

# CASE STUDY

## Algorithmic Trading: Perspectives from Mathematical Modelling

### Background

The emergence of new technologies and the advent of computerised trading have changed the landscape of financial markets in recent years, but there are concerns about the effect this is having on trading behaviours and markets.

Algorithmic trading, automated trade execution and high frequency trading (HFT) at the millisecond time scale are now prominent components of all major financial exchanges. Hailed by some as a source of market liquidity, algorithmic trading has been criticised by others as a mechanism for market instability and volatility.

Whereas there have been numerous HFT events, this TGM workshop was radically different because it brought together perspectives from a range of experts, allowing for a more complete and balanced view. These included academics, regulators, practitioners (both investors and traders) to share knowledge and insights on this important area.



### Challenges

The impact of algorithmic trading on market dynamics is yet to be fully understood. Questions persist around a number of issues. For instance, how do markets in which computers trade against other computers differ from markets with human traders? What are the implications for price behaviour, market regulation and financial stability?

These questions have raised concerns for regulators, market participants and risk managers. Therefore a key motivation for developing this event was that because mathematical modelling has historically played a vital role in financial risk management and in the development of algorithmic trading, it was felt that the subject still has a lot to contribute to this debate. Some of the issues specifically addressed at the workshop included:

- The role of algorithmic trading in managing large institutional portfolios;
- Flash crash: algorithmic trade execution and intraday market dynamics;
- High-frequency cross-market trading: model free measurement and applications.



*"It was wonderful to have the opportunity to bring together excellent participants from academia, industry and regulators to discuss the very important topic of algorithmic trading".*

**Adrian Weller (University of Cambridge)**

## Activity

One of the aims of this one-day workshop was to disseminate the latest advances in quantitative modelling and empirical studies on the impact of HFT and algorithmic trading on markets, with an emphasis on emerging phenomena and implications for risk management and policy. It was attended by over 100 delegates, with well over half that number from the business and public sectors.

The development of this event, in keeping with other TGM activities, had included a rigorous peer review process, with inputs from experts in both academic and financial sectors. Consequently, the talks were chosen and the discussion session structured in such a way as to help highlight potential strategies which could mitigate against negative effects and risks of algorithmic trading in the future.

The programme of talks included leading academics – Rama Cont (Imperial College London), Albert Menkveld (VU University Amsterdam) and Matthew Baron (Cornell University). Phil Allison of KCG presented a practitioner talk from a HFT perspective, whilst Yazid Aharaiha of Norges Bank Investment Management gave insights into the management of large investment portfolios. From the UK's regulatory body, the Financial Conduct Authority, Matteo Aquilina's talk focused on cross-venue evidence from the UK market on whether high frequency traders are anticipating the order flow. Cantab Capital Partners LLP's Hasan Amjad presented a hedge fund perspective and Evangelos Benos of the Bank of England talked about the systemic risk angle from a central bank point of view.

## Impacts

One of the main impacts of this event was its success in bringing together balanced perspectives from a range of experts and to enable all market participants to come together and share knowledge and insights. Providing such an event in the context of expertise in mathematical modelling, brought a distinctive flavour and made it particularly attractive for those from the investment business community.

There are clear advantages of HFT to those who can best deploy them, such as, for instance, being able to implement clever algorithms with extremely low latency. However, this has also stimulated an escalation in competitiveness to be fastest, with the winner making the most money! Perceived disadvantages of HFT are that it can be a source of market instability and volatility and possibly lead to problems such as an increase in systemic risk in financial systems.

The talks and discussion sessions which took place clearly helped to stimulate greater understanding between all market participants. Via the various talks and the panel session at the end of the day, speakers and participants were able to discuss the many interesting questions relating to the perceived advantages and disadvantages of HFT. Issues such as what evidence exists on the positive and negative aspects of HFT, what possibly causes them, and how much trading can be controlled so as to reduce risks, were discussed.

Some challenges that were highlighted by participants were:

- Accounting for the dynamic nature of liquidity provision and its impact on market quality, functioning and volatility.
- How HFT could be applied to other sectors.
- What could be the impacts of high value trading on the world's majority of poor citizens?
- Fast debugging of recurrent nets; explanations of model decisions.

Overall, feedback indicated that the effort to form synergies between academics, regulators and the industry were appreciated. Participant comments reflected that talks were highly relevant and thought provoking, giving good overviews of current practice and models, and although some content was fairly technical, speakers managed to translate this sufficiently for the audience to make it comprehensible. Speakers focused on real-world issues as examples. The programme covered a wide range of issues across HFT and algorithmic trading.

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