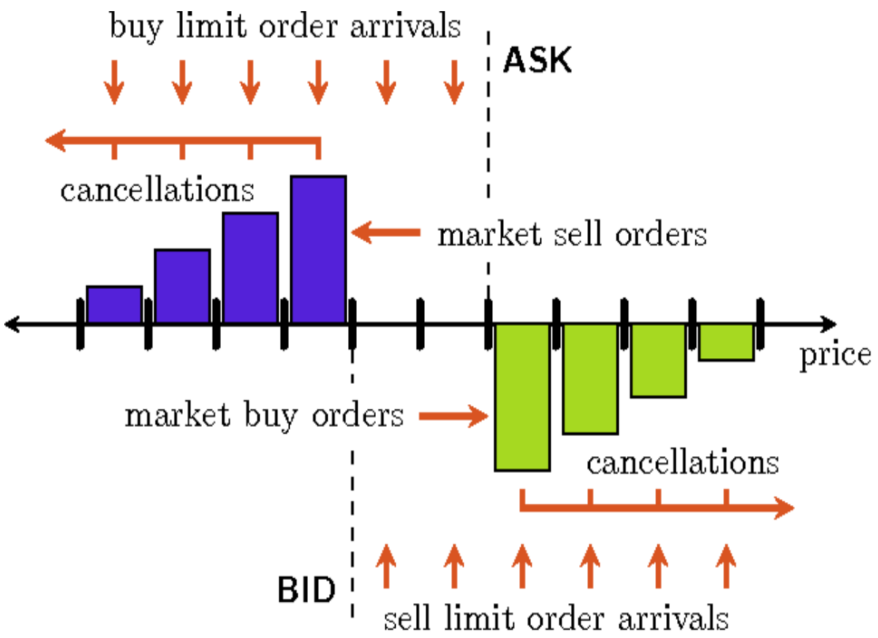
LOO - limit on open, LOC - limit on close

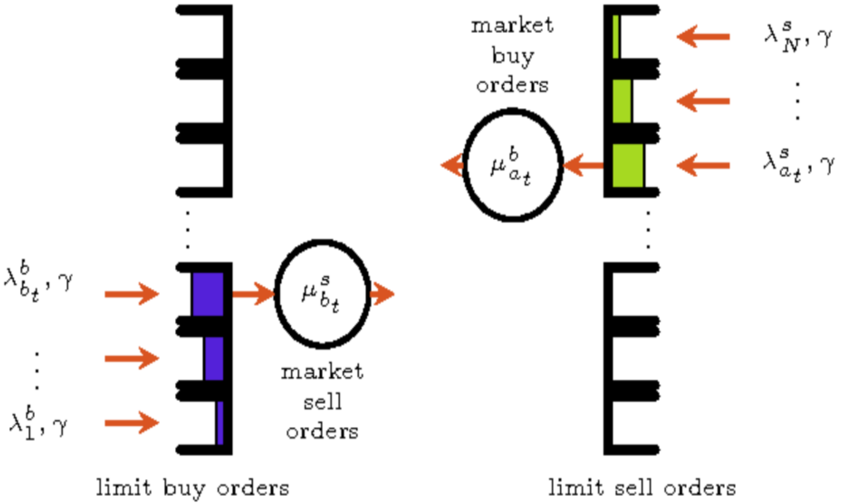
MOO - market on open, MOC - market on close

Limit Order Book



Limit Order Book (2)





Tick Data and Trading

Level 1: quotes: ticker, time_stamp, Best Bid/Ask BidSize/AskSize

trades: ticker, time_stamp, TradePrice, TradeSize

Trades: Price Size	Quotes:	
	IBM 10:00:01 101/102 200x300	
IBM 10:00:02 102 100		
	IBM 10:00:03 101/102 200x200	Size at best ask level decreased as a result of the trade
	IBM 10:00:03 101/102 200x100	Cancelation of the ask (Sell order canceled)
IBM 10:00:04 102 100		
	IBM 10:00:03 101/103 200x500	Ask price changed, since the offer was taken by “agressive” buy order

Level 2: Detailed Limit Order Book

Bid/Ask bounce (Roll model)

Roll (1984)

- The bid-ask spread complicates research, since we don't observe the true price.
  - We have three prices: bid, P^b, ask, P^a, and true price, P^*.
  - The true price is often between P^a and P^b, although it need not be.
  - How do we define returns: From P^a to P^a, P^b to P^b , P^b to P^a...?
  - How is $P^a - P^b$ determined?
- It is fairly intuitive that the bid-ask spread has an effect on returns.
- Roll (1984) provides a simple model of how the bid-ask spread might impact the time-series properties of returns.
- Roll (1984) provides most of the intuition and the framework on how financial economists think about the bid-ask spread.

Roll model (2)

- The observed market price is

$$P_t = P_t^* + q_t\, s/2\ .$$

  P_t^*: fundamental price in a frictionless economy
  s: bid-ask spread (independent of the P_t level)
  q_t: iid index variable -takes values of 1 with prob. 0.5 (buy)
  -takes value of -1 with prob. 0.5 (sell).
- q_t is unobservable. But, with the assumptions, $E[q_t] = 0$ and $Var(q_t) = 1$.

- For simplicity assume that P_t^* does not change - $Var(\Delta P_t^*)=0$.

- The change in price is:

$$\Delta P_t = \Delta P_t^* + q_t\, s/2 - q_{t-1}\, s/2 = \Delta P_t^* + c\, \Delta q_t. \quad (c=s/2)$$

- Its variance, covariance, and correlation are:

$$Var(\Delta P_t) = Var(\Delta P_t^*) + c^2\, Var(I_t) + c^2\, Var(I_t) = 2c^2 \ \ (= s^2/2)$$
$$Cov(\Delta P_t, \Delta P_{t-1}) = -c^2$$
$$Cov(\Delta P_t, \Delta P_{t-k}) = 0;\ k > 1$$
$$Corr\ (\Delta P_t, \Delta P_{t-1}) = -1/2$$

Roll model (3)

• The fundamental value is fixed, but there is variation from c.
• The bid-ask spread induces negative correlation in returns even in the absence of other fluctuations.
• The variance and covariance depend on the magnitude of the bid-ask spread.
• In this particular example, it induces a 1st-order serial correlation.

• We can also express the spread as a function of the covariance:

$$c = [-\mathrm{Cov}(\Delta P_t, \Delta P_{t-1})]^{-1/2}$$

• In practice, we can find $\mathrm{Cov}(\Delta P_t, \Delta P_{t-1})] > 0$. (Misspecification?: Glosten and Harris (1988) and Stoll (1989).)

• To avoid this problem, Roll (1984) defines the spread as

$$c = -\,[|\mathrm{Cov}(\Delta P_t, \Delta P_{t-1})|]^{-1/2}$$

Roll calls s(=2c) the "effective spread," which is estimable.