Dynamic Trade Informativeness: A Research Proposal

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Abstract. We propose to develop novel methodology to better utilize the massive intraday trading data and to better understand the high-frequency price dynamics (O'Hara, 2015). In particular, we would like to focus on the estimation of *high-frequency trade informativeness*, i.e., the permanent price impact of each and every trade. Such high-frequency measures could allow researchers, to name a few, (1) to assess theoretical models, (2) to examine informed trading at un/scheduled intraday events, (3) to separate a trade's informativeness from its aggressiveness, and (4) to study the cross-sectional systematic patterns of informed trading.

Theoretical motivation. The extensive theory literature has established various reasons why (and how) trade informativeness can be time-varying: The degree of informed trading (relative to noise) might vary over trading hours, due to investors coordination (Admati and Pfleiderer, 1988), to time-varying volatility of noise trading (Back and Pedersen, 1998; Collin-Dufresne and Fos, 2016), to intraday corporate events, or to informed investors' strategic behavior (Baruch, 2002; Back and Baruch, 2004). It could also be driven by investors' strategic behavior due to risk aversion (Baruch, 2002), competition and learning (Holden and Subrahmanyam, 1992; Foster and Viswanathan, 1996; and Back, Cao, and Willard, 2000), and discounting or random horizon (Back and Baruch, 2004). In a limit order market, Riccó, Rindi, and Seppi (2018) show that there is non-Markovian learning, implying that the information content of trades dynamically depends on the full order book history.

Existing methods. Various econometric methods have been developed to gauge trade informativeness, pioneered by Hasbrouck (1991a,b), with latest state space applications like Hendershott and Menkveld (2014); and Chordia, Green, and Kottimukkalur (2018). A second stream of the literature estimates probability of informed trading (PIN), led by Easley et al. (1996); Easley, Kiefer, and O'Hara (1997a,b), with recent developments like VPIN (Easley, López de Prado, and O'Hara, 2012). These canonical methods only produce low-granular *average* estimates of trade informativeness over the sample. Possibly informative intraday, high-frequency patterns are likely averaged out, defeating the purpose of using high-granular trading data.

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Our approach (and current progress). We propose to treat the informativeness of each and every trade as a hidden state variable, allowing them to vary freely over time. That is, the per-dollar permanent price impact can differ from one trade to another. We shall then filter out such informativeness dynamically from the observed price and trade time-series.

As a first attempt, in Yueshen and Zhang (2019, https://goo.gl/aiVGci), we develop a structural model featuring the trade informativeness as a time-varying parameter, which is then filtered using the Generalized Autoregressive Method of Moments (GaMM, Creal et al., 2018) from 300 randomly selected stocks (2014 TAQ data). The results find strong support that trade informativeness is indeed time-varying: (1) Failure to account for the dynamics of trade informativeness underestimates the true information content in order flows by 13%; and (2) the time-varying component of trade informativeness can better explain long-run, future price returns. We then also demonstrate the usefulness of the filtered trade informativeness to address economic questions.

Plan ahead. We have two major objectives moving forward. First, we would like to extend the analysis to include all CRSP stocks for a longer time period. This would enrich the community's understanding of market-wide phenomenons, such as: (1) across the market, whether there is a systematic component in trade informativeness (in the sense of nondiversifiable market risk factors); (2) how specific investor groups (e.g., algorithmic traders and/or high-frequency traders; and corporate insiders) contribute to intraday price discovery; and (3) how policy changes (experiments), like tick size and transaction fee pilots, affect information diffusion in the real time. For this purpose (large cross-section and long history data application), we need support of computing power.

Second, we would like to improve the structural model and the filtering technique, account for more real-world data features and strengthen data fitting. For example, one central question in the analysis of modern microstructure data is the distinction between short-term (transitory) and long-term (permanent) price impact (O'Hara, 2015). Relatedly, certain well-known data features like time-varying volatility, jumps, etc., are worth specifically treating in our applications. Yueshen and Zhang (2019), our first attempt, adopts a parsimonious specification due to the limitation of computing power. Certain machine learning techniques (like LASSO, inspired by Chinco, Clark-Joseph, and Ye, 2019), are currently being implemented to improve model specification and filtering results. With the support from XSEDE and NSF, we believe we could significantly push forward this front.

Our target research outcome is to standardize an empirical framework, which shall be democratized in the form of an open-source package, to facilitate the high-frequency analysis of trade informativeness. Currently and in Yueshen and Zhang (2019), we implement all estimation in Julia (https://julialang.org/). We are open to and comfortable with other programming languages.

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