Index-based Investment and Intraday Stock Dynamics

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Background

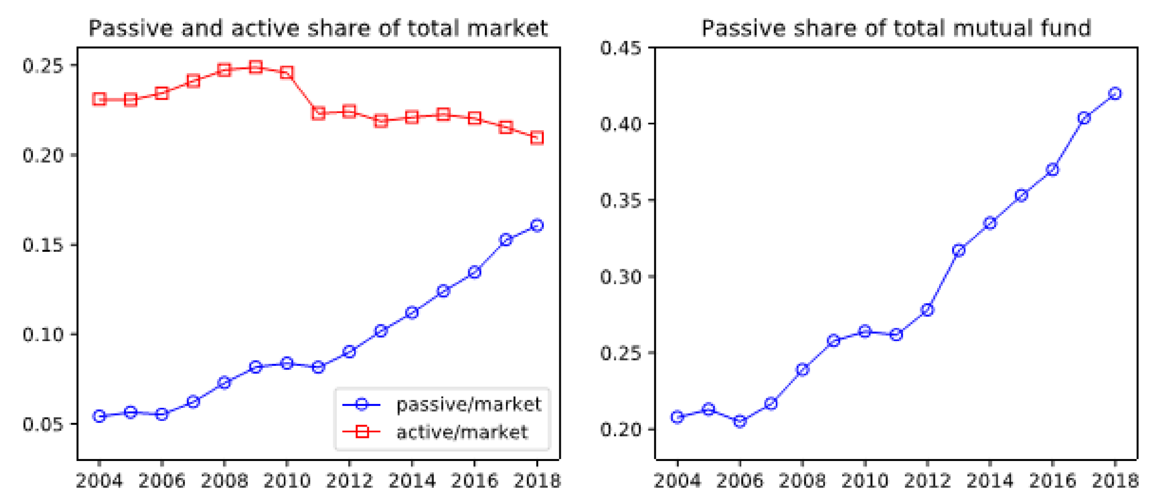
- Two important trends in finance industry in the recent decade
  - prevalence of passive investing and index-based strategies
  - increased usage of high-frequency data
- We connect the two trends by studying the intraday patterns of US stocks, including volume, volatility, correlation, and beta
- We use a large-scale data set that has not been studied in previous literature: second-level trade data for all S&P 500 components from 2003 to 2018.
- We construct efficient and robust estimators to study the general intraday patterns for US large-cap & liquid stocks
- We find the prevalence of index-based strategies and the “active-open, passive-close” liquidity provision leads to informative intraday patterns

Methodology

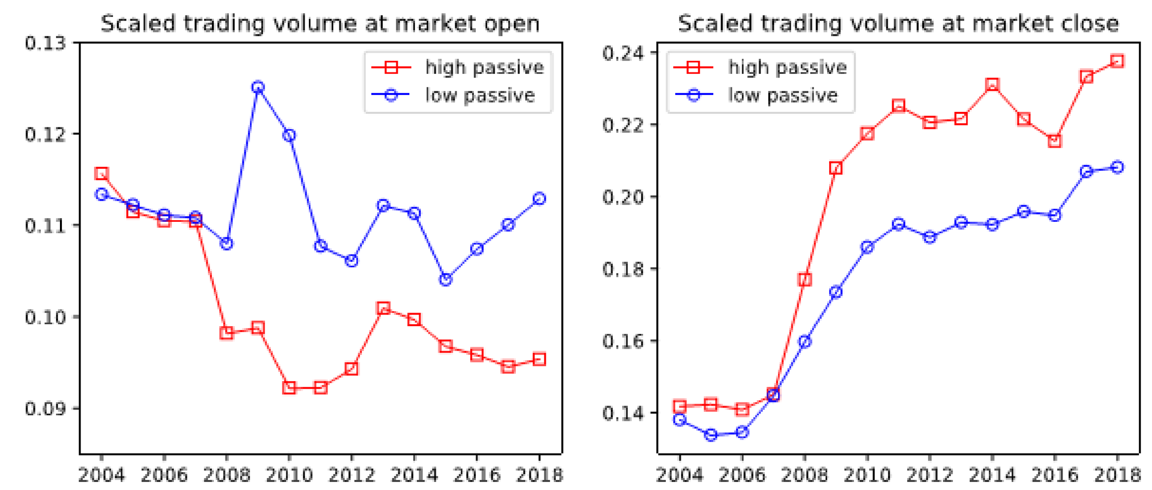
- Traditional estimates for volatility and correlation are severely biased under high-frequency setting
- Market microstructure noise and price observation asynchronicity
- We use the two-scale based estimators in Zhang et al. (2005) and Zhang, which are asymptotically unbiased and efficient to implement
- The two-scale based estimators eliminate the bias by leveraging two sampling scales (a slow and a fast one)
- We compute the intraday quantities for every 30 minutes with a five-minute moving window from 9:30AM to 16PM.

Motivation from Empirical Evidence

- Prevalence of passive investment and index-based strategies in the recent decade



- The “active-open, passive-close” liquidity provision pattern, i.e., more discretionary (index-based) trading at the market open (close)



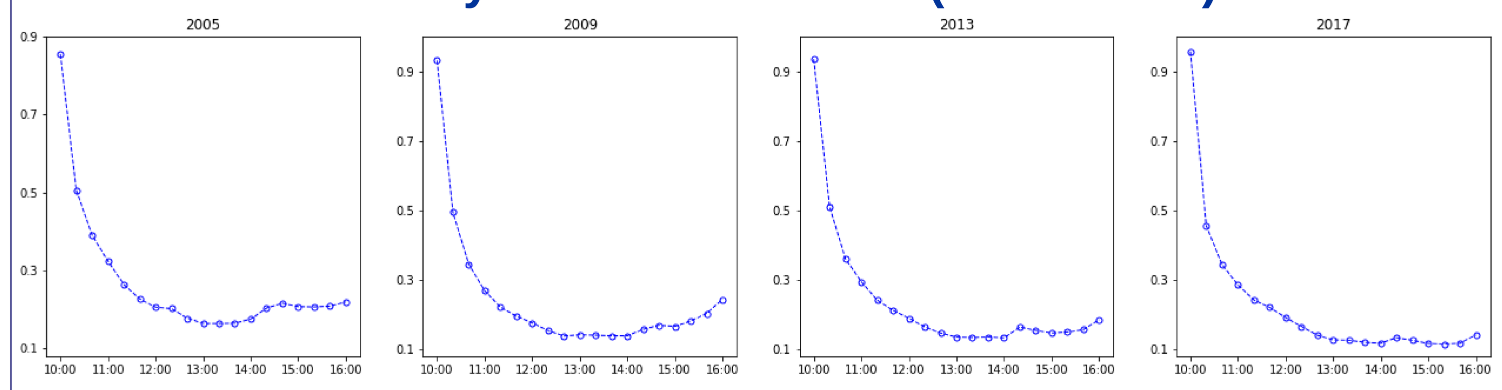
References

Zhang, Lan, Per A. Mykland, and Yacine Aït-Sahalia. "A tale of two time scales: Determining integrated volatility with noisy high-frequency data." *Journal of the American Statistical Association* 100.472 (2005): 1394-1411.

Zhang, L. (2011). Estimating covariation: Epps effect, microstructure noise. Journal of Econometrics, 160(1), 33-47.

Realized Variance & Trading Volume

Intraday Realized Variance (normalized)

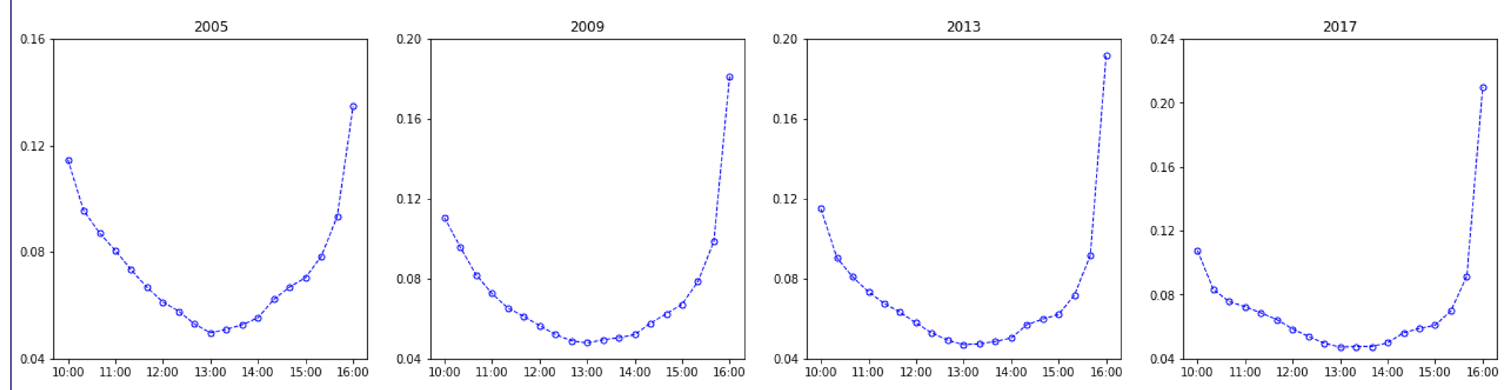


For stock i, day k, and time t, we define normalized RV as

$$NormRV_{ikt} = \frac{RV_{ikt}}{max_j\{RV_{ikj}\}}$$

- Intraday RV generally decreases with trading time, with a small spike near market close.

Intraday Trading Volume Share

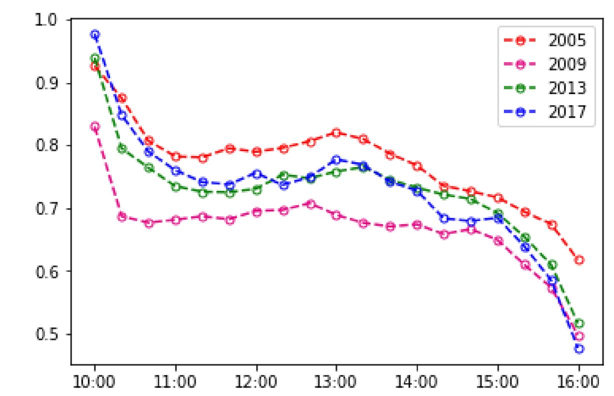


We define volume share as

$$VolShare_{ikt} = \frac{Vol_{ikt}}{TotVol_{ik}}$$

- The intraday volume changes from U-shape to lopsided smile, i.e., increasing trading volume near market close.
- This may be due to increased passive trading in recent years.

Daily Dispersion of Trading Volume

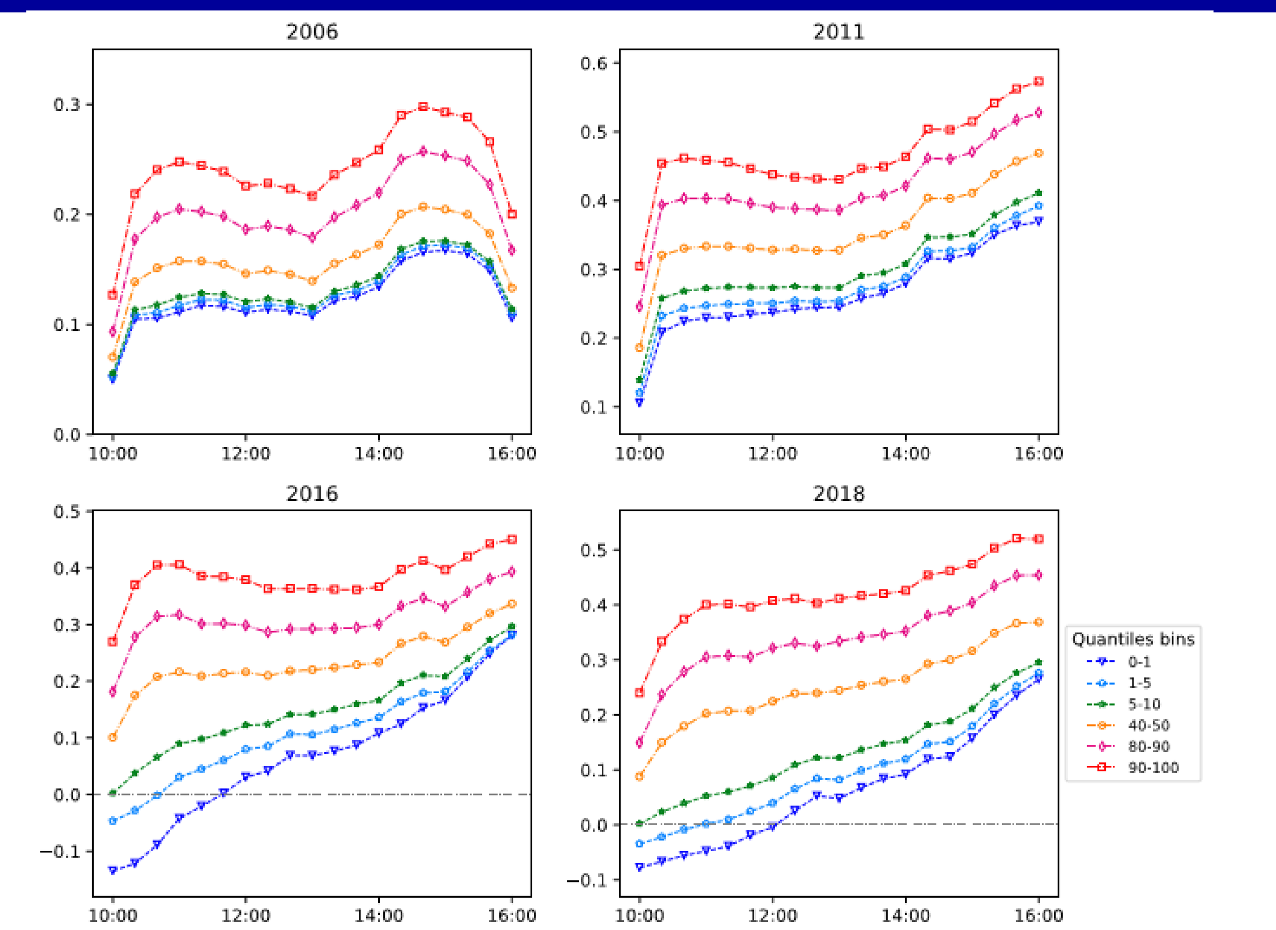


We measure the dispersion of trading volume across trading days at each time t as

$$VolStd_{it} = \frac{Std([Vol_{ikt}]_k)}{Mean([Vol_{ikt}]_k)}$$

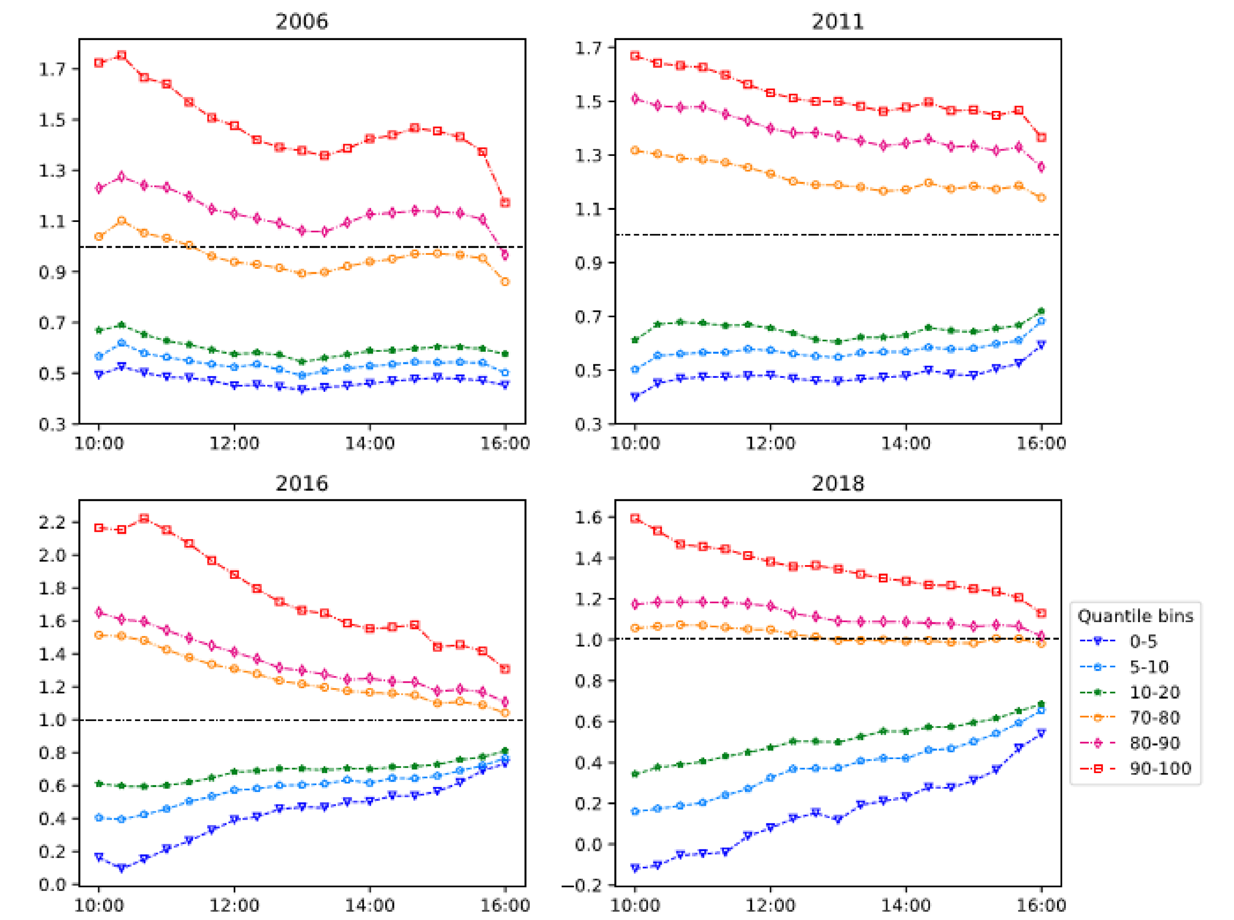
- Daily dispersion decreases during the day: more active trading in the morning, more index-based trading around market close.
- The decrease in dispersion is more significant in recent years.

Intraday Realized Correlation for Stock Pair Buckets



- We compute the average intraday correlation for different pairs buckets Q based on the daily correlation of stock pairs
- For example, “0-1” bucket includes the stock pairs that have lowest daily correlation, below the first percentile of all stock pairs (total 100,000+ pairs).
- In the recent decade, the intraday correlation starts low at the market open, increases during the trading session, reaches the highest level near the market close
- This pattern is especially significant for low correlation buckets in recent three years
- A result of the “active-open, passive-close” liquidity provision due to more index-based strategies

Intraday Realized Market Beta of Stocks



- We compute the average intraday realized market beta of different stocks based on their beta estimated from daily returns
- In the recent decade, realized beta starts dispersed in the morning, but generally converge towards one near the market close
- This suggests individual stock returns are driven more by market index return at the end of trading session
- A result of the “active-open, passive-close” liquidity provision due to more index-based strategies

A market impact model with time-varying liquidity provision

- We develop a theoretical market impact model to support out interpretation
- Two types of investors: single-stock and index-fund investors; linear impact on price from trading
- Time-varying liquidity provisions: more liquidity from single-stock (index-fund) investors near the market open (close)
- We calibrate the correlation structure to market data in 2018
- The model produces the intraday patterns observed
  - increasing pattern of correlation between stock pairs
  - convergence pattern of market beta