QUANTITATIVE PORTFOLIO MANAGEMENT CONFERENCE

Using LCS (Liquidity Cost Scores) in Portfolio Construction and Alpha Strategies

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Quantitative Portfolio Strategy

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BARCLAYS CAPITAL

LCS – Definition

We define a bond's liquidity as the cost of immediately transforming the bond to cash, and vice versa, for normal market trade amounts.

A bond's Liquidity Cost Score (LCS) is the cost – as a percent of the bond's price – to execute a round-turn transaction

Liquidity Cost Score (LCS)$_{i,t}$

= OASD$_{i,t}$ x (bid spread$_{i,t}$ – ask spread$_{i,t}$) **if spread quoted**

= (Offer Price$_{i,t}$ – Bid Price$_{i,t}$)/Bid Price$_{i,t}$ **if price quoted**

Example

Suppose a bond with an OASD of 5 has a trader-quoted bid spread of 40bp and an ask spread of 25bp.

Given this bid-ask spread of 15bp, the bond's LCS = 5 $\times$.15 = 0.75%.

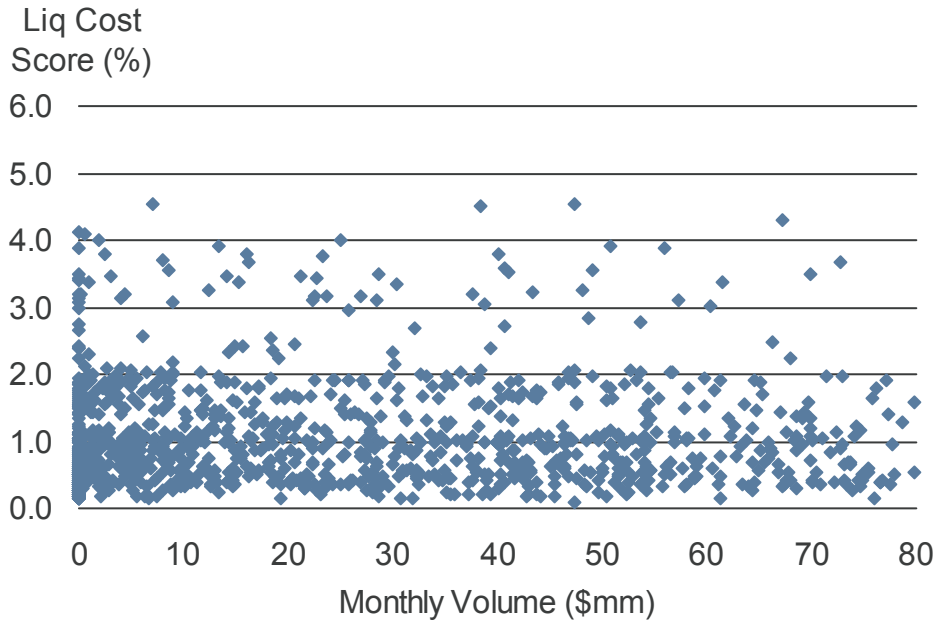
In other words, an immediate round-turn would currently cost 75bp of the bond's price.

Many thanks to Michael Ng, Vadim Konstantinovsky, Ariel Edelstein, Hans Fless, and Arne Staal for their significant contributions to LCS

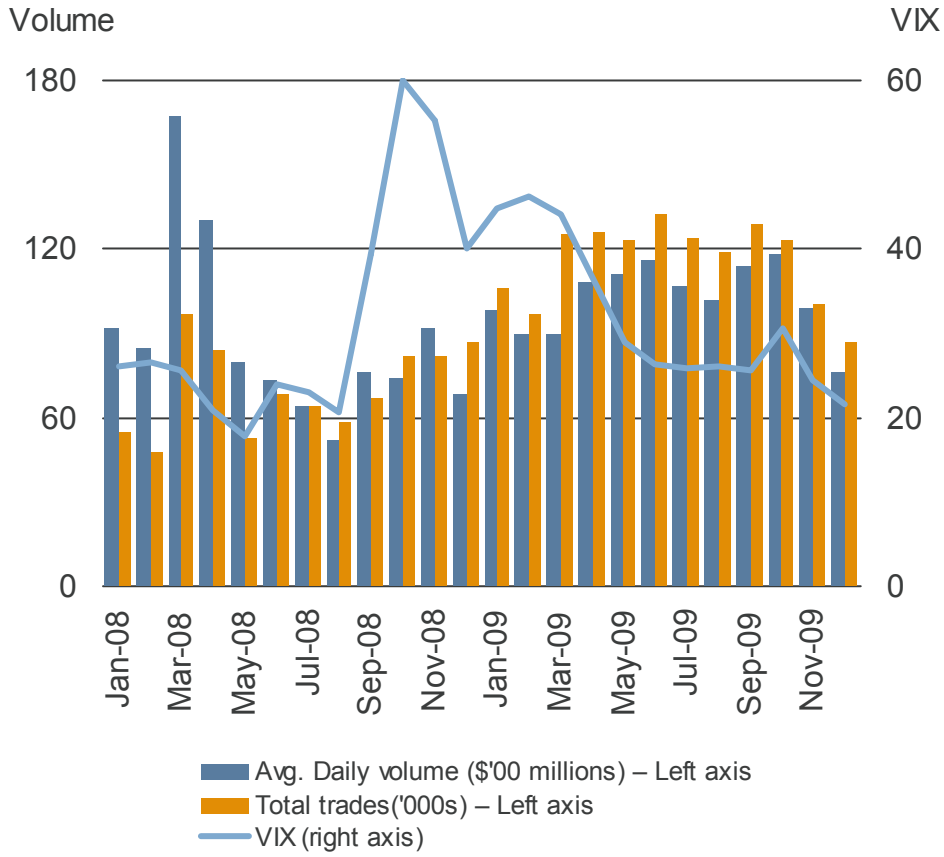
Why We Need LCS – Volume Is an Inadequate Measure of Liquidity in the Cross-Section and over Time

A closer look at trader-quoted bonds with <$80mm trading volume (80%+ of sample) shows that bonds with high trading volume can have relatively high LCS and that bonds with relatively low volume can have low LCS.

Trader-Quoted IG Bonds that Traded <$80mm in November 2009



Overall market volume can move inversely to changes in the degree of market liquidity as perceived by PMs.



Source: Barclays Capital / TRACE.

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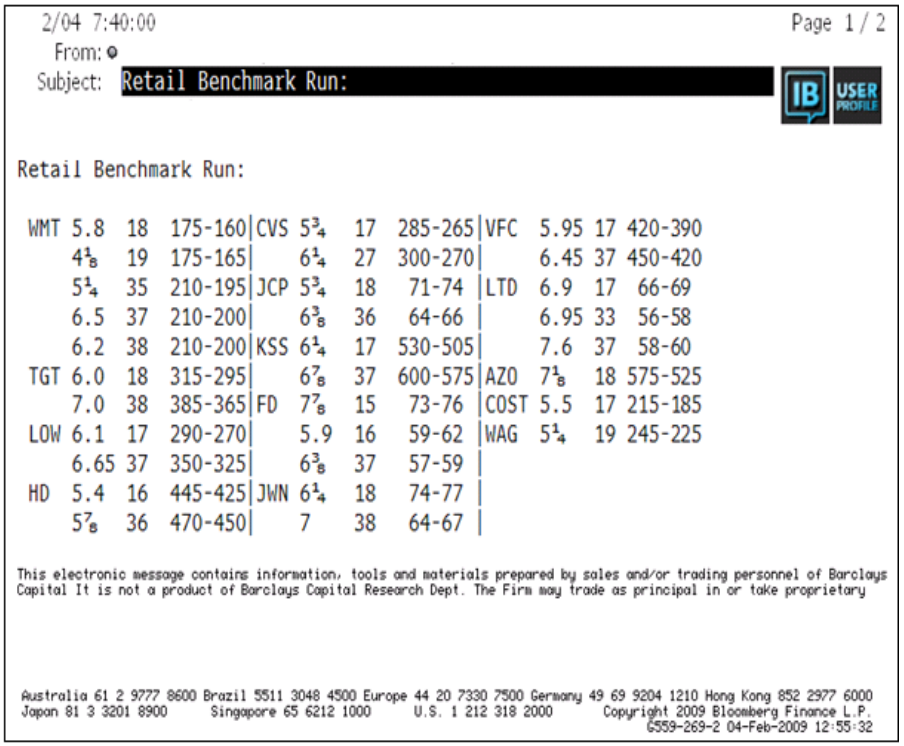
LCS Model – Broad Overview

- LCS is a *direct, objective CUSIP-level* liquidity metric based on trader bid-ask spread data obtained from trader broadcasts to clients (*via* Bloomberg), and parsed by Barclays Index Production. It is valid for roughly a $3–5mm trade size
- LCS is measured in return (%) units which makes it easy to interpret, compare and aggregate
- LCS is computed monthly for every CUSIP in the Barclays Capital IG and HY Indices
- LCS is computed directly from trader quotes for about 1/3–1/2 of index bonds, and is estimated for the remaining (i.e., bonds not quoted by traders)



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From:
Subject: Retail Benchmark Run:

Retail Benchmark Run:

WMT	5.8	18	175-160	CVS	5 3/4	17	285-265	VFC	5.95	17	420-390
	4 1/8	19	175-165		6 1/4	27	300-270		6.45	37	450-420
	5 1/4	35	210-195	JCP	5 3/4	18	71-74	LTD	6.9	17	66-69
	6.5	37	210-200		6 3/8	36	64-66		6.95	33	56-58
	6.2	38	210-200	KSS	6 1/4	17	530-505		7.6	37	58-60
TGT	6.0	18	315-295		6 7/8	37	600-575	AZO	7 1/8	18	575-525
	7.0	38	385-365	FD	7 7/8	15	73-76	COST	5.5	17	215-185
LOW	6.1	17	290-270		5.9	16	59-62	WAG	5 1/4	19	245-225
	6.65	37	350-325		6 3/8	37	57-59				
HD	5.4	16	445-425	JWN	6 1/4	18	74-77				
	5 7/8	36	470-450		7	38	64-67				

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Source: Bloomberg.

Some LCS Limitations

- LCS is not necessarily the “effective” bid-ask spread facing a PM
- LCS does not measure the bid-ask for larger trades (i.e., is there a volume “discount” or “penalty”?)
- LCS does not directly measure trade impact – what happens to a bond’s spread level after a trade?

Our LCS Modeling Ingredients

- We do not always believe trader quotes. Some are commitments to make a market, others are only *indications* and it may be difficult to execute at those quotes
- Liquidity varies by sector, subordination, size, age, risk characteristics, TRACE volume, etc.
- We believe that how often a bond has been trader-quoted over recent months is important in determining its liquidity
- Technical issues also affect liquidity. For example, seasoned bonds often become more liquid as they approach maturity ➔ Interactive term between age and original maturity

LCS Recognizes that Trader Bid-Ask *Indications* Are Not Always Bid-Ask *Markets*

- LCS assumes bid-ask indications for *high volume* and/or *"on-the-run"* bonds likely represent bid-ask markets. We call these bonds "benchmark bonds"
  - High trading volume suggests traders have comfort quoting two-way markets
  - "On-the-run" means that traders know their bid-ask indications are readily compared with those of other market makers
- Indications for other quoted bonds are more likely to be indicative quotes
  - Traders will often say

    "In theory, this is where the bond should trade, but …"

    "I haven't seen this bond in a long time, but …"

    "I won't offer the bond at that spread, but would work an order …"
  - For these quoted bonds we adjust the trader bid-ask indication to arrive at a bid-ask market quote, based on LCS dispersion. We also impose a minimum adjustment factor of 1.5

Relation of LCS to Bond Attributes: Guidance for Building an LCS Model

- LCS (from trader quotes) relates to bond characteristics as PMs would generally expect
- Bonds with higher OAS (or DTS), controlling for issue size and age, have higher LCS
- After accounting for age and OAS (or DTS), LCS is related significantly to monthly trading volume, e.g., lower trading volume, higher LCS
- *Results suggest a model for estimating LCS for non-quoted bonds*

Dependent Variable – LCS in %
Sample Period – Jan 2007–Dec 2009

Explanatory Variables	Coefficient	t-Stat
Intercept	0.0235	0.8
Age (years)	0.0392	19.6
Issue Size ($bn)	(0.1920)	(23.2)
Monthly Trading Vol. ($mm)	(0.0009)	(29.8)
DTS (year %)	0.0883	202.4
Monthly Dummies?	Yes	
Number of Observations	34,063	
Adj-Rsquared	0.66	

Source: Barclays Capital.

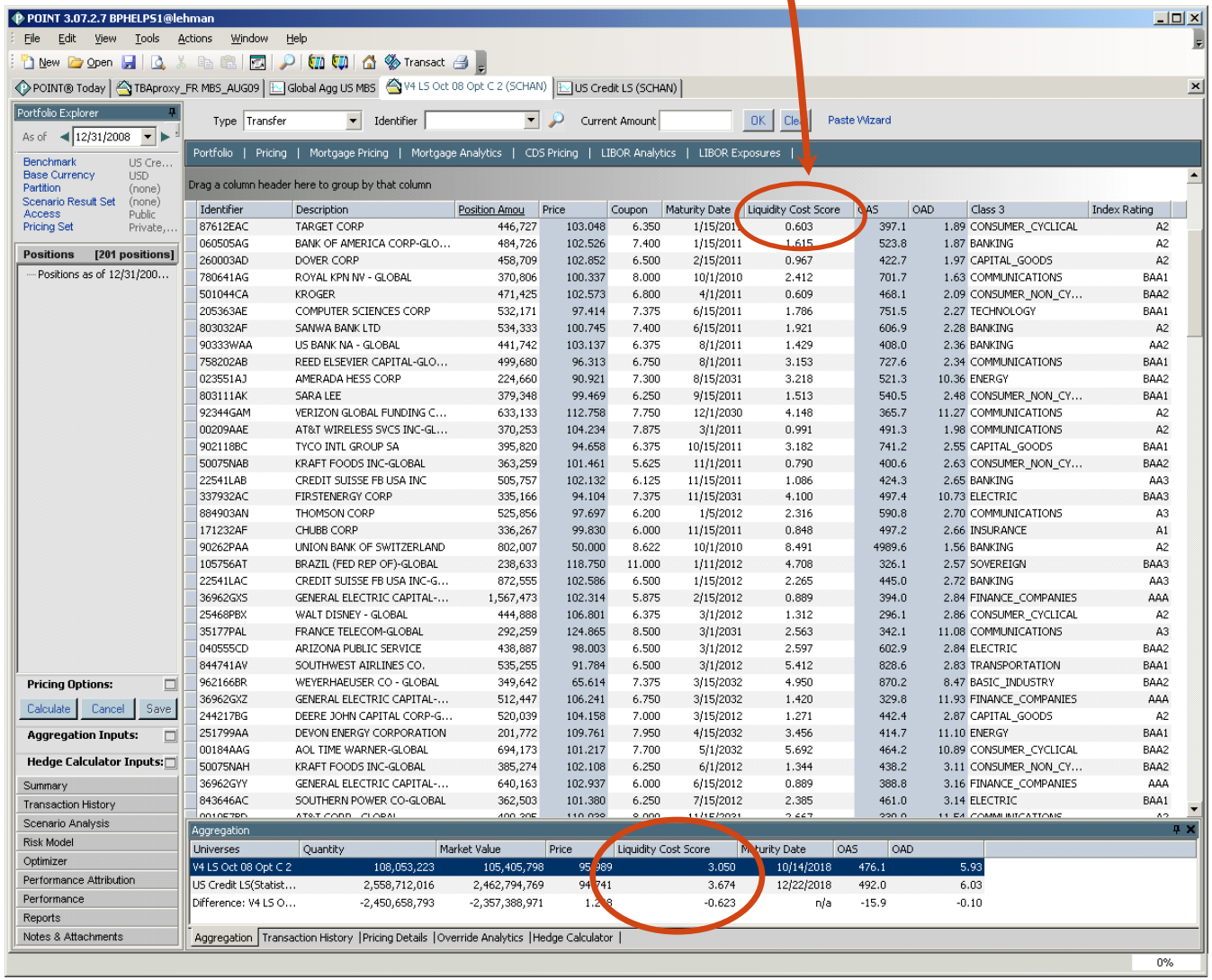
Estimating LCS for Non-Quoted Bonds

- We first use LCS values for trader-quoted bonds to estimate, using regression, the LCS for a non-quoted bond based on its observed characteristics

$$\text{Estimated LCS Non-Quoted Bond} = f\,[\text{sector; age; DTS; amount outstanding; trading volume; benchmark status; …}]$$

- This attribute-based score is adjusted, based on how often the bond was quoted in recent months

Liquidity Cost Scores (LCS[SM]) Available *via* POINT®



- Monthly LCS data since January 2007
- Can employ POINT®'s analytical tools to construct portfolios with desired LCS attributes
- LCS may also be made available through Barclays Capital Live and Time Series Plotter

Source: Barclays Capital.

LCS Example 1 – Kroger (KR)

Monthly TRACE Vol	JUN09	Amt Out	OAS	OASD	DTS	Index_P	ageinyrs	yrstored	Bid_Sp	Ask_Sp	Bid_Ask	origmat	quoted?	B/M?	LCS	implied B-A
90,880,000	501044CJ	400,000	2.43	3.5	8.4	101.9	1.3	3.9	0	0	0	5	NO	YES	1.195	35
26,401,000	501044CL	600,000	2.44	3.8	9.4	111.1	0.6	4.6	0	0	0	5	NO	YES	0.987	26
64,705,000	501044CA	478,395	2.34	1.7	3.9	105.95	8.1	1.8	0	0	0	10	NO	NO	1.151	69
42,430,000	501044CD	350,000	2.30	2.7	6.3	106.31	7.0	3.0	0	0	0	10	NO	NO	1.996	73
7,289,000	501044CG	600,000	1.97	6.3	12.4	106.34	1.9	8.2	225	210	15	10	YES	NO	1.421	23
11,481,000	501044CE	500,000	2.52	3.2	8.2	103.41	6.4	3.7	0	0	0	10	NO	NO	1.769	55
33,326,000	501044CC	500,000	2.39	2.6	6.1	107.41	7.2	2.9	0	0	0	10	NO	NO	1.321	52
3,535,000	501044CF	300,000	2.47	4.8	11.8	98.8	4.5	5.6	0	0	0	10	NO	NO	2.374	50
57,578,000	501044CH	750,000	1.67	7.6	12.7	104.5	1.5	10.6	235	220	15	12	YES	YES	1.147	15
1,600,000	501044BM	300,000	1.96	7.1	13.9	108.15	10.6	9.5	0	0	0	20	NO	NO	2.866	40
34,480,000	501044BZ	440,441	2.07	11.1	22.9	113.91	8.1	21.8	225	205	20	30	YES	NO	3.333	30
1,674,000	501044BT	281,145	2.57	10.5	26.9	109.57	10.0	20.0	0	0	0	30	NO	NO	3.960	38
2,472,000	501044BV	250,000	2.38	10.4	24.7	115.3	9.8	20.3	0	0	0	30	NO	NO	3.729	36
63,710,000	501044CK	375,000	2.15	12.6	27.2	106.3	1.3	28.9	240	220	20	30	YES	NO	3.790	30
	501044CM															

Monthly TRACE Vol	FEB10	Amt Out	OAS	OASD	DTS	Index_P	ageinyrs	yrstored	Bid_Sp	Ask_Sp	Bid_Ask	origmat	quoted?	B/M?	LCS	implied B-A
9,740,000	501044CJ	400,000	1.19	2.9	3.5	107.0	1.9	3.2	125	115	10	5	YES	NO	0.435	15
36,041,000	501044CL	600,000	1.45	3.4	5.0	115.3	1.3	4.0	92	82	10	5	YES	NO	0.517	15
69,305,000	501044CA	478,395	1.18	1.0	1.2	105.71	8.8	1.2	0	0	0	10	NO	NO	0.863	82
26,494,000	501044CD	350,000	1.11	2.2	2.4	109.10	7.7	2.4	0	0	0	10	NO	NO	0.950	44
82,394,000	501044CG	600,000	1.46	6.1	8.9	110.97	2.5	7.5	0	0	0	10	NO	YES	0.587	10
2,197,000	501044CE	500,000	1.34	2.7	3.7	107.79	7.1	3.0	0	0	0	10	NO	NO	1.109	40
14,921,000	501044CC	500,000	1.20	2.0	2.4	109.60	7.9	2.2	0	0	0	10	NO	NO	0.939	47
31,850,000	501044CF	300,000	1.25	4.4	5.5	106.2	5.2	5.0	120	110	10	10	YES	NO	0.658	15
68,975,000	501044CH	750,000	1.32	7.5	9.9	108.3	2.1	10.0	138	128	10	12	YES	YES	0.750	10
1,198,000	501044BM	300,000	1.60	6.7	10.8	111.81	11.2	8.9	0	0	0	20	NO	NO	1.666	25
94,650,000	501044BZ	440,441	1.70	10.8	18.4	116.01	8.8	21.2	150	140	10	30	YES	YES	1.068	10
0	501044BT	281,145	1.85	10.4	19.2	116.15	10.7	19.3	0	0	0	30	NO	NO	2.258	22
1,924,000	501044BV	250,000	1.86	10.2	18.9	119.6	10.4	19.6	0	0	0	30	NO	NO	2.186	21
7,900,000	501044CK	375,000	1.62	12.4	20.2	110.2	1.9	28.2	150	140	9	30	YES	NO	1.694	14
111,018,000	501044CM	500,000	1.05	5.0	5.2	101.20	0.4	5.7	130	125	11	6.0	YES	YES	0.538	11

Index_P(rice), Bid_Sp(read) and Ask_Sp(read) refers to end-of-month numbers. Bid_Ask is an average over the month.

Source: Barclays Capital.

LCS Example 2 – JC Penney (JCP)

JUN09

Monthly TRACE Vol	cusip	Amt Out	OAS	OASD	DTS	Index_P	ageinyrs	yrstored	Bid_Price	Ask_Price	origmat	quoted?	B/M?	LCS
32,250,000	708160BY	230,203	6.51	2.7	17.3	101.9	6.9	3.2			10	NO	NO	3.347
20,959,000	708130AB	300,000	4.30	6.5	28.1	86.5	2.2	8.7	88	89	11	YES	YES	1.133
49,800,000	708160BQ	285,000	5.09	5.7	29.1	97.00	12.2	7.8	98	99	20	YES	NO	1.523
8,100,000	708160BJ	200,000	5.34	5.4	28.7	95.00	12.9	7.2			20	NO	NO	4.302
8,125,000	70816FAD	200,000	5.93	5.0	29.9	90.0	13.7	6.4			20	NO	NO	4.531
43,425,000	708130AC	700,000	5.00	10.3	51.3	71.5	2.2	27.4	73.5	74.5	29	YES	YES	1.344
12,475,000	708160BE	255,000	4.53	8.5	38.3	87.00	15.6	14.5			30	NO	NO	4.814
13,475,000	708160BS	326,000	5.72	9.5	54.3	76.00	12.2	27.9			40	NO	NO	5.640
8,000,000	708160BL	500,000	6.99	8.5	59.5	68.00	12.4	87.8			100	NO	NO	6.775

FEB10

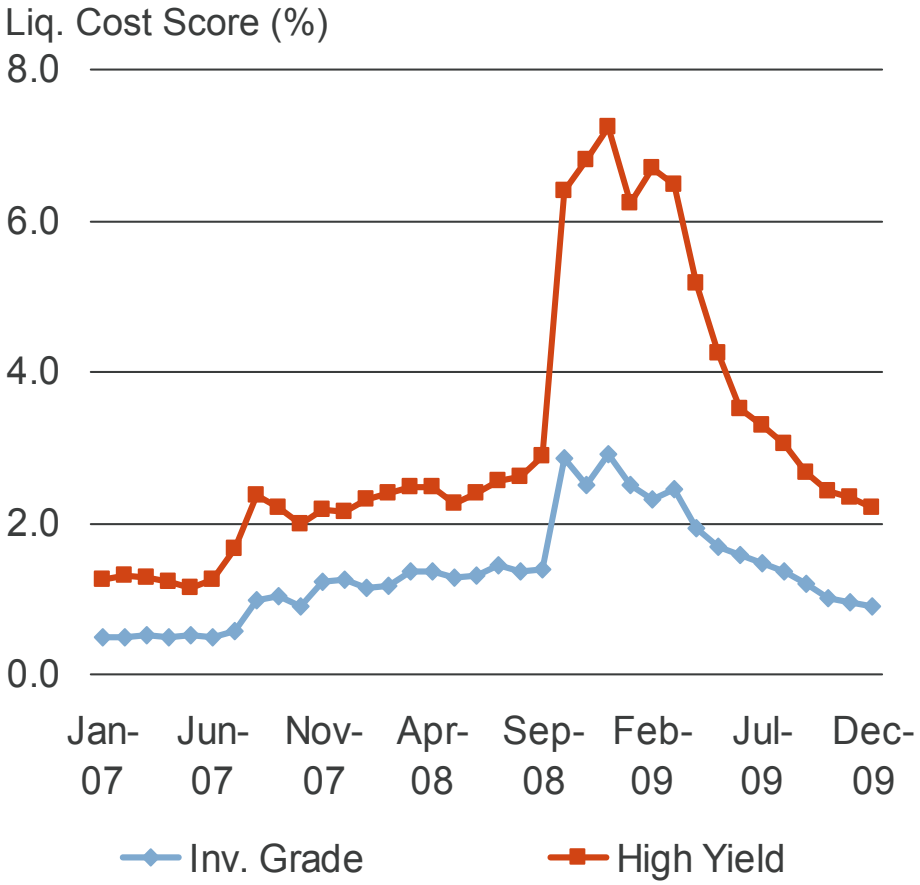
Monthly TRACE Vol	cusip	Amt Out	OAS	OASD	DTS	Index_P	ageinyrs	yrstored	Bid_Price	Ask_Price	origmat	quoted?	B/M?	LCS
8,200,000	708160BY	230,203	3.08	2.2	6.9	111.0	7.6	2.5			10	NO	NO	2.152
174,130,000	708130AB	300,000	2.66	6.4	17.1	98.3	2.8	8.0	98.25	98.75	11	YES	YES	0.967
64,475,000	708160BQ	285,000	3.28	5.4	17.8	109.00	12.9	7.2	109	110	20	YES	NO	1.336
500,000	708160BJ	200,000	3.29	5.2	17.2	107.75	13.5	6.5			20	NO	NO	3.627
28,550,000	70816FAD	200,000	3.31	4.7	15.4	104.5	14.4	5.7			20	NO	NO	3.503
57,750,000	708130AC	700,000	2.71	11.5	31.1	90.3	2.8	26.7	90	91	29	YES	NO	3.127
275,000	708160BE	255,000	3.05	8.5	26.0	99.00	16.3	13.8			30	NO	NO	4.105
22,160,000	708160BS	326,000	3.04	10.9	33.3	98.75	12.9	27.2			40	NO	YES	2.054
20,000,000	708160BL	500,000	3.91	10.9	42.8	91.00	13.0	87.1			100	NO	NO	4.671

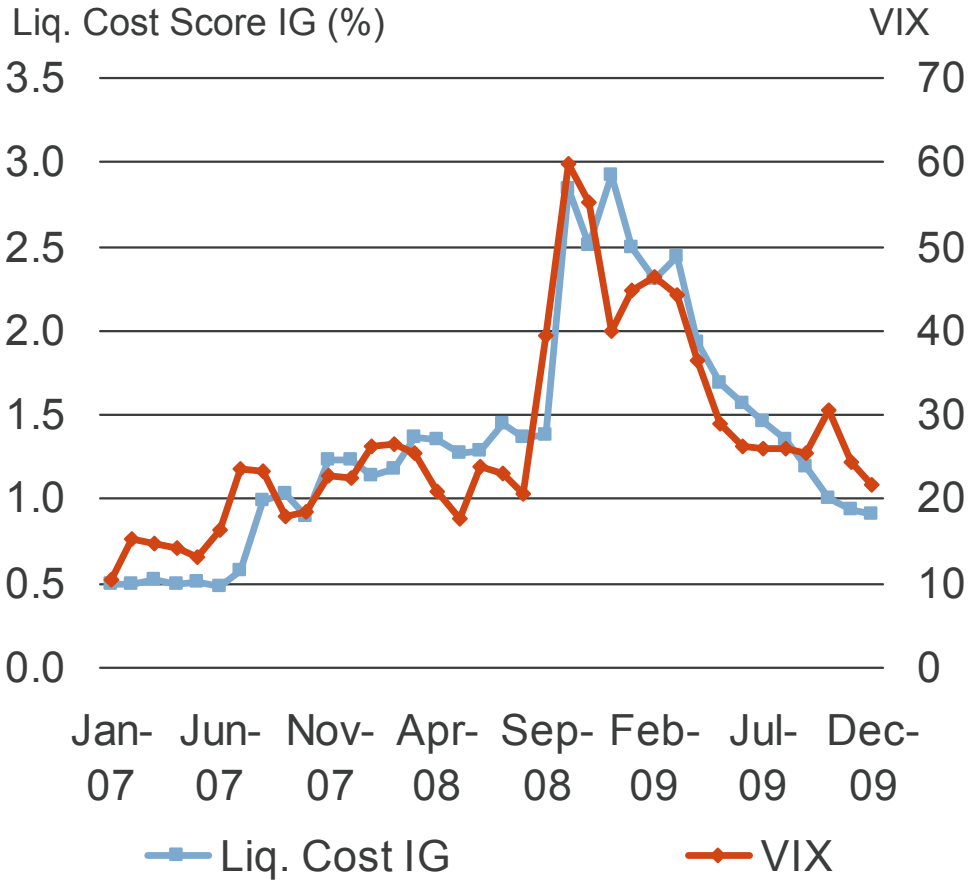
Index_P(rice), Bid_Price and Ask_Price refers to end-of-month numbers. LCS is computed using a monthly average.

Source: Barclays Capital.

Aggregate-Level LCS Shows Variability over Time

- LCS allows PMs to objectively measure and report the liquidity of their portfolio versus a benchmark and over time
- LCS is related to other indicators of market liquidity used by PMs intuitively (e.g., VIX)

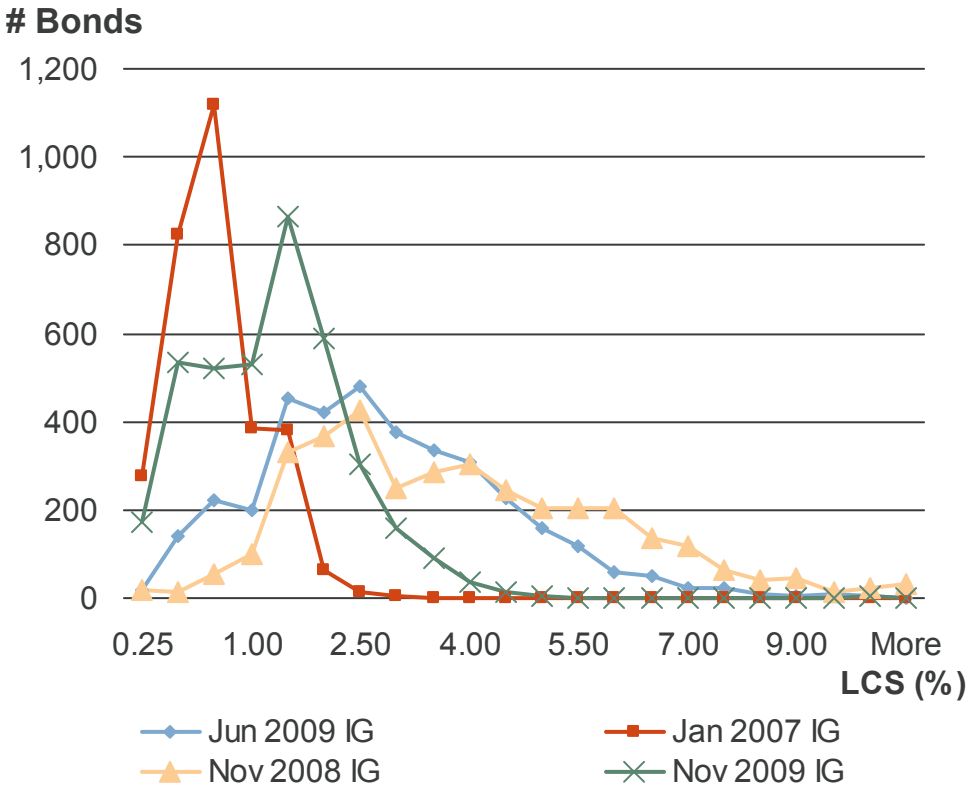




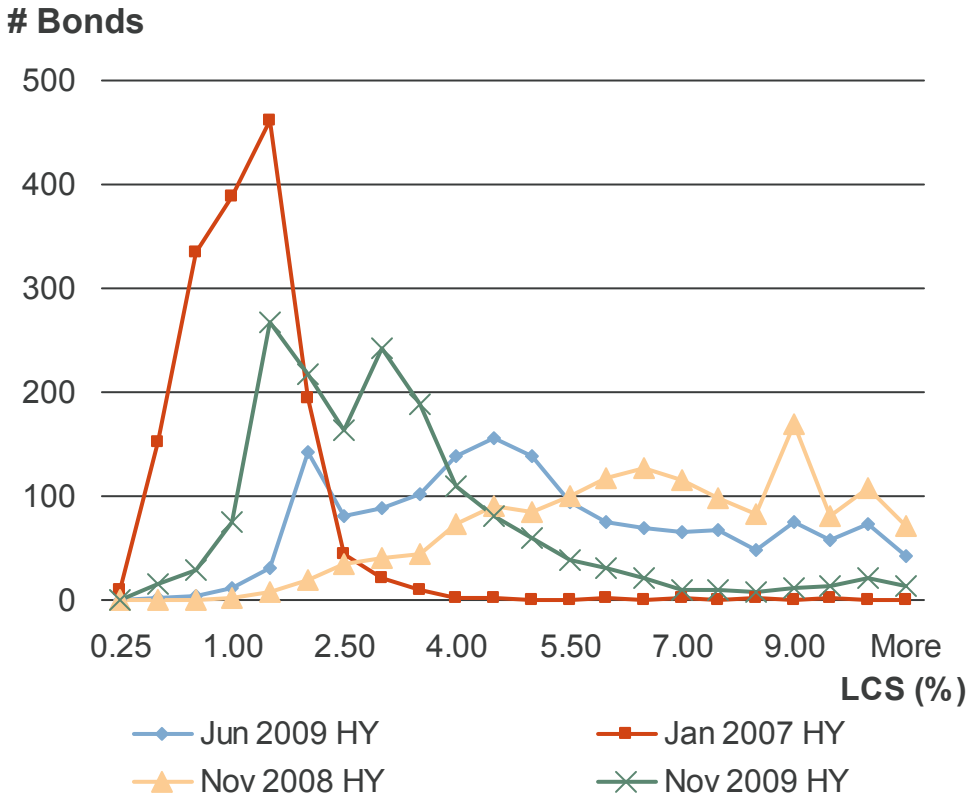
Source: Barclays Capital.

LCS Also Shows Significant Cross-Sectional Variability

Investment Grade Bonds – Liquidity Cost Freq. Distⁿ



High Yield Bonds – Liquidity Cost Freq. Distⁿ

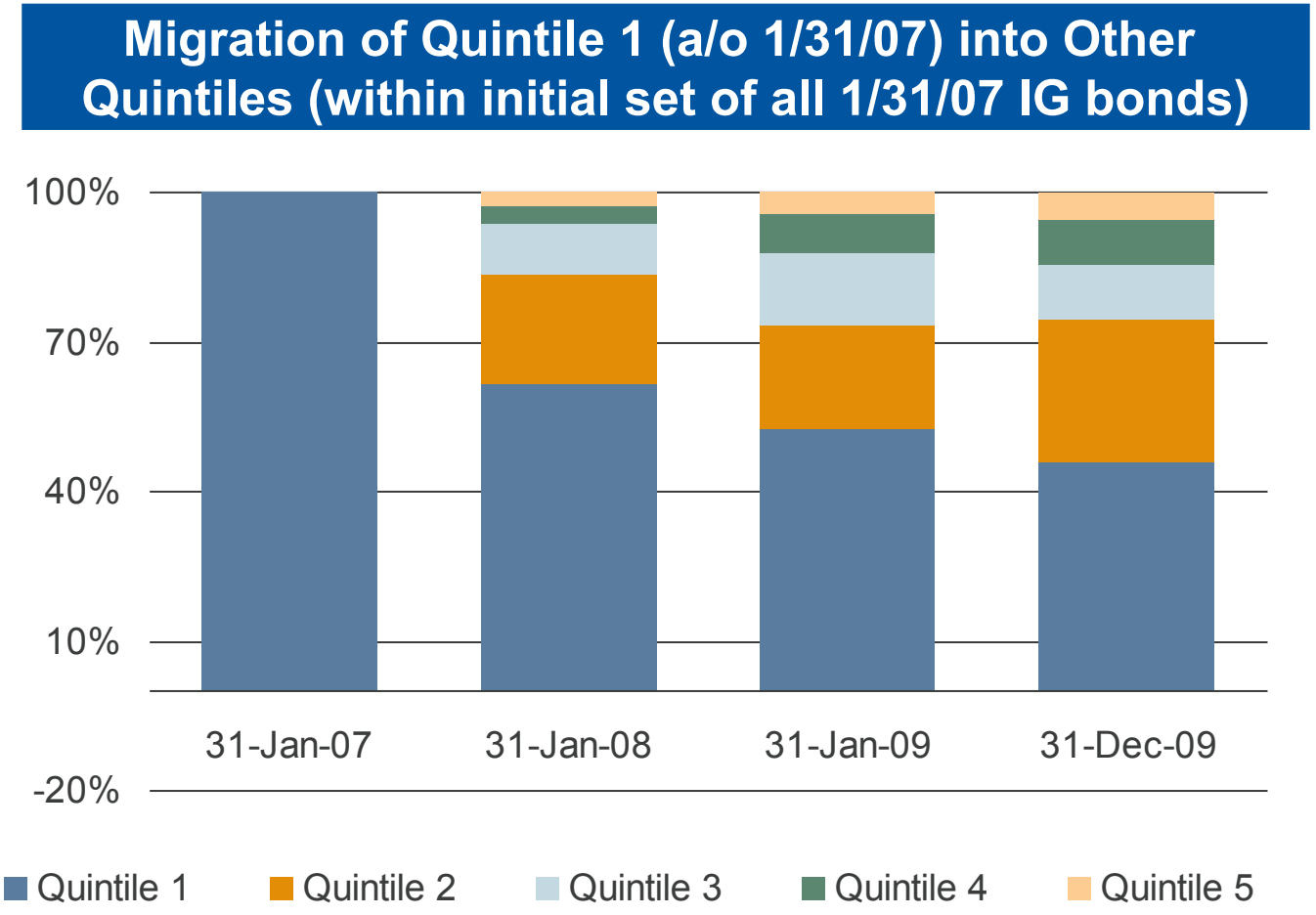


LCS displays cross-sectional variability and shows increased variability as the market became less liquid in late 2008. The LCS distribution is again becoming more concentrated.

Source: Barclays Capital.

Long-Term Persistence in LCS: Migration from Highest LCS Quintile to Other Quintiles

- From the most liquid quintile (#1), there is migration of bonds over time to other quintiles
- However, after almost *three years*, over 60% of the bonds in the top quintile of the IG Index remained in the top quintile among this set of index bonds

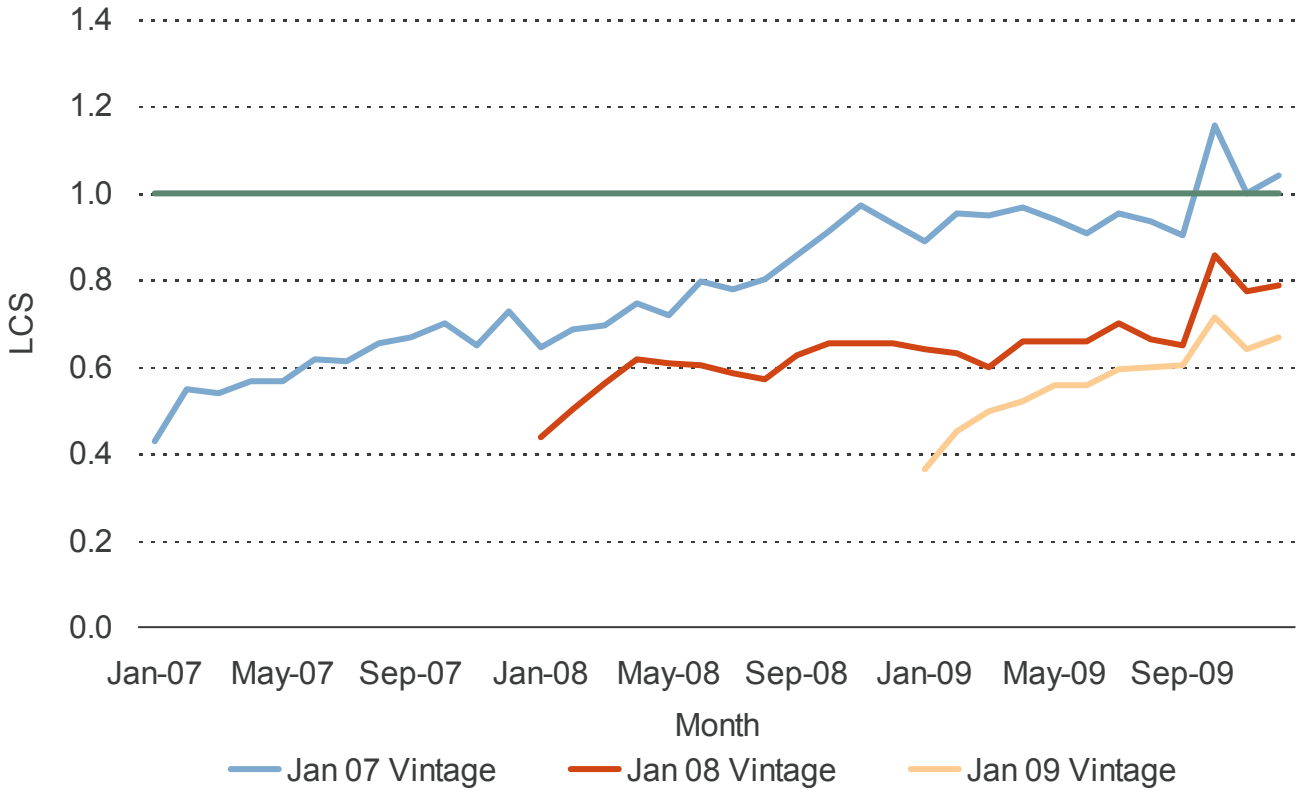


Source: Barclays Capital.

Persistence in LCS: How Long Do Highly Liquid Bonds Retain their Liquidity Edge?

- Bonds tend to become less liquid over time (versus the IG Credit Index)
- However, liquid bonds tend to remain relatively liquid for some time

Migration of Quintile 1's (various vintages) LCS Relative to IG Index's LCS over Time



Source: Barclays Capital.

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Using LCS in Portfolio Construction

Liquid Credit Baskets (TCX)

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Use LCS to Construct a Small Portfolio of Highly Liquid Bonds to Track Credit Index

- Clients seek long (and sometimes, short) exposure to the Barclays Credit Index. However,
  - Difficult to know basket of bonds to track index
  - Synthetic replication of credit indices (e.g., RBIs) has had high tracking errors
- Goal: Design a small proxy portfolio of cash bonds that will track excess returns (vs. US Treasuries) of the Barclays Capital Credit Index
  - Use relatively few bonds (e.g., 30–50)
  - MV limit per issuer
  - Use only highly liquid bonds to facilitate trading and financing
  - Composition changes over time should be minimized
  - Construction methodology must be transparent, no “black box” or “risk model”

TCX: Portfolio Design

- TCX uses objective liquidity criteria (LCS) to identify liquid bonds
  - Does not need subjective trader input
  - Selects only bonds in the top 20% of LCS in each of the five duration buckets
  - LCS values are public information on POINT (possibly Barclays Capital *Live*)
- TCX selects bonds using a stratified sampling approach
  - Can be replicated by others
  - TCX is partitioned into a 25-cell matrix; five sectors and five duration buckets ➔ 50 bonds in TCX
  - Two bonds are chosen within each cell to match market value weight and DTS (duration times spread)
  - TCX is rebalanced monthly
  - While the TCX tracks excess returns of Credit Index, a duration overlay may be required to match OAD exposure of Index, if desired

TCX Example: Portfolio Constituents (a/o February 28, 2010)

Identifier	Ticker	Description	Coupon	Mat Date	MV [%]	LCS	Identifier	Ticker	Description	Coupon	Mat Date	MV [%]	LCS
00206RAR	T	AT&T INC - GLOBAL	5.80	2/15/2019	0.50	0.50	50075NBA	KFT	KRAFT FOODS INC-GLOBAL	5.38	2/10/2020	0.90	0.32
022095AG	MO	ALTRIA GROUP INC	7.75	2/6/2014	1.15	0.35	574300HZ	MDSTRN	MARYLAND ST TRANSN AUTH TRANSN	5.89	7/1/2043	3.13	1.01
055451AH	BHP	BHP BILLITON FINANCE	6.50	4/1/2019	0.93	0.35	58013MEE	MCD	MCDONALDS CORP	5.35	3/1/2018	1.85	0.49
10138MAH	PBG	BOTTLING GROUP LLC	6.95	3/15/2014	1.66	0.18	58405UAD	MHS	MEDCO HEALTH SOLUTIONS	7.13	3/15/2018	1.47	0.60
105756AE	BRAZIL	BRAZIL (FED REP OF)-GLOBAL	10.13	5/15/2027	1.21	0.24	59023VAA	BAC	MERRILL LYNCH & CO. - GLOBAL	7.75	5/14/2038	1.97	1.13
105756BD	BRAZIL	BRAZIL (FED REP OF)-GLOBAL	10.50	7/14/2014	2.22	0.41	61747YCM	MS	MORGAN STANLEY DEAN WITTER	5.50	1/26/2020	1.32	0.40
105756BE	BRAZIL	BRAZIL (FED REP OF)-GLOBAL	8.88	10/14/2019	2.62	0.47	620076AP	MOT	MOTOROLA INC	6.50	11/15/2028	1.42	1.16
126408AP	CSX	CSX CORP	6.75	3/15/2011	1.35	0.15	65334HAG	NXYCN	NEXEN INC	6.40	5/15/2037	1.82	1.23
126650BD	CVS	CVS CORP	5.75	8/15/2011	2.20	0.14	676167AT	OKB	OESTERREICH KONTROLLBANK-GLOBA	4.75	11/8/2011	5.29	0.25
14040HAQ	COF	CAPITAL ONE FINANCIAL	5.70	9/15/2011	5.17	0.23	68233DAS	TXU	ONCOR ELECTRIC DELIVERY	6.38	5/1/2012	1.94	0.23
172967CQ	C	CITIGROUP INC-GLOBAL	5.00	9/15/2014	2.08	0.33	6832348H	ONT	ONTARIO PROV CANADA-GLOBAL	2.95	2/5/2015	4.18	0.40
172967EQ	C	CITIGROUP INC-GLOBAL	5.50	4/11/2013	2.91	0.17	70109HAH	PH	PARKER - HANNIFIN CORP	5.50	5/15/2018	2.12	0.66
20030NAZ	CMCSA	COMCAST CORPORATION	5.70	7/1/2019	0.88	0.56	803854FA	SCDA	SASKATCHEWAN PROV CANADA	8.50	7/15/2022	2.17	0.56
20825CAT	COP	CONOCOPHILLIPS	4.60	1/15/2015	2.03	0.44	806605AH	MRK	SCHERING-PLOUGH CORP	6.55	9/15/2037	2.05	0.64
233835AT	DAIGR	DAIMLERCHRYSLER NORTH AMER-GLO	7.30	1/15/2012	0.93	0.18	87425EAL	TLM	TALISMAN ENERGY	7.75	6/1/2019	1.24	0.47
260543BW	DOW	DOW CHEMICAL	7.60	5/15/2014	1.21	0.36	87927VAW	TITIM	TELECOM ITALIA CAPITAL-GLOBAL	6.18	6/18/2014	1.04	0.38
260543BZ	DOW	DOW CHEMICAL	4.85	8/15/2012	1.42	0.23	883203BL	TXT	TEXTRON INC	5.60	12/1/2017	1.60	0.63
337932AC	FE	FIRSTENERGY CORP	7.38	11/15/2031	2.73	1.06	88732JAS	TWC	TIME WARNER CABLE INC	8.25	4/1/2019	1.18	0.55
35177PAS	FRTEL	FRANCE TELECOM-GLOBAL	4.38	7/8/2014	1.42	0.40	913017BS	UTX	UNITED TECHNOLOGIES	5.70	4/15/2040	2.01	1.00
36962G3H	GE	GENERAL ELECTRIC CAPITAL-GLOBA	5.63	9/15/2017	4.74	0.51	92344GAM	VZ	VERIZON GLOBAL FUNDING CORP-GL	7.75	12/1/2030	2.08	0.78
38143UAB	GS	GOLDMAN SACHS GROUP-GLOBAL	5.15	1/15/2014	4.49	0.27	92857WAR	VOD	VODAFONE GROUP PLC-GLOBAL	5.35	2/27/2012	1.36	0.19
40414LAA	HCP	HCP INC	6.70	1/30/2018	3.48	0.64	931422AE	WAG	WALGREEN CO	5.25	1/15/2019	0.65	0.36
4042Q1AD	HSBC	HSBC BANK USA-GLOBAL	7.00	1/15/2039	2.04	1.03	961214BK	WSTP	WESTPAC BANKING CORP	4.88	11/19/2019	0.50	0.38
428236AS	HPQ	HEWLETT PACKARD CO-GLOBAL	5.50	3/1/2018	1.47	0.64	984121BS	XRX	XEROX CORP	5.50	5/15/2012	1.28	0.21
471060AQ	JFM	JAPAN FINANCE CORP 4 MUNI ENT.	5.00	5/16/2017	2.81	0.31	988498AD	YUM	YUM! BRANDS INC	6.88	11/15/2037	1.76	0.62
									Liquid 50-bond Credit Proxy				**0.50**
									US IG Credit Index				**0.88**

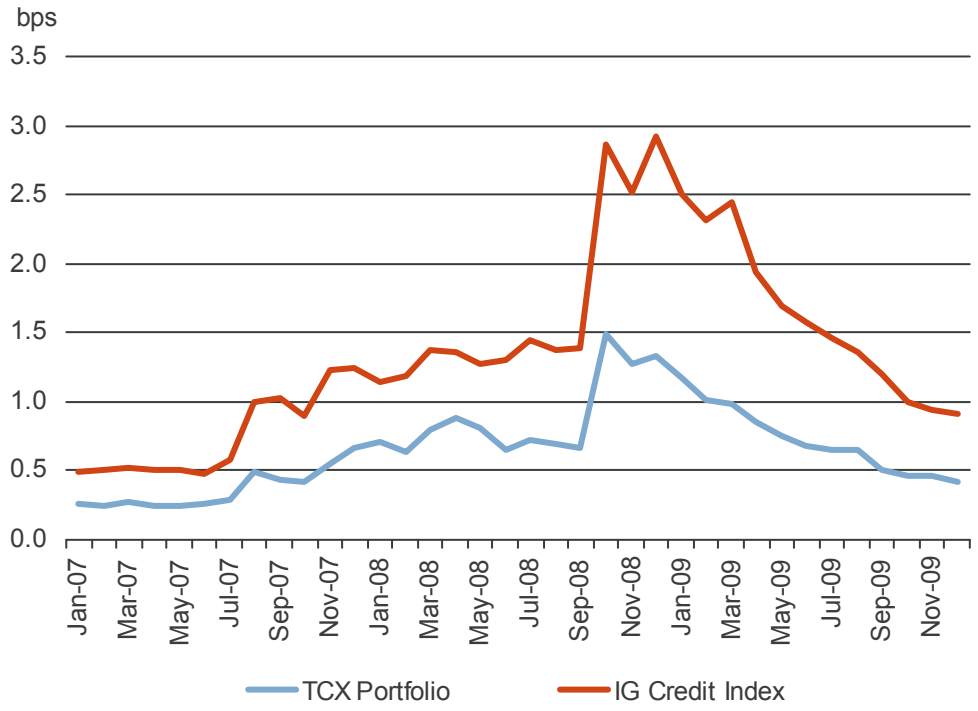
Source: Barclays Capital.

Comparison of TCX and IG Credit Index: LCS and Yield

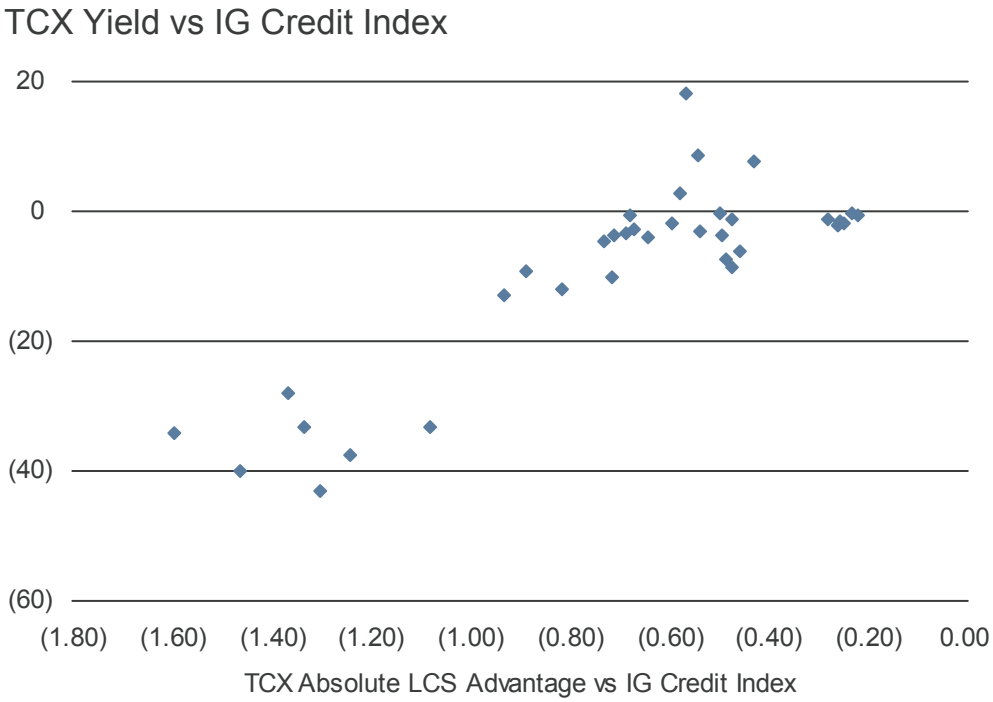
TCX maintains a significant LCS advantage over the IG Credit Index.

As TCX's LCS advantage increases, it suffers a yield give-up versus the IG Credit Index.

LCS: TCX and IG Credit Index



TCX Yield Give-Up vs. LCS Advantage (versus IG Credit Index)



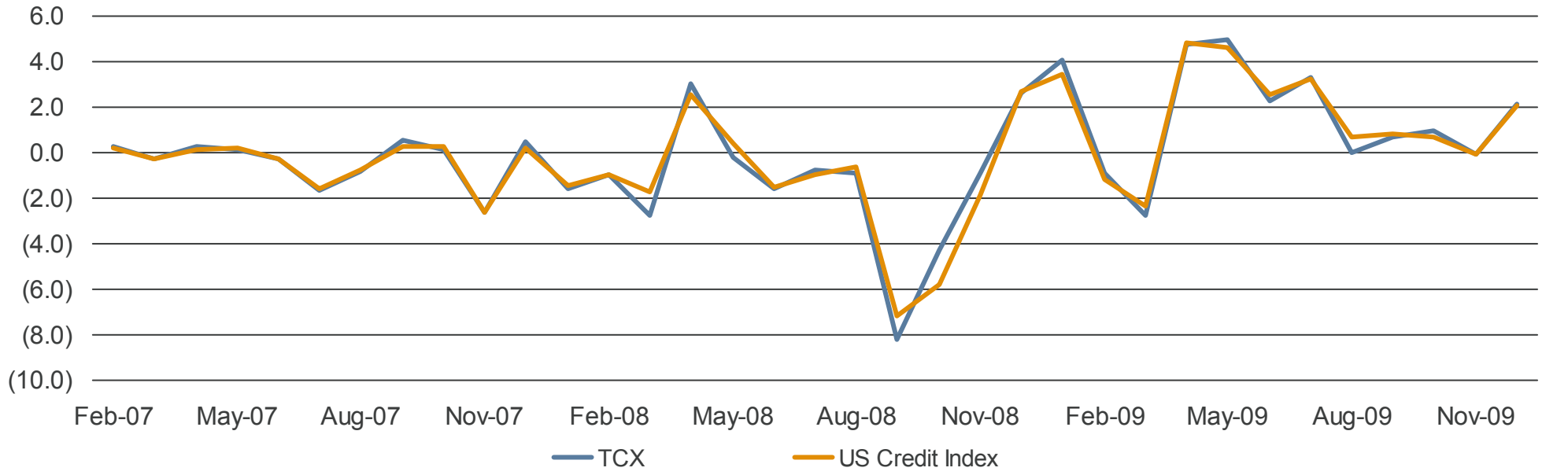
Source: Barclays Capital.

Comparison of TCX and IG Credit Index: Excess Returns

	Mean Monthly TE	Volatility (TEV)
Feb 07–July 08	(5.4 bp)	0.34%
Aug 08–Dec 09	7.1 bp	0.61%
Feb 07–Dec 09	**0.7 bp**	**0.48%**

- From Feb 07 through Dec 09, the TCX had mean excess return tracking error of just 0.7bp
- Even as the credit crisis unfolded, the TCX continued to track the US Credit Index excess returns well on average, albeit with slightly higher volatility

Excess Returns (%)



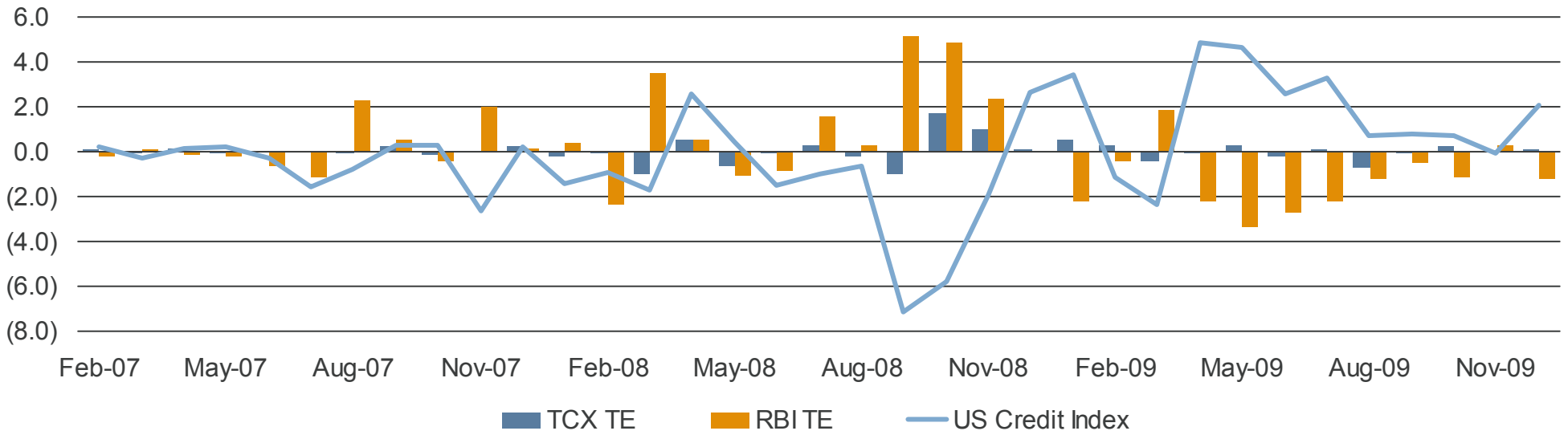
Source: Barclays Capital.

TCX vs. Credit Index RBI: Comparative Performance

	Mean		Volatility (TEV)	
	TCX	RBI	TCX	RBI
Feb 07–July 08	(5.8 bp)	21.4 bp	0.34%	1.40%
Aug 08–Dec 09	8.6 bp	(13.8 bp)	0.61%	2.46%
Feb 07–Dec 09	**1.2 bp**	**4.3 bp**	**0.49%**	**1.96%**

- Overall, the TCX tracked the US Credit Index much more closely than the RBI, with lower volatility
- RBI outperforms Credit Index when the latter does poorly, and *vice versa*. May be undesirable for clients looking for credit exposure

Realized Tracking Error vs. the US Credit Index (%)



Source: Barclays Capital.

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Using LCS in Alpha Strategies

Decomposing Cash Credit Spreads into Expected Loss and Liquidity Cost

- For a given month, we can fit a cross-sectional model

$$OAS_i = f(Expected\ Loss_i, Liquidity_i) + \varepsilon_i$$
$$= f(CDS_i, LCS_i) + \varepsilon_i$$

- This will give us a sense of the relative role of credit and liquidity-related variables in pricing bonds in the cross section
- We use **CDS Spreads** as a measure of market perception of expected default loss
  - Universe restricted to IG tickers whose 5y CDS are included in the CDX
  - Use only bonds with trader-quoted LCS
  - Pick only one bond per ticker, closest to 5y point
  - Ignore cross-sectional variation in liquidity across different CDS

Relative Effect of Default and Liquidity on OAS (using CDS as measure of ex. loss from default)

OAS vs Default and Liquidity Proxy (April 2009- December 2009) - IG Bonds *(t-stats in italics)*								
For both regs		Reg 1 - only Default			Reg 2 - Default and Liquidity			
Month	# obs	Intercept	CDS Sprd	R-sq	Intercept	CDS Sprd	LCS	R-sq
Apr-09	60	3.9 *6.8*	0.007 *6.4*	0.41	1.6 *3.3*	0.005 *5.7*	1.1 *8.5*	0.74
May-09	50	2.7 *6.6*	0.008 *6.8*	0.49	1.5 *4.3*	0.005 *5.9*	0.9 *6.8*	0.74
Jun-09	49	2.2 *5.1*	0.009 *5.6*	0.40	1.6 *3.9*	0.005 *3.4*	0.7 *4.7*	0.59
Jul-09	40	2.1 *4.8*	0.009 *5.7*	0.46	1.4 *3.3*	0.007 *4.2*	0.6 *3.5*	0.59
Aug-09	50	1.7 *4.2*	0.009 *4.5*	0.30	0.9 *2.2*	0.007 *4.0*	0.8 *4.2*	0.49
Sep-09	72	1.3 *5.7*	0.009 *6.1*	0.35	0.7 *3.1*	0.008 *6.1*	0.7 *5.0*	0.52
Oct-09	75	1.3 *7.4*	0.007 *7.3*	0.43	0.7 *4.0*	0.006 *7.5*	0.7 *5.6*	0.60
Nov-09	73	1.3 *5.2*	0.008 *4.8*	0.25	0.4 *1.5*	0.006 *4.9*	1.3 *7.1*	0.56
Dec-09	54	1.1 *3.8*	0.009 *3.6*	0.20	-0.3 *-1.8*	0.006 *4.8*	2.4 *12.9*	0.81
Jan-10	73	1.0 *4.2*	0.008 *4.5*	0.22	-0.3 *-1.5*	0.007 *5.5*	1.9 *8.8*	0.63
Feb-10	67	0.8 *3.4*	0.009 *5.2*	0.29	-0.1 *-0.4*	0.0 *4.1*	1.7 *8.0*	0.65

For April 2009, IG sample average OAS was 5.72(%), average LCS was 2.73(%) and average CDS was 252bp for this sample.

So, using Regression 2 for April 09 with the mean values: $2.73 \times 1.1 + 0.005 \times 252 + 1.6 = 5.72$.

Source: Barclays Capital.

Alternative Measures of Expected Loss from Default: CDP and CRR

- Corporate Default Probability (CDP)[1] and Conditional Recovery Rate (CRR)[2] can together be used as measure of expected loss
  - ✓ CDP – incorporates firm-specific market and fundamental information as well as the economic environment to come up with 1y corporate default probabilities (CDP = 0.2 implies a 20% probability of default in one year)
  - ✓ CRR – predicts recovery rates on corporate debt instrument, driven by the seniority, industry and economic environment. (CRR = 0.4 implies a 40% recovery rate)
  - ✓ Expected loss from default = CDP $\times$ (1-CRR)

1. *Asvanunt, A. and A. Staal (2009), "The Corporate Default Probability model in the Barclays Capital POINT platform (POINT CDP)", Portfolio Modeling, Barclays Capital, April 2009.*
2. *Asvanunt, A. and A. Staal (2009), "The POINT Conditional Recovery Rate (CRR) Model", Portfolio Modeling, Barclays Capital, August 2009.*

Relative Effect of Default and Liquidity on OAS (using CDP × (1-CRR))

Many more tickers have CDP values than liquid CDS Spreads, producing a larger sample size.

LCS plays an even more significant part here because the CDS sample is probably more liquid than this sample. Note the significant improvement in R^2 on inclusion of LCS.

OAS vs Default and Liquidity Proxy (April 2009- December 2009) - IG bonds *(t-stats in italics)*								
For both regs		Reg 1 - only Default			Reg 2 - Default and Liquidity			
Month	# obs	Intercept	CDP*(1-RR)	R-sq	Intercept	CDP*(1-RR)	LCS	R-sq
Apr-09	83	3.8 *13.4*	117.8 *4.3*	0.19	2.2 *8.4*	62.8 *3.2*	0.8 *9.3*	0.61
May-09	110	4.2 *12.5*	95.4 *3.7*	0.11	1.8 *6.5*	26.8 *1.6*	1.2 *13.5*	0.67
Jun-09	113	4.0 *12.0*	94.2 *3.1*	0.08	1.6 *6.5*	27.5 *1.5*	1.3 *15.0*	0.70
Jul-09	85	3.7 *9.7*	115.3 *3.7*	0.14	1.5 *4.5*	44.2 *1.9*	1.2 *9.7*	0.60
Aug-09	105	3.2 *10.4*	86.1 *3.0*	0.08	1.0 *3.8*	25.2 *1.3*	1.6 *12.0*	0.62
Sep-09	133	2.4 *11.7*	114.7 *4.5*	0.13	0.9 *4.4*	52.7 *2.8*	1.4 *11.6*	0.57
Oct-09	136	2.2 *14.3*	87.8 *4.8*	0.15	0.9 *6.3*	45.2 *3.5*	1.3 *12.4*	0.61
Nov-09	139	2.2 *12.7*	102.1 *4.6*	0.13	0.7 *4.7*	54.0 *4.0*	1.7 *15.9*	0.70
Dec-09	123	1.9 *10.3*	136.4 *4.6*	0.15	0.6 *4.4*	53.1 *3.2*	1.6 *17.6*	0.76
Jan-10	164	1.8 *13.4*	111.0 *4.9*	0.13	0.3 *1.9*	59.4 *4.1*	1.9 *15.7*	0.66
Feb-10	167	1.8 *14.2*	111.0 *5.7*	0.16	0.4 *4.0*	73.1 *4.6*	1.7 *17.7*	0.71

For this sample in Apr 09, Avg. OAS = 4.29 (%), Avg. LCS = 2.21 (%), Avg. CDP = 0.006 (i.e., 0.6%), Avg. CRR = 0.288 (i.e., 28.8%), Avg. (CDP × (1-CRR)) = 0.0043.

So using Regression 2 with the April 09 mean values: 4.29 = 2.2 + 62.8 × 0.0043 + 0.8 × 2.21.

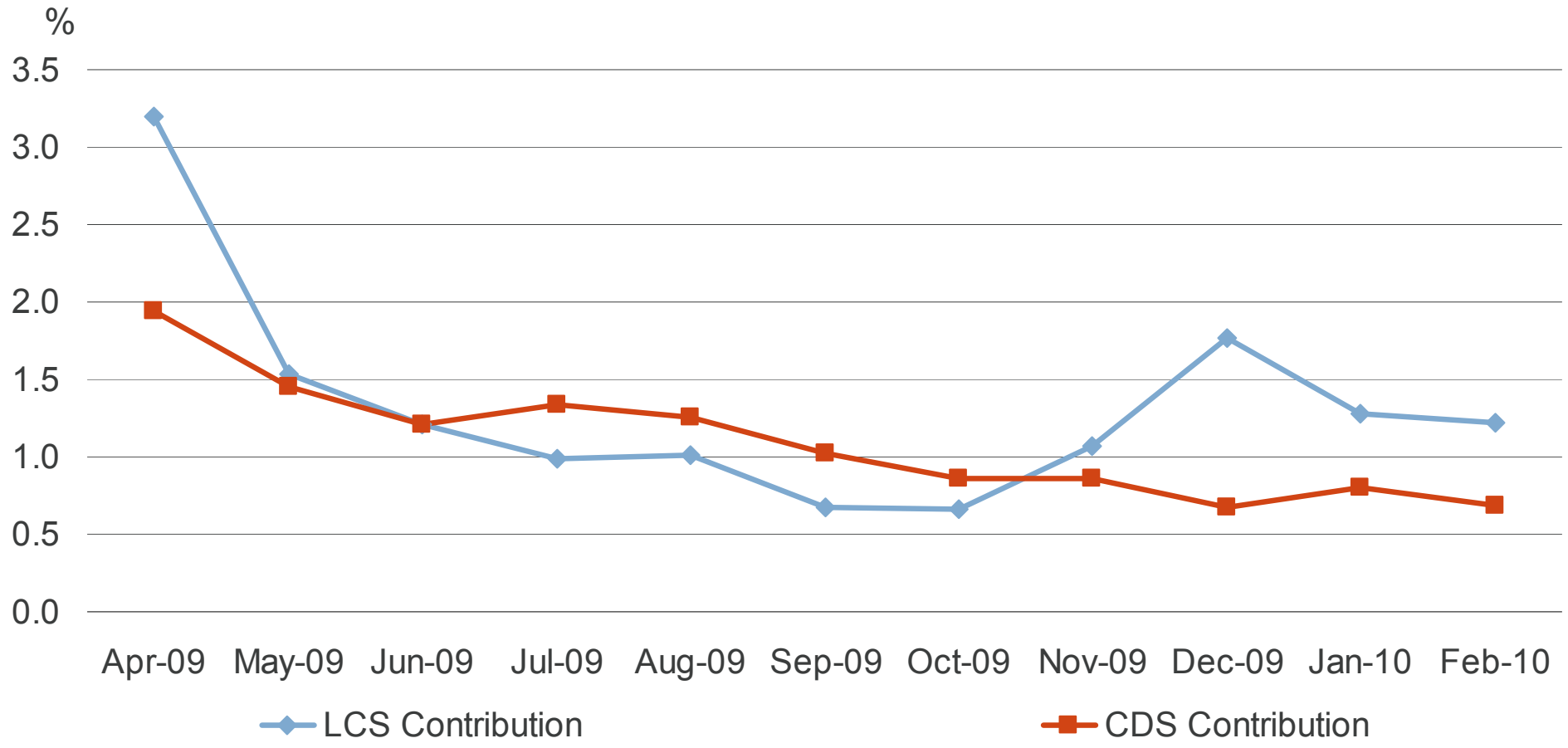
Source: Barclays Capital.

Relative Effect of Default and Liquidity on Spread

- LCS results in significant model improvement in every month
- Similar results are obtained in robustness tests using
  - ✓ High-yield bonds
  - ✓ Other maturities

Contribution of Expected Default Loss and Liquidity Cost to Cash Spreads

Expected Default (LGD) and Liquidity Contributions to OAS in IG Bonds



Source: Barclays Capital.

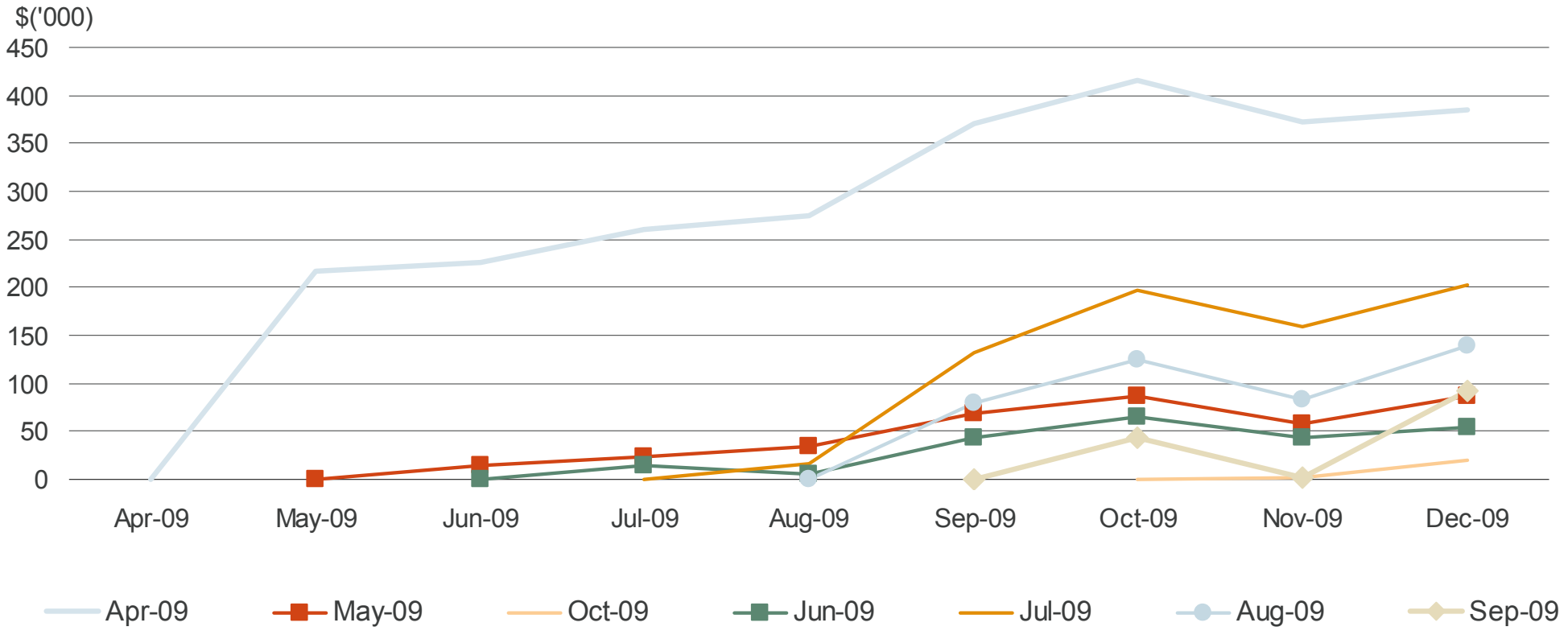
Note: Based on a regression of OAS on LCS and CDS Spreads, using multiple bonds per ticker.

Using LCS in a Naïve Alpha Strategy

- Go long bonds with large positive residuals (observed OAS is “too high”) and short bonds with large negative residuals (observed OAS is “too low”)
  - As with any trading strategy, we restrict our universe to liquid tradable bonds, based on LCS. Here, we use the LCS values between 10th and 90th percentile of the restricted universe
  - Portfolio Construction
    - Bonds with residuals larger than 1-standard deviation (of residuals) chosen (nine bonds for April 2009)
    - Among these bonds, go long (five) bonds with positive residuals, and short (four) bonds with negative residuals
    - Total risk capital: $1mm short and $1mm long, equally distributed across these bonds on each side of the market

Performance of Naïve LCS Alpha Strategy

Alpha Strategy Portfolio Value over Time (USD1mm short + USD1mm long)



Naïve alpha strategy yields positive returns across different holding periods and inception dates

Source: Barclays Capital.

Other Potential Uses for LCS℠

- Margin Setting: Incorporating LCS in Prime Brokerage
- Risk Management: Monitor liquidity levels, provide liquidity budgets to managers; liquidity-enhanced VaR
- Transition Management: Estimate transaction costs because of portfolio restructuring
- Investor Reporting: Indicating liquidity levels of portfolios

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