

Do Liquidity Proxies Measure Liquidity Accurately in ETFs?

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Background 1

- It is important to measure liquidity accurately:
 - When assessing whether active investment strategies add value (e.g. Lesmond, Schill, and Zhou (2004))
 - When measuring diversification benefits (e.g. De Roon, Nijman, and Werker (2001))
 - For exchanges (e.g. Harris (2003))
 - When measuring the speed of price discovery (e.g. Chordia, Roll, and Subrahmanyam (2008))
- Accurately measuring liquidity using high-frequency intraday data can be time consuming so empirical research tends to use liquidity proxies based on daily or monthly data

Background 2

- There has been a number of papers investigate how best to measure liquidity in various asset classes:
 - **Stocks** - Goyenko, Holden, and Trzcinka (JFE, 2009)
 - **Bonds** - Schestag, Schuster, and Uhrig-Homburg (RFS, 2016)
 - **Currencies** - Mancini, Ranaldo, and Wrampelmeyer (JF, 2013)
 - **Commodities** - Marshall, Nguyen, and Visaltanachoti (RFS, 2012)

Background 3

- Most liquidity proxies were developed for stocks.
- However, ETF and stock liquidity differ in two important respects:
 - ETFs can be expected to have lower adverse selection costs
 - ETFs have a two-tier ETF market structure with both a centralized exchange (secondary market) and a creation/redemption mechanism (primary market)

Research Question

- Do Liquidity Proxies Measure Liquidity Accurately in ETFs?

Data

- US listed ETFs
- Morningstar - fund classifications and primary market creation and redemption data
- CRSP - daily price, volume, and shares outstanding data
- Thomson Reuters Tick History (TRTH) - intraday data
- We include ETFs that appear in all three data sets between January 1, 1996 and December 31, 2009
- Our data ends at 31 December, 31 2014, so we do not include ETFs listed in recent years due to concerns around insufficient time-series length

Data

Year	U.S. Equity	Sector Equity	International Equity	Municipal Bond	Taxable Bond	Commodities	Currency	Alternative	Allocation
1996	2	.	17	.	.	.	.	.	.
1997	2	.	17	.	.	.	.	.	.
1998	3	9	17	.	.	.	.	.	.
1999	3	9	17	.	.	.	.	.	.
2000	20	22	24	.	.	.	.	.	.
2001	24	34	27	.	.	.	.	.	.
2002	25	34	33	1	4	.	.	.	.
2003	30	35	35	1	6	.	.	.	.
2004	47	46	37	.	6	1	.	.	.
2005	57	65	43	.	6	2	1	.	.
2006	83	117	57	.	7	6	7	12	.
2007	102	148	91	11	32	13	10	46	.
2008	107	174	110	14	35	14	13	73	4
2009	118	179	127	17	58	15	14	92	7
2010	118	178	128	17	58	15	14	93	7
2011	118	178	128	17	58	15	14	93	7
2012	118	179	128	17	58	15	14	93	7
2013	118	178	128	17	58	15	14	93	7
2014	118	178	128	17	58	15	14	93	7

Liquidity Benchmarks

- Two dimensions of liquidity
 - Spread
 - Price Impact

1. Effective Spread

$$\text{Effective Spread} = 2 \cdot |\ln(P_k) - \ln(M_k)|,$$

- where P_k is price and M_k is the midpoint of bid and ask quotes when the k th trade occurs.
- Following Goyenko, Holden, and Trzcinka (2009), we calculate monthly average effective spreads by weighting intraday spreads by dollar volume.

2. Quoted Spread

- Quoted Spread = $(A_k - B_k)/M_k$
- where A_k , B_k , and M_k are ask price, bid price, and midpoint of these two prices, respectively. Following Fong, Holden, and Trzcinka (2011), monthly average quoted spread is calculated by time-weighting the intraday spreads.

3. Price Impact

- Price Impact =
$$\begin{cases} 2 \cdot (\ln(M_{k+5mins}) - \ln(M_k)) & \text{when the } k^{th} \text{ trade is a buy,} \\ 2 \cdot (\ln(M_k) - \ln(M_{k+5mins})) & \text{when the } k^{th} \text{ trade is a sell,} \end{cases}$$
- where $M_{k+5mins}$ (M_k) are the midpoints (at the time of the k th trade). Again, we use the Lee and Ready (1991) algorithm to classify trades, and monthly averages are calculated using the same approach as for effective spreads.

Average ETF Transaction Costs

- Currency ETFs have the lowest effective spreads overall at 0.114%, followed by taxable bond (0.145%), commodity (0.158%), and U.S. equity (0.171%) ETFs
- International equity ETFs have the largest effective spreads, at 0.576%
- Of course, these are average numbers for all ETFs within a category. Many U.S. equity ETFs, such as the S&P 500 SPDR and iShare ETFs, have extremely low transaction costs
- By way of comparison, Goyenko, Holden, and Trzcinka (2009) report average effective spreads of 2.6–2.9% for 400 randomly selected NYSE, AMEX, and NASDAQ stocks over the 1993–2005 period

ETF v Stock Liquidity 1

	All	1998–2005	2006–2014
ETF	0.046	0.075	0.021
Underlying	0.050	0.081	0.023
Difference	-0.004	-0.006	-0.002
Difference t-stat	-9.710	-10.600	-3.630

ETF v Stock Liquidity 2

	Mean	Mean
	Across All	Across Group
Positive Net Flow	0.080	0.115
Negative Net Flow	0.067	0.095
Total Net Flow	0.147	0.210

ETF v Stock Liquidity 3

Intercept	coeff	0.130	0.132	0.096
	t-stat	38.539	38.167	30.882
$NF_{i,t}$	coeff	-0.086	-0.112	0.074
	t-stat	-0.434	-0.572	0.416
$NF_{i,t-1}$	coeff		-0.500	-0.399
	t-stat		-2.546	-2.275
$NF_{i,t-2}$	coeff			-0.339
	t-stat			-1.640
$Spread_{i,t-1}$	coeff	0.324	0.324	0.267
	t-stat	18.759	18.759	16.881
$Spread_{i,t-2}$	coeff			0.230
	t-stat			15.076
Adj. R ²		0.106	0.106	0.172
N		1,320,011	1,320,011	1,299,920

Liquidity Proxies

- **Roll** – covariance of price changes
- **Gibbs** – more sophisticated way of estimating Roll
- **Zeros** – proportion of days with zero returns
- **Zeros2** – proportion of positive volume days with zero returns
- **FHT** – variation of the zero return proxy
- **Effective Tick** – probability-weights each spread size and divides by average price
- **High-Low** – the relationship between high and low prices
- **Daily Spread** – the last spread of the day

Liquidity Proxies

- **Amihud** – the absolute daily return divided by volume
- **Amivest** – volume divided by the absolute daily return
- **Pastor and Stambaugh** – gamma from regression of return on volume

Correlations – Effective Spread All

	Roll	Gibbs	Zeros	Zeros2	FHT	Eff. Tick	D Spread	High-Low	Amihud	Amivest
U.S. Equity	0.313	0.032	-0.174	-0.175	0.026	0.098	0.547	0.538	0.386	-0.254
Sector Equity	0.547	0.036	-0.033	-0.057	0.484	0.435	0.759	0.813	0.616	-0.583
International Equity	0.362	0.178	0.660	0.674	0.762	0.863	0.768	0.762	0.763	-0.785
Municipal Bond	0.758	0.332	-0.203	-0.202	0.362	0.463	0.869	0.882	0.427	-0.114
Taxable Bond	0.579	0.037	-0.369	-0.373	0.502	0.259	0.747	0.831	0.473	-0.299
Commodities	0.417	-0.048	-0.098	-0.103	0.102	0.304	0.674	0.672	0.518	-0.367
Currency	0.436	-0.007	-0.145	-0.145	0.090	0.232	0.732	0.650	0.769	-0.225
Alternative	0.325	-0.113	-0.109	-0.122	-0.091	-0.159	0.815	0.397	0.291	0.083
Allocation	0.901	0.255	0.133	-0.145	0.818	0.646	0.751	0.972	0.892	-0.252
AVERAGE	0.515	0.078	-0.038	-0.072	0.339	0.349	0.740	0.724	0.571	-0.311

Correlations – Quoted Spread All

	Roll	Gibbs	Zeros	Zeros2	FHT	Eff. Tick	D Spread	High-Low	Amihud	Amivest
U.S. Equity	0.281	0.023	-0.187	-0.187	-0.010	0.082	0.476	0.511	0.349	-0.209
Sector Equity	0.464	0.025	-0.025	-0.051	0.452	0.290	0.678	0.745	0.526	-0.607
International Equity	0.365	0.161	0.611	0.615	0.698	0.798	0.719	0.802	0.779	-0.739
Municipal Bond	0.818	0.340	-0.280	-0.278	0.359	0.425	0.880	0.937	0.522	-0.132
Taxable Bond	0.520	-0.001	-0.314	-0.317	0.444	0.247	0.689	0.778	0.412	-0.251
Commodities	0.428	-0.043	-0.112	-0.116	0.112	0.277	0.660	0.706	0.425	-0.340
Currency	0.212	-0.065	-0.012	-0.012	0.147	0.311	0.517	0.436	0.455	-0.091
Alternative	0.248	-0.104	-0.103	-0.118	-0.101	-0.177	0.766	0.356	0.284	0.068
Allocation	0.867	0.251	0.015	-0.235	0.698	0.606	0.719	0.886	0.796	-0.148
AVERAGE	0.467	0.065	-0.045	-0.078	0.311	0.318	0.678	0.684	0.505	-0.272

Correlations – Effective Spread No Primary Market Flows

	Roll	Gibbs	Zeros	Zeros2	FHT	Eff. Tick	D Spread	High-Low	Amihud	Amivest
U.S. Equity	0.248	0.038	-0.159	-0.160	0.017	0.070	0.482	0.455	0.394	-0.260
Sector Equity	0.590	0.025	-0.104	-0.124	0.376	0.535	0.661	0.799	0.721	-0.447
International Equity	0.392	0.179	0.647	0.661	0.748	0.853	0.765	0.772	0.762	-0.781
Municipal Bond	0.587	0.190	-0.136	-0.133	0.276	0.418	0.714	0.685	0.242	-0.129
Taxable Bond	0.500	0.025	-0.358	-0.361	0.368	0.334	0.798	0.755	0.644	-0.300
Commodities	0.402	-0.042	-0.113	-0.118	0.114	0.340	0.777	0.700	0.495	-0.382
Currency	0.047	0.047	-0.069	-0.069	-0.116	0.006	0.153	0.021	0.257	-0.319
Alternative	0.363	-0.089	-0.111	-0.121	0.006	-0.106	0.846	0.499	0.170	0.173
Allocation	0.872	0.202	-0.017	-0.221	0.575	0.701	0.789	0.844	0.681	-0.254
AVERAGE	0.445	0.064	-0.047	-0.072	0.263	0.350	0.665	0.614	0.485	-0.300

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International Equity	0.392	0.179	0.647	0.661	0.748	0.853	0.765	0.772	0.762	-0.781
Municipal Bond	0.587	0.190	-0.136	-0.133	0.276	0.418	0.714	0.685	0.242	-0.129
Taxable Bond	0.500	0.025	-0.358	-0.361	0.368	0.334	0.798	0.755	0.644	-0.300
Commodities	0.402	-0.042	-0.113	-0.118	0.114	0.340	0.777	0.700	0.495	-0.382
Currency	0.047	0.047	-0.069	-0.069	-0.116	0.006	0.153	0.021	0.257	-0.319
Alternative	0.363	-0.089	-0.111	-0.121	0.006	-0.106	0.846	0.499	0.170	0.173
Allocation	0.872	0.202	-0.017	-0.221	0.575	0.701	0.789	0.844	0.681	-0.254
AVERAGE	0.445	0.064	-0.047	-0.072	0.263	0.350	0.665	0.614	0.485	-0.300

Spread Benchmark and Proxy Means

	N	Effective	Quoted	Roll	Gibbs	Zeros	Zeros2	FHT	Eff. Tick	D Spread	High-Low
U.S. Equity	16,063	0.171	0.225	0.552	0.566	0.971	0.968	0.025	0.020	0.241	0.322
Sector Equity	23,198	0.302	0.379	0.685	0.866	1.142	1.122	0.036	0.032	0.492	0.385
International Equity	17,082	0.576	0.765	0.949	0.640	4.665	4.387	0.180	0.061	1.162	0.443
Municipal Bond	1,709	0.294	0.403	0.264	0.248	7.413	7.365	0.036	0.033	0.334	0.158
Taxable Bond	6,026	0.145	0.222	0.239	0.895	3.172	3.166	0.018	0.016	0.149	0.138
Commodities	1,726	0.158	0.207	0.753	1.032	1.052	1.046	0.032	0.031	0.161	0.338
Currency	1,568	0.114	0.181	0.342	0.932	2.233	2.233	0.023	0.023	0.166	0.134
Alternative	9,398	0.233	0.287	1.401	1.604	0.569	0.559	0.024	0.028	0.283	0.689
Allocation	621	0.405	0.416	0.443	0.411	2.112	2.041	0.032	0.033	1.085	0.220
AVERAGE		0.266	0.343	0.625	0.799	2.592	2.543	0.045	0.031	0.453	0.314

Conclusions

- Movements in the Daily Spread, High-Low, and Amihud do a good job of mirroring movements in the effective and quoted spread benchmarks, with time-series correlations ranging from 0.48 to 0.74
- The ability of proxies to measure changes in liquidity is not affected by the creation or redemption of units in the primary market
- None of the price impact proxies consistently measure the price impact benchmark
- Researchers in asset pricing and other areas in which movements in liquidity are important can use proxies to capture the effective and quoted spreads, but not price impact
- All proxies have a scale that is statistically significantly different from the benchmark, so using proxies has limitations for researchers in areas that require actual cost of trading

Not Used

Correlations – Price Impact All

	Amihud	Amivest	Pastor	Roll PI	Gibbs PI	Zeros PI	Zeros2 PI	FHT PI	Eff. Tick PI	D Spread PI
U.S. Equity	0.279	0.081	-0.161	0.342	0.213	0.353	0.234	0.365	0.355	0.390
Sector Equity	0.459	0.029	-0.403	0.569	0.306	0.043	0.027	0.132	0.342	0.260
International Equity	0.009	0.035	0.002	0.006	-0.001	0.005	-0.004	0.005	-0.002	0.006
Municipal Bond	0.031	-0.326	-0.016	0.048	0.010	-0.081	-0.086	0.005	-0.004	0.136
Taxable Bond	-0.024	-0.048	0.050	0.002	-0.009	0.016	0.045	0.029	-0.019	-0.006
Commodities	0.326	-0.092	0.040	0.120	0.015	0.077	0.049	0.098	0.191	0.166
Currency	0.040	-0.066	-0.017	-0.016	-0.002	0.093	0.093	0.014	0.100	0.000
Alternative	-0.015	0.223	0.008	-0.023	-0.036	-0.022	-0.047	-0.014	-0.028	0.011
Allocation	0.518	-0.229	-0.338	0.721	0.626	0.070	-0.023	0.468	0.466	0.544
AVERAGE	0.180	-0.044	-0.093	0.197	0.125	0.062	0.032	0.122	0.156	0.167