Developments in credit market liquidity
SEC FIMSAC Meeting
Jan 11, 2018

Sonali Theisen, Global Head of Market Structure & Data Strategy
Citi Global Credit & Securitized Markets
Agenda

Credit as a principal market

Liquidity in credit – macro themes

Liquidity in credit – microstructure

Market structure considerations
Trading in credit versus equities

Many more bonds than stocks
Composition of major equity indices

<table>
<thead>
<tr>
<th></th>
<th>Unique securities*</th>
<th>Market cap/Outstanding ($Tn)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S&amp;P 500</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equities</td>
<td>500</td>
<td>23.48</td>
</tr>
<tr>
<td>Bonds</td>
<td>11,990</td>
<td>4.35</td>
</tr>
<tr>
<td><strong>Russell 1000</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equities</td>
<td>1,000</td>
<td>26.58</td>
</tr>
<tr>
<td>Bonds</td>
<td>13,083</td>
<td>4.75</td>
</tr>
<tr>
<td><strong>Deutsche Börse</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equities</td>
<td>30</td>
<td>1.43</td>
</tr>
<tr>
<td>Bonds</td>
<td>5,559</td>
<td>0.73</td>
</tr>
<tr>
<td><strong>Euro Stoxx 50</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equities</td>
<td>50</td>
<td>3.47</td>
</tr>
<tr>
<td>Bonds</td>
<td>8,173</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Bonds trade less often…
Average # trades per day

<table>
<thead>
<tr>
<th></th>
<th>Liquid S&amp;P stocks</th>
<th>Liquid IG bonds</th>
<th>Liquid HY bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S&amp;P 500</strong></td>
<td>60,430</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td><strong>Russell 1000</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deutsche Börse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Euro Stoxx 50</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

…but in larger sizes
Average trade size, $

<table>
<thead>
<tr>
<th></th>
<th>Liquid S&amp;P stocks</th>
<th>Liquid IG bonds</th>
<th>Liquid HY bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>S&amp;P 500</strong></td>
<td>1,736,152</td>
<td>1,658,587</td>
<td></td>
</tr>
<tr>
<td><strong>Russell 1000</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deutsche Börse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Euro Stoxx 50</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Bloomberg, Dec 2017. *Bond unique securities equals total count of instruments per corporate in relevant equity index.


Relative to equities, few trades are spread out across many corporate bonds
## Ingredients for principal versus agency-driven markets

<table>
<thead>
<tr>
<th>Principal – Credit</th>
<th>Agency – Equities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Typically non-standardized products</td>
<td>1. Typically standardized products</td>
</tr>
<tr>
<td>2. Larger average ticket sizes; less retail involvement due to instrument</td>
<td>2. Smaller average ticket sizes; strong retail involvement due to simplicity of</td>
</tr>
<tr>
<td>features</td>
<td>instruments</td>
</tr>
<tr>
<td>3. No easy borrow, particularly on small size</td>
<td>3. Easy borrow facilitates two-way flow</td>
</tr>
<tr>
<td>4. Algorithmic trades not a major source of volume</td>
<td>4. Algorithms promote ticket proliferation</td>
</tr>
<tr>
<td>5. Sustained two-way flow unlikely without market-makers to commit discretionary</td>
<td>5. Sustained two-way flow likely without market-makers to commit discretionary</td>
</tr>
<tr>
<td>capital</td>
<td>capital</td>
</tr>
<tr>
<td>6. Liquidity takers less willing/able to manage their own execution risk; rely</td>
<td>6. Liquidity takers more willing/able to manage their own execution risk by</td>
</tr>
<tr>
<td>on discretionary capital to warehouse or move risk</td>
<td>breaking trades into smaller lots in firm orders</td>
</tr>
<tr>
<td>7. Counterparty identity more important due to lack of active daily trading in</td>
<td>7. Counterparty identity less important due to depth of liquidity</td>
</tr>
<tr>
<td>most instruments</td>
<td></td>
</tr>
<tr>
<td>8. Predominantly negotiated market</td>
<td>8. Firm, disparate liquidity on same instrument across multiple venues</td>
</tr>
</tbody>
</table>

Credit has traditionally relied on warehousers of risk
Agenda

Credit as a principal market

Liquidity in credit – macro themes

Liquidity in credit – microstructure

Market structure considerations
What do we mean by liquidity?

As noted, 'liquidity' in the sense of "trading liquidity" reflects the ability to transact quickly without exerting a material effect on prices. Liquidity is optimally achieved when myriad buyers and sellers are ready and willing to trade. The trading is enhanced by market-makers and speculators alike. Underlying this concept is that while buyers and sellers have different views on the most likely outcomes—that is, after all what generates trading—they largely can agree on the distributions of possible outcomes for which they demand risk-based compensation.

Consider liquidity, then, in terms of investor confidence. Liquidity exists when investors are confident in their ability to transact and where risks are quantifiable. Moreover, liquidity exists when investors are creditworthy. When considered in terms of confidence, liquidity conditions can be assessed through the risk premiums on financial assets and the magnitude of capital flows. In general, high liquidity is generally accompanied by low risk premiums. Investors' confidence in risk measures is greater when the perceived quantity and variance of risks are low.

But it is impossible to define optimal targets.
Cumulative impact of regulation and policy is difficult to isolate

Buyside
- Mutual fund concentration
- SFAS 158
- Mark-to-market accounting
- SEC MMkt Reform
- Solvency 2

Sellsie
- G-SIFI
- TRACE
- Dodd-Frank
- SEF
- Basel / capital rules

Monetary policy
- Volcker
- MiFID II
- QE
- Negative interest rates
- Reaching for yield

Liquidity

But the outcome is reduced buffers and a loss of heterogeneity
Market diversity has fallen significantly

Ownership base may seem diverse…
US corporate bond outstandings by owner, % total

…but 80% of buying is funds and foreigners
US corporate bond net buying, 4Q sum, $bn

The buyer base has become more homogenous
Decline in dealer inventory

Balance sheet: contraction or correction?
Street holdings of credit*, $Bn

After a decade of deleveraging, street inventory is similar to early 2000s

Source: Federal Reserve.
*Inventory numbers also include RMBS/ABS, which were likely much larger in 06-07.
Issuance, volumes and bid-offer continue to improve

Traded volumes up with issuance
US IG gross issuance vs secondary trading (6m sum, $bn)

Bid-offer spreads are tight
Average bid-offer spread in IG cash (bp)

Market is near highs in new issue supply and traded volumes and near lows in bid-offer spread
Capital rules may be impacting risk transformation

The role of market-maker
Absorbs supply and demand imbalances by transforming risk

<table>
<thead>
<tr>
<th>Risk transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curve risk</td>
</tr>
<tr>
<td>(e.g. curve steepeners)</td>
</tr>
<tr>
<td>Liquidity</td>
</tr>
<tr>
<td>(e.g. off-the-run vs. on-the-run)</td>
</tr>
<tr>
<td>Instrument type</td>
</tr>
<tr>
<td>(e.g. funded vs. unfunded)</td>
</tr>
<tr>
<td>Replication</td>
</tr>
<tr>
<td>(eg. Index reconstruction)</td>
</tr>
</tbody>
</table>

Capital costs have risen
Bank* RoE and change in capital estimates under old and new leverage ratio constraints, by business, %

Market-making has become more expensive in the many cases where trading requires risk transformation

Source: Citi. *Numbers derived from one particular bank but are likely to be representative.
Investors need more conviction to trade

The cost of business…
Citi US Broad Investment Grade Corporate Index 2007 vs. 2017

<table>
<thead>
<tr>
<th>Transaction Cost Scenario</th>
<th>12/31/2007</th>
<th>12/31/2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citi USBIG Corporates Index YTM</td>
<td>5.72%</td>
<td>3.26%</td>
</tr>
<tr>
<td>Bid-Ask</td>
<td>2-3 bps</td>
<td>2-3 bps</td>
</tr>
<tr>
<td>Assume: Midpoint of Bid-Ask</td>
<td>2.5 bps</td>
<td>2.5 bps</td>
</tr>
<tr>
<td>Duration</td>
<td>6.1</td>
<td>7.5</td>
</tr>
<tr>
<td>Bid-Ask Cost, adjusted for duration, round trip</td>
<td>23 bps</td>
<td>28 bps</td>
</tr>
<tr>
<td>Transaction Cost as % of Par</td>
<td>0.23%</td>
<td>0.28%</td>
</tr>
</tbody>
</table>

Consider the break-even horizon…

<table>
<thead>
<tr>
<th>Then</th>
<th>2007 break-even period = 15 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transaction cost = 4.03% of yield; Market yield = 5.72%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Now</th>
<th>2017 break-even period = 32 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transaction cost = 8.63% of yield; Market yield = 3.26%</td>
</tr>
</tbody>
</table>

Low yields, low volatility and high transaction costs create longer holding periods and disincentive to trade

…with $10mm to invest
Expected transaction costs for switch trade, 1yr horizon
Holding spreads & yields constant (no roll-down)

<table>
<thead>
<tr>
<th>Expected Transaction Costs</th>
<th>12/31/2007</th>
<th>12/31/2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Return, Gross</td>
<td></td>
<td>$571,700</td>
</tr>
<tr>
<td>Bid-Ask Cost, adjusted for duration, round trip</td>
<td>$23,051</td>
<td>$28,101</td>
</tr>
<tr>
<td>Transaction Cost as % of Yield</td>
<td>4.03%</td>
<td>8.63%</td>
</tr>
</tbody>
</table>

Source: Yield Book, Citi. Assumes a switch into a similar bond (price, yield, maturity) assuming selling at mid-market and buying new security at offer side.
ETFs – driving the market, or reacting to it?

Higher ETF flows have coincided with a decline in relative value trading and a period of technological innovation.

Contributors to the rise of passive investing:
- Decline in relative value trading
- Reduced leverage
- Less credit dispersion
- Less investor diversity
- Low volatility & yields

Source: ICI, Citi.
Agenda

- Credit as a principal market
- Liquidity in credit – macro themes
- Liquidity in credit – microstructure
- Market structure considerations
Liquidity in corporate bonds is transient.

The liquid core is very, very small….

Trading days for US corporate bonds

CUSIPs outstanding: 29,062
Never traded: 2,698 (9.3%)
Traded ≤5 days: 9,532 (39.0%)
Traded daily: 449 (1.5%)

… and it migrates through time

% of bonds that would have been deemed liquid* under MiFID II framework in 3Q13 and again in subsequent quarters, € corps

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Illiquid in 3Q13</th>
<th>Liquid in 3Q13</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Q13</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>4Q13</td>
<td>44%</td>
<td>56%</td>
</tr>
<tr>
<td>1Q14</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>2Q14</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>3Q14</td>
<td>15%</td>
<td>85%</td>
</tr>
</tbody>
</table>

Source: MarketAxess Research.

*Uses previous ESMA (Scenario 6) definition of liquidity: >2,400 trades per year, average daily volume of at least €1m, plus requirements on the number of days the bond traded and number of participants in the market.

Agents connect buyers and sellers only when two-way interest exists, which can be sporadic.
Time since issuance impacts liquidity

Newly issued bonds trade largest volume…
Dealer US corp bond trading data, normalized

…as well as trade count
US corp bonds average trade count post-issuance

Trading volumes and frequency taper quickly after issuance

Source: Citi, 2014-15.

Source: TRACE, 1H15-1H16.
Size of issuance impacts liquidity

US IG – Avg days traded by issue size excluding matured and 144a, including converts

US HY – Avg days traded by issue size excluding matured and 144a, including converts

There are many smaller issues which trade less actively than larger issues, especially in IG

Reciprocally high investor and dealer concentration

Half the volume from a few investors...
% total US IG volume of a large dealer

...who themselves use few dealers
Proportion of investor trading by number of dealers, US IG, %

Source: Citi, FY 2017.

Bouts of illiquidity more likely when activity is dominated by few participants with similar strategies
Agenda

Credit as a principal market

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Liquidity in credit – microstructure

Market structure considerations
Building robust electronic markets is a good safeguard

SEC Former Chair, Mary Jo White
Commentary to the major equities markets following the Aug 1 2012 Knight Capital software glitch and the Aug 22 2012 NASDAQ trade halt

The relevant parties in consultation with other market participants will:

- Provide comprehensive action plans that address the standards necessary to establish highly resilient and robust systems for the securities information processors (SIPs), including testing standards and disclosure protocols.
- Identify and provide assessments of the robustness and resilience of other critical infrastructure systems.
- Provide SIP plan and/or rule amendments addressing the issuance, effectiveness, and communication of regulatory halts.
- Review their rules relating to the trade break process and procedures to reopen trading following a trading halt, and provide amendments to those rules as necessary.
- Provide rule amendments to implement “kill switches” that would allow exchanges to shut down trading in the event of technological failures, and review and consider other potential risk mitigation mechanisms.

Best practices from more mature electronic markets are still largely missing in Credit
Standardizing issuance is an unlikely option

Most issuers have only a few bonds...
Number of bonds outstanding by issuer, $ and €

… and cherish their flexibility
Considerations upon issuance consolidation

- Maturity management
  - Large towers can cause significant refinancing and credit risk

- Reopening bond amid fluctuating rates and credit markets
  - Potential OID and premium issues

- Bespoke transactions for each issuer
  - Potential impediment on capital raising strategies

- Standardized coupons
  - Hinder cash management strategies

- Covenant language
  - Could be used by issuers, limiting bond reopening

- Infrequent, small issuers
  - Elevated borrowing costs as a result of not reaching the threshold

- Secondary market underperformance
  - Reopening of bonds could push issuers wider

Source: Markit, 2015.

Would impact only a small number of issuers
Transparency is helpful but also introduces new complexities.

**TRACE**
- “One size fits all” approach
- Impact on less liquid blocks
- Timing of reporting conventions
- Embedded e-trading fees

**MiFID II**
- “Big bang” implementation
- Data quality
- Recalibration of transparency and liquidity thresholds
- Global harmonization

Transparency does not automatically beget liquidity; each framework has advantages and challenges.
Protocols best left to evolve organically as suited to market

Insufficient to prescribe protocols; better to remove barriers to confidence
Conclusion

Credit remains a predominantly principal market

A myriad of influences have led to a loss of heterogeneity

Prudent to focus on building robust infrastructure
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Exchange Traded Notes (ETNs): ETNs are not funds and are not registered under the Investment Company Act of 1940. ETNs are not secured debt and do not provide principal protection unless stated specifically in the prospectus. The repayment of the principal, interest (if any), and the payment of any returns at maturity or upon redemption are dependent on that issuer's ability to pay. Risks of investing in ETNs include limited portfolio diversification, trade price fluctuations, uncertain principal repayment, and illiquidity. ETNs may have call features that allow the issuer to call the ETN at the issuer's discretion due to the occurrence of certain market events. A call right by an issuer may adversely affect the value of the notes. Investing in ETNs is not equivalent to investing directly in an index or in any particular index components. The investor fee will reduce the amount of your return at maturity or on redemption, and as a result you may receive less than the principal amount of your investment at maturity or upon redemption of your ETN even if the level of the relevant index has increased or decreased (as may be applicable to the particular series of ETNs). An investment in ETNs may not be suitable for all investors. Commissions may apply and there are tax consequences in the event of sale, redemption or maturity of Securities. Investors should refer to the ETN's prospectus to obtain a complete discussion of the risks involved when investing.

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