The Value of ETF Liquidity

Marta Khomyn[1], Tālis Putniņš[1,2], and Marius Zoican[3]

University of Technology Sydney

Stockholm School of Economics in Riga

University of Toronto Missssissauga and Rotman School of Management

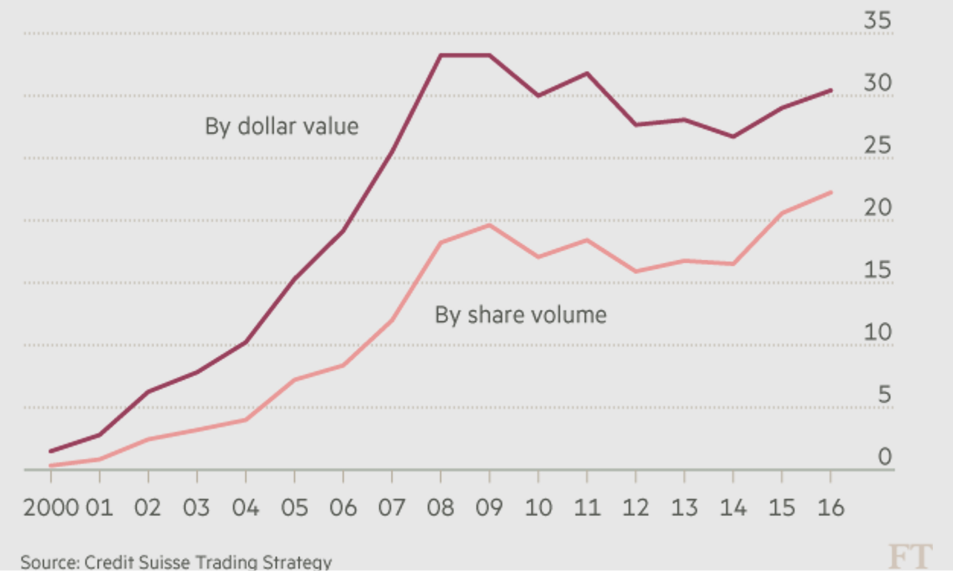
Outline

Motivation: A tale of three ETFs

Model of ETF competition

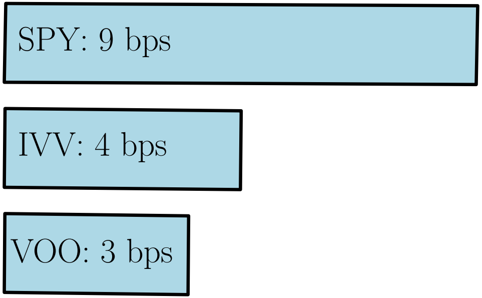
Empirical evidence

ETFs as % of all U.S. trading volume



Zoom in on S&P 500: Management expense ratios

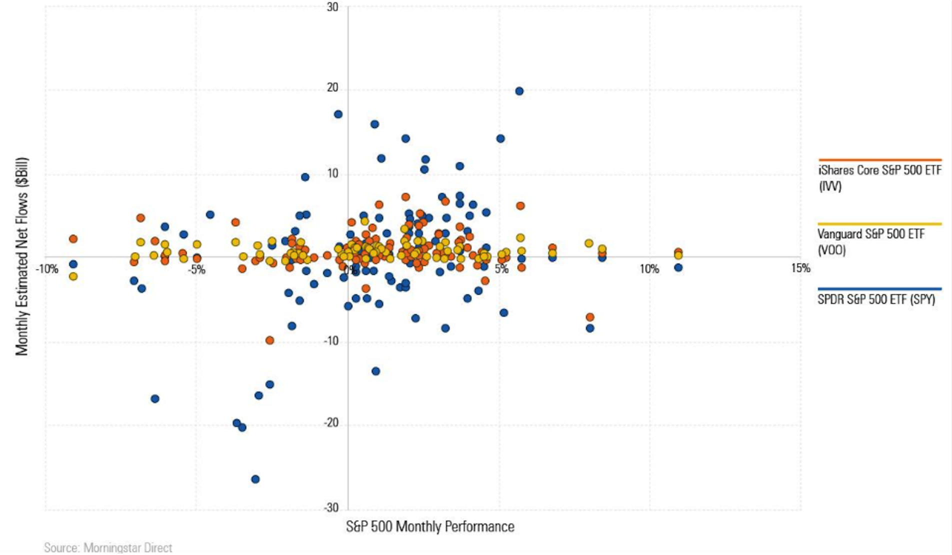
- Three ETFs track the S&P 500 index $\Rightarrow$ Quasi-perfect substitutes.
- SPY (State Street) started in 1993. IVV (Blackrock) launched in 2000.
- SPY has the highest tracking error, and yet charges the highest MER.



Zoom in on S&P 500: Trading volume

- A higher MER seems to go hand in hand with trading volume.
- SPY trades 20 times a second.

Are SPY traders different?



This paper

Contribution

1. Empirical evidence that ETFs charge a "liquidity MER premium."
2. Model of endogenous liquidity clienteles and ETF market power.

Economic channels and frictions

1. **Network effects:** investors prefer widely traded ETFs, but difficult to coordinate.
2. **Horizon heterogeneity:** Investors have different expected holding periods.
3. **Staggered entry:** First-mover advantage for ETFs due to switching costs.

Related literature

Product differentiation in the fund industry

- Hortaçsu and Syverson (2004, QJE): search costs and product differentiation allow managed funds to extract rents.
- **Our paper:** ETFs are homogenous products, no search friction. Differentiation is endogenous through liqudity network effects.

"Liquidity begets liquidity," fragmentation, and network effects

- Classical paper on liquidity networks: Pagano (1989, QJE).
- Foucault, Kadan, and Kandel (2005, JF), Pagnotta and Philippon (2018, Etrica).

Role of ETFs in financial markets

Easley, Michalyuk, O'Hara, and Putninš (2019), Chinco and Fos (2019), Ben-David, Franzoni, and Moussawi (2018, JF), Da and Shive (2016).

Takeaways

- Liquid ETFs charge higher fees: Spread $\searrow$ 1 bp $\Rightarrow$ MER $\nearrow$ 0.51 bps.
- Heavily traded ETFs charge higher fees: Turnover $\nearrow$ 1% $\Rightarrow$ MER $\nearrow$ 0.24%.
- Investors trade off liquidity and management fees:
  1. Short-horizon investors value liquidity relatively more than low fees.
  2. Long-horizon investors value low fees relatively more than liquidity.
- In equilibrium, ETFs specialize in different clienteles and earn economic rents:
  1. First-mover ETF serves frequent traders: charges a high fee, but is very liquid.
  2. Second-mover ETF serves long-term investors: charges a low fee, but is illiquid.
- For low overall AUM, the first-mover ETF optimally deters entry of competitors.
- Market segmentation generates network inefficiencies and reduces welfare.

Outline

Q&A Break

Setup

Assets

1. One risky equity index with payoff $\tilde{v} \sim \mathcal{N}\left(\mu, \sigma^2\right)$. Risk-free rate normalized to zero.

Agents

1. Two **ETF**s that track the index, labeled **L** and **F**.
   - Leader **L** launches before follower **F**.
   - Marginal cost c, fixed entry cost $\Gamma \geq 0$.
   - Management fees f_L and f_F.
2. Continuum of risk-neutral **investors** who choose between funds.
3. Competitive **authorized participants** who makes markets in each ETF.
   - Inventory constraint of Q ETF units.
   - *Creation/redemption*: With intensity η, unloads inventory to underlying market dealer.
4. Mean-variance competitive **dealers** in underlying stocks (risk-aversion γ).

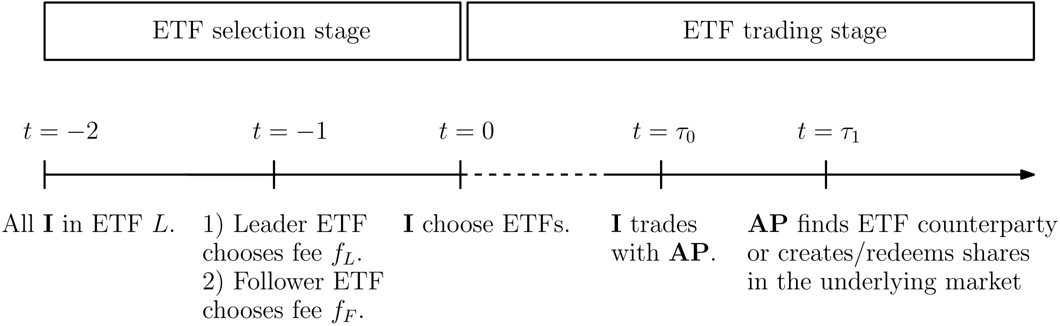
Investors' trading mechanism

- Unit measure of investors, indexed by i.
- Investor i has a stochastic private value for Q units of the index, $\tilde{\theta}_{it} \in \{\theta, 0\}$.
- At any point in time, exactly half the investors hold the index $\Rightarrow \text{AUM} = \dfrac{Q}{2}$.
- Investor i's private value switches between 0 and θ_i with intensity λ_i.
  $\Rightarrow$ The expected holding period for investor i is λ_i^{-1}.
- Switching rates are uniformly distributed:

$$\lambda_i \sim \text{Uniform}\,[\Lambda - \xi, \Lambda + \xi]$$

- Investors know ξ (dispersion), but not Λ.
- Each investor trades off management fees and expected liquidity across ETFs.
- Investors start in **L** but can switch at cost δ.

Model timing



Equilibrium

An *equilibrium* of the game consists of:

(i) An entry decision for F at $t = -1$.

(ii) ETF management fee choices at $t = -1$.

(iii) investors' choice of funds at $t = 0$;

(iv) authorized participant's demand schedule on the ETF market, $p(q)$;

(v) buy and sell prices quoted by the dealer on the underlying market, $\pi(q)$.

Dealer's demand function (follows from Kyle, 1985)

$$\pi(q) = \mu + \frac{\gamma}{2}\sigma^2 q.$$

Q&A Break

Authorized participant (AP) market making

Counterparty arrival rate:

Once an investor arrives at the ETF market, the AP finds a counterparty at rate:

$$\lambda_k = \frac{1}{2} \int_{i \in \Omega_k} \lambda_i \frac{1}{2\xi} \mathrm{d}\lambda_i \text{ for } k \in \{L, F\}.$$

where Ω_k is the set of investors who choose ETF k.

AP's expected profit for price schedule $p(q) = a + bq$:

$$\underbrace{\frac{\lambda_k}{\eta + \lambda_k} [a + bQ - (a - bQ)]}_{\text{match on ETF market}} + \underbrace{\frac{\eta}{\eta + \lambda_k} \left[a + bQ - \left(\mu + \frac{\gamma}{2}\sigma^2 Q\right)\right]}_{\text{trade with underlying dealer}}.$$

Authorized participant (AP) market making

Equilibrium ETF price

The equilibrium price for ETF k sets the AP expected profit to zero:

$$p_k(q) = \mu + \frac{\eta}{\eta + 2\lambda_k} \frac{\gamma}{2} \sigma^2 q$$

Round-trip cost for investors

Investors pay a round-trip transaction cost equal to $2\,\|p(Q) - \mu\|$, which depends on:

- aggregate liquidity in ETF k $(-)$
- creation-redemption activity intensity $(+)$.

$$\text{Round-trip cost} = \frac{2\eta}{\eta + 2\lambda_k} \frac{\gamma}{2} \sigma^2 Q$$

Investors' ETF selection

Investors' trade off ETF fees and liquidity

$$\mathbb{E}\text{Profit}_{\text{investor}} = \underbrace{\frac{1}{\lambda_i}\left(\theta - f_k\right) Q}_{\text{fees, scaled by holding period}} - \underbrace{\frac{2\eta}{\eta + 2\lambda_k}\frac{\gamma}{2}\sigma^2 Q}_{\text{round-trip cost (liquidity)}} .$$

- **Network effects**: The more investors join ETF k, lower trading costs for ETF k.
- Coordination problem: investors want to be where other investors are.

Marginal investor (Katz and Shapiro, 1985)

There exists a threshold $\bar{\lambda}$ such that:

- investors with $\lambda_i > \bar{\lambda}$ choose the most liquid ETF (ℓ^+);
- investors with $\lambda_i \leq \bar{\lambda}$ choose the least liquid ETF (ℓ^-).

Investors' ETF selection

ETF turnover

Under the global game conjecture, the matching rate in the ETF market is:

$$\lambda_{\ell^+} = \frac{1}{2}\int_{\bar{\lambda}}^{\bar{\lambda}+\xi} \lambda \frac{1}{2\xi}\, \mathrm{d}\lambda = \frac{1}{8}\left(2\bar{\lambda}+\xi\right).$$

$$\lambda_{\ell^-} = \frac{1}{2}\int_{\bar{\lambda}-\xi}^{\bar{\lambda}} \lambda \frac{1}{2\xi}\, \mathrm{d}\lambda = \frac{1}{8}\left(2\bar{\lambda}-\xi\right).$$

The marginal investor, $\bar{\lambda}$ is indifferent between the two ETFs.

Multiple equilibria

Liquid-leader (LL)

All investors with $\lambda_i > \bar{\lambda}^{\star}$ choose the ETF L and all investors with $\lambda_i \leq \bar{\lambda}^{\star}$ choose the ETF F, where

$$\bar{\lambda}^{\star} = \frac{2\eta\left(f_L - f_F\right)}{2\delta\eta + \gamma\xi\sigma^2} \text{ and } f_L > f_F.$$

Liquid-follower (LF)

All investors with $\lambda_i > \bar{\lambda}^{\star\star}$ choose the ETF F and all investors with $\lambda_i \leq \bar{\lambda}^{\star\star}$ choose the ETF L, where

$$\bar{\lambda}^{\star\star} = \frac{2\eta\left(f_F - f_L\right)}{\gamma\xi\sigma^2 - 2\delta\eta} \text{ and } f_F > f_L.$$

Equilibrium selection

We argue the *liquid-leader* equilibrium is more natural:

- The industry leader builds reputation, coordinating investor beliefs on a focal fund.
- Past liquidity in the incumbent serves as an anchor for expected future liquidity.
- The liquid-follower equilibrium breaks down for high enough switching costs:

$$\delta \leq \frac{\gamma}{2\eta}\sigma^2\xi.$$

- The liquid-leader equilibrium yields a higher welfare measure.

ETF fee-setting problem (liquid-leader)

Market shares

The equilibrium ETF market shares are:

$$w_L = \frac{1}{2\xi}\left(\Lambda + \xi - \frac{2\eta\left(f_L - f_F\right)}{2\delta\eta + \gamma\xi\sigma^2}\right) \text{ and}$$

$$w_F = \frac{1}{2\xi}\left(\frac{2\eta\left(f_L - f_F\right)}{2\delta\eta + \gamma\xi\sigma^2} - (\Lambda - \xi)\right).$$

ETF profits

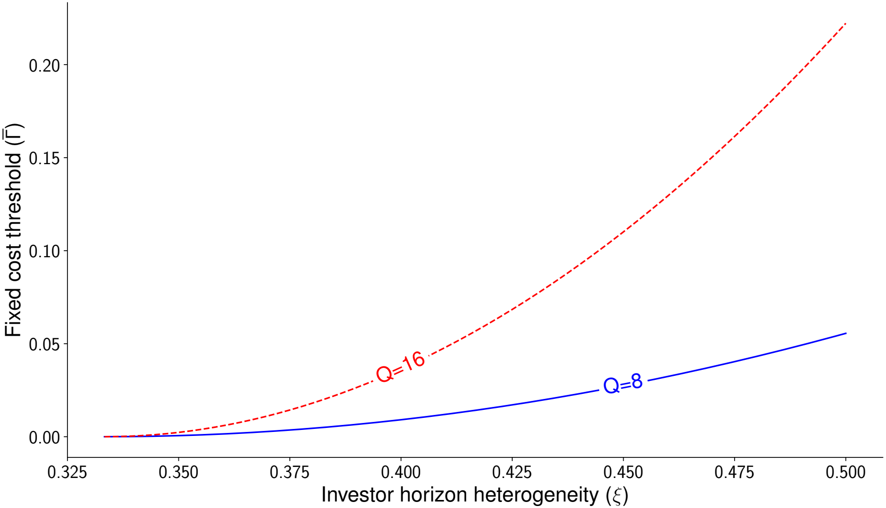
At $t = -1$, ETFs jointly maximize profits:

$$\mathbb{E}\text{Profit}_L = \max_{f_L} \frac{Q}{2} w_L\left(f_L, f_F\right)\left(f_L - c\right) - \Gamma$$

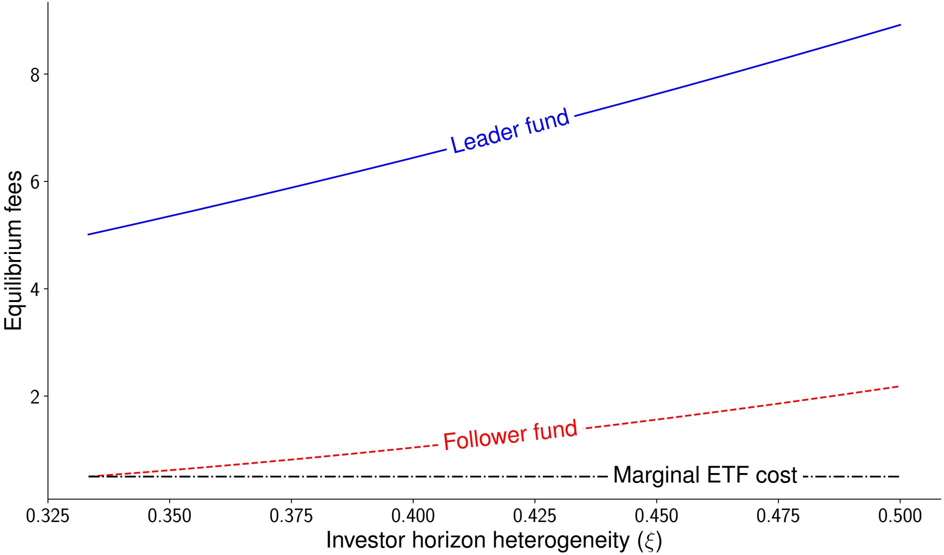
$$\mathbb{E}\text{Profit}_F = \max_{f_F} \frac{Q}{2} w_F\left(f_L, f_F\right)\left(f_F - c\right) - \Gamma,$$

ETF entry occurs for sufficient investor horizon heterogeneity

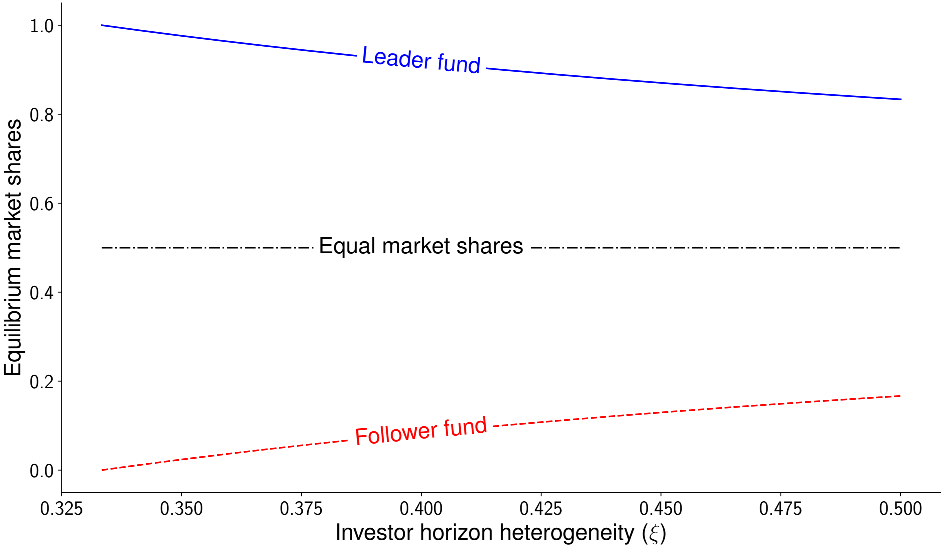
Follower ETF enters if fixed cost is lower than some threshold, $\Gamma \leq \overline{\Gamma}$.



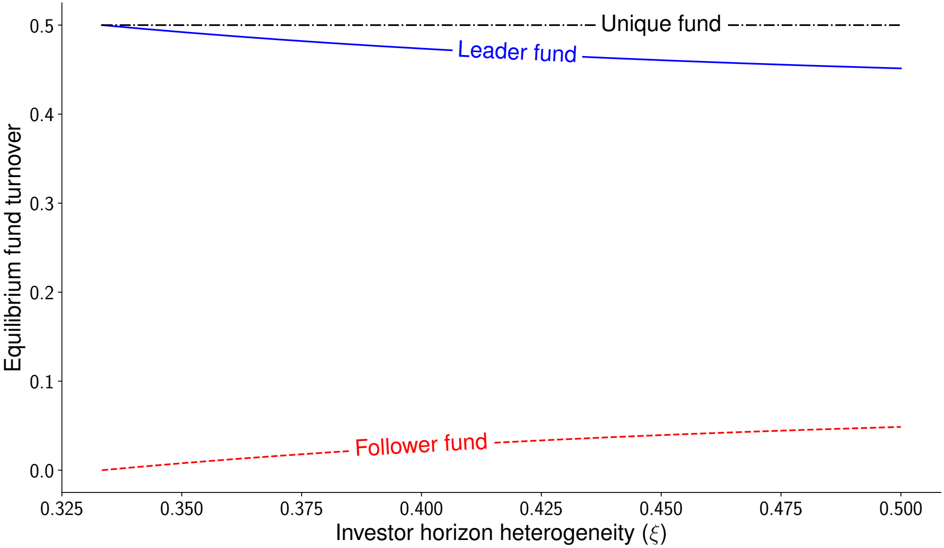
ETFs charge equilibrium fees above marginal operating cost



ETF leader enjoys larger market share in equilibrium



ETF leader has higher overall turnover



Welfare

Benchmark economy

1. Competitive ETF: no imperfect competition frictions.
2. Unique ETF: "no network splitting" inefficiency.
3. Turnover in the single ETF is $\frac{1}{2}\int_{\Lambda-\xi}^{\Lambda+\xi}\lambda_i \frac{1}{2\xi}\mathrm{d}\lambda_i = \frac{1}{2}\Lambda$.

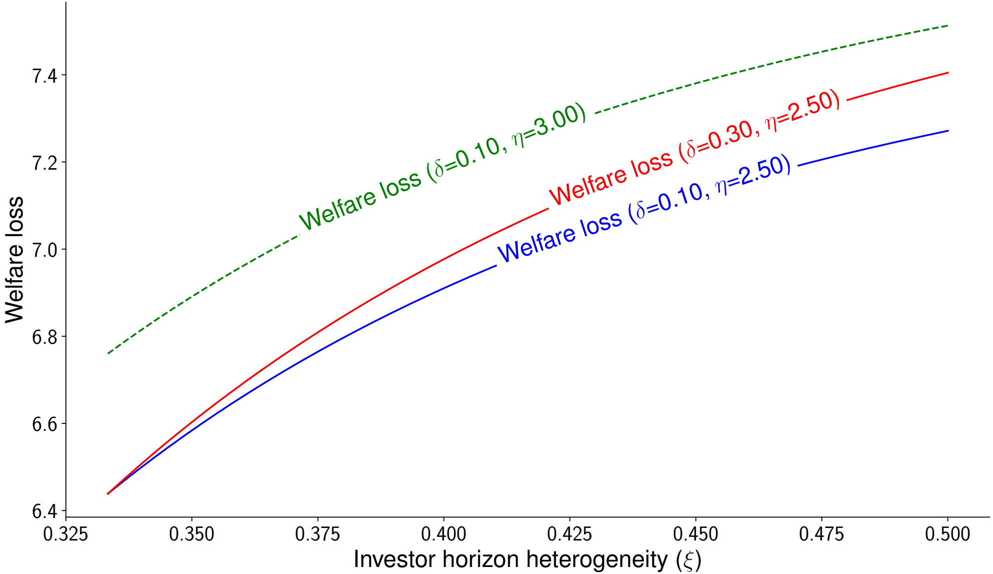
- Aggregate utility across all investors (fees wash out):

$$\text{Welfare}_{\text{Benchmark}} = \frac{Q}{2}\left[(\theta - c) - \frac{\eta\Lambda}{\eta+\Lambda}\gamma\sigma^2\right] - \Gamma.$$

- Welfare loss relative to equilibrium:

$$\Delta W = \Gamma + Q\delta w_F + \underbrace{\frac{Q}{2}\gamma\sigma^2\left[\frac{1}{2\xi}\left(\int_{\bar{\lambda}}^{\Lambda+\xi}\frac{\eta\lambda_i}{\eta+2\lambda_L}\,\mathrm{d}\lambda_i + \int_{\Lambda-\xi}^{\bar{\lambda}}\frac{\eta\lambda_i}{\eta+2\lambda_F}\,\mathrm{d}\lambda_i\right) - \frac{\eta\Lambda}{\eta+\Lambda}\right]}_{\text{Network inefficiencies}}.$$

Welfare loss



Outline

Q&A Break

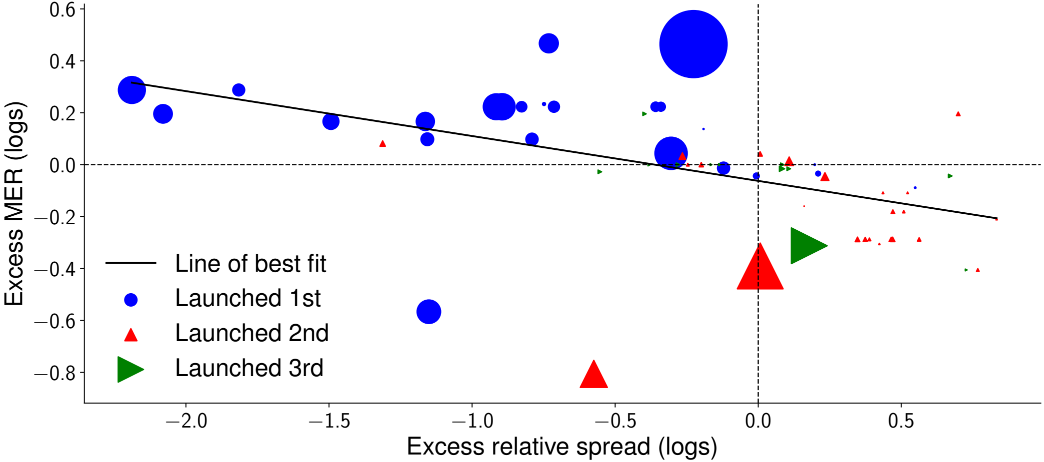
Data

- Daily data from ETF Global: exclude ETNs, leveraged/inverse ETFs.
- Daily ETF spreads and prices from CRSP.
- Large cross-section: 1035 ETFs traded in the United States in 2017.
- 24 indices tracked by multiple ETFs (60 ETFs out of 1035).
- However, the sample of multi-ETF indices accounts for:
    1. 36% of total assets under management.
    2. 47% of total volume.

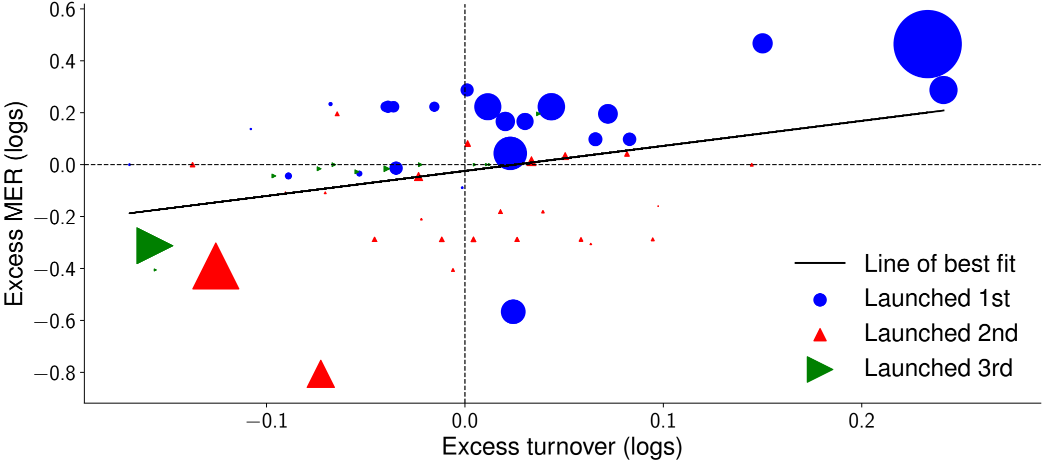
Summary stats

	Mean	StDev	25th pctl	50th pctl	75th pctl
Panel A. Indices with multiple ETFs per index					
MER (bps)	22.67	11.80	15.11	20.00	26.66
Spread (bps)	6.19	4.92	3.45	4.88	6.68
Turnover (%)	331.21	283.01	191.47	244.11	328.47
AUM ($ bn)	34.32	85.85	4.79	8.70	34.34
Panel B. Indices with one ETF per index					
MER (bps)	50.13	40.25	35.00	48.00	62.20
Spread (bps)	29.02	66.83	6.13	14.37	31.81
Turnover (%)	534.35	1,458.76	171.21	289.54	495.36
AUM ($ bn)	1.48	5.44	0.02	0.12	0.69

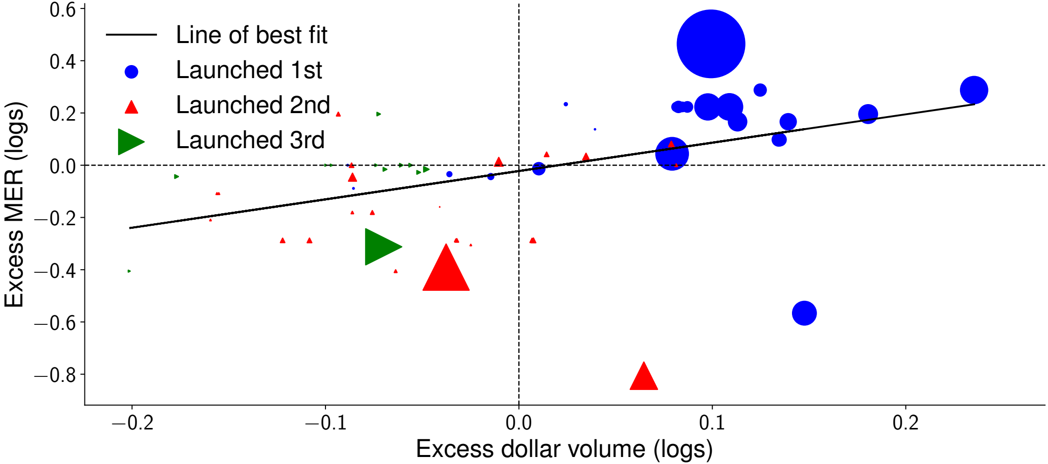
MER and bid-ask spreads



MER and turnover



MER and volume



Regression specification

1. Subsample of 60 ETFs tracking 24 indices.
2. Data is averaged at ETF level across trading days in 2017.
3. Turnover is computed as ratio of daily dollar volume scaled by AUM.

$$MER_i = \beta_0 + \beta_1 \text{Relative spread}_i + \beta_2 \text{Turnover}_i + \text{Controls} + \delta_{\text{Index}_i} + \text{error}.$$

What does the model predict?

(i) $\beta_1 < 0$: Expensive MERs are more liquid.

(ii) $\beta_2 > 0$: Expensive MERs are more extensively traded.

MERs and liquidity: Results

	MER	MER (log)	MER
Intercept	22.97***	1.83***	2.28
	(8.62)	(4.82)	(0.36)
Relative Spread	−0.51***		
	(-3.83)		
Log Turnover		0.24***	
		(3.21)	
Log Dollar Volume			1.15***
			(3.11)
Tracking Error	−0.08*		
	(-1.92)		
Log Tracking Error		−0.12***	−0.09**
		(-3.00)	(-2.13)
Adjusted R^2	86%	78%	84%
Fixed effects	Index	Index	Index

Multi-ETF indices: A Probit model

- What drives ETF competition for the same index?
- Unconditional probability of a multi-index ETF is 2.4%:
  1. 24 indices are tracked by multiple ETFs.
  2. 975 indices are tracked by a single ETF.

$$\text{Prob}\,(\text{Multi-ETF Index}) = \delta_0 + \delta_1 \text{AUM} + \text{Controls} + \text{error}.$$

What does the model predict?

(i) $\delta_1 > 0$: Higher AUM is correlated with ETF entry.

Probit regressions

	Multiple ETFs in the same index			
Intercept	-2.87^{***}	-2.87^{***}	-2.37^{***}	-2.32^{***}
	(127.11)	(126.87)	(68.87)	(73.69)
Dollar Volume		-0.07	0.44^{**}	0.42^{**}
		(0.06)	(4.21)	(3.83)
Relative Spread			-0.03^{**}	-0.03^{**}
			(5.32)	(4.10)
Major Index Dummy	0.56^{**}	0.56^{**}	0.56^{**}	
	(3.60)	(3.62)	(4.32)	
AUM	0.04^{***}	0.04^{***}		
	(23.76)	(17.22)		
Top3 Issuer Dummy	0.51^{*}	0.51^{***}	0.56^{**}	0.82^{***}
	(3.12)	(3.07)	(4.09)	(10.24)

- *Top 3 Issuer*: Vanguard, BlackRock, State Street.
- *Major Index*: MSCI, S&P, Russel.

Conclusions

- Liquid ETFs charge higher fees: Spread $\searrow$ 1 bp $\Rightarrow$ MER $\nearrow$ 0.51 bps.
- Heavily traded ETFs charge higher fees: Turnover $\nearrow$ 1% $\Rightarrow$ MER $\nearrow$ 0.24%.
- Investors trade off liquidity and management fees:
  1. Short-horizon investors value liquidity relatively more than low fees.
  2. Long-horizon investors value low fees relatively more than liquidity.
- In equilibrium, ETFs specialize in different clienteles and earn economic rents:
  1. First-mover ETF serves frequent traders: charges a high fee, but is very liquid.
  2. Second-mover ETF serves long-term investors: charges a low fee, but is illiquid.
- For low overall AUM, the first-mover ETF optimally deters entry of competitors.
- Market segmentation generates network inefficiencies and reduces welfare.