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Order-to-trade ratios and market liquidity ☆

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ABSTRACT

We study the impact on market liquidity of the introduction of a penalty for high order-to-trade ratios (OTRs), implemented by the Italian Stock Exchange to curtail high-frequency quote submission. We find that the fee is associated with a collapse in the quoted depth of the stocks that make up the bulk of trading in Italian equities and with an increase in price impacts of trading across the treated stocks. Spreads do not change, however. Stocks from a pan-European control sample show no such liquidity changes. Thus, the Italian OTR fee had the effect of making Italian stocks markets more shallow and less resilient. Large stocks are more severely affected than midcaps. We also find evidence of a limited decrease in turnover. Consolidated liquidity, constructed by aggregating across all electronic trading venues for these stocks, decreases just like that on the main exchange. Thus, liquidity was not simply diverted from the main exchange, it was reduced in aggregate.

1. Introduction

Enforcing order-to-trade ratios (OTRs) on a trading venue involves financially penalising individual member firms if the orders to buy or sell they enter do not lead to a "sufficient" number of trades. As OTRs attack High-Frequency Trading (HFT) at its root – targeting the high number of "messages" that high speed participants rely upon – regulators currently consider them as one of the policy tools of choice to reduce the incidence of HFT. For example Mary Schapiro, then Head of the US Securities and Exchange Commission, indicated that the SEC was considering implementation of an OTR penalty scheme.[1] The EU Parliament and Commission have gone further: the current draft of the piece of legislation that will regulate trading across all EU exchanges from 2016, the "Markets in Financial Instruments Directive" (MiFID), includes across-the-board implementation of OTRs.[2]

In fact, the national regulators of some of the largest EU countries have decided not to wait and have either already implemented OTRs or intend to do so. This includes the Italian Stock Exchange, which is the focus of our study. On April 2nd, 2012, the Milan Borsa, the historical stock exchange of Italy and part of the London Stock Exchange Group, implemented an order to trade ratio applying to all its member firms. This event presents us with a direct way of estimating the link between messaging activity and liquidity.

There is little doubt that a measure causing high-frequency quoting to contract has the potential to alter pricing, trading and liquidity processes in a significant way. By all accounts, high-frequency flow has become very significant in today's markets. The Tabb

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[1] *Financial Times*, 28 February and 10 April 2012.

[2] Its Article 51(3) states that "Member States shall require a regulated market to have in place effective systems, procedures and arrangements to ensure that algorithmic trading systems cannot create or contribute to disorderly trading conditions on the market including systems to limit the ratio of unexecuted orders to transactions that may be entered into the system by a member or participant (...)." Proposal for a Directive of the European Parliament and of the Council on markets in financial instruments repealing Directive 2004/39/EC of the European Parliament and of the Council, COM(2011) 656 final, 20.10.2011.

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Group, a consultancy, estimated the incidence of High-Frequency Trading at 39% for Europe in 2012 (reported in "*Understanding High-Frequency Trading*", World Federation of Exchanges report, 29 May 2013). Consistent estimates are available for a few markets where research-based evidence is available: In Nasdaq data, Brogaard et al. (2014) find that HFT makes up about 42% of traded volume in large stocks over their sample period, a figure that they indicate does not include all HFT flow. In Nasdaq-OMX data, Hagströmer and Nordèn (2013) report an interval estimate of 26–30% for pure HF firms, and a total amount of HF trading that could be as high as 52%. (The first figures do not include firms using a mix of low and high frequency strategies.) The effect of a reduction of high frequency quoting is not clear however. If those using large numbers of messages are making markets, then liquidity might decline with the imposition of an OTR. If instead, firms with high messaging rates impose adverse selection costs on other participants, then constraining this behaviour might attract other traders back to market and thus increase liquidity.

We find that the introduction of the OTR penalty scheme is associated with a marked deterioration in quoted depth for Italian stocks. Depth declines particularly steeply in large stocks that make up the bulk of turnover in Italian equities. Price impacts from trading are significantly increased following the introduction of the OTR penalty for all Italian stocks. Measures of quoting and trading activity also fall. Perhaps more surprisingly, we also find that the deterioration of liquidity on the historical exchange extends to measures of consolidated liquidity (where consolidated liquidity is measured from aggregated orders across the historical exchange and alternative trading venues). Thus, activity did not simply move away from Borsa Italiana and towards venues such as Chi-X, but liquidity was reduced in aggregate. This suggests that the historical exchange may dominate price and liquidity discovery. Another interpretation is that only a limited number of liquidity suppliers make markets across all venues, resulting in the maintenance of liquidity at less than competitive levels (see Biais et al. (2010) for evidence along these lines from US markets).

In the next Section we discuss the motivation for the Italian OTR scheme. In Section 3, we review relevant theory and evidence and formulate some testable hypotheses. In Section 4 we give details on the data we use and the market from which it is drawn. Section 5 explains our modelling approach and Section 6 presents estimation results.

2. Policy debates and stated goals of the Italian OTR scheme

There is widespread interest in OTRs on the part of politicians, regulators and exchanges. Policy-makers seem driven by the intuition that there must be something untoward in the submission of a large number of orders that do not lead to executions. With such low probability of execution, high-frequency orders must either have lifetimes so short that they cannot be traded against or be too far from current prices to be "bona fide" (O'Hara, 2010). At best, such orders are dismissed as not constituting genuine liquidity, while at worst, extremely short-lived quotes raise suspicions of abusive behaviour, the most obvious example being "quote-stuffing" (attempts to flood the systems of other firms with order entries and cancellations to hide manipulative behaviour.) Other manipulative strategies such as "layering" the order book or "spoofing" also rely on the submission of multiple orders which are subsequently cancelled.[3]

These views are exactly what inspired the Italian OTR scheme – widely reported in the financial press to have been implemented at the request of the national regulators CONSOB (see *Financial Times*, February 20, 2012, and *The Trade*, February 27, 2012.) To a Finance commission of the Italian Senate, the Head of CONSOB gave more details on the rationale behind the fee, stating that "the ability of high frequency traders to suddenly cancel orders placed before they are executed, displacing other investors, can generate a misleading representation of the actual depth of the order book, creating favourable conditions for market manipulation." He went on to say that "the increase in the number of orders placed in the trading systems and in the order-to-trade ratio may endanger the regular course of the negotiations and the integrity of markets, given the limits on capacity and the reliability of the infrastructure."[4] This confirms that the OTR scheme was explicitly directed at HF traders and motivated by concern that their rates of order entry may disrupt markets and foster manipulation.

3. Priors and testable hypotheses: HF trading and liquidity

Whether an OTR will enhance or reduce liquidity depends on the net contribution to liquidity of those HF agents targeted by the OTR as using the highest speed (equivalently, the lowest latency). We review both sides of the argument.

An OTR may reduce the likelihood of outright manipulation. If the highest speed targeted by the OTR is chiefly used for manipulative purposes (e.g. through quote stuffing or layering of order books), then the OTR may improve liquidity by reducing the costs that fast traders impose on slower participants. We have no estimate of how much HF flow might be abusive in nature because such behaviour is very difficult to detect unambiguously, particularly in its high-frequency flavour.[5] Few cases are prosecuted successfully and fewer cases still are found to involve HF traders.[6] However, some academic work does raise the possibility that some HFTs engage in behaviour that is consistent with manipulation. Gai et al. (2012) and Egginton et al. (2013) find patterns consistent with quote-stuffing in their data. Clark-Joseph (2013) finds that HF traders forecast the order flow of slower traders. When they know that liquidity is low and that a big non-HFT order is being worked, then they trade in front of that order and increase the trading costs of slower traders. Using Nasdaq data, Hirschey (2013) finds that HFTs trade in front of other traders and forecast returns associated with price pressure of other traders. All of these examples of behaviour (quote stuffing, anticipatory trading) will likely have the effect of increasing the execution costs of slow traders, i.e. reducing realised liquidity.

One might also argue that, if HF traders are better informed than other market participants, then if the OTR was to discourage them from participating in markets, adverse selection risk would drop and liquidity increase. Both Hendershott and Moulton (2011) and Menkveld and Zoican (2014) report evidence of greater adverse selection after systems upgrades that increase the incidence of HF trading by reducing latency on the NYSE and NASDAQ-OMX respectively.

A counter-argument to this last point relies on the idea that an OTR may damage liquidity due to the fact that HF traders may be

[3] The European regulator ESMA defines layering and spoofing as "submitting multiple orders often away from the inside on one side of the order book with the intention of executing a trade on the other side of the order book. Once that trade has taken place, the manipulative orders will be removed." In ESMA, "Guidelines – Systems and controls in an automated trading environment for trading platforms, investment firms and competent authorities", 24 February 2012.

[4] "Audizione del Presidente della CONSOB Giuseppe Vegas, Senato Della Repubblica VI Commissione (Finanze)", 26 June 2012, 54 p., Appendix 5, "High-Frequency Trading", pp 39–40. (Our translation.)

[5] There is a suspicion that regulators are overwhelmed by the amounts of data that today's markets generate and that they are lagging behind brokers and exchanges in respect of the skills required to analyse the data. This view is expressed for example in "U.S. Securities and Exchange Commission, Organizational Study and Reform", Boston Consulting Group report, March 10, 2011.

[6] At the time of writing, we are aware of only three cases of successful prosecution of firms considered HF traders: fines were imposed on Trillium Brokerage Services and Panther Energy Trading in the U.S. and on Swift Trade in the U.K.