The causal impact of algorithmic trading on market quality

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Introduction

The causal impact of algorithmic trading (AT) is difficult to establish due to endogeneity bias. Common factors such as macroeconomic events are likely to affect both AT and market quality. In addition, market quality and AT are jointly endogenous. For instance, AT might affect the liquidity of a stock, but it is also be affected by this liquidity. Thus, correlations between market quality variables should not be interpreted in terms of causality (Biais and Foucault, 2014).

The second issue relates to the focus of the current literature on the US equity markets. Trading in the US markets is heavily fragmented, and a study of a single market in the US may not give the correct inference on how AT affects market quality, since the effect needs to be seen on the overall market.

This paper addresses the above issues in the following manner:

1. Clean market microstructure: The paper focusses on an exchange which has 80% market share in equity trading. This solves the issue of fragmented trading.
2. An exogenous event: The paper exploits an exogenous event of introduction of co-location after which AT increased.
3. Data recorded well: The paper uses a dataset where every single order is explicitly tagged as ‘AT’ or ‘non AT’ for every security at the exchange.

Within this framework, the paper uses a research design which can better control for threats to validity that arise from macro-economic factors and endogeneity issues related to which securities are picked by AT.

The rise of algorithmic trading on the National Stock Exchange, India

Data

Using proprietary tick-level dataset of all orders and trades on the equity spot market from NSE, the paper analyses two periods:

1. Pre co-lo: Jan ’09 to Dec ’09 (260 days)
2. Post co-lo: Jul ’12 to Aug ’13 (291 days)

The dataset contains additional flag on whether the order or the trade was by an AT or non AT.

Cross-sectional variation in adoption of AT

Clean market microstructure

Using proprietary tick-level dataset of all orders and trades on the equity spot market from US markets is heavily fragmented, and a study of a single market in the US may not give the results we use

Research design we use

1. Matching at security level
   i. We identify firms that got low AT adoption and firms that got high AT adoption.
   ii. Use propensity score matching to identify matched sample.
   iii. These are the firms that are lot like each other, but was an almost experimental allocation where one group got treatment of a surge in AT but the other group did not.
2. Matching on macroeconomic conditions
   i. Pick dates in the post co-lo period when market volatility matched the levels in the pre co-lo period.
   ii. Use Mahalanobis distance to identify matched dates.
   This allows us to go beyond correlations, or before-after studies, and go closer to identifying the causal impact of AT upon market quality.

Final sample: 91 treated, 73 control securities on 59 dates in the pre and post co-lo period.

Results: DID regression on matched securities, matched dates

We estimate the following DID regression:

\[
Mkt-Quality_{i,t} = \beta_0 + \beta_1 AT_{DUMMY_{i,t}} + \beta_2 CO-LO_{DUMMY_{i,t}} + \beta_3 (AT_{DUMMY_{i,t}}\times CO-LO_{DUMMY_{i,t}}) + \beta_4 Mkt-Quality_{i,t-1} + \beta_5 (AT_{DUMMY_{i,t}} \times Mkt-Quality_{i,t-1}) + \beta_6 DUMMY_{i,t} + \epsilon_{i,t}
\]

- \(\beta_1\) estimates with different set of matching covariates

The null is rejected less than 5% of the times. Indicates that there is no impact on market quality in the absence of changes in AT.

Impact on extreme price movements

The results hold for all market quality variables except DEPTH, TOP5DEPTH which are sensitive to the match design.

Conclusion

The results suggests that

- Overall good for market quality in terms of higher liquidity and better price efficiency.
- No evidence in support of increase in flash crashes.
- Contrary to the existing literature, the evidence indicates that AT is beneficial for small stocks.

References


References