Module 8 - Price Discovery, Liquidity, Market Fragmentation

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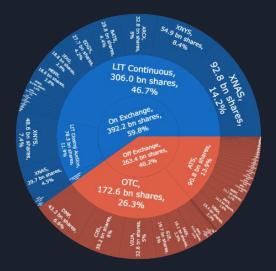
Price Discovery Process

- Fundamental analysis by analysts
- Asset pricing by quantitative models
- Law of one price (no arbitrage) by algorithmic trading models
    - Pricing model to compute "fair mid"
    - Bid/ask spread adjustments
    - Mark or take orders to provide liquidity or to arbitrage away trading opportunities
    - Executions and risk updates
    - Incorporate new information to pricing model
- Ultimately, multiple counterparties selectively reveal information in exchange for information ultimately leading to a trade and new prices on order book

Market Liquidity

- Liquidity means "possibility of immediate execution of a transaction"
- Liquid market leads to market efficiency
- Definition
  - Depth - large quantity available for sale above "current market price"
  - Breadth - has many participations, without monopoly
  - Resiliency - small temporal market impact
- Bid/ask spread as a function of size

Market Fragmentation

- A security can be traded on multiple venues.
- For example, U.S. equity markets are highly fragmented across multiple exchanges, ECNs and dark pools:

https://www.bmlltech.com/news/market-insight/bmll-market-lens-us-liquidity-maps

Market Fragmentation II

Some implications of a fragmented market include:

- May lead to excessive price dispersion, and harder to determine the actual price
- Outright arbitrage opportunities could arise where markets are "crossed"
- Existence of lead-lag relationship of the same asset on multiple venues has been a primary source of profitability of many HFTs
- Trading cost could increase as compared to centralized trading
    - Less competition because different liquidity providers are operating on different platform, hence may quote larger spread
    - More efforts involved to search for liquidities to trade larger size, brokers may not offer best quotes
    - Trading fees could have otherwise reduced if there are more participants on centralized venue to share the fixed cost of running a market
- Monitoring challenges in market conducts by regulators

Backtesting Approach - Vectorized vs Event-driven

- Event-driven backtesting runs in a loop, feeding input data to your algorithm one tick at a time and collect the output
- Vectorized backtesting feed the entire data history to your algorithm all at once and collect all the outputs in one go
- Vectorized approach is very fast, but inflexible and only suitable for relatively simple setup that do not require interaction of many components in decision making
- Where trading idea cannot be expressed in a vector calculation, because overall logic is complex and consists of multiple structures, then an event-driven approach is most appropriate (but also harder to build correctly)
  - Main challenge is the handling of time and scheduling
  - When running in real-time, wall-clock is the the time
  - When running in backtesting mode, historical timestamp is the time

Accessing Predictive Power of Trading Signals

- When optimizing parameters for a single signal/indicator (e.g. finding the optimal window period in moving average crossover), we need a methodology to verify if the winning configuration (say rank by sharpe ratio) is just a statistical fluke among all the possible configurations (i.e. simply data fitting) or indeed is reliable. This is a multiple testing bias problem when the researcher employs the best performing signal from among multiple candidates, and fails to account for doing so.
- When multiple signals/indicators are combined, there is the overfitting biases problem where highly "significant" backtested construction has no true predictive power.
- Does the winning configuration has predictive power? One way is to apply White's Reality Check.

Trading Performance Metrics

Evaluating trading performance is essential to measure overall quality of a trading system. Some popular metrics are given below:

- max positive return
- min negative return
- max drawdown
- time to target profit
- max drawdown
- Volatility measures e.g. variance or standard deviation
- risk/reward ratios such as Sharpe ratio
- win ratios
- equity curve
- compound annual growth rate (CAGR)
- total net profit

Transaction Costs

Transaction costs include implicit costs and explicit costs of trading a security:

- Bid/ask spreads
- Unfilled trades
- Slippage
- Market impact
- Delay and opportunity costs
- Broker commissions
- Rebates
- Stamp duties
- Exchange fees
- Transaction taxes

Backtesting shall include transaction costs, however implicit costs can be hard to be incorporated correctly.

Classroom exercises: week_08

- A demonstration of technical trading strategy
  - intraday-signal
  - medium -frequency trading
  - Make use of pandas-ta that come with 130+ indicators