

# Contagious Markets:

## On Crowd Psychology and High-Frequency Trading

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*Market Psychology in an Era of  
High-Frequency Trading*

Q: Does the transition towards automated trading render market psychology obsolete?

A: Not entirely.



# *Crowd Dynamics in Financial Markets – I*

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The aim of the project is to understand how, why, and with what consequences ideas from crowd psychology have been deployed to understand and make sense of financial markets.

# *Crowd Dynamics in Financial Markets – II*

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Our ambition is to understand how, why and with what consequences this way of thinking about crowd behavior was subsequently adopted to understand financial markets.

# Agenda

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1. Crowd Dynamics in Financial Markets
  2. The HFT Debate (Data and Methods)
  3. Empirical Analysis
    - I: Interactive Feedback Loops and Black Box Systems
    - II: Human – Algo Interaction
  4. Conclusion
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# *From Contrarian Speculation ...*

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- Contrarian investment thinking was developed in explicit engagement with crowd psychology. For example, Humphrey Neill (1920s) argued that markets are in essence similar to the crowds described by crowd psychologist: they are characterized by fickleness, hysteria and irrationality.

- Behavioral finance: Robert J. Shiller

“mass psychology may well be the dominant cause of movements in the price of the aggregate stock market.”



## *... to High-Frequency Trading*

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- How does crowd psychology affect traders' daily work in financial markets – and how might that be changed when trading becomes automated and computerized?
- How implicit assumptions (originating from crowd psychology) might be programmed into the design of high-speed trading algorithms?



# Sociological Approaches to Financial Markets

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- Norms in financial markets: the market as a moral community (Mitchel Abolafia)
- Financial markets as a platform for symbols and an object of emotional attachment (Karin Knorr Cetina)
- Donald MacKenzie (2014): questions of morality reappear in HFT, as HFT participants distinguish sharply between appropriate and less appropriate algorithmic action, the former being associated with liquidity-making, the latter with liquidity-taking

# Methods and Data – I: Ethnography

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- A sociological approach to HFT allows us to follow the daily practices and conversations among high-frequency traders (HFTs).
  - How professional HFTs (traders and programmers) themselves describe their jobs is highly informative about the reasoning behind their trading strategies – e.g. if they draw implicitly or explicitly on assumptions from crowd psychology.
- Ethnographic observations: HFTs were observed while working at their desk.
  - 6 weeks inside a small HFT prop shop close to Wall Street.
  - One-day visits to 3 other HFT trading firms in New York and New Jersey.
  - Designing and building black box market automata, supervising and monitoring algorithms.
  - The establishment of back-office facilities necessary for HFT activity.

# Methods and Data – II: Interviews

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- 50 interviews conducted with a broad range of actors involved with HFT (in Copenhagen, London, Chicago, and New York).
  - Broker-dealers, institutional investors (investment bankers) and hedge funds.
  - Exchange officials from different major US exchanges servicing HFTs as well as central banks officials involved with HFT/algo-trading research.
  - US academics and New York research analysts servicing HFT.
  - Programmers, software developers, and providers of high-speed telecommunications (fiber optic cables).
- Focusing on US Treasury Bond Futures and Index Futures.
  - Buying and selling shares rapidly: profiting from rebates, market-making activities, short-term mispricings and statistical arbitrage opportunities.
  - Low-latency strategies for data transmission (the average holding time is 10 seconds).



# Defining HFT

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The SEC definition: “professional traders acting in a proprietary capacity that engages in strategies that generate a large number of trades on a daily basis” (SEC: Concept Release on Equity Market Structure, January 14, 2010).

The US Commodity Futures Trading Commission has launched the following working definition (May 2012):

High frequency trading is a form of automated trading that employs: a) algorithms for decision making, order initiation, generation, routing, or execution, for each individual transaction without human direction; b) low-latency technology that is designed to minimize response times, including proximity and co-location services; c) high speed connections to markets for order entry; and d) high message rates (orders, quotes or cancellations).

# The HFT Debate – I

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## HFT is a threat to fair and transparent markets

- Scott Patterson: *The Quants: The Math Geniuses who Brought Down Wall Street* (2010); *Dark Pools: The Rise of A.I. Trading Machines and the Looming Threat to Wall Street* (2012)
- Michael Lewis: *Flash Boys* (2014):

The U.S. stock market was now [after the introduction of HFT] a class system, rooted in speed, of haves and have-nots. The haves paid for nanoseconds; the have-nots had no idea that a nanosecond had value. The haves enjoyed a perfect view of the market; the have-nots *never saw the market at all*. What had once been the world's most public, most democratic, financial market had become, in spirit, something more like a private viewing of a stolen work of art.

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# *The HFT Debate – II*

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## **HFT provides liquidity and improves market quality.**

- Hendershott, Jones and Menkveld (2010); Angel, Harris and Spatt (2010) show the narrowing of bid-ask spreads.
- Brogaard (2010) finds that HFT engage in price reversal strategies but no evidence that HFT withdraw from markets in bad times.
- Brogaard, Hendershott and Riordan (2013): HFTs trade in the direction of reducing pricing errors both on average days and during periods of relative market turbulence.

## **HFT withdraws liquidity under certain (negative) conditions.**

- Kirilenko et al (2010): HFTs compete for liquidity and amplify price volatility.
- Hasbrouck (2013): Identify increased short-term volatility in bids and offers.
- Golub, Keane, Poon (2012): Mini flash crashes have an adverse impact on market liquidity.
- Johnson et al (2012): Uncover the emergence of frequent black swans events with ultra-fast durations.
- Baron, Brogaard and Kirilenko (2014): HFT firms have strong incentives to take liquidity and to compete over small increases in speed.



## *The HFT Debate – III*

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Despite and across these debates one major concern remains, namely, the rise of a new financial order.

the growing interconnectedness of financial markets and institutions has created a new forms of accident: a systematic event, where the "system" now extends beyond any single organization or market.

Kirilenko, A., and Lo, A. 2013. "Moore's Law versus Murphy's Law: Algorithmic Trading and Its Discontents." *Journal of Economic Perspectives* 27(2): 51-72.



# HFT and Contagion – I

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Didier Sornette and Susanne von der Becke (2011) “Crashes and High Frequency Trading”:

HFT stimulates “the crowding of adaptive strategies that are pro-cyclical ... As HFT use short-term information as well as adaptive algorithms, there is potential for herding as the strategies can crowd to the same signal, synchronize and lead to transient large instabilities.”

→ **Strong contagion**

# HFT and Contagion – II

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Easley, López de Prado and O’Hara (2014) “Liquidity and Toxicity Contagion”.

Examine “contagion as the natural consequence of market makers revising their orders in one market in response to changing liquidity conditions in *related markets*.”

→ **Weak contagion**

## *Empirical Analysis I: Traders' Use of Crowd Psychology*

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Strategic use of financial contagion (due to securities being correlated).

As one HFT trader stated: “we profit from correlation and hedge ourselves. We exploit securities that move in sync due to them being tightly hedged.”

Similarly, a programmer from a research firm specializing in HFT stated that “what [HFT traders] do is to empirically measure the correlation between securities. Virtually every pair of securities in the market has a positive correlation.”

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## *Empirical Analysis I: Traders' Use of Crowd Psychology*

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In the words of a CEO of a small HFT firm in New Jersey:

people are in the business of propagating that price impact to other securities [...] So what we are doing, basically, is transferring the price impact of one security to a large set of other securities. That's where liquidity comes from, we're sourcing liquidity from other securities and transferring them to a specific future contract and then we're taking the price impact from that future and spreading it to other securities.

Weak contagion (in the sense of a mere structural correlation) is not simply a feature that can be identified in HFT, it is rather a fundamental condition. It is something HFT acts upon and exploits.

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# *Empirical Analysis I: Time-Jump the Spreading Effect*

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A trader reflects on how his algorithms are designed to exploit contagion effects:

What you do is making markets. So you are offering and bidding competitively on one exchange. That way when someone pays the spread, when someone buys the offer or sells the bid, they are first to know because they got filled. If they are part of that sell or buy, they find out immediately and that gives them the time-jump to go on to the next exchange and if they sold they can buy on that exchange and make profit on the difference.



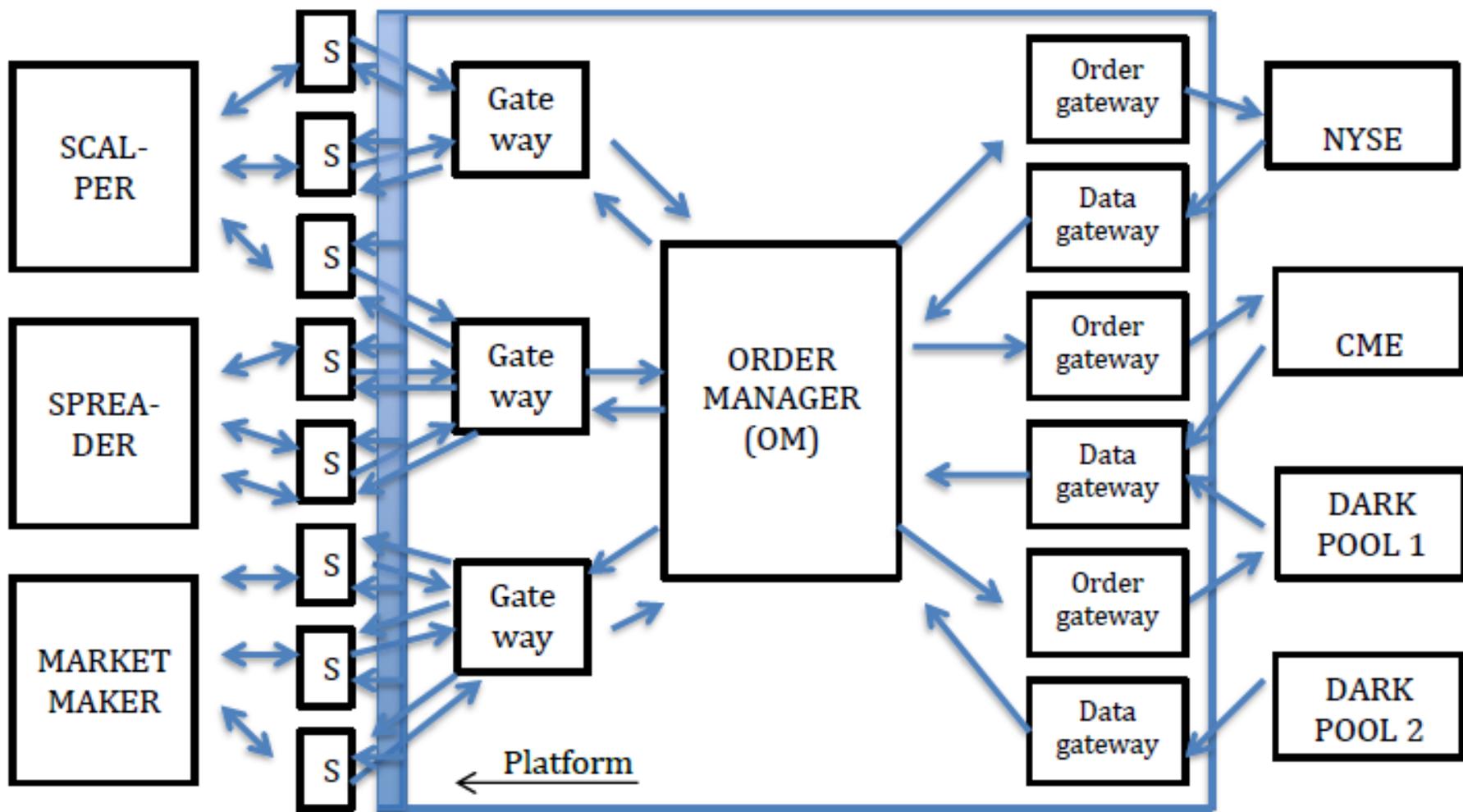
# *Empirical Analysis I: Contagious Order Flow*

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Another trader, acting CEO of a major HFT firm in Chicago, described a similar strategy:

The fact that I am participating on the market gives me time to speed-jump because the information were a fill and that preempts market data significantly [...] and when you receive that fill, that's what triggers your hedge orders essentially, to these other exchanges.





# *Empirical Analysis I: Market Recognos*

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Sophisticated tools are built to detect market moves initiated by ‘real money’ (i.e. institutional investors and banks) in order to act upon or counteract expected price moves.

... the first thing I did when I entered this business was to build an iceberg detector. And that is very much that kind of recognos where you’re looking for patterns that indicate micro-structure activity and base decisions on that.



# *Empirical Analysis II: Human–Algo Interaction*

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## *Empirical Analysis II: Human–Algo Interaction*

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... human beings are naturally trend followers. If the market is selling off, then they start panicking and everybody else does. But that's not what machines do. What machines do is they'll say, 'okay, historically, when everybody else is selling, it's more profitable to be a buyer'. Because that's what the data says. So machines are not emotional. They don't really care.

## *Empirical Analysis II: Detachment from Market Crowds*

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A trader managing a HFT firm stated that:

I like the quantitative, very computer-based approach. Get rid of the emotion, you know. If you just lost [...] much money yesterday you might be pushing more to make it up. A computer program never pushes to make up for an error from yesterday. If it lost money yesterday, it's not taking more risk to make more money. It's going to take exactly [the risk it is programmed to].

## *Empirical Analysis II: Emotional Interference*

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... I try not to get too happy on a winning day. I try to temper myself in both directions. When it's a losing day it's very much part of the strategy. So I try as much as possible not to let myself experience the emotional swings.



## *Empirical Analysis II: Emotional Interference*

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The importance of controlling oneself and not becoming emotionally affected by the market and its apparent pulls evokes a key idea in much twentieth-century contrarian investment theory.



## *Empirical Analysis II: Emotional Interference*

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The turn to HFT does not make human beings irrelevant, but it does reconfigure the relations between individual HFT traders and the market since this relation is now mediated through algorithms.

In spite of this reconfiguration, and in spite of the rationality and non-emotionality ascribed to algorithms, emotional crowd contagion remains a concern to be constantly addressed in practice.

The alleged need for market detachment – a notion derived from crowd psychology in early twentieth-century speculation theory – is very alive also in HFT.

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# Conclusion

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Contagious crowd dynamics are indeed central to HFT strategies:

- 1.HFT strategies seek to exploit contagion in the form of structural correlations – what we have referred to as weak contagion.
- 2.HFT black boxes are designed in a fashion where adaptive feedback loops play a crucial role, thereby rendering strong contagion across markets more likely.
- 3.It is a widespread concern that traders interfere too much, and too emotionally, in their allegedly rational algorithms – and that irrational market contagion may therefore creep into the HFT algorithms. As a result efforts are made to ensure detachment from contagious, irrational market crowds.

As a consequence, HFT at once takes for granted market contagion, is implicated in reinforcing it, and seeks to avoid it.

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Thank you!

