

## [Fast Trading and the Virtue of Entropy: Evidence from the Foreign Exchange Market](#)

CFM-DP2019-14

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We pursue a novel approach to the analysis of fast trading, i.e. of transactions executed against a limit order within 200 milliseconds, and of its impact on the microstructure of financial markets, where we focus attention on how fast traders affect the patterns of exchange rate quotes.

What motivates our analysis is the observation that algorithmic and fast traders not only exploit arbitrage opportunities arising from their ability to place and execute orders over infinitesimal time intervals but may also try to exploit their ability to process large volumes of information simultaneously, to direct and test the market with orders at disparate prices, not necessarily in line with the market norm given available information. Correspondingly, algorithmic trading may rely on programs that either generate a structured and tidy flow of orders, conditionally predictable once the market starts to move in response to news, or place seemingly erratic orders.

In light of these observations, information theory provides a natural metric to quantify the structure of the order book, the Shannon entropy. Intuitively, the Shannon entropy of a distribution can be understood as the extent of its diversity—maximal for a uniform distribution. Applied to the sequence of orders in reaction to news hitting the market, a low entropy will result from distributions of order prices that are quite compact and concentrated. Conversely, entropy will be high when prices in the order book are spread out and erratic.

We carry out our study on the foreign exchange market, focusing on the response to news. Our sample covers seven of the most liquid currency pairs (EURUSD, USDJPY, EURJPY, GBPUSD, EURGBP, USDCHF and EURCHF), sampled at the 100-millisecond frequency, with information on bid-ask spreads, volumes and direction of trades, over the first quarter of 2015. This dataset enables us to identify fast trades as those executed against a limit order within 200 milliseconds, i.e. faster than the reaction time of human beings. Moreover, we build a dataset of about 150 announcements concerning macro, financial and policy variables relevant for the exchange market in 17 countries.

We show that the entropy of the distribution of quotes is a good indicator to synthesize the structure of the order book and its evolution in response to news, with a straightforward behavioural interpretation in the spirit of Hong and Stein (1999). Second, we document that entropy is significantly correlated with the share of fast trading in total trade. Third, we use a natural experiment – the reform of the WM Reuters’ fixing methodology on 15 February 2015 – to ascertain the direction of causality and show that high-frequency trading tends to create, rather than react to, a richer distribution of exchange rate quotes as measured by entropy. Finally, we produce evidence that fast trading has a significant and strong impact on market performance—improving rather than deteriorating indicators of market efficiency and quality of trade execution.

In our interpretation, entropy is a key channel by which this occurs. That fast traders post diverse quotes at no specific price levels arguably adds noise to fundamental information which, in principle, might complicate the problem of other individual traders. But from a market-wide perspective, this additional noise may help offset existing distortions that move prices away from efficiency standards. By increasing the amount of information to be processed by traders, higher entropy in the distribution of quotes helps avoid one-sided concentration and mitigates overshooting, in turn bringing the pricing process closer to the prediction of classic theoretical models.

These findings matter for policy and research. From a policy perspective, they suggest that an increasing diversity of exchange rate quotes associated with fast trading is not necessarily damaging for market performance. It is actually beneficial in our estimates. This is a point deserving further attention in the discussions about fast traders’ optimal regulatory regime. In particular, from a research perspective, this suggest that future research should complement the results of this paper with an analysis of possible nonlinearities and a reconsideration of the role of entropy in situations of market stress. Finally, our paper makes a contribution to the literature on high-frequency identification of macro shocks, notably monetary policy shocks. It suggests that micro-market conditions, especially high frequency quoting patterns, are crucial aspects of the mechanism underlying the transmission – and interpretation – of monetary policy and other macro shocks to exchange rates.