The Low Frequency Trading Arms Race: Machines Versus Delays

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Overview

- This paper proposes a new way to compute **transaction costs** of trading strategies in the corporate bond market where bonds are not traded frequently
- Corporate bond transaction costs are a decreasing function of trade size for corporate bonds Edwards, Harris, and Piwowar (2007)
- This paper investigates the trade-off that investors face between **bid-ask spreads** and **execution delays**:
  - **Trade immediately**: quick execution but higher bid-ask spreads
  - **Wait**: smaller bid-ask spreads but potential delayed (or missed) execution

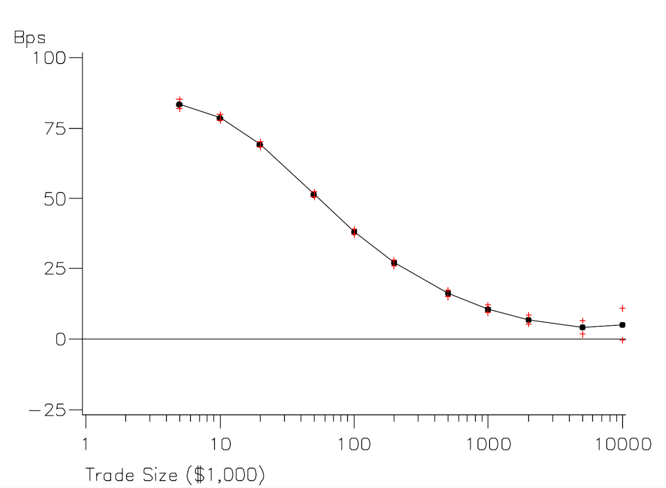
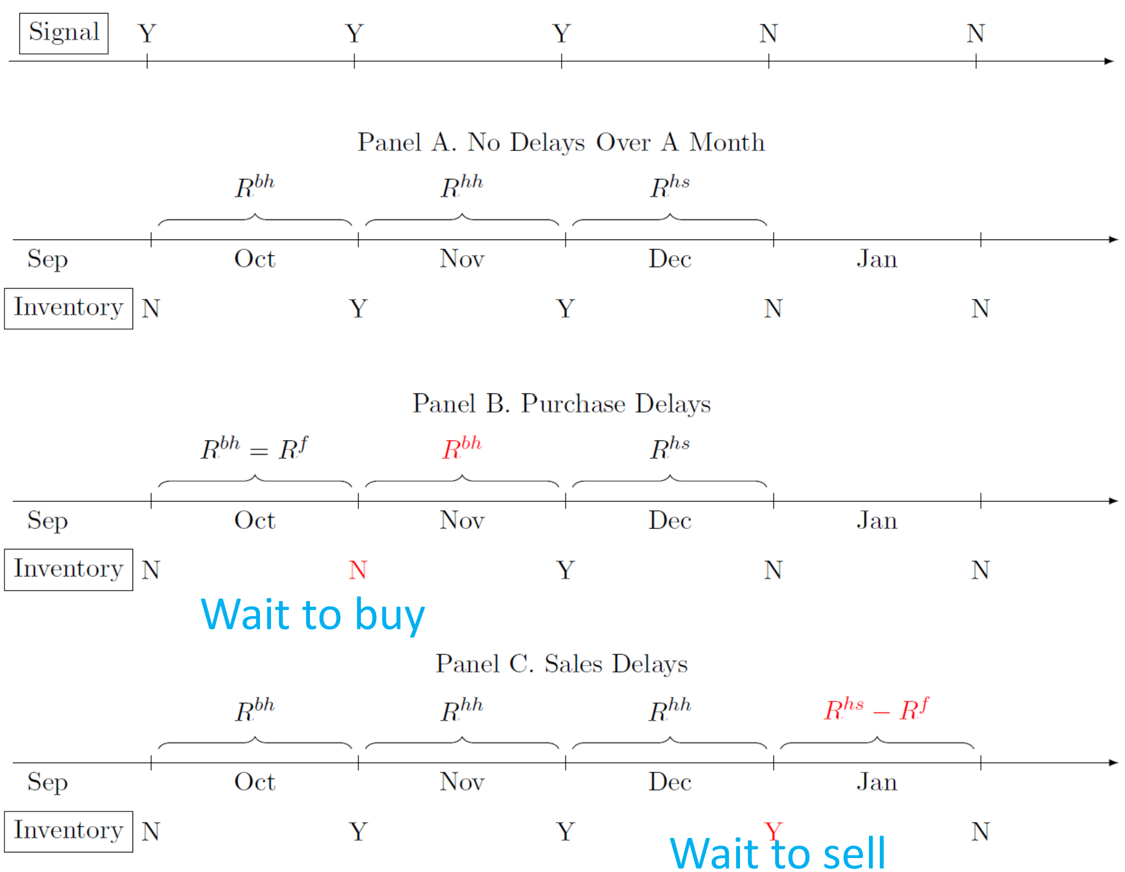


Figure 2, Edwards, Harris, and Piwowar (2007)

Calculate Net-Returns by Explicitly Accounting for Trading Delays

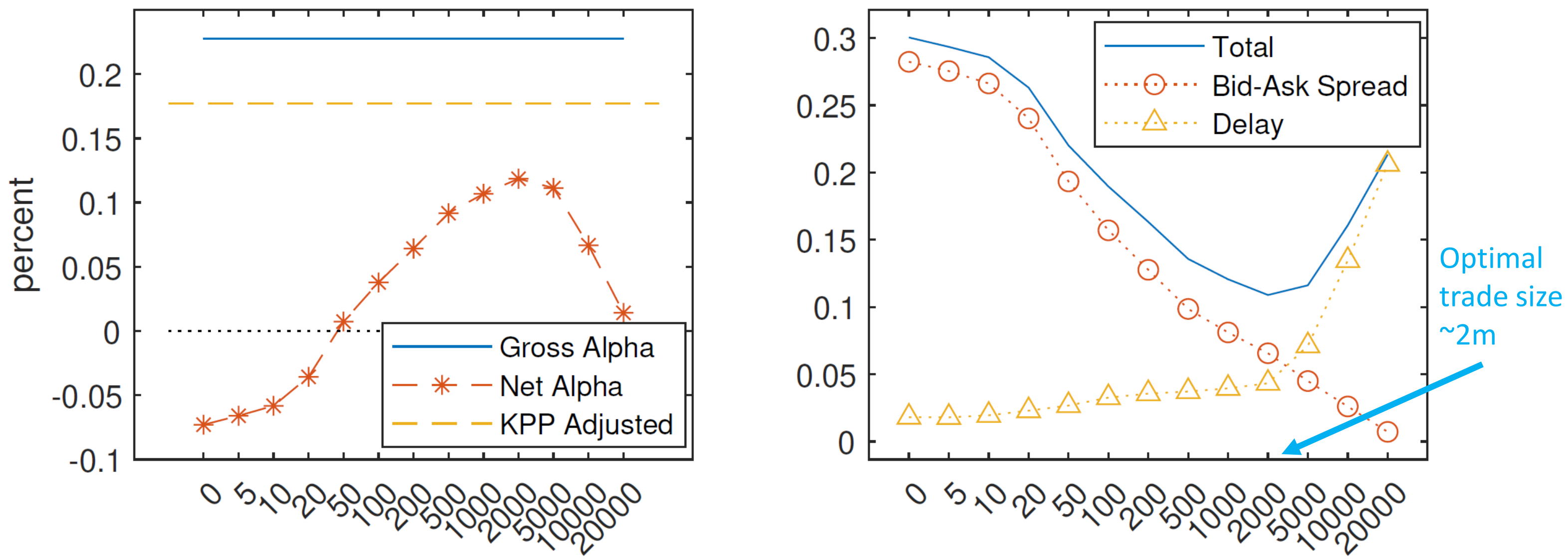
- Buy (b) at the ask price, sell (s) at the bid price only if the “TRACE” actual transaction volume larger than the target trading volume
- Otherwise, wait (earn/pay risk-free rates) till the trading opportunity arrives

Figure 2: Delays and Inventory Dynamics



Bid-Ask Spreads vs Delay Costs: Both as a Function of Trade Size

Figure 1: Effect of Transaction Costs: Example of Credit Spread-Sorted Portfolio



This figure plots the bond CAPM alphas of the long-short strategies based on corporate bonds' credit spreads before and after accounting for transaction costs (left panel). The transaction costs are decomposed into the bid-ask spread costs and delay costs (right panel). Values on the x-axis are the trade size in thousand dollars.

Main Empirical Findings

- Even the latest machine-learning-based learning strategies earn **zero or negative bond CAPM alphas** after transaction costs
  - Based on 200 bond and equity-based characteristics
  - The best trade size that maximizes the net CAPM alpha is between 2 and 10 million per trade
  - Significant CAPM alphas before transaction costs, but insignificant after transaction costs
  - Half of the cost is due to delays
- **Bond Mutual Fund Performance**
  - Only 8.5% of all corporate bond mutual funds (42 funds) generate significant after-cost alphas
  - Investors are better off by simply holding a corporate bond ETF that tracks the market

Overview

- Very clear message – using a simple way to answer an important question
- Comprehensive - already 100+ pages

- My comments:
  1. Potential bias
  2. Delay costs vs bid-ask spreads
  3. Optimal trade size

Comments #1

- It is difficult to estimate the “true” transaction costs because bond trades are **infrequent**, **large**, and often **pre-negotiated** by dealers and investors
- Existing methods (effective bid-ask spreads, regression based, round-trip estimation, etc.) are based on the actual realized “transactions” -- often delivers a **downward cost function of trade size**
  - Retailed investors receive less favorable prices from dealers
  - However, bond trading costs couldn’t decrease monotonically in trade size (which implies infinite capacity)
- The fundamental reason is that we don’t observe the **intended trades that did not go through**

Comments #1

- This is also related to the debate whether corporate bond market liquidity has improved/worsened post financial crisis
- Commonly used liquidity measures suggest high liquidity in the corporate bond market
- Traders feel differently in reality
  - Trade size
  - Turnover
  - Agency vs principal trades
- Why?
  - Dealer inventory capacity
  - More difficult to hedge single-name positions
  - Change in ownership

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Business

Goldman Contrarian Joins Chorus Warning on Bond-Market Liquidity

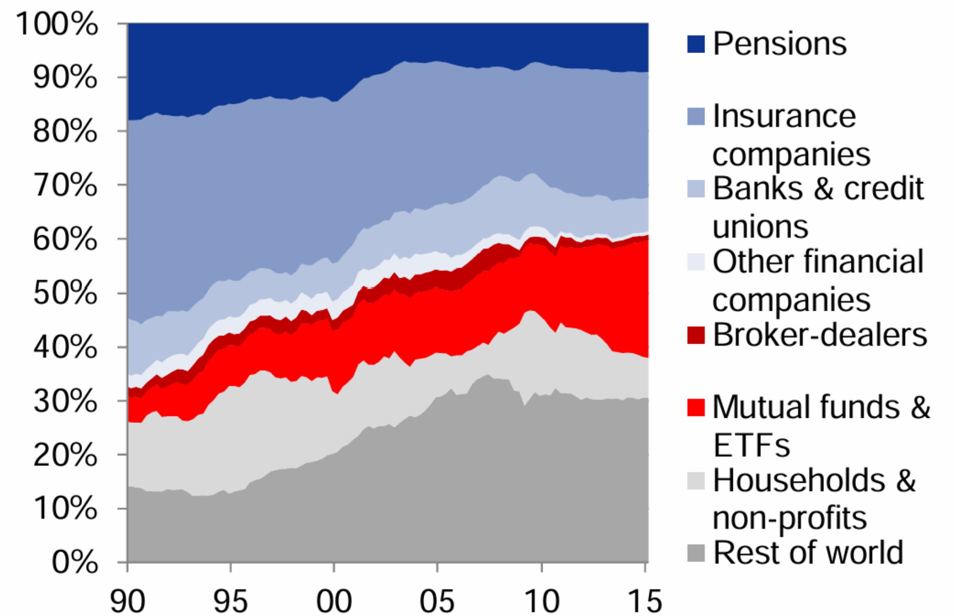
- Latest bad omen: dealer corporate-debt inventories go negative
- That light at the end of the tunnel? It might be `a train'

MARKETS

Investors' New Headache: It's Getting Harder to Buy or Sell When They Want

Changing hands

Share of corporate bond ownership by investor type, %



Note: Includes US-owned foreign bonds, private MBS, and other ABS.

Source: Federal Reserve Board, Goldman Sachs Global Investment Research

Comments #1

- This paper, based on observed transactions, still reflects an equilibrium outcome
  - Liquidity supply
  - Liquidity demand
- The observed transactions reflects the trading cost of the trading needs of existing traders
- **Is the estimation biased?**
  - "Current" institutional investors do not need to trade as often (large) as the ML algorithm/bond strategy

    -- downward bias on capacity
  - Investor composition is changing
    - Growth of corporate bond funds (smart beta, etc)
    - New liquidity suppliers (asset management firms)

Comments #2

$$\alpha^{Gross} - \alpha^{Net} = \underbrace{\alpha^{Gross} - \alpha^{NetDelay}}_{=\text{Delay Cost}} + \underbrace{\alpha^{NetDelay} - \alpha^{Net}}_{=\text{Half-Spread Cost}}$$

Estimated Total Costs

Estimated

Residuals

- The decomposition of the bid-ask spreads and trading delays
- $\alpha^{NetDelay}$ is calculated based on net returns similar to gross returns, but on quoted prices rather than bid/ask prices
- As trade size goes to infinity, delay cost will mechanically converge to total costs
- But that will imply that half-spread costs of these trades will converge to zero

Comments #2

- Alternative method: Ivashchenko and Kosowski (2024) estimate transaction costs based on market microstructure invariance (MMI) method proposed by Kyle and Obizhaeva (2016)
- Link trading size, costs, and risk together -- address trading capacity through model calibration

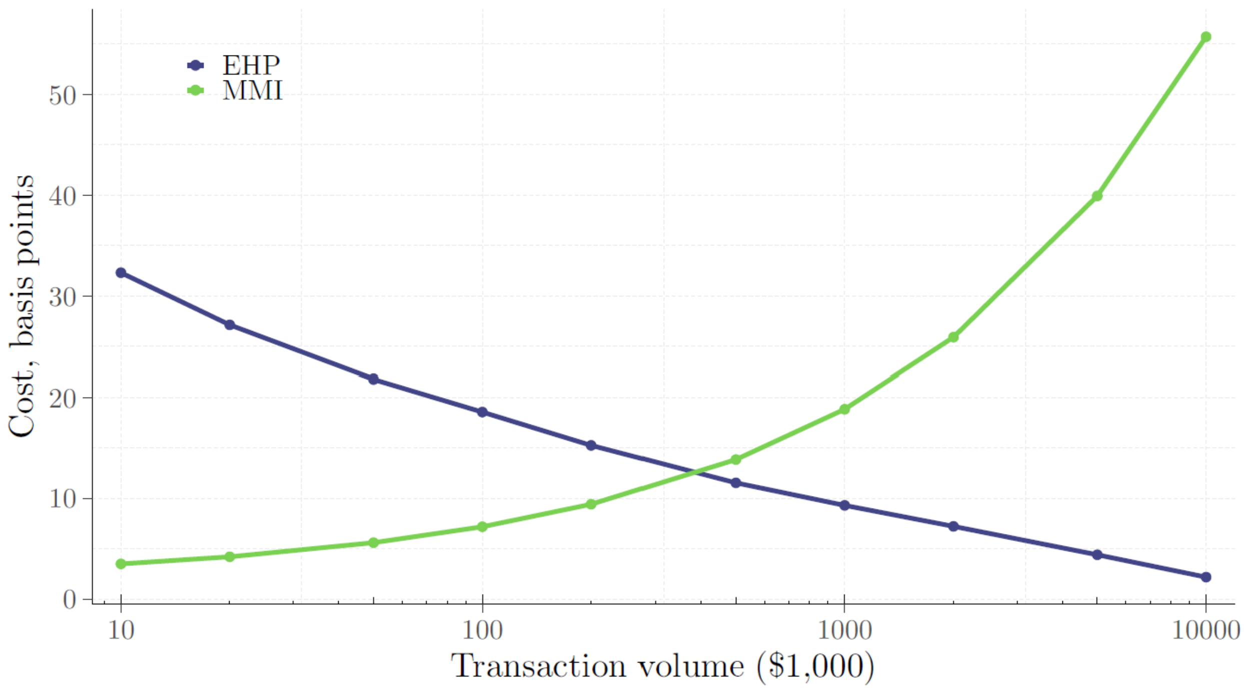


Figure 1: **Average MMI-implied and transaction-based corporate bond trading costs.**

Comments #2

- Net alphas of ML strategies are around 30~40 bps in terms of magnitudes

Table 7: Performance of ML Strategies

	Excess Returns		CAPMB α		Information Ratio			
Signal	Gross	Net Optimal	Gross	Net Optimal	Gross	Net Optimal	Optimal Volume	Turnover (%)
NN	0.531	0.110	0.430	0.039	1.192	0.177	5000	49.10
	(3.69)	(1.71)	(2.97)	(0.67)				
XT	0.548	0.166	0.393	0.042	0.901	0.118	2000	39.71
	(3.40)	(1.39)	(2.48)	(0.40)				
RF	0.387	0.056	0.239	-0.033	0.595	-0.125	10000	32.58
	(3.33)	(0.78)	(2.16)	(-0.49)				
ENET	0.535	0.129	0.422	0.041	0.980	0.121	2000	48.67
	(3.82)	(1.40)	(2.75)	(0.44)				
RIDGE	0.567	0.177	0.504	0.122	1.371	0.425	2000	46.22
	(4.07)	(1.86)	(3.77)	(1.41)				
LASSO	0.517	0.093	0.414	0.019	0.981	0.071	5000	49.92
	(3.08)	(1.04)	(2.21)	(0.20)				
ENS	0.592	0.162	0.476	0.068	1.152	0.215	2000	49.32
	(3.60)	(1.52)	(2.90)	(0.68)				
LENS	0.575	0.159	0.479	0.077	1.226	0.258	2000	49.46
	(3.76)	(1.56)	(3.18)	(0.83)				
NENS	0.562	0.142	0.421	0.029	1.038	0.092	2000	47.67
	(3.45)	(1.33)	(2.58)	(0.30)				

Comments #2

- What is the right benchmark of trading costs?

Panel B. Papers Incorporating Transaction Costs

Bali et al. (2020)	Roll measure of Bao et al. (2011)
Bali, Beckmeyer, and Goyal (2023)	Fixed at 35bps
Bartram, Grinblatt, and Nozawa (2023)	Portfolio-level bid-ask spreads
Bredendiek, Ottonello, and Valkanov (2023)	Round-trip transaction costs
Cao et al. (2023)	Estimates following Edwards et al. (2007)
Choi and Kim (2018)	Considers transaction costs as characteristics
Chordia et al. (2017)	Portfolio-level bid-ask spreads
He, Feng, Wang, and Wu (2024)	Fixed at 20 to 80bps
Houweling and Zundert (2017)	Maturity-rating, following Chen et al. (2007)
Israel, Palhares, and Richardson (2017)	Maturity-rating, following Chen et al. (2007)
Ivashchenko (2023)	Average 12m moving average of bond bid-ask spreads
Ivashchenko and Kosowski (2023)	Estimates following Kyle and Obizhaeva (2016)
Jostova et al. (2013)	Estimates following Edwards et al. (2007)
Kelly, Palhares, and Pruitt (2021)	Fixed at 19bps
Lin, Wu, and Zhou (2017)	Break-even transaction costs
Nozawa, Qiu, and Xiong (2023)	Bond-level bid-ask spreads

Comments #2

- Half bid-ask spreads and half delay costs
- By simply using a fixed 35 bps (higher than KPP 19 bps), ML strategies likely couldn't deliver positive net alphas at optimal volume, even worse at the typical $100K size

Table 9: Decomposition of Transaction Costs

	$100K			Optimal Volume			KPP
Signal	Total	BidAsk	Delay	Total	BidAsk	Delay	Cost
NN	0.689	0.582	0.107	0.390	0.144	0.246	0.258
XT	0.539	0.463	0.076	0.351	0.188	0.163	0.174
RF	0.678	0.620	0.058	0.272	0.065	0.208	0.185
ENET	0.651	0.552	0.098	0.381	0.213	0.168	0.223
RIDGE	0.614	0.507	0.108	0.382	0.195	0.187	0.209
LASSO	0.724	0.615	0.109	0.395	0.147	0.248	0.262
ENS	0.672	0.559	0.114	0.408	0.218	0.191	0.225
LENS	0.663	0.554	0.110	0.402	0.215	0.187	0.226
NENS	0.638	0.539	0.099	0.393	0.210	0.183	0.216

Comments #3

- The implied best trading size is 2-10 million, much higher than the typical institutional trading size (around 100K)
- Why?
  - "Existing" institutional traders do not trade like factor traders/ML algorithms?
  - Split trades into small ones?
- Validate the method using insurance company/mutual funds actual trading sizes
- Compare with their actual expense ratios

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	(3.45)	(1.33)	(2.58)	(0.30)				

Comments #3

- If we allow ML algorithm to choose trade size dynamically:
  - Different trade size for different bonds based on their historical transactions
  - Different trade size under different market conditions
- If we allow ML algorithms to **partially** fill an order when the trading signal is strong enough
- Can ML algorithms deliver significant net alphas?

Conclusion

- Very interesting and promising
- A simple method to estimate trading costs in the corporate bond market
- I really enjoyed reading the paper
- Good luck!