The Long-Run Evolution of the Financial Sector

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Main Question

- Does the financial economy have a balanced growth path?
- How does productivity growth change financial analysis?
  Can productivity growth generate a sectoral shift?
  1. Rise of order-flow trading, relative to fundamental-based trading
  2. Increase in price informativeness
     (Bai, Philippon, Savov, 2011)
  3. Decline in market liquidity
     (Burnside & Patton 2015)

Hedge Funds Love Order Flow Data

- Hedge funds often “partner” with a broker to take opposite side of uninformed trades.
- ”Right now, ETrade sends about 40 percent of its customer trades to Citadels market-maker division . . . Indeed, the deal is so potentially lucrative for Citadel that the hedge fund is willing to make an upfront $100 million cash payment to the financially-strapped online broker.” (Goldstein, 2009)
- “[I]t’s all about getting as much customer order flow as possible. . . . The more trades these sophisticated machines get to see, the better they become at predicting price trends and making money for their creators.” (Reuters 2009)

Rise of Hedge Funds vs. Mutual Funds

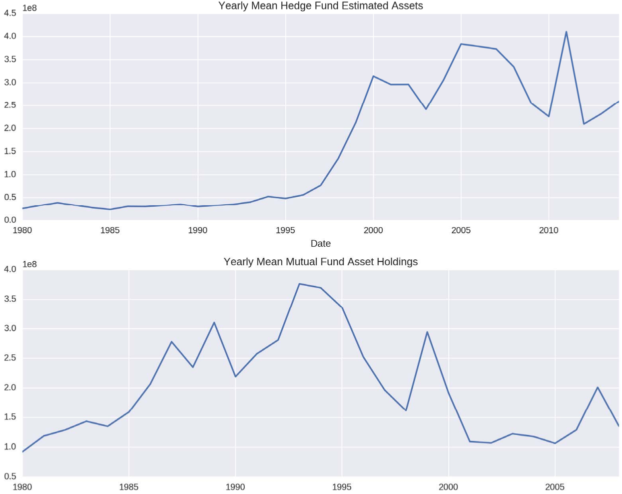


Figure: A sectoral shift in financial intermediation

Rise of Automated Trading

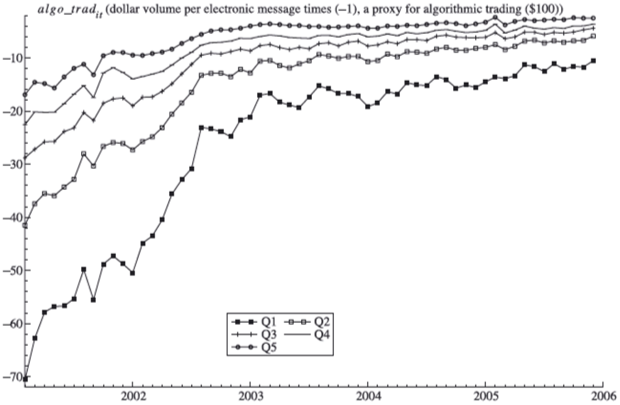


Figure: Henderschott, Jones and Menkveld (2011)

- Clear tech transformation (5 lines are 5 size quintiles of assets)

Google Trends: Order Flow vs. Fundamental Analysis

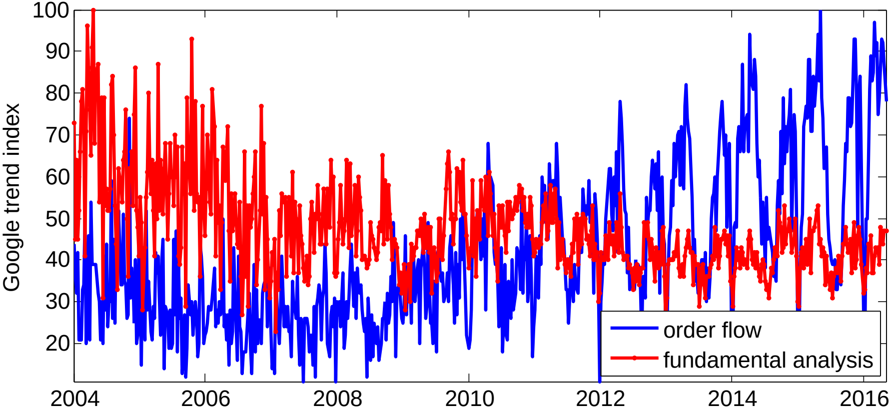


Figure: Google search frequency (Index normalized to 100 at highest entry)

Overview

- Model has 4 key elements
  1. Information acquisition and portfolio choice
  2. Choice between fundamental and order-flow information
  3. Long-lived assets
  4. Long-run growth in technology (more information)

  As information production grows, do fundamental and order-flow information grow in a balanced way?

- Rough calibration and numerical results
- Effects on the real economy

Model Setup

- A continuum of 2-period lived overlapping investors
- Preferences: $U(c_{it}) = -e^{-\rho(rc_{it}+c_{i,t+1})}$
  - $\rho > 0$: risk aversion
  - $r > 1$: rate of time preference
- 1 long-lived asset with dividend: $d_{t+1} = \mu + Gd_t + y_{t+1}$
  - $\rho > 0$: risk aversion
  - $y_{t+1} \sim N(0, \tau_0^{-1})$ unknown at t
- Endowments: $e_{it} = \bar{e} + h_{it}y_{t+1} + \tilde{e}_{it}$
  - $\bar{e}$ known, $\tilde{e}_{it} \sim N(0, \tau_e^{-1})$ iid (non-essential)
  - Exposure to aggt risk: $h_{it} = x_{t+1} + \epsilon_{hi(t+1)}$ (known)
  - $x_{t+1} \sim N(0, \tau_x^{-1})$, $\epsilon_{hi(t+1)} \sim N(0, \tau_h^{-1})$ (unknown)
    - Creates price noise
- Budget: $c_t = e_{it} - q_{it}p_t$ and $c_{t+1} = q_{it}(p_{t+1} + d_{t+1})$.
- Market clears: $\int q_{it}di = \bar{x}$ (supply = $\bar{x}$).

Setup: Information Choice

- For each asset, 2 types of signals
  - Fundamental: $\eta_{fit} = y_{t+1} + \epsilon_{fit}$ $\qquad \epsilon_{fit} \sim iid\, N(0, \Omega_{fi}^{-1})$
  - Order flow: $\eta_{xit} = x_{t+1} + \epsilon_{xit}$ $\qquad \epsilon_{xit} \sim iid\, N(0, (\Omega_{xi} - \tau_h)^{-1})$
- Individual optimization

$$\begin{aligned} \max_{\Omega_{fi} \geq 0, \Omega_{xi} \geq \tau_h} \quad & E[\log E[U]] \\ \text{s.t. Information Constraint:} \quad & \chi_f \Omega_{fit}^2 + \chi_x \Omega_{xit}^2 \leq K_t \end{aligned}$$

- Technological progress: K_t grows deterministically over time

Asset Market Solution

- Optimal portfolio

$$q_{it} = \frac{E[p_{t+1} + d_{t+1} | \mathcal{I}_{it}] - rp_t}{\rho_{it} Var[p_{t+1} + d_{t+1} | \mathcal{I}_{it}]} - h_{it}$$

- Market clearing price:

$$p_t = A + Bd_t + Cy_{t+1} + Dx_{t+1}$$

- Info choice problem becomes

$$\max_{\Omega_{ft}, \Omega_{xt}} \;\; \Omega_{ft} + \left(\frac{C_t}{D_t}\right)^2 \Omega_{xt}$$

$$\text{s.t.} \quad \chi_f \Omega_{fit}^2 + \chi_x \Omega_{xit}^2 \le K_t, \quad \Omega_{ft} \ge 0, \text{ and } \Omega_{xt} \ge \tau_h.$$

Growth Is Not Balanced

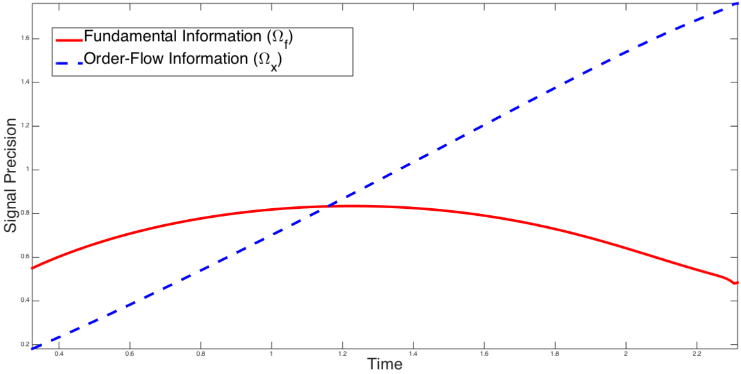
- Key force: $(C_t/D_t)^2$ grows with information technology (K_t)

Lemma

As $K \to 0$, if we take C_{t+1} and D_{t+1} as given, then the unique solution for the price coefficient C_t is $C_t = 0$ and therefore the marginal value of order-flow information is zero as well.

- As others become more informed, finding dumb money to trade against becomes more valuable. Structural shift to order flow analysis.

Main Result: Structural Shift from Fundamental to Order Flow



- Share of fundamental analysis falls and order flow grows, as everyone become more informed

Why Does Order Flow Analysis Keep Growing?

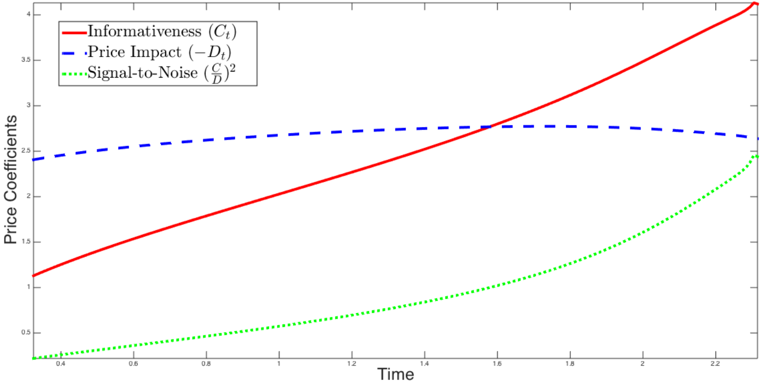
Lemma

***Complementarity in Order Flow Analysis**: If $c\,\Omega_{xt}$ and C_t/D_t are sufficiently small, then an increase in order flow analysis increases the relative value of order flow analysis: $\partial(C_t/D_t)^2/\partial\Omega_{xt} \geq 0$.*

- Agents who use order flow to extract information from prices trade on this extracted information.
- Trades move prices.
- Prices become more informative: C/D rises. Easier to clean up a clearer signal than unscramble a messy one.
- Value of order flow information rises.

Price Information and Liquidity

Liquidity falls, price informativeness rises
$\rightarrow$ order flow more valuable



- Behavior of D_t specific to these parameters. Rise of C_t and C_t/D_t is general.

Why is Liquidity Deteriorating?

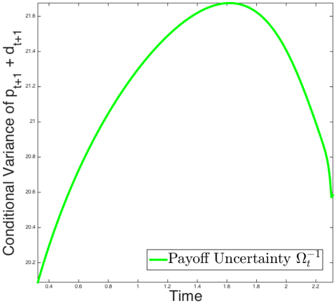
- In a static model
  - Price informativeness and liquidity move together
  - Precise information makes prices more informative
  - Less uncertain investors are more willing to absorb demand shocks
- In our **Dynamic model**
  - payoff uncertainty can rise or fall

$$Var[p_{t+1} + d_{t+1}|\mathcal{I}] = C_{t+1}^2 \tau_0^{-1} + D_{t+1}^2 \tau_x^{-1} + (1+B)^2 Var(y_{t+1}|\mathcal{I})$$

  - Information reduces $Var(y_{t+1}|\mathcal{I})$
  - But can increase C_{t+1}^2 or D_{t+1}^2.
- When everyone learns more, (t+1) prices are more sensitive to (t+2) shocks. The higher loading makes p_{t+1} more uncertain.
- High uncertainty = high price impact. One unit sale forces others to bear more risk. Price adjusts more to compensate.

Real Spillover I: Liquidity and Issuance

- Does Financial analysis make capital issuance too expensive?
- Maximize revenue minus cost: $\max_{\Delta \bar{x}} E[\Delta \bar{x} p - c(\Delta \bar{x}) | \mathcal{I}_f]$
- Price impact rises for the same reason liquidity falls.



Financial analysis, especially order-flow, raises risk for long-lived assets. Deters equity issuance and real investment.

Real Spillover II: Price Sensitivity and Manager Incentives

- When firm managers are compensated with equity, sensitive prices provide incentives.
- Suppose managers can exert effort to raise dividends:

$$d_{t+1} = g(l_t) + y_{t+1}$$

- Managers get compensated with equity. Utility is:

$$U_m(l_t) = \bar{w} + p_t - l_t$$

- First-order condition: $C_t g'(l_t) = 1$. Effort will be optimal if $C_t = 1$.

Both fundamental and order flow information improve C and improve real incentives.

Conclusion

- Balanced growth? No.

  As others' information improves over time, watching order flow and finding the uninformed trades becomes more valuable.

- Explains changes in informativeness and liquidity.

Parameters

- Estimate $d_{t+1} = \mu + Gd_t + y_{t+1}$ for S& P500 dividends
- Estimate $p_t = A + Bd_t + Cy_{t+1} + e$ on S& P500 prices, divs
- Interpret residual variance as $E[(D_t x_{t+1})^2]$. 7 moments. ρ free

Parameter	Value	Description
μ	0.41	Constant in dividends
G	0.87	Dividend persistence
Σ	0.05	Dividend variance
r	1.03	Time preference
τ_x	1.718	Variance of aggregate hedging
K	$0.2 - 5.2$	Total information capacity
χ_x / χ_f	0.0135	Relative cost of order flow info
ρ	0.2	Risk aversion