Do regulatory hurdles on algorithmic trading work?

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1 Introduction

The debate surrounding algorithmic trading (AT) and high frequency trading (HFT) continues to attract a lot of regulatory as well as media attention. While some claim that this form of trading could dilute the quality of fair market access to all, others assert that AT and HFT benefit the markets by improving liquidity and price efficiency.[1] Even before the debate has been settled, regulators worldwide have been contemplating measures to restrict the impact of AT and HFT in the exchange-traded markets.

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An earlier version of the paper was based on a different sample and a different methodology. The current methodology is much more robust to the endogeneity issues in the paper.

[1]The divergence in the opinion continues despite a lot of empirical evidence that suggests that AT and HFT improve market quality.

Amongst the measures that are being contemplated, the one that has attracted maximum attention is the fee charged on a high *orders-to-trades-ratio*. This fee, which is called the *OTR fee*, is charged to an individual member, if the number of orders sent by the member is in significant excess of the number of trades executed on the member account.

One rationale behind the imposition of this fee is to curb an excessive number of messages which do not result in trades. The argument is that such orders unnecessarily burden the exchange infrastructure and result in restraining other traders from being able to send their orders to the trading platform. Another argument in favor of implementing such a fee is that orders that do not lead to execution do not constitute genuine liquidity to trade against. In such cases, the fear is that high frequency traders will cancel orders as soon as it is visible to other traders. Such trading is thought of as increasing the chances of market abuse in the form of quote stuffing, spoofing, layering – all intended to mislead genuine traders.

A fee on such excessive levels of orders-to-trades is meant to discourage market participants from sending unproductive orders and to reduce the scope of market abuse. However, while such a fee may have the potential to discourage high frequency access and manipulative orderflow, it can also have adverse consequences of lowering the liquidity available in the market, and consequently, the real-time efficiency of prices. This will be particularly true if the traders who use large number of messages are also the liquidity suppliers or market makers.

Following the global regulatory thinking, regulators in India put in place a fee on excessive orders-to-trades in the Indian equity derivative markets in July 2012, in an attempt to curb the possibility of market manipulation by

algorithmic and high frequency traders. A few other countries (Italy, Norway and Canada) also implemented the OTR fee around the same time.

The regulatory intervention in India is interesting and different because the regulatory application of such a fee was the second instance of this fee being applied in the market. The first instance was when the exchange itself imposed a fee on excessive orders to trade a few years prior. During the first instance, the exchange had imposed this fee in order to better manage limitations on bandwidth, which was getting choked off by too many orders that were being placed by traders.

Thus, compared to the other country studies, India poses an interesting setting, of two different agencies using the same regulatory intervention to manage excessive orders to trades. This allows a more sophisticated evaluation of the impact of such fee on market quality, taking into account the differences in implementation details of the intervention.

2 The context

We describe the similarities and the differences in the implementation of both episodes when the OTR fee was charged on excessive orders to trades in the Indian equity markets.

In both episodes, the fee was charged on orders and trades on *only* the derivatives segment of equity markets at the exchange.

In the first episode (Episode 1, 2009-2010), when the fee was implemented by the exchange to manage the excessive orderflow, it was done to curb

order flooding by traders and ensure *orderly* trading in the market.[2] In this implementation, the fee was uniformly applied across all market participants and order types. The exchange put in place a two-element plan to manage the battle for order flow in the limited exchange bandwidth. The first element was the fee on excessive orders to trades in derivatives market. The second element was the simultaneous introduction of spread orders that the traders could use to carry out arbitrage instead of using "immediate or cancel" (IOC) orders through trading systems.

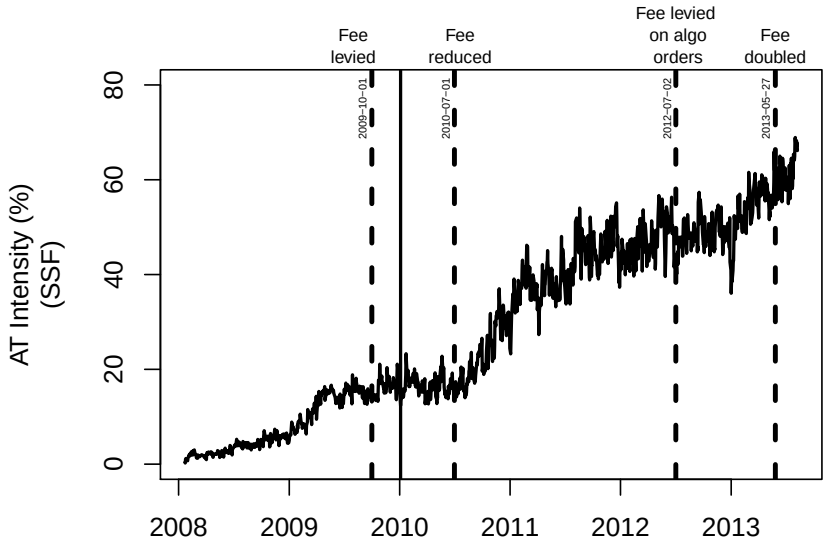
In Episode 2 (2012-2013), the fee was implemented at the directive of the securities market regulator, SEBI. In this implementation, the fee was applicable *only* on algorithmic orders. Further, the application was done with other exemptions, one of which was that orders which fell within $+/-$ 1 percent of the last traded price in the market were excluded from the calculation of orders to trades. The stated explanation for the exemptions was that the regulator wanted to minimise any adverse impact of the fee on the available liquidity at the best bid and ask prices in the limit order book.

Figure 1 shows the dates on which the fee was charged on the single stock futures (SSF) at NSE. It shows the rise of algorithmic trading at the exchange in single stock futures. The percentage of AT was relatively low during Episode 1 and the fee charged was applicable to all orders and not just orders from algorithmic traders. In Episode 2, the fee was applicable only to orders from algorithmic traders.

[2]The exchange had put the fee the curb the high rate of IOC orders that were used by traders to execute arbitrage strategies on derivative markets. A large proportion of these orders remained unexecuted but added significant load on the bandwidth.

Figure 1 AT intensity in single stock futures at the National Stock Exchange

The graph shows the AT intensity on the single stock futures (SSF) market at NSE between 2009 and 2013.
AT intensity is measured as a fraction of the total traded value of AT trades in a day vis-a-vis the total traded value on that day. The vertical line in boldface indicates the date on which co-location was introduced by the exchange.
The first two dotted line indicate dates of the fee intervention by the exchange, and the last two dotted lines indicate the dates of the fee intervention by the regulator.



3 The research design

We use an event study analysis to understand the effect of the fee on market quality. We examine the quality of the market in a three month period *before* the exchange imposed the fee, and then in the three month period *after*. We then statistically test if the measures of market quality are significantly different between these two periods. Market quality is calculated using tick by tick orders and trades data for stocks traded on the equity derivatives segment of the National Stock Exchange.

Since the fee was only charged on derivatives, it is tempting to compare the change in market quality of derivatives using changes in similar measures

on the spot market as the benchmark. Since no fee was charged on the spot market, it is tempting to assume that the spot market was not affected by the fee. However, this assumption is violated since the equity spot and derivatives market are connected by arbitrage.

Spot markets can respond to changes in derivatives markets in the following two ways: when arbitrage ensures that the derivatives and the spot respond similarly to information, these two markets can be used as substitutes. When the cost of trading on one market (fee on derivatives) increases, order flow may flow to the other (the spot). Similarly, any increase in the cost of trading in one market will adversely effect the costs of doing this arbitrage. When arbitrage between the two markets becomes weaker, it may be optimal to continue trading the derivatives, because the leverage advantage of trading derivatives is still likely to dominate the trading the spot.

In either case, the fee on derivatives is likely to affect the spot market. This means that the equity spot market cannot be used as a "control" which provides a benchmark against which to understand the impact of imposing a fee.

Instead, we choose as "control", a sample from the equity spot, of stocks that did not have SSFs trading, but had high levels of liquidity that just fell short of meeting the eligibility criteria required by the exchange to start SSF trading.

We use a propensity score matching to identify "control" stocks which, during the sample period, were similar to the main sample in terms of their market capitalisation, price, turnover, number of trades and percentage of floating stock. But these "control" stocks did not have SSFs trading on them.

4 Results

The first measure we examined for change is the level of the orders to trade. If the fee is imposed because this ratio (called the OTR) is excessive, then we should observe a drop in the OTR after the fee is imposed. This would indicate that the implementation is effective.

We also measure changes in other measures including liquidity and price efficiency. Here, market liquidity is measured using quoted spread, impact cost and Rupee depth at the top, and Rupee depth in the best five prices. Price efficiency is measured by volatility of returns and variance ratio.

4.1 Results for *Episode 1*, the fee of 2009

The analysis indicates that after Episode 1, the OTR on derivatives for the sample stocks *dropped*. This leads us to believe that the exchange achieved the objective for which the fee was introduced.

We find that the liquidity of the SSF *increased*, and this evidence is consistent across all measures of liquidity. There was no significant change in the measures of efficiency. In fact, the standard deviation of price impact cost of a trade *decreased*, which shows that *liquidity risk* decreased.

This evidence suggests that the fee implementation in 2009 achieved the intended objective without an adverse impact on the market quality of the derivatives. What is remarkable is that even though the fee raised the cost of trading on the market, market quality improved on the SSF. This is likely because the cost imposed by the fee was compensated by the exchange putting in place a new market microstructure feature (enabling spread orders) that

was more efficient in allowing the traders to carry out arbitrage compared to the previous microstructure (IOC orders). Jointly, the new trading feature helped reduce unnecessary load on the exchange infrastructure and brought genuine liquidity by bringing back the traders who may have been earlier crowded out by the high flow of IOC orders on the exchange.

4.2 Results for *Episode 2*, the fee of 2012

A similar analysis of Event 2 shows that the level of orders to trades showed an *increase* in the OTR after the fee was imposed. There was no impact on any of the liquidity or price efficiency variables.

This indicates that the fee of Episode 2 had no effect. One interpretation could be that the results reflect only the average liquidity available in the book, while the intervention was targeted differentially at different parts of the limit order book. Orders at *the touch* were exempt and there, traders may have increased their order with prices that are similar to the best bid and ask price. It is likely that the results may be different if we focussed on the OTR or liquidity in the limit order book beyond the $+/-$ 1 percent of the last traded price.

5 Conclusion

The analysis suggests that the outcome of a regulatory intervention depends upon the design intentions and details in implementation. Interventions are likely to be more effective when they are designed to specifically target outcomes. Further, any negative impact of the intervention can be mitigated

by using mutiple microstructure features that can increase benefits while simultaneously increasing costs. This requires a careful understanding of the requirements and incentives of the market participants.