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Master Thesis in Cooperation with Deutsche Börse: The Emergence of Short-Wave Data Links for Trading

To maximize profitability, high-frequency trading firms stay on the cutting edge of computing and networking technologies to process information at high speed and make trading faster (Gomber and Haferkorn, 2013). The firms fight the latency battle on two fronts. The first is the reduction of the reaction time once a market data update has been received. State-of-the-art field programmable gate array implementations have reduced the wire-to-wire latency to around 10 nanoseconds. The second front is to transmit market data as quickly as possible – especially cross-venue. The most widely known example of this was the "Spread Line" connecting Chicago and New York by a fiber optic cable laid almost in a straight line (Laughlin et al., 2014). This was made mostly obsolete by the introduction of microwave links between these trading hubs (Shkilko and Sokolov, 2020). Millimeter-wave and laser links are also used as they provide higher bandwidth than microwaves. Similar microwave links exist between major European exchanges. Until recently, the fastest path between the Chicago Mercantile Exchange (CME) and Frankfurt Stock Exchange (XETRA and EUREX) was by microwave link from Chicago to New York, then through the dedicated Hibernia trans-Atlantic fiber optic cable to Wales, then by microwave to Frankfurt.

The latest evolution in the arms-race of high-frequency trading employs short-wave radio links. While the bandwidth is very low (a few bits every few milliseconds), the latency advantage over the fastest alternative route is approximately 9 milliseconds – an eternity in high-frequency trading.

Using Deutsche Börse's A7 Analytics platform that provides API access to tick-by-tick market data from both markets CME and EUREX, this master thesis aims to analyze the emergence of short-wave radio links, i.e., measure the prevalence of orders sent by short-wave radio links in historical market data over time. Furthermore, this thesis examines the interdependencies of various instrument pairs. For instance, a limit buy order in the S&P 500 Future may lead to another limit buy order within the EuroSTOXX50 Future a few milliseconds later. Finally, the student is asked to investigate the orders that were sent by short-wave radio links with respect to intra-day patterns, profitability and volume.

In order to address the goal of this thesis, the student first needs to review common literature about the evolution of state-of-the-art technologies in high-frequency trading. Afterwards, the student may collect and preprocess market data from Deutsche Börse's A7 Analytics and conduct an empirical study that tackles the previously mentioned goals. Students interested in this thesis are expected to have at least basic programming skills (preferably in Python) and are required to deal with large amounts of data.

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Literature

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Laughlin, G., Aguirre, A., & Grundfest, J. (2014). Information transmission between financial markets in Chicago and New York. *Financial Review*, 49(2), 283-312.

Shkilko, A, Sokolov, K. (2020). Every Cloud Has a Silver Lining: Fast Trading, Microwave Connectivity, and Trading Costs. *Journal of Finance*, 75(6), 2899-2927.

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