Steering a Ship in Illiquid Waters: Active Management of Passive Funds

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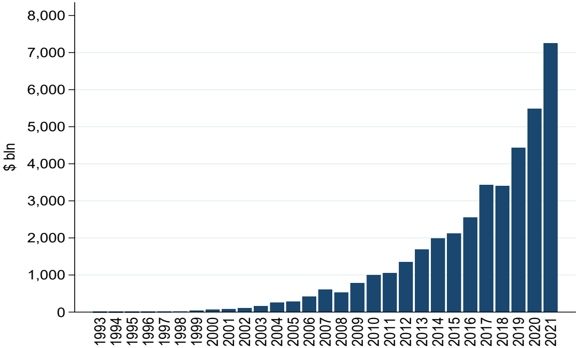
Exchange-Traded Funds (ETFs)

- ETFs manage $7.2 trillion at the end of 2021 (U.S.)



- The vast majority of ETFs track **passive** indexes
- ETF shares tend to be more **liquid** than underlying securities

Our Main Points

1. Liquidity transformation $\longrightarrow$ **ETF activeness**
    - Passive ETFs are remarkably active in portfolio management
    - *"To be passive, ETFs must be active"*

2. **ETF activeness** $\longrightarrow$ Liquidity of underlying securities

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- How do passive ETFs manage their portfolios?

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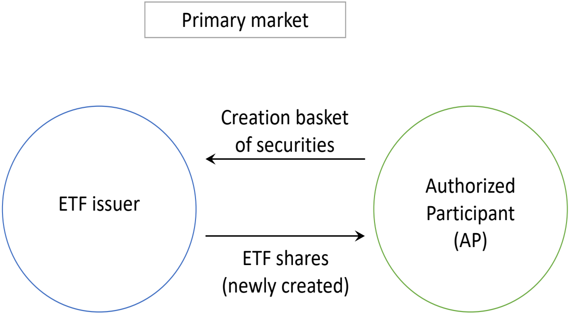
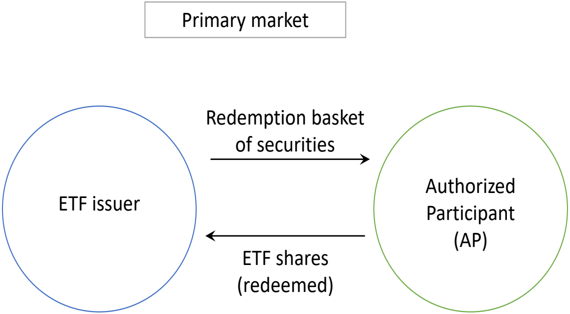
- How do passive ETFs manage their portfolios?
  - ETFs typically do not trade on their own, to avoid tax liabilities
  - Instead, they exchange **creation and redemption baskets** of securities in-kind for ETF shares with authorized participants (APs)
  - ETFs manage baskets **actively**

Creation of ETF Shares



Redemption of ETF Shares



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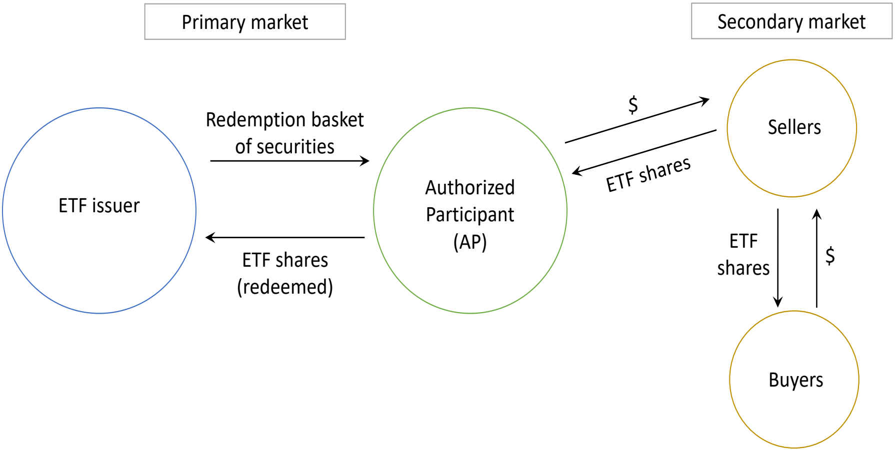

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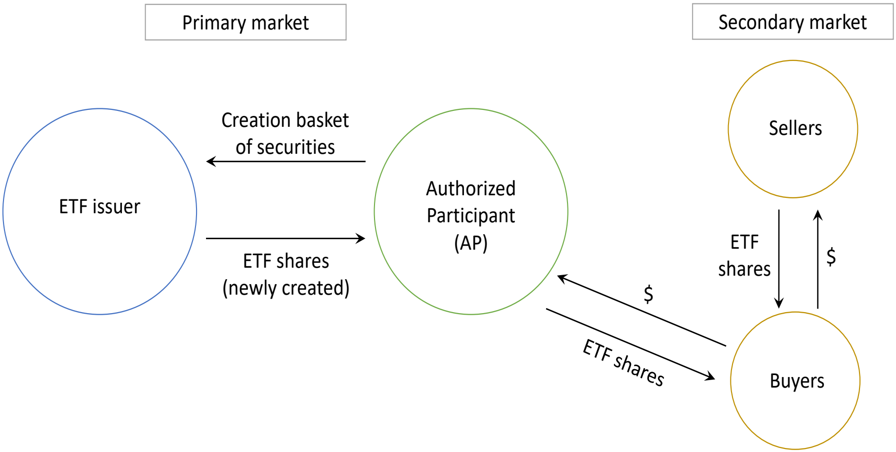
Creation of ETF Shares



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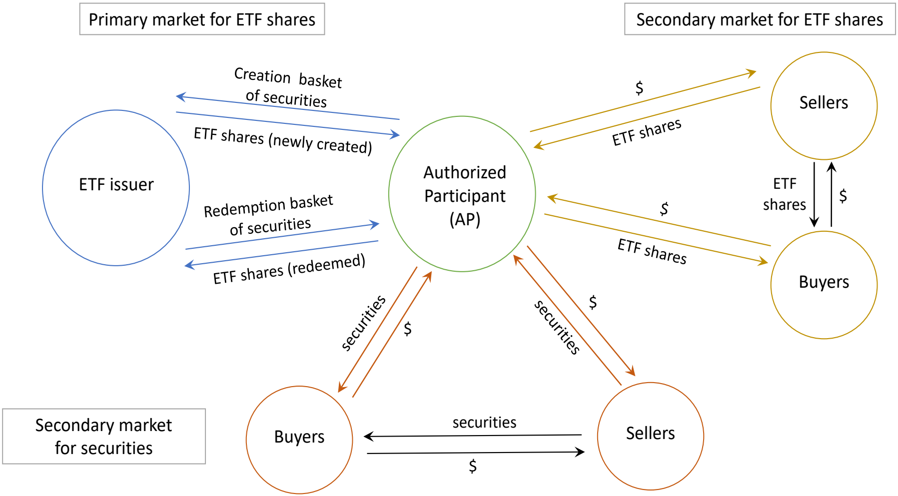
Central Role of APs



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Model

- Diamond-Dybvig-style, but with a tradable ETF
- Agents: Patient investors, impatient consumers, impatient savers
- AP can trade, create/redeem ETF shares
    - Meet the imbalance in the secondary market for ETF shares
- Index: Equal-weighted portfolio of risky, illiquid securities

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- Diamond-Dybvig-style, but with a tradable ETF
- Agents: Patient investors, impatient consumers, impatient savers
- AP can trade, create/redeem ETF shares
  - Meet the imbalance in the secondary market for ETF shares
- Index: Equal-weighted portfolio of risky, illiquid securities
- Optimization
  - ETF issuer chooses basket cash weight and basket security count
    - Cares about both index tracking and liquidity transformation
  - AP chooses profit-maximizing amount of ETF arbitrage
- Derive
  - ETF's equilibrium premium/discount
  - Four testable predictions. All supported empirically.

Our Empirical Findings for Corporate Bond ETFs

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     - Less liquid bonds $\Rightarrow$ More cash, larger tracking errors

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   - ETFs **dynamically adjust** their **basket composition**
     - Add underweighted bonds to CR, remove them from RD baskets
     - Add overweighted bonds to RD, remove them from CR baskets
     - Too much cash $\Rightarrow$ Add cash to RD, remove it from CR basket
     - Too little cash $\Rightarrow$ Add cash to CR, remove it from RD basket
     - Smaller adjustments when underlying bonds are less liquid

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     - Smaller adjustments when underlying bonds are less liquid
2. ETF activeness $\longrightarrow$ Liquidity of underlying securities
   - **Basket inclusion** makes a bond **more liquid**
   - This result flips in periods of large CR/RD imbalance
   - RD basket inclusion made bonds **less liquid** in the COVID-19 crisis

Data

- 118 passive U.S. **corporate bond ETFs** Summary Statistics
  - Daily data from January 1, 2017 to December 31, 2020
- ETF **baskets**
  - Pre-announced (reported): Depository Trust & Clearing Corporation
    - Observed every day but not capturing intra-day negotiations
  - Realized (imputed): From daily changes in ETF holdings and shares
    - Observed only on CR and RD days
- ETF **portfolio holdings**, shares, and prices from ETF Global
- ETF **index holdings** from Bloomberg
- Bond-level prices, characteristics from TRACE, Mergent FISD

Cash in ETF Baskets and Holdings

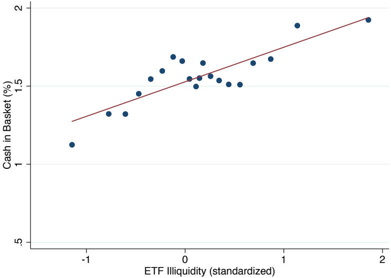
- Cash, money-market funds, short-term Treasury ETFs

	Average		Distribution				
	EW	VW	p10	p25	p50	p75	p90
Realized CR baskets	11.60	7.27	-0.44	0.28	6.25	18.96	34.26
Realized RD baskets	8.18	3.68	-2.05	-0.00	0.73	6.43	35.19
Reported baskets (All days)	5.39	2.03	0.19	0.54	1.09	2.27	9.28
Reported baskets (CR days)	4.58	1.89	0.11	0.34	0.97	2.23	5.94
Reported baskets (RD days)	7.78	2.45	0.01	0.24	0.80	2.69	10.89
Portfolio holdings	1.70	0.85	0.00	0.44	0.83	1.57	2.47

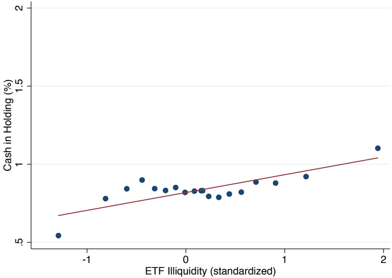
$\Rightarrow$ ETF baskets include a significant amount of cash

Cash and Illiquidity (Imputed Roundtrip Cost)

Basket Cash



Holdings Cash



$$Cash_{jt} = \beta \ Illiquidity_{jt} + \omega_{It} + \epsilon_{jt}$$

- Index illiquidity ↑ by one standard deviation

  ⇒ 22 bps more cash in ETF baskets

  ⇒ 11 bps more cash in ETF holdings

Definitions of liquidity measures

Results for other liquidity measures

Active Cash Management

$$BasketCash_{jt} = \beta_1 \Delta Cash_{jt-1} + \beta_2 \Delta Cash_{jt-1} \times Illiquidity_j + \omega_j + \epsilon_{jt}$$

- $BasketCash_{jt} \equiv$ Proportion of cash in ETF j's basket on day t
- $\Delta Cash_{jt-1} \equiv Cash_{jt-1} - \text{Avg}(Cash_{jt-1})$ over prior month,
  where $Cash_{jt} \equiv$ Proportion of cash in ETF j's portfolio on day t

	RD Basket			CR Basket		
	IL1	IL2	IL3	IL1	IL2	IL3
$\Delta Cash$	3.07***	3.16***	3.16***	-3.38***	-3.57***	-3.33***
	(0.74)	(0.74)	(0.74)	(0.46)	(0.47)	(0.46)
$\Delta Cash \times Illiq$	-1.42**	-1.18*	-1.12**	1.66***	1.58***	1.28***
	(0.63)	(0.61)	(0.55)	(0.44)	(0.41)	(0.43)
Observations	2,272	2,272	2,272	5,108	5,108	5,108
Adjusted R^2	0.13	0.13	0.13	0.09	0.09	0.09

Concentration of ETF Baskets and Holdings

- # of bond names in the ETF basket (portfolio) relative to index

	Average		Distribution				
	EW	VW	p10	p25	p50	p75	p90
Realized CR baskets	24.56	18.13	4.22	10.21	19.44	37.44	52.75
Realized RD baskets	29.80	18.00	3.77	9.64	22.01	38.72	87.12
Reported baskets (All)	76.06	57.51	44.65	64.28	84.09	94.88	97.35
Reported baskets (CR)	77.56	59.53	45.15	63.98	85.42	95.13	97.56
Reported baskets (RD)	78.40	56.22	45.73	69.80	86.75	96.72	100.00
Portfolio holdings	81.28	91.39	45.64	64.76	88.03	96.70	102.39

$\Rightarrow$ ETF baskets include only a subset of index bonds

Tracking Error

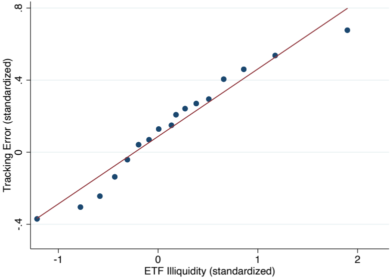
- Weekly std dev of (daily ETF return − daily index return)

1. ETF return:
    - From ETF share prices (Tracking Error 1)
    - From NAVs/bond prices (Tracking Error 2)

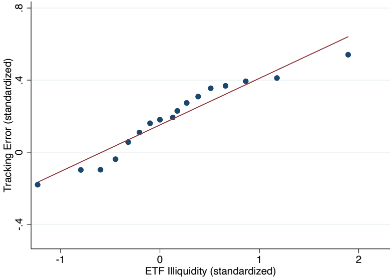
2. Index return: From the underlying bond prices

Tracking Error and Illiquidity (Imputed Roundtrip Cost)

Tracking Error 1



Tracking Error 2



$$TrackingError_{jt} = \beta\ Illiquidity_{jt} + \omega_{It} + \epsilon_{jt}$$

- Index illiquidity $\uparrow$ by one standard deviation

  $\Rightarrow$ 0.28 sd increase in Tracking Error 1

  $\Rightarrow$ 0.29 sd increase in Tracking Error 2

Results for other liquidity measures

Active Basket Management

- Bond indexes rebalance monthly $\Rightarrow$ Index weights jump
  - We see spikes in bond i's "overweighting" in ETF j's portfolio: Figure

$$Deviation_{ijt} \equiv w_{ijt}^{ETF} - w_{ijt}^{index}$$

- For each rebalancing day h, compute **shock** to overweighting:

$$\Delta Deviation_{ijh} \equiv Deviation_{ijh} - \frac{1}{5}\sum_{k=1}^{5} Deviation_{ijh-k}$$

- Regress basket inclusion $Basket_{ijt}$ on $\Delta Deviation_{ijh}$ and its interaction with the illiquidity of ETF j's index
- Use first ten baskets after each monthly rebalancing date Back

ETFs Dynamically Adjust Baskets, Steer Toward Index

$$Basket_{ijt} = \beta_1 \Delta Deviation_{ijh} + \beta_2 \Delta Deviation_{ijh} \times Illiquidity_j + \omega_{jt} + \epsilon_{ijt} \,,$$

where $Basket_{ijt} = 1$ when bond i is included in ETF j's basket on day t, 0 otherwise

	RD Basket			CR Basket		
	IL1	IL2	IL3	IL1	IL2	IL3
$\Delta Deviation$	1.98***	1.74***	1.99***	-2.96***	-2.88***	-2.97***
	(0.15)	(0.14)	(0.15)	(0.09)	(0.09)	(0.09)
$\Delta Deviation \times Illiq$	-0.59***	-0.32***	-0.57***	0.58***	0.54***	0.53***
	(0.11)	(0.11)	(0.10)	(0.06)	(0.06)	(0.06)
Observations	2726592	2726592	2726592	7803001	7803001	7803001
Adjusted R^2	0.41	0.41	0.41	0.30	0.30	0.30

Basket inclusion: Number of bonds

Effect of Basket Inclusion on Bond Liquidity

- We estimate this effect in two ways:
  1. **OLS** regression with controls and fixed effects
  2. **IV** with an instrument for basket inclusion
- Three measures of a bond's **basket inclusion**
  - Number of ETFs that include this bond in their baskets on this day
  - Number of shares of this bond included in ETFs' baskets on this day
  - Dummy $= 1$ if the bond is in at least one ETF basket (Appendix)
- Three measures of **bond liquidity**, as before

Effect of Basket Inclusion on Bond Liquidity: OLS

$$Illiquidity_{it+1} = \beta^{CR}\, Basket_{it}^{CR} + \beta^{RD}\, Basket_{it}^{RD} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

- **Controls:**
  - Average $Illiquidity_{it}$ over the prior week: $Illiquidity_{i,t-5\rightarrow t-1}$
  - Average basket size of ETFs holding bond i
  - Number of bond i's outstanding shares
- **Fixed effects:** Firm-day (ω_{Ft}) and maturity-day (ω_{mt})
  - Compare near-identical bonds (same issuer & maturity) on same day

Effect of Basket Inclusion on Bond Liquidity: OLS

$$Illiquidity_{it+1} = \beta^{CR}\ Basket_{it}^{CR} + \beta^{RD}\ Basket_{it}^{RD} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	Number of Baskets			Basket Shares		
	IL1	IL2	IL3	IL1	IL2	IL3
CR	-3.68***	-1.02***	-1.96***	-0.18***	-0.05**	-0.12***
	(0.14)	(0.14)	(0.14)	(0.02)	(0.02)	(0.02)
RD	-4.31***	-1.84***	-2.31***	-0.18***	-0.11***	-0.10***
	(0.26)	(0.27)	(0.25)	(0.02)	(0.03)	(0.02)
$Illiquidity_{i,t-5\rightarrow t-1}$	12.77***	11.81***	19.71***	11.42***	11.64***	19.21***
	(0.19)	(0.19)	(0.36)	(0.18)	(0.19)	(0.35)
Observations	3254055	2831031	2901286	3254055	2831031	2901286
Adjusted R^2	0.23	0.13	0.44	0.23	0.13	0.44

Back 3-day liquidity

Instrument for Basket Inclusion

- For any day t after index rebalancing on day h, compute

$$
\begin{aligned}
CRInstr_{it} &\equiv \sum_{j \in J_t^{CR}} \Delta Deviation_{ijh} \qquad \text{(instrument for } Basket_{it}^{CR}\text{)} \\
RDInstr_{it} &\equiv \sum_{j \in J_t^{RD}} \Delta Deviation_{ijh} \qquad \text{(instrument for } Basket_{it}^{RD}\text{)}
\end{aligned}
$$

  where J_t^{CR} (J_t^{RD}) is the set of ETFs that have CR (RD) baskets

- Recall that $\Delta Deviation_{ijh}$ is the shock to bond i's overweighting in ETF j's portfolio induced by the index rebalancing Recall definition

First Stage

$$
\begin{aligned}
Basket_{it}^{RD} &= \beta_1^{RD}\, RDInstr_{it} + \beta_2^{RD}\, CRInstr_{it} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it} \\
Basket_{it}^{CR} &= \beta_1^{CR}\, RDInstr_{it} + \beta_2^{CR}\, CRInstr_{it} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}
\end{aligned}
$$

- Expect to see $\beta_1^{RD} > 0$ and $\beta_2^{CR} < 0$

	Number of Baskets		Basket Shares	
	RD	CR	RD	CR
$RDInstr_{it}$	1.17***	-0.08	11.06***	-1.06**
	(0.11)	(0.05)	(1.10)	(0.41)
$CRInstr_{it}$	-0.46***	-2.51***	-6.17***	-18.99***
	(0.05)	(0.13)	(0.56)	(0.89)
$Illiquidity_{i,t-5\rightarrow t-1}$	-0.50***	-0.75***	-3.08***	-2.71***
(IRC)	(0.04)	(0.06)	(0.38)	(0.40)
Observations	3304918	3304918	3304918	3304918
Adjusted R^2	0.474	0.387	0.409	0.359

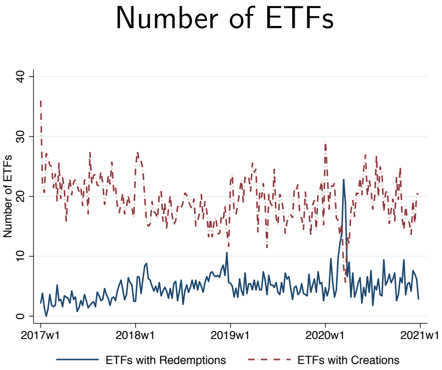
Second stage

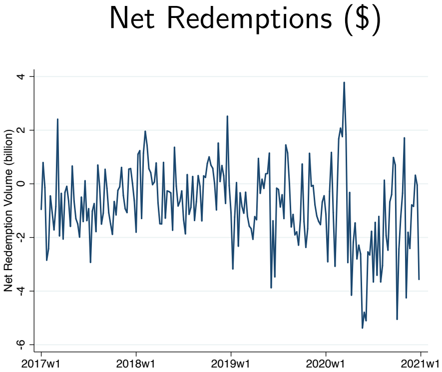
$$Illiquidity_{it+1} = \beta^{CR}\, \widehat{Basket}^{CR}_{it} + \beta^{RD}\, \widehat{Basket}^{RD}_{it} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	Number of Baskets			Basket Shares		
	IL1	IL2	IL3	IL1	IL2	IL3
CR	-3.80*	-5.38**	-8.58***	-1.32***	-0.92**	-1.55***
	(2.26)	(2.58)	(1.90)	(0.33)	(0.37)	(0.28)
RD	-15.25***	-15.08***	-7.30*	-1.07**	-1.41**	-0.55
	(4.93)	(5.50)	(4.18)	(0.52)	(0.58)	(0.45)
$Illiquidity_{i,t-5\rightarrow t-1}$	11.78***	11.16***	18.06***	10.46***	11.03***	17.70***
	(0.12)	(0.09)	(0.11)	(0.10)	(0.09)	(0.10)
Observations	2020546	1753639	1803581	2020546	1753639	1803581
Adjusted R^2	0.01	0.01	0.02	0.01	0.01	0.02

Intuition 3-day liquidity

ETF Creations and Redemptions Over Time





Effect of Basket Inclusion on Bond Liquidity: COVID-19

- Sample period: March 2 to April 15, 2020

Full sample 3-day liquidity

$$Illiquidity_{it+1} = \beta^{CR}\ Basket_{it}^{CR} + \beta^{RD}\ Basket_{it}^{RD} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	Number of Baskets			Basket Shares		
	IL1	IL2	IL3	IL1	IL2	IL3
CR	-1.45	-0.55	2.69	0.10	-0.12	0.31*
	(1.29)	(0.86)	(1.82)	(0.13)	(0.10)	(0.18)
RD	0.64	3.98***	4.03***	0.20*	0.35**	0.39*
	(0.96)	(1.13)	(1.43)	(0.11)	(0.13)	(0.20)
$Illiquidity_{i,t-5\rightarrow t-1}$	9.52***	8.04***	15.39***	9.50***	7.96***	15.07***
	(0.62)	(0.54)	(0.74)	(0.62)	(0.54)	(0.71)
Observations	111707	100263	101341	111707	100263	101341
Adjusted R^2	0.26	0.07	0.36	0.26	0.07	0.36

Basket Imbalance

- Define basket imbalance measures:

$$\begin{aligned} Imbal_{it} &\equiv \left|N_{it}^{CR} - N_{it}^{RD}\right| \\ Imbal_{it}^{CR} &\equiv \max\left(N_{it}^{CR} - N_{it}^{RD}, 0\right) \\ Imbal_{it}^{RD} &\equiv \max\left(N_{it}^{RD} - N_{it}^{CR}, 0\right) \end{aligned}$$

  where N_{it}^{CR} (N_{it}^{RD}) is the number of CR (RD) baskets in which bond i appears during the week preceeding day t

$$Basket_{it} \equiv N_{it}^{CR} + N_{it}^{RD}$$

- Regress individual bond illiquidity on $Basket_{it}$ and its interactions with the imbalance measures

Interactions with Basket Imbalance

$$\begin{aligned} Illiquidity_{it+1} &= \beta_1\ Basket_{it} + \beta_2^{CR}\ Basket_{it} \times Imbal_{it}^{CR} + \beta_2^{RD}\ Basket_{it} \times Imbal_{it}^{RD} \\ &+ Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it} \end{aligned}$$

	IL1	IL2	IL3
$Basket_{it}$	-10.98***	-4.27***	-6.65***
	(0.40)	(0.40)	(0.40)
$Basket_{it} \times Imbal_{it}^{CR}$	1.89***	1.90***	1.70***
	(0.24)	(0.23)	(0.21)
$Basket_{it} \times Imbal_{it}^{RD}$	2.98***	1.48**	2.64***
	(0.51)	(0.70)	(0.61)
$Illiquidity_{i,t-5 \to t-1}$	12.52***	11.78***	19.59***
	(0.19)	(0.19)	(0.35)
Observations	3254055	2831031	2901286
Adjusted R^2	0.23	0.13	0.44

Single imbalance measure 3-day liquidity

Conclusions

- Passive ETFs actively manage their portfolios
  - To balance index-tracking and liquidity transformation
- ETF activeness affects the underlying asset markets
  - Basket inclusion has a state-dependent effect on bond liquidity: positive in normal times, negative in times of large CR/RD imbalance

Additional Slides

Summary Statistics (Full Sample)

- 118 ETFs. Statistics at the ETF level.

	Mean	Std Dev	p25	p50	p75
AUM (Million $)	2127	5547	77	340	1346
ETF Days	748	251	547	823	969
Bonds in Portfolio	753	1008	186	323	1004
Bonds in Reported Basket	424	485	121	223	556
Bonds in Realized RD Basket	147	137	52	97	205
Bonds in Realized CR Basket	104	90	51	78	119
Proportion of RD Days	0.058	0.096	0.003	0.012	0.058
Proportion of CR Days	0.169	0.169	0.022	0.107	0.274
Proportion of No Change Days	0.773	0.240	0.679	0.847	0.966

Index-merged sample Back

Summary Statistics (Index-Merged Sample)

- 57 ETFs. Statistics at the ETF level.

	Mean	Std Dev	p25	p50	p75
AUM (Million $)	2702	5645	118	576	1723
ETF Days	585	289	364	575	790
Bonds in Index	1153	1217	297	536	1847
Bonds in Portfolio	835	849	256	414	1126
Bonds in Reported Basket	696	683	170	523	924
Bonds in Realized RD Basket	138	123	54	91	242
Bonds in Realized CR Basket	128	96	74	97	172
Proportion of RD Days	0.078	0.112	0.006	0.016	0.139
Proportion of CR Days	0.208	0.190	0.044	0.155	0.342
Proportion of No Change Days	0.715	0.269	0.635	0.806	0.931

Back

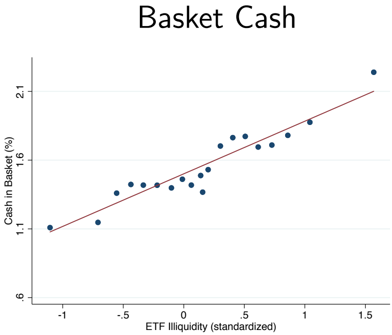
Measures of Bond Illiquidity

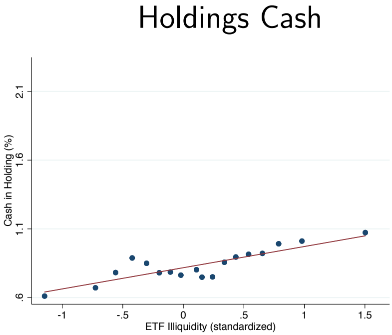
1. **Effective Tick Size** (IL1):
   - Infers the effective bid-ask spread from the frequency with which closing trade prices occur in particular price clusters
   - Holden (2009), Goyenko et al. (2009)
2. **Imputed Roundtrip Cost** (IL2):
   - = Highest minus lowest bond price among those that are likely part of the same round-trip trade (2-3 trades of same volume within 15 min)
     - Highest price: Assumed to be an investor buying from a dealer
     - Lowest price: Assumed to be an investor selling to a dealer
   - Feldhutter (2012)
3. **Inter-Quartile Range** (IL3):
   - $IQR = 100 \times (p_{75} - p_{25})/\bar{p}$, where $\bar{p}$ is the bond's average trade price on that day and (p_{25}, p_{75}) is the interquartile range of prices
   - Song and Zhou (2007), Pu (2009)

- We calculate all three measures for each bond on each day

Back

Cash and Illiquidity (Effective Tick Size)





$$Cash_{jt} = \beta \; Illiquidity_{jt} + \omega_{It} + \epsilon_{jt}$$

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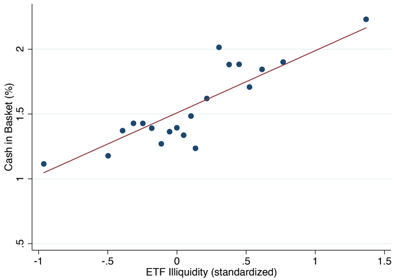
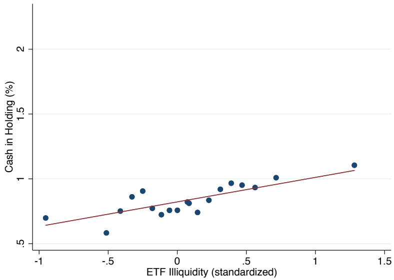
Cash and Illiquidity (Interquartile Range)

Basket Cash



Holdings Cash



$$Cash_{jt} = \beta \; Illiquidity_{jt} + \omega_{It} + \epsilon_{jt}$$

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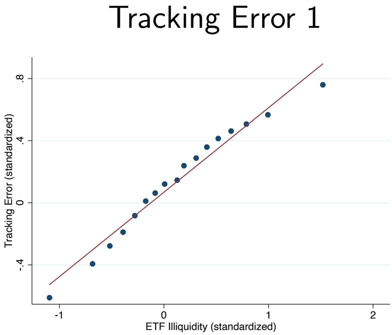
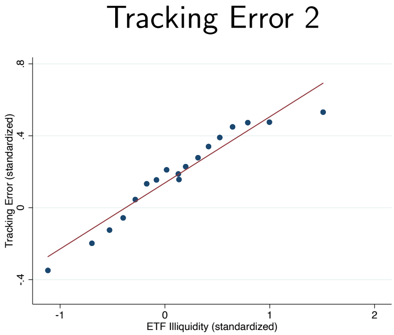
Tracking Error and Illiquidity (Effective Tick Size)





$$TrackingError_{jt} = \beta\ Illiquidity_{jt} + \omega_{It} + \epsilon_{jt}$$

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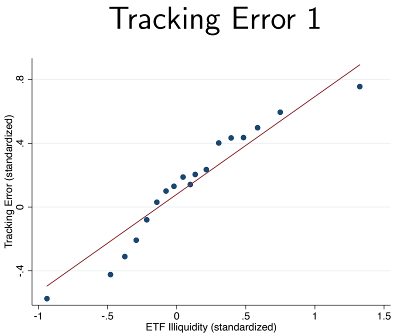
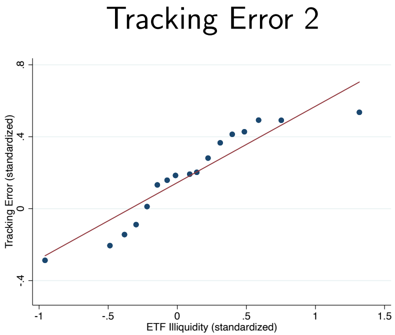
Tracking Error and Illiquidity (Interquartile Range)





$$TrackingError_{jt} = \beta \; Illiquidity_{jt} + \omega_{It} + \epsilon_{jt}$$

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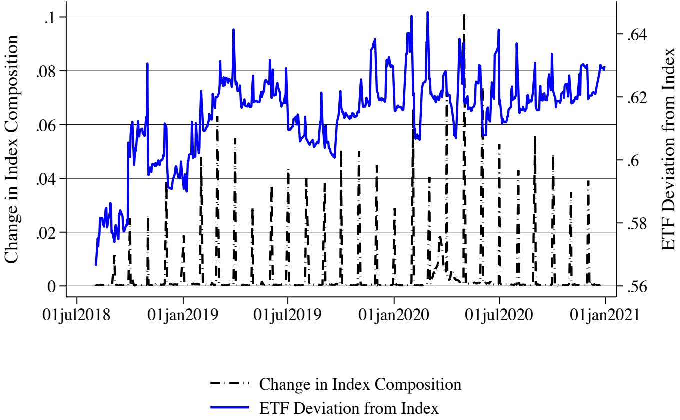
Changes in Index Composition and ETF Index Deviations



Example: iShares 1-5 Year Investment Grade Corporate Bond ETF (IGSB). To compute daily changes in index composition, we first compute the first difference in each bond's daily index weights and then sum the absolute values of these differences across bonds. To compute the ETF's index deviation on a given day, we first calculate the difference between the ETF portfolio weights and index weights for each bond, and then sum the absolute values of these differences across all bonds in the ETF's portfolio.

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ETFs Dynamically Adjust Baskets, Steer Toward Index

$$Basket_{ijt} = \beta_1 \, \Delta Deviation_{ijh} + \beta_2 \, \Delta Deviation_{ijh} \times Illiquidity_j + \omega_{jt} + \epsilon_{ijt} \; ,$$

where $Basket_{ijt}$ = Log(1 + number of shares of bond i in ETF j's baskets on day t)

	RD Basket			CR Basket		
	IL1	IL2	IL3	IL1	IL2	IL3
$\Delta Deviation$	23.70***	20.94***	23.77***	-34.13***	-33.18***	-34.16***
	(1.84)	(1.69)	(1.83)	(1.08)	(1.06)	(1.08)
$\Delta Deviation \times Illiq$	-6.94***	-3.88***	-6.54***	6.84***	6.51***	6.14***
	(1.33)	(1.34)	(1.29)	(0.76)	(0.75)	(0.77)
Total shares	60.08***	60.19***	60.08***	54.06***	54.02***	54.05***
	(3.08)	(3.08)	(3.08)	(1.53)	(1.53)	(1.53)
Observations	2639566	2639566	2639566	7579237	7579237	7579237
Adjusted R^2	0.45	0.45	0.45	0.35	0.35	0.35

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Interactions with Basket Imbalance (Single Measure)

$$Illiquidity_{it+1} = \beta_1\, Basket_{it} + \beta_2\, Basket_{it} \times \underbrace{Imbalance_{it}}_{|N_{it}^{CR} - N_{it}^{RD}|} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	IL1	IL2	IL3
$Basket_{it}$	-10.94***	-4.29***	-6.61***
	(0.41)	(0.41)	(0.41)
$Basket_{it} \times Imbalance_{it}$	2.00***	1.86***	1.79***
	(0.22)	(0.23)	(0.19)
$Illiquidity_{i,t-5\to t-1}$	12.52***	11.78***	19.59***
	(0.19)	(0.19)	(0.35)
Observations	3254055	2831031	2901286
Adjusted R^2	0.23	0.13	0.44

Effect of Basket Inclusion on 3-Day Bond Liquidity: OLS

$$Illiquidity_{i,t+1\to t+3} = \beta^{CR}\ Basket_{it}^{CR} + \beta^{RD}\ Basket_{it}^{RD} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	Number of Baskets			Basket Shares		
	IL1	IL2	IL3	IL1	IL2	IL3
CR	-4.35***	-1.20***	-2.45***	-0.20***	-0.03*	-0.15***
	(0.16)	(0.14)	(0.15)	(0.02)	(0.02)	(0.02)
RD	-5.00***	-2.48***	-2.47***	-0.20***	-0.15***	-0.11***
	(0.28)	(0.28)	(0.29)	(0.02)	(0.02)	(0.02)
$Illiquidity_{i,t-5\to t-1}$	12.20***	12.96***	17.70***	10.99***	12.76***	17.20***
	(0.19)	(0.23)	(0.35)	(0.17)	(0.22)	(0.34)
Observations	4551644	4254774	4196240	4551644	4254774	4196240
Adjusted R^2	0.30	0.18	0.48	0.30	0.18	0.48

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Second Stage: 3-Day Bond Liquidity

$$Illiquidity_{i,t+1\to t+3} = \beta^{CR}\,\widehat{Basket}_{it}^{CR} + \beta^{RD}\,\widehat{Basket}_{it}^{RD} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	Number of Baskets			Basket Shares		
	IL1	IL2	IL3	IL1	IL2	IL3
CR	-7.15***	-6.24***	-10.74***	-1.86***	-1.23***	-1.84***
	(1.82)	(2.02)	(1.54)	(0.26)	(0.29)	(0.22)
RD	-8.66**	-5.40	-10.29***	-0.34	-0.32	-0.83**
	(3.80)	(4.14)	(3.25)	(0.40)	(0.43)	(0.34)
$Illiquidity_{i,t-5\to t-1}$	11.18***	12.25***	16.18***	10.00***	12.06***	15.85***
	(0.08)	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)
Observations	2807592	2626760	2589840	2807592	2626760	2589840
Adjusted R^2	0.01	0.01	0.02	0.01	0.01	0.01

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Effect of Basket Inclusion on 3-Day Liquidity: COVID-19

- Sample period: March 2 to April 15, 2020

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$$Illiquidity_{i,t+1\rightarrow t+3} = \beta^{CR}\ Basket^{CR}_{it} + \beta^{RD}\ Basket^{RD}_{it} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it}$$

	Number of Baskets			Basket Shares		
	IL1	IL2	IL3	IL1	IL2	IL3
CR	0.34	-0.00	3.60*	0.17	-0.03	0.32*
	(1.30)	(0.83)	(2.08)	(0.10)	(0.08)	(0.18)
RD	1.56	4.69***	6.05***	0.11	0.30***	0.34**
	(0.94)	(0.96)	(1.46)	(0.10)	(0.10)	(0.17)
$Illiquidity_{i,t-5\rightarrow t-1}$	9.21***	7.26***	13.57***	9.17***	7.21***	13.11***
	(0.58)	(0.53)	(0.68)	(0.59)	(0.53)	(0.65)
Observations	152571	145920	142237	152571	145920	142237
Adjusted R^2	0.32	0.11	0.40	0.32	0.11	0.41

Interactions with Basket Imbalance (3-Day Liquidity)

$$\begin{aligned} Illiquidity_{i,t+1\to t+3} = \; & \beta_1 \, Basket_{it} + \beta_2^{CR} \, Basket_{it} \times Imbal_{it}^{CR} \\ & + \beta_2^{RD} \, Basket_{it} \times Imbal_{it}^{RD} + Controls_{it} + \omega_{Ft} + \omega_{mt} + \epsilon_{it} \end{aligned}$$

	IL1	IL2	IL3
$Basket_{it}$	-13.03***	-5.83***	-7.90***
	(0.49)	(0.47)	(0.49)
$Basket_{it} \times Imbal_{it}^{CR}$	2.23***	2.68***	2.13***
	(0.28)	(0.27)	(0.25)
$Basket_{it} \times Imbal_{it}^{RD}$	4.04***	1.98***	3.61***
	(0.57)	(0.72)	(0.69)
$Illiquidity_{i,t-5\to t-1}$	11.96***	12.92***	17.58***
	(0.18)	(0.22)	(0.34)
Observations	4551644	4254774	4196240
Adjusted R^2	0.30	0.18	0.48

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