News Trading and Speed

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Plan

1. Introduction - Research questions
2. Model
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Marketable orders from high frequency traders contain information (e.g., Brogaard, Hendershott and Riordan, 2012)

- **Mainly public info**: news, macro announcements, market data (updates in the limit order books, trades, market-wide returns), blog posts, etc.

**Computers That Trade on the News**

By **GRAHAM BOWLEY**

The number-crunchers on Wall Street are starting to crunch something else: the news.

Math-loving traders are using powerful computers to speed-read news reports, editorials, company Web sites, blog posts and even Twitter messages — and then letting the machines decide what it all means for the markets.
High Frequency Trading

Real-time market insight for high-frequency trading

High-frequency trading professionals are responsible for many of the dynamic shifts taking place in the equities, commodities and currency markets. That’s because high-frequency trading models automatically move huge numbers of shares based on market drivers and can trigger large, sustained price shifts. **Timing is everything and to make lucrative, well-timed trades, institutional and electronic traders need accurate real-time news available, including company financials, earnings, economic indicators, taxation and regulation shifts. Dow Jones is the leader in providing high-frequency trading professionals with elementized news and ultra low-latency news feeds for algorithmic trading.**

**Dow Jones Lexicon helps build more predictive models for high-frequency trading**

To make the absolute most of market cycles, high-frequency trading professionals need to know where the market is headed, not just where it is right now. **Dow Jones Lexicon** helps traders get more out of their low-latency news to uncover hidden market trends and opportunities algorithmic applications miss.

Instead of assigning news stories an arbitrary “sentiment score,” **Dow Jones Lexicon**’s derived data technology looks at news – even archival content -- in a truly unbiased, quantitative way. As real-time news is published, words are coded based on sentiment, strength and litigiousness and then quantitatively analyzed for frequency and use. This data can then be use to create objective indicators to support high-frequency trading models.
High Frequency Trading on News

- How can it be profitable to trade on public information?
  1. **Faster access to information** (co-location, real-time data feed, etc.)
  2. **Greater processing capacity** of vast amount of information
     \[\rightarrow\] Only computers can process such vast amount of data quickly to generate trading signals
Questions

- What is the optimal trading strategy for a high frequency trader on news (HFTN)?
- How does it differ from that of traders with only an information processing advantage?
Why are these questions important?

- **Many empirical papers relate returns to order flows from HFTs**
  (e.g., Kirilenko et al., 2011; Brogaard, Hendershott and Riordan, 2012; Hirschey, 2011; Zhang, 2012; etc.)
  1. How to interpret these findings? What should we expect regarding HFT flows?
  2. Need of structural foundations

- **Many debates about the effects of HFT on price discovery and volatility**
  1. HFT often accused of increasing volatility
  2. Is this the case? Is speed associated with greater price volatility, or is it greater information processing? Should trading been slow down or should processing capacity be constrained?
Our approach

- **We build on the dynamic version of Kyle (1985)** and consider an informed investor with **two** informational advantages:
  1. Greater ability to process information: his forecast of the asset payoff is more precise than that of market-makers (standard)
  2. Faster reaction than market-makers to public information (non standard)

- **We compare the equilibrium with and without the speed advantage**

- **Main finding:** even an infinitesimal speed advantage has large effects on equilibrium strategies and the relationship between trades and returns
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Model

- Kyle (1985) + public information (news) + speed advantage for the informed investor
- Continuous time \( t \in [0, 1] \)
- Fundamental value of the asset, \( \nu_t = \nu_0 + \int_0^t d\nu_t \), follows a random walk
- News = \( d\nu_t \)
Participants

- **One risk-neutral informed trader (the HFTN):** observes $v_0$ and news $dv_t$ perfectly
  1. **Position at date t:** $x_t$
  2. **Strategy:** market order for $dx_t$ shares traded at date $t$

- **Noise traders**
  1. Exogenous trade at date $t$: $du_t$, contains no info

- **Competitive market-makers**
  1. Absorb net order imbalance $dy_t = dx_t + du_t$ at a price equal to the expected payoff of the asset conditional of their information
  2. **Public flow of information:** $dz_t = dv_t + de_t$ where $de_t \sim \mathcal{N}(0, \sigma_e^2 dt)$
     $\sigma_e > 0$: the informed trader has an information processing advantage
Timing

Figure 2: Timing of events during \((t, t + dt]\) in the benchmark and the fast model

- **Informed trader** receives signal \(dv_t\)
- **Market maker’s quote** \(q_t\)
- **Order flow** \(dx_t + du_t\)
- **Execution price** \(p_{t+dt}\)

**Benchmark**: The market-makers observe news before the informed investor can trade on them: the informed investor only has an information processing advantage.

**Fast model**: The informed investor can trade on news before they are observed by the market-makers.

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14 This interpretation is correct if the price impact is increasing in the signed order flow and a zero order flow has zero price impact. These conditions are satisfied in the linear equilibrium we consider in Section 3.
Equilibrium trading strategy for the informed investor

- **Informed trader’s optimal strategy has two components:**

\[ dx_t = \beta_t(v_t - q_t)dt + \gamma dv_t \]

where \( q_t \) is market-makers’ expectation of the asset payoff before observing the order flow

1. **Pricing error component** \( \beta_t(v_q - q_t)dt \): buy (sell) when market-makers undervalue (overvalue) the asset. Standard in Kyle’s type of model

2. **News trading components** \( \gamma dv_t \): trade on news because they are correlated with short run returns

- **Result:** If the informed investor has no speed advantage (benchmark): \( \gamma = 0 \), even if he has an information processing advantage \( (\sigma_e > 0) \) \( \implies \) **No HFTN without a speed advantage**
Informed investor’s position

\[ X_t \]

\begin{align*}
\text{Informed Inventory} & \quad \text{t} \\
0 & \quad 0.1 \quad 0.2 \quad 0.3 \quad 0.4 \quad 0.5 \quad 0.6 \quad 0.7 \quad 0.8
\end{align*}

\[ dX_t \]

\begin{align*}
\text{Informed Order Flow} & \quad \text{t} \\
-0.015 & \quad -0.01 \quad -0.005 \quad 0 \quad 0.005 \quad 0.01 \quad 0.015
\end{align*}

red = benchmark
blue = model with speed
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Implications for the trades of HFTNs

- **High participation rate:** Fraction of volume due to informed trader is an order magnitude higher when he has a speed advantage
  - Consistent with the large volume due to HFTs
- **Anticipatory trading:** Positive correlation between short run returns and the trade of the informed investor
  - “Possibly due to their speed advantage or superior ability to predict price changes, HFTs are able to buy right as the prices are about to increase.” (Kirilenko et al., 2012)
- **Zero autocorrelation in trades** $(dx_t)$ over short time intervals
- None of these properties obtain if the informed investor has no speed advantage
The effect of HFTN on market performance

- There are many debates about the effect of HFT on liquidity, price discovery and volatility
- Causality is difficult to establish empirically
- Compare the model with and without a speed advantage
Liquidity

- Speed advantage is an *additional source of adverse selection*
- Hence, liquidity is smaller with HFTN
Price discovery

- **Measure of informational efficiency:**  $E[(v_t - p_t)^2]$
- **Two effects of granting a speed advantage to the informed investor:**
  1. Price changes are more correlated with news: $\text{Cov}(dp_t, dv_t)$ higher with HFTN
  2. but less correlated with pricing error: $\text{Cov}(dp_t, v_t - p_t)$ is smaller with HFTN, because the informed investor trades less aggressively on the pricing error when he trade on news
- **Net effect on** $E[(v_t - p_t)^2]$ **is zero**
Volatility

- **Volatility of returns can be decomposed in two components**
  
  \[ \text{Var}(dp_t) = \text{Var}(p_{t+dt} - q_t) + \text{Var}(q_t - p_t) \]

  - **Transactions** \( (dy_t) \)
  - **Public signals** \( (dz_t) \)

- The first component is higher in the fast model and the second is smaller.
  
  Net effect = zero \( \implies \) HFTN has no effect on volatility

- **However, the contribution of news to volatility is smaller in the fast model**
Implications

Determinants of HFTN

**Results:** When market-makers’ public information is more precise

1. The informed investor trades more aggressively on news
2. The market is more liquid

Yet, liquidity is lower when the informed investor has a speed advantage

⇒ **Risk of spurious positive correlation between measures of HFTN activity and liquidity**
Interpreting econometric models

- Our model can be used to offer structural foundations to econometric models of high frequency trading
  - VAR models
  - State-space models
Conclusion

- Speed of access to information has effects distinct from greater processing capacity of information.
- Slowing down HFTs may have no effect on volatility or price discovery (they will simply trade more aggressively on their long-lived information advantage).
- Dynamic models of HFT help to interpret relationships between HFTs’ flows and returns.
- Caveat: HFTs’ strategies are heterogeneous. Our results apply only to one specific strategy (High Frequency Trading on News).