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Barclays Liquidity Cost Scores (LCS®): A Brief Introduction

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In 2009, Barclays launched a bond-level liquidity measure, Liquidity Cost Score (LCS), which focuses on cost of trading, an important, and quantifiable, dimension of liquidity. More specifically, LCS measures the cost of an immediate, round-trip transaction of a typical institutional size and is expressed as a percent of the bond's price.

Liquidity is an important and widely monitored characteristic of financial markets. At the same time, many common proxies of it are difficult to quantify rigorously. Some frequently used metrics are market aggregates, but a truly useful liquidity measure must be security-level. It can still be aggregated to market level, but with a complete flexibility in defining the "market." If computed consistently across asset classes and over time, it can be used in multiple portfolio management and research applications. Among them are portfolio/benchmark liquidity monitoring and reporting; quantifying the effect of transaction costs on alpha strategies performance; liquidity-constrained portfolio construction and optimization; adding a liquidity factor into market risk and VaR models; and many others.

At the time of writing, Barclays computes LCS for 23,000 fixed-income securities with a total outstanding amount of $50trn, across a broad range of asset classes. Figure 1 shows the current LCS coverage universe.

FIGURE 1
LCS Market Coverage, as of March 2020

Asset Class	Data since
USD Credit IG	Jan-07
USD Credit HY	Jan-07
USD IG Credit 144A (no reg rights)	Jan-07
USD Treasuries	Nov-09
USD Fixed Rate Agency MBS	Mar-10
USD TIPS	Jul-10
USD Emerging Markets	Feb-12
USD Convertible Bonds	Dec-19
Pan Euro Credit IG	May-10
Pan Euro Credit HY	May-10
Pan Euro Credit FRN	May-10
Pan Euro Agencies	May-10
Pan Euro Local Authorities	May-10
Pan Euro Treasuries	Feb-11
Pan Euro Inflation Linked	Mar-11
GBP Corporate £100–200mn	May-10
Global Covered Bonds	Sep-12
Japan Treasuries	Sep-13

Source: Barclays Research

Definition

Unlike exchange-traded equities and bond ETFs, individual bond transaction data are not widely available. Besides, relatively few bonds trade on a daily basis, especially in broad credit markets. However, many more are quoted every day. For that reason, LCS relies on two-way quotes issued by Barclays traders to other market participants. This data set is quite extensive. Each day, traders post thousands of simultaneous, bond-level quotes assuming typical institutional transaction amounts. LCS reflect activities of Barclays only. Any particular bid-ask quote from any particular broker/dealer may not always be "best execution", ie, the highest bid and the lowest offer across all market makers. However, given Barclays' material presence in fixed-income markets, its bid-ask quotes are never far from market levels. LCS are published on a monthly frequency. Bid-ask spreads averaged over the course of a full month certainly reflect the "market" quite accurately.

LCS is defined in "return space" and assumes a round-trip transaction. The reasoning for this definition is as follows. Strictly speaking, and unlike commissions-based trades, the cost of a one-way transaction in a bond is not known precisely. This cost is realized because an investor buying something whose fair value is the *unobserved* mid price is paying a higher ask price. Hence, the reasonable estimation of the cost of a one-way transaction is one half of LCS.

Trader quotes, collected on a daily basis, are the principal input into our proprietary LCS methodology. From the outset, the goal was to make LCS primarily data-driven, as opposed to being a modelled quantity. The small model component of the methodology (tailored to different asset classes) deals with two issues. The degree of commitment behind trader quotes for a particular bond varies at different points in time. Actively traded issues are likely to be quoted at executable levels and uniformly among broker-dealers. For less liquid bonds, traders may issue bid-ask indications, not necessarily executable as quoted. To differentiate between the two, the LCS methodology uses transparent, market-specific algorithms based on multiple objective and observable criteria, such as a bond's age, issue size, spread, and trading volume, among others. Bid-ask spreads deemed indicative are widened to ensure they are not on the "too narrow" side of the prevalent market levels. Bid-ask spreads are never tightened, in the spirit of keeping LCS a conservative measure.

The second issue concerns bonds that have no two-way trader quotes in a particular month. Barclays traders issue quotes for the majority of bonds in all the major markets. Nevertheless, to achieve the complete market coverage (as defined by widely used Bloomberg Barclays bond indices), bid-ask spreads of non-quoted bonds must be estimated. The methodology (again, customized to different asset classes) relies on simple and transparent models that establish a relationship between LCS computed directly from traders' quotes and various intuitive and observable bond attributes, eg, issue size, spread, sector, and trading volume. It is reasonable to assume that the same relationship holds for bonds not quoted in a particular month, and it is used to estimate LCS of these bonds. The estimated LCS are then adjusted upwards (wider bid-ask spreads) to reflect the non-quoted status of these bonds. The model includes a smoothing mechanism that takes into account whether a bond was quoted in previous months, among other factors. This prevents unwarranted large changes in LCS values.

The attributes used in the model are what investors would look at when trying to gauge a bond's liquidity. For example, recent and large issues are usually cheaper to trade than seasoned and small ones, so bond age and issue size must be important. Still, however intuitive an attribute seems, we always seek empirical confirmation, with examples given in the next two figures. Figure 2 segments the universe of trader-quoted credit bonds by age and issue size while controlling for maturity (hence, four tables). Two clear gradients emerge: LCS tend to decrease for larger issues and to increase for older bonds.

FIGURE 2

Average LCS by Issue Size and Age, USD Investment Grade Credit, March 2020

Maturity: 1-5 (0.0% MV)

Size, $mn	Age, yr <1	1-5	5-7.5	7.5+
<500	0.91	0.67	0.83	0.65
500-750	0.65	0.76	0.97	0.65
750-1,500	0.75	0.58	0.83	0.67
1,500-2,000	0.57	0.43	0.76	0.65
2,000-3,000	0.56	0.51	0.65	0.39
>3,000	0.44	0.34	0.57	0.80

Maturity: 5-10 (0.0% MV)

Age, yr <1	1-5	5-7.5	7.5+
1.29	1.18	1.56	1.26
1.32	1.21	2.11	1.40
1.11	1.21	1.06	1.30
1.09	1.13		
1.15	1.17	1.17	
1.15	1.10		

Maturity: 10+ (0.0% MV)

Size, $mn	Age, yr <1	1-5	5-7.5	7.5+
<500	1.92	2.17	2.21	2.02
500-750	2.02	2.17	2.06	2.08
750-1,500	1.81	2.27	2.25	2.10
1,500-2,000	1.99	2.10	2.19	2.08
2,000-3,000	1.92	2.17	2.34	2.32
>3,000	2.41	1.99	1.89	2.04

Maturity: All

Age, yr <1	1-5	5-7.5	7.5+
1.50	1.39	1.38	1.56
1.35	1.30	1.39	1.59
1.20	1.19	1.31	1.55
1.17	1.11	1.35	1.61
1.16	1.20	1.13	1.75
1.21	0.93	0.84	1.41

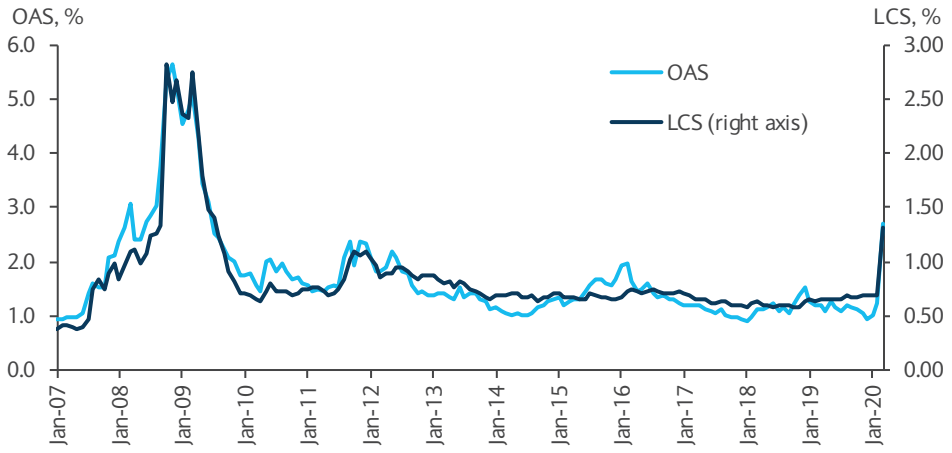
Buckets with fewer than 10 bonds are not shown

Source: Barclays Research

Another strong liquidity driver is credit spread. Traders are likely to charge a premium for taking a position in a risky security whose price can move significantly while the bond is in the trader's inventory. Figure 3 demonstrates the stability and strength of this relationship. Their correlation from January 2007 through March 2020 is 0.95 (0.70 in changes).[1]

FIGURE 3

LCS versus OAS, USD Investment Grade Corporates, January 2007-March 2020



Source: Barclays Research

[1] In the model, we use Duration Times Spread (DTS) to represent credit risk. See Ben Dor, A., Dynkin, L., Hyman, J., Houweling, P., Van Leeuwen, E., and Penninga, O., "DTS (Duration Times Spread)," *The Journal of Portfolio Management*, 2007, vol. 33. no. 2.

As we mentioned, not all seemingly intuitive attributes are necessarily strongly related to liquidity. One example is trading volume, a popular indicator and criterion of liquidity, often used by academics and practitioners alike. Yet when looking at the transaction costs dimension of liquidity (as opposed to market effect, for example, where volume usually plays a bigger role), one has to be careful. We have not found a discernible relationship between LCS and volume – most of the time. In fact, even though one would assume volume and LCS to be negatively correlated, they occasionally move in concert. Only during the credit crisis of 2008-09 did LCS and trading volume exhibit a clear negative relationship. During the current COVID-19 crisis, however, at least at the time of writing, market activity has not slowed, despite the dramatic spread widening and deterioration in liquidity. Over long time periods, the correlation between LCS and trading volume is close to zero.

Relative Liquidity Metric – Trade Efficiency Score (TES)

LCS is an absolute measure, so it is affected by overall market liquidity trends. Certain applications, such as liquidity filtering in portfolio construction, would benefit from a metric insulated from market-wide liquidity fluctuations.

To address this need, for certain asset classes we also produce a relative liquidity measure, derived from LCS. This metric is called Trade Efficiency Score (TES). It represents a bond's liquidity rank among its peers, ranging from 1 (best) to 10 (worst). It helps to quickly judge a bond's liquidity relative to similar bonds, both currently and over time. By definition, TES is an intra-market measure, so several asset-specific TES are computed every month. Currently, TES scores are produced for seven markets: USD investment grade corporates, USD high yield, EUR investment grade corporates and high yield, global covered bonds, USD emerging markets, and USD convertible bonds.

In addition, while LCS captures the cost of trading, it does not directly reflect a bond's actual trading flow. Many corporate bonds, for example, trade very infrequently. Quoted bid-ask spreads are rarely perfectly aligned with trading volume, so LCS may not be enough to gauge the difficulty of implementing large or numerous trades in a particular bond. Investors looking for quick execution may prefer a bond with a higher current trading volume to a similar bond with the same, or even higher, LCS but lower volume. TES blends LCS and trading volume into a single relative score that reflects both the cost and flow. Within one market, bond-level TES are comparable over time and among bonds, and come close to the way many traders think about liquidity, ie, in terms of both transaction costs and potential market effect. As a relative measure, TES can serve as a stable liquidity filter that does not need to be adjusted when the overall market liquidity conditions change. It is also a valuable tool for back-testing investment strategies. Using different TES buckets in back-testing shows how liquidity-sensitive the strategy's performance is and how achievable its promised returns are.

To compute TES, each bond in a particular market is assigned to an OASD-adjusted[2] LCS quintile and to a monthly trading volume decile. Then, the two ranks are added up, and the sum (which ranges from 2 to 15) is mapped to a TES rank from 1 to 10. Figure 4 provides the details.

[2] LCS is a product of the bid-ask spread and OASD, so the duration adjustment is necessary for relative-liquidity comparison of bonds with different durations.

FIGURE 4
Trade Efficiency Scores Calculation

LCS Quintile + Trading Volume Decile	TES
2 and 3	1
4 and 5	2
6	3
7	4
8	5
9	6
10	7
11	8
12	9
13-15	10

Source: Barclays Research

TES buckets differ in the number of bonds and market value allocation. For example, the TES1 bucket of the Bloomberg Barclays USD Corporate Index comprises approximately 10% of the corporate market by number of bonds, but 20% by market value, while the TES10 bucket has roughly the same number of bonds and only 5% of market value.

The attributes of bonds in different TES buckets vary substantially and predictably. By construction, low-TES buckets have bonds with low LCS and high trading volume. As Figure 5 shows, the average LCS of TES10 is about 1.7 times that of TES1. Just a month ago, in February 2020, the ratio was 2.3. This change is directly connected to the widening of the LCS cross-sectional distribution in March 2020 (shown in Figure 9 later in the report). Low-TES buckets tend to be populated by large and recent issues. The average issue size of TES1 is more than four times that of TES10, while the average age of TES10 is 3.7 times higher.

FIGURE 5
Trade Efficiency Scores, USD Investment Grade Corporates, March 2020

TES	# bonds	# bonds %	MV %	Age, yr	Issue size, mn	OAS, bp	LCS, %	Vol, mn
1	612	9.9	19.8	2.3	1,710	214	1.047	351
2	929	15.0	22.4	3.3	1,302	234	1.171	154
3	570	9.2	11.2	3.7	1,073	270	1.290	98
4	568	9.1	9.4	4.2	913	291	1.332	61
5	597	9.6	8.5	4.9	786	302	1.429	44
6	596	9.6	7.1	4.8	659	317	1.406	26
7	602	9.7	6.4	5.7	582	318	1.481	16
8	580	9.3	5.6	5.7	526	323	1.562	10
9	504	8.1	4.5	7.2	477	322	1.674	6
10	650	10.5	5.1	8.4	420	360	1.791	2

Source: Barclays Research

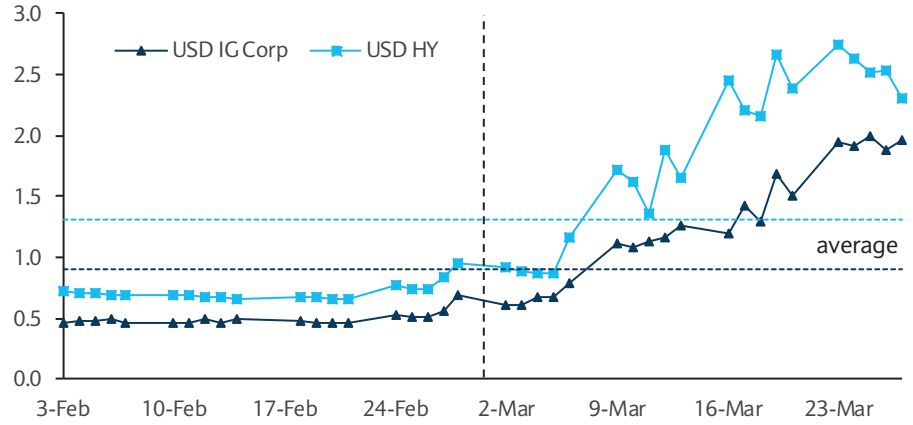
Market-Segment Level Daily LCS

Many portfolio management tasks, such as portfolio rebalancing, are done on a monthly basis, so the monthly-frequency, bond-level LCS are an appropriate metric for most portfolio management applications. At the same time, particularly in stressful market

conditions, monitoring liquidity on a daily basis provides additional benefits. Figure 6, showing Daily LCS of USD corporate markets at the outset of the COVID-19 crisis, provides a convincing illustration of this. Daily LCS serve as a market's "liquidity pulse." This purpose is better served by computing them on a market-segment level, removing the idiosyncratic noise of individual bonds' liquidity variations.

FIGURE 6

Daily LCS, USD Investment Grade Corporates and High Yield, %, February-March 2020



Source: Barclays Research

Figure 7 shows the market segments for which Daily LCS are currently produced.

FIGURE 7

Daily LCS Market Segments, by Asset Class

USD and EUR Corporates

Investment Grade Corporates	All	
	Industry sectors	Financial Basic Industry Consumer Technology Energy & Utility
	Quality ratings	Aaa-Aa A Baa
High Yield	All	
	Industry sectors	Financial Basic Industry Consumer Technology Energy & Utility
	Quality ratings	Ba B Caa-C

USD Emerging Markets

USD Investment Grade (Sov rating) Emerging Markets	All	
	Latin America	All Government Corporate
	Asia Pacific	All Government Corporate
	Europe	All Government Corporate
	M.East/ Africa	All Government Corporate
High Yield (Sov) USD Emerging Markets	All	
	Latin America	All Government Corporate
	Asia Pacific	All Government Corporate
	Europe	All Government Corporate
	M.East/ Africa	All Government Corporate

USD Convertible Bonds

USD Convertible Bonds, by Profile	All	
	Balanced	All Small Cap Medium Cap Large Cap Investment Grade Intermediate Grade Lower Grade Non-rated
	Equity Sensitive	All Small Cap Medium Cap Large Cap Investment Grade Intermediate Grade Lower Grade Non-rated
	Credit / Rate Sensitive	All Small Cap Medium Cap Large Cap Investment Grade Intermediate Grade Lower Grade Non-rated

Source: Barclays Research

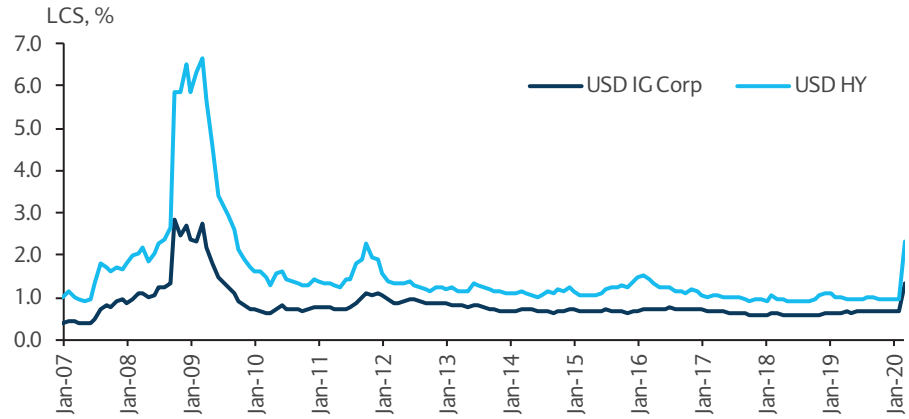
Applications of LCS

LCS is used by asset managers, plan sponsors, and researchers for a variety of purposes. We provide just a few examples pertaining specifically to bond portfolio management.

As mentioned before, a bond-level measure can be used for monitoring and analysing market liquidity while allowing full flexibility in defining the universe of interest, from broad markets such as USD credit to narrowly defined market segments suited for some particular inquiry, to actual portfolios. Investors often compare today's liquidity environment with various periods in the past. Aggregated to market level, LCS makes such comparisons rigorous and clear, replacing qualitative opinions, often unsupported by evidence, with hard numbers. As an example, Figure 8 shows historical LCS for USD investment grade credit and high yield. Because of this, we have seen interest in LCS from not only asset managers but also regulators and central banks. During the current market turmoil, investors, money managers, and regulators want to see how the liquidity conditions in the current crisis compare with those during previous market stresses. This plot shows exactly where the current deterioration of liquidity stands in a historical context.

FIGURE 8

Time Series of USD Investment Grade Credit and High Yield LCS, %, January 2007-March 2020



Source: Barclays Research

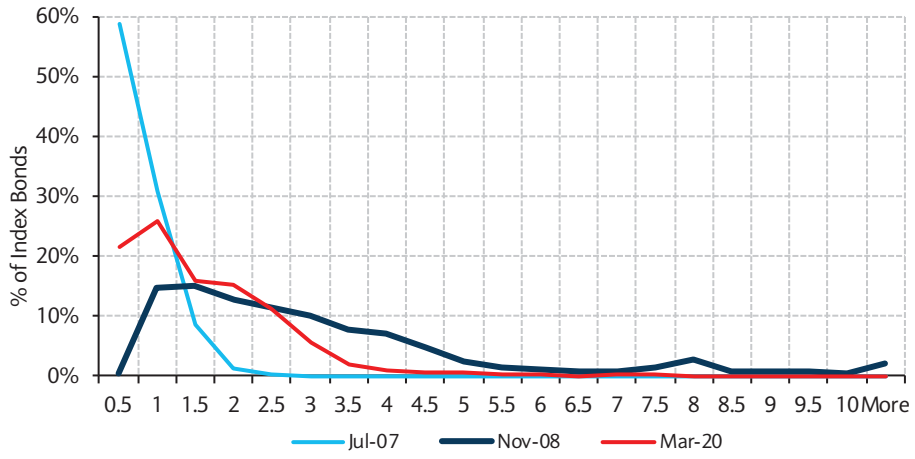
Contemporaneous, cross-sectional market analysis can be as useful as historical patterns. An intra-market distribution of LCS contains valuable information about market conditions, beyond simple statistics such as market value-weighted average or median. Side-by-side distributions for various markets or points in time highlight differences between their liquidity conditions. We have found that increased levels of LCS are always accompanied by widening of LCS dispersion across individual bonds. In extreme market events, such as the financial crisis of 2008 or the COVID-19 crisis of 2020, this creates significant "fat tails." In other words, deterioration of liquidity entails higher tail risk.

To illustrate this phenomenon, we compare three distributions of USD investment grade credit LCS: one from July 2007, which was a period of ample liquidity; one from the peak of the 2008 crisis; and one from March 2020. As Figure 9 shows, the two distributions representing stressful market conditions differ drastically from that of the quiet period. In November 2008, there were practically no very liquid corporates, as the distribution line originates close to zero. In March 2020, there were still bonds with low LCS, yet this kind of distribution tail has not been seen since 2008. Liquidity tail risk is often overlooked in VaR models. The loss from selling a deeply distressed bond comes from not only its falling price,

but also the sharply increased cost of selling it. LCS provides an easy way to enhance a VaR model to account for liquidity tail risk.

FIGURE 9

Historical Comparisons of Cross-Sectional LCS Frequency Distribution for USD Investment Grade Credit



Source: Barclays Research

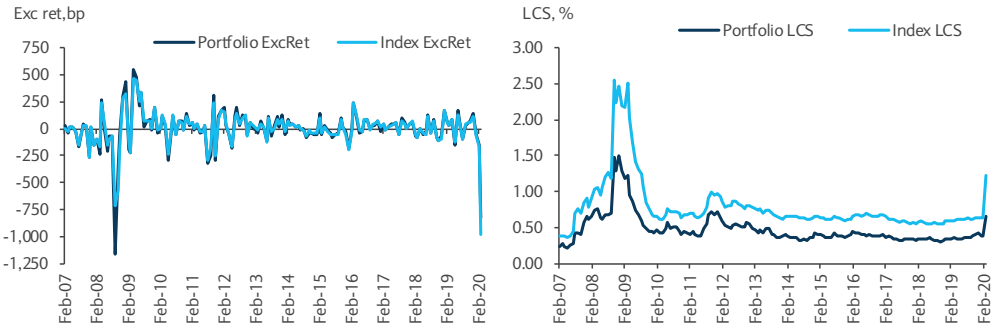
Portfolio managers often look for ways to obtain exposure to short-term beta, for reasons ranging from passive index replication to hedging out market exposure in alpha strategies. In broad markets such as USD corporates, which comprise thousands of securities, this is not a trivial task. While good tracking is the main objective, realistic implementation at a reasonable cost is vital. One of the challenges of benchmark replication with cash bonds is to determine which bonds out of hundreds of potential candidates are sufficiently liquid. By its very nature, a tracking portfolio needs to be rebalanced on a regular basis, so liquidity is especially important.

Narrowing down the market universe to a manageable set of liquid securities is necessary before applying any replication strategy, be it simple stratified sampling or a sophisticated optimisation process. A consistent, bond-level measure of liquidity allows portfolio managers to select objectively a universe of liquid bonds from which to construct benchmark-tracking portfolios (or any other, for that matter).

One example of such liquidity filtering in benchmark replication is a transparent, rules-based stratified sampling methodology that we employ to construct and maintain tracking portfolios for several widely used bond indices. One of them is a 50-bond portfolio that tracks the Bloomberg Barclays USD Credit Index (6,971 bonds as of March 2020). To construct it, the index is divided into five sectors (basic, consumer, financial, technology, and other) and five duration categories (0-3, 3-5, 5-7, 7-10, and 10+). The eligible universe is formed by selecting for each of the resulting 25 buckets the top 20% most liquid index bonds according to their LCS rank and adding to this set the lowest-LCS quintile of bonds by duration category. Fifty bonds are then selected by stratified sampling to match the contribution to DTS and the market value allocation of the index within each of the 25 sector-duration buckets.

FIGURE 10

Liquid Tracking Portfolio vs. the Bloomberg Barclays USD Investment Grade Credit Index: Excess Return Tracking and LCS Comparison, January 2007 – March 2020



Source: Barclays Research

Figure 10 shows the portfolio's historical excess return tracking, as well as the LCS comparison between the portfolio and the index. Despite consisting of only 50 bonds, the tracking has been quite accurate. Excluding the 2008 crisis period, from July 2009 through March 2020, the mean tracking error has been 0.7bp, with a tracking error volatility of 25bp, which is just 20% of the index excess return volatility of 129bp over the same period. The portfolio LCS has been lower in every month, with the average almost 40% lower than the index (0.474 vs. 0.783).

Summary

LCS, a bond-level liquidity measure comparable across bonds, asset classes, and over time, adds to bond investors' toolbox an objective and quantitative instrument that has multiple applications: portfolio liquidity monitoring and reporting; quantifying the effect of transaction costs on alpha strategies' performance; liquidity-constrained portfolio construction and optimization; introducing a liquidity factor into market risk and VaR models; and many others.

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Konstantinovsky, V., and B. Phelps, September 2014, *Corporate Liquidity across Markets*, Barclays Cross Asset Research

Konstantinovsky, V., and B. Phelps, March 2015, *Liquidity and Market Efficiency: Cash Corporates, ETFs, and CDX*, Barclays Cross Asset Research

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Konstantinovsky, V., K. Y. Ng, and B. Phelps, October 2015, *A Price Impact Measure of Corporate Bond Liquidity: PIM*, Barclays Cross Asset Research

Konstantinovsky, V., and B. Phelps, October 2015, *A Note on Daily LCS and the Recent Market Volatility*, Barclays Cross Asset Research

"Estimating Return Impact of Portfolio Redemptions," Presentation at 2016 Insurance CIO Conference, January 2016

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Konstantinovsky, V., and B. Phelps, October 2016, *Liquidity Dynamics of Newly Issued Bonds*, Barclays Cross Asset Research

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Konstantinovsky, V., K. Y. Ng, and B. Phelps, "Measuring Bond-Level Liquidity," *Journal of Portfolio Management*, Summer 2016

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