DTCC

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TRENDS AND RISKS IN BOND MARKET LIQUIDITY

DISCUSSION PAPER

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FOREWORD

Liquidity in global financial markets has become a top concern for market participants who fear that changes in market structure and new regulations may be leaving markets more fragile and susceptible to elevated volatility, instability and systemic risk. In particular, constrained liquidity within U.S. bond markets has been debated across the financial industry, particularly after the October 15, 2014, "Flash Crash" in U.S. Treasuries.[1]

On the following pages, we explore changes in financial markets since the 2008 financial crisis that may have contributed to reduced market liquidity in U.S. Treasury and/or corporate bond markets. We evaluate a variety of liquidity metrics using both external and internal data to assess whether they suggest an actual deterioration in market conditions. In the process, we highlight the perspectives of several industry experts, and we provide an overview of steps that have already been taken to help address this issue. We also highlight a number of initiatives that DTCC is pursuing that may provide structural improvements that contribute – directly or indirectly – to further mitigating market liquidity risks.

At the same time, DTCC firmly believes that it is crucial that the financial industry work together on developing a comprehensive approach to addressing the structural factors that impact market liquidity. As such, this paper serves as a springboard to further engage with clients and other key stakeholders globally. It is intended to stimulate debate and foster discussion on an area of risk that is top of mind with regulators and market participants.

The financial market landscape has fundamentally changed since the 2008 financial crisis, so we must work together to fully understand these changes and learn how to adapt to them in order to ensure that markets continue to function properly in the future.

We look forward to your thoughts, comments and insights. We encourage you to share them with us in the months ahead so we can incorporate them into the initiatives we are developing to provide effective and robust solutions to these industry-wide challenges.

[1] On October 15, 2014, a "Flash Crash" occurred in U.S. Treasuries, wherein the U.S. Treasury bond market experienced significant volatility amid record trading volumes, with the benchmark 10-year U.S. Treasury yield plunging 34 basis points before bouncing back to its earlier level within minutes.

EXECUTIVE SUMMARY

Adequate market liquidity is paramount to financial stability, not only to mitigate the impact of direct liquidity shocks, but also to guard against the risk that seemingly unrelated events will impair liquidity to the point of developing into a widespread financial crisis.

While the risk of a direct liquidity shock may be modest at this point, we believe that liquidity in the fixed income markets has become more vulnerable as a result of several structural changes over the past decade. These changes may have a limited effect on liquidity in normal market circumstances, but they could exacerbate the impact of future disruptions – possibly leading to a deeper crisis that could be more easily contained in an environment with more robust liquidity conditions.

The views presented in this paper are based on a quantitative analysis of internal and external metrics, as well as a more qualitative assessment of liquidity drivers and structural changes that may affect liquidity conditions.

Research conducted by industry experts on bond market liquidity to date has been inconclusive, as some market participants warn of the risk of a future crisis, while others downplay these concerns. Our internal analysis, which focuses specifically on U.S. corporate bond trades submitted to the National Securities Clearing Corporation (NSCC), finds several indications that are consistent with deteriorating liquidity conditions: declining interdealer trade volumes in the face of rising issuance activity, lower average trade sizes, a decreasing pool of executing firms and a shrinking credit default swap (CDS) market. The evidence for the U.S. Treasury bond market is less clear, but nonetheless, some of the same structural changes affect both markets – and thus suggest that liquidity could become a concern for both markets during stressed periods at some point in the future.

The structural changes that may affect liquidity conditions include the growing importance of electronic trading, the expansion of fixed income mutual funds and exchange-traded funds (ETFs), new regulations, shifts in banks' business models and risk appetite, changes in the ownership of U.S. Treasuries and the shrinking of the repo market. These developments highlight the importance of sustained vigilance and the need for the financial industry to work together proactively to develop effective mitigants.

The key findings of this paper can be summarized as follows:

- **Liquidity metrics for U.S. corporate and Treasury bonds provide a mixed message**, as traditional measures, such as bid-ask spreads, do not show significant deterioration, while other metrics, such as market depth and turnover, suggest otherwise.

- **An internal analysis of U.S. corporate bond interdealer trades submitted to NSCC over the last five years provides indications that liquidity in this market may be deteriorating**, based on trade volumes, average transaction size and the number and concentration of trade counterparties.

- **Multiple factors are responsible for impacting liquidity,** with no one factor being the obvious overriding element. Some of the key factors are changes to market structure, new product developments and growth of products such as bond ETFs, shifting ownership of bonds and new regulations.

- **Collaboration between market participants, including DTCC, is crucial** to mitigate this risk, as initiatives already underway or on the horizon will play a key role in minimizing the potential for constrained liquidity to drive or exacerbate a future crisis.

Although market participants and regulators disagree about the primary drivers of constrained liquidity, and some disagree more fundamentally about whether or not liquidity is constrained at all, there is a general consensus that the topic warrants continued monitoring and that it is prudent to take proactive steps to address risks resulting from a deterioration of market liquidity.

DTCC is proactively working with the financial industry to develop new initiatives to address this issue. We are also monitoring our exposure to liquidity risks, and we are evaluating whether to enhance margin requirements to further mitigate these risks. Regulators and financial industry participants are also taking steps to address newly emerging market liquidity risks.

INTRODUCTION

Constrained liquidity in U.S. bond markets has become a top concern, particularly after the October 15, 2014, Flash Crash in U.S. Treasuries, which raised fears about elevated volatility, market disruptions and potential systemic instability.

This is further evidenced by the results of the 1Q 2016 DTCC Systemic Risk Barometer survey, which indicated that 30% of respondents consider decreasing liquidity as one of the top five systemic risks to the broader economy, up from 24% of respondents a year earlier.

The goal of this paper is to explore the factors impacting liquidity, assess liquidity trends using both external and internal NSCC data, and highlight the initiatives led by the financial industry and by DTCC to address this issue.

> **"It's hard to find any financial market player who doesn't talk about being concerned about potential liquidity issues."**
>
> – Eric Rosengren, President and Chief Executive Officer of the Federal Reserve Bank of Boston

The drivers of reduced liquidity are unclear, but this debate will become more urgent in the coming years.

Market participants and regulators have debated whether new regulations or shifting market fundamentals are constraining liquidity. They disagree on whether today's market is simply the "new normal" that market participants must adapt to or whether it represents a systemic risk that must be addressed. This debate has been mostly theoretical so far, as fixed income markets have been relatively calm since the 2008 financial crisis. However, this issue may become more pressing when central banks tighten monetary policy and create a rising interest rate environment. In these circumstances, it may quickly become apparent how markets will react to stressed conditions in a potentially constrained liquidity environment.

Liquidity metrics provide a mixed message.

Traditional measures of liquidity, such as bid-ask spreads, do not show significant deterioration, although other metrics, such as market depth, turnover (volumes/outstanding debt) and more anecdotal accounts of the declining ability to conduct large transactions, suggest otherwise. The rise of electronic trading and other structural changes may be distorting these metrics, so they could be misleading and should be interpreted with great care. In addition, the real concern is how liquidity will behave in times of stress, when it is needed most, not during the calm conditions that have prevailed during most of the past five to seven years.

While structural changes in fixed income markets have already affected liquidity to some degree, they could have an even larger impact during a future crisis.

Electronic trading has grown in importance, which has increased the speed of trading, made liquidity more fleeting and shifted the identity of key market participants. Fixed income mutual funds and ETFs have also grown rapidly and now account for nearly a quarter of the U.S. corporate bond universe, which creates the risk of liquidity mismatches, self-reinforcing sell-offs, contagion risk and maturity mismatches. Higher capital requirements and other new regulations have also sharply increased the cost of capital for banks, potentially contributing to a pullback in market making and other activities that have historically supported liquidity, market volumes and market stability. Banks' business models and risk appetite have also shifted, causing more hoarding of assets rather than trading and internalization of activity. The ownership picture for U.S. Treasuries has also changed, as central banks and foreign investors increase their share of holdings but do not necessarily contribute proportionally to trade volumes. The shrinking repo market may also be impacting liquidity by weighing on demand for underlying assets.

1. THE IMPORTANCE OF LIQUIDITY IN U.S. BOND MARKETS

Key takeaway

Liquidity is the lifeblood of the financial industry – it is essential to well-functioning financial markets and a thriving economy.

Simply put, liquidity is the ability to buy or sell an asset at the prevailing market price without significantly affecting the price of that asset. Liquidity is essential to well-functioning financial markets and a thriving economy, as it allows for the efficient movement of capital throughout an economy with minimal friction, which ensures an optimal allocation and pricing of resources.

The U.S. Treasury bond market has historically been one of the deepest and most liquid markets in the world, which has helped the U.S. economy to thrive by minimizing borrowing costs. In addition to having minimal liquidity risk, U.S. Treasuries are also considered virtually free of credit risk, as they are backed by the unquestioned creditworthiness of the U.S. government. This combination supports their status of the ultimate safe-haven asset.

The depth of the U.S. corporate bond market has allowed U.S. corporations to raise capital at affordable borrowing costs, thus allowing them to redeploy that capital to grow their businesses and the U.S. economy.

Liquidity can be measured by various metrics, which we discuss on the following pages as we assess the recent trends for each:

- **Bid-ask spreads**, which are the difference in price between what buyers are willing to pay and what sellers are willing to accept;
- **Volumes**, which is not an exact measure of liquidity, but which does provide a sense of the amount of trading conducted in markets;
- **Turnover**, which compares the trading volume of a security to the amount outstanding or recently issued; and
- **Market depth**, which measures the ability to trade large amounts of a security at a particular price without moving the price.

2. THE RISK FROM INSUFFICIENT LIQUIDITY

Key takeaway

In addition to having a detrimental effect on markets, constrained liquidity can potentially spread and even cause financial instability.

The Potential Fallout from Constrained Liquidity

Although fixed income markets have generally been calm over the past several years, partly thanks to accommodative monetary policy, market volatility could revert toward historical norms or rise even more sharply in the years ahead, particularly given that the Federal Reserve has begun tightening monetary policy. Constrained liquidity could further exacerbate this volatility by interfering with the proper functioning of markets. Extreme volatility could exceed the historical market movements that are used by margining models, potentially exposing market participants and infrastructures to excess market losses.

Market participants, including DTCC, could also face more difficulty in selling positions if they need to liquidate assets quickly. This could force a firm to either accept less attractive market prices or be forced to hold onto assets for longer than desired, if possible, which could result in further downstream effects. Inadequate liquidity may lead to larger through-the-cycle margin requirements in order to allow market participants to mitigate their risk exposure and prepare for bouts of future volatility.

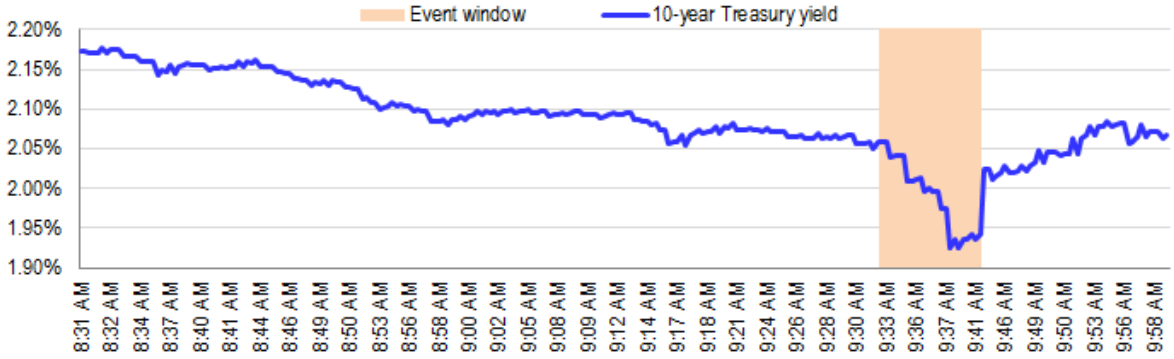
Liquidity issues could also be contagious and spread beyond fixed income markets to other classes of financial assets.

October 15, 2014, Flash Crash: A Case Study on the Risk from Insufficient Liquidity

The October 15, 2014, Flash Crash in the U.S. Treasury market illustrates the risk of market dislocations when liquidity is insufficient to meet demand. On that day, the U.S. Treasury bond market experienced significant volatility amid record trading volumes, with the benchmark 10-year U.S. Treasury yield plunging 34 basis points before bouncing back to its earlier level within minutes. While economic data (retail sales) that was released an hour prior to the incident was weaker than expected, the surprise of that data was only 1.4 standard deviations from its mean, whereas the move of the benchmark Treasury yield was 7.0 standard deviations from its mean – intraday moves of such a size have been observed on only three occasions since 1998, according to the Treasury Department's joint staff report.[2]

[2] *Joint Staff Report: The US Treasury Market on October 15, 2014*. Rep. U.S. Department of the Treasury, Board of Governors of the Federal Reserve System, Federal Reserve Bank of New York, U.S. Securities and Exchange Commission, U.S. Commodity Futures Trading Commission, July 13, 2015.

Figure 1: On-the-run 10-year U.S. Treasury yield on October 15, 2014 (8:30 AM ET – 9:58 AM ET)



The 10-year yield suddenly dropped 34 basis points before quickly reverting to its earlier level.

Source: Bloomberg. Note: Data from Bloomberg was unavailable for the period of 9:41 AM to 9:45 AM.

During the 12-minute event window (highlighted area in Figure 1 above), trading volumes in the Treasury market also reached six to 10 times the average levels, whereas market depth – as measured by the dollar amount of standing quotes in the central limit order books (CLOB) – fell to about 20% of its year-to-date average. In addition, in the face of a sharp deterioration of market liquidity, market participants reportedly temporarily pulled the plug on their automated price quoting systems and relied on manual or voice trading, further exacerbating an acute liquidity shortage at that time.

Following the 12-minute disruption, price volatility quickly reverted back to normal, and by the end of the day, the 10-year Treasury yield recovered to 2.14%, only six basis points below the previous day's closing level. However, a growing number of market participants have warned that brief dislocations such as this Flash Crash may happen more frequently in coming years due to changing market conditions.

3. RECENT PERSPECTIVES ON LIQUIDITY TRENDS IN U.S. BOND MARKETS

Key takeaway

Industry professionals and regulators not only differ on the drivers of liquidity concerns in bond markets, they also disagree on the more fundamental question of whether liquidity is constrained at all.

The debate over liquidity concerns in U.S. bond markets has become a hot topic, with industry experts and regulators unable to agree on a clear driver of market illiquidity or the extent to which liquidity is actually an issue. In general, industry professionals have largely cited post-financial crisis regulations for hampering liquidity, while regulators have pointed to other developments, such as shifting market fundamentals, including the proliferation of ETFs and high-frequency trading, as well as other factors.

Regulators have pledged to continue studying the issue and to propose asset-specific regulatory reforms where necessary. However, they generally believe that the benefits of these new regulations outweigh the risks, pointing out that fixed-income markets are overall more resilient than they were before the 2008 financial crisis. As a result, prior to implementing modifications to the post-crisis regulatory regime, regulators continue to seek more evidence that points to a serious liquidity problem that is primarily driven by post-crisis regulations, as opposed to other market developments.

3.1 Perspectives of market participants

Many financial institutions and industry groups have largely cited new regulations for hindering market liquidity and introducing new risks to markets. These same groups have called on global regulators to revisit parts of the post-crisis supervisory framework to alleviate the liquidity crunch.

A top concern for market participants is the impact of new regulations on market-making activity. Banks have historically played a crucial role as market makers to provide liquidity to bond markets, but they have scaled back from this role as post-crisis regulations on trading and capital requirements have constrained their market-making ability and made it more costly for them to hold bonds in their inventories. As market makers pull back, they are no longer available to step in to buy to match selling demand. Economist Nouriel Roubini warned that banks' reduced market-making activities as a result of post-crisis regulation have contributed to a "time bomb" that will eventually burst and collapse in times of trouble.[3]

The Volcker Rule of the Dodd-Frank Act may have further complicated banks' role as market makers, particularly in corporate bond markets. The Volcker Rule prohibits proprietary trading by banks and their affiliates, and the absence of these trades could have contributed to declining trading volumes. Additionally, it is not straightforward for banks and regulators to distinguish proprietary trading activity from market making, which is allowed under Dodd-Frank. As a result, banks may pull away from market-making activity to avoid any potential violations, while the operational costs of complying with new rules may have also deterred activity.[4]

[3] Roubini, Nouriel. "The Liquidity Timebomb - Monetary Policies Have Created a Dangerous Paradox." *The Guardian,* June 1, 2015: n. pag. Web.
[4] PricewaterhouseCoopers LLC, comp. "Global Financial Markets Liquidity Study." (n.d.): n. pag. Aug. 2015. Web.

Higher overall capital requirements may have also affected market liquidity, as market participants have less capacity to support their trading activity while complying with risk-weighted capital requirements. Some market participants believe that this has led to a diminished role of banks as a potential source of stability during times of market stress. For example, JPMorgan CEO Jamie Dimon warned in his 2015 annual letter to shareholders that new capital and liquidity rules had hindered banks' previous role as market shock absorbers and that large banks would not be able to accept new deposits from collapsing competitors or act as market makers for safe-haven assets like Treasuries during the next crisis, as they did in 2008.[5]

Many asset managers, on the other hand, are accepting reduced liquidity as the "new normal" and acting accordingly. For instance, BlackRock said in a viewpoint paper that it is adapting to the changed environment by identifying new tools and making changes in its trading platform and capabilities.[6]

An overarching concern for market participants is that deteriorating liquidity has been disguised by favorable market conditions, most notably record-low interest rates from global central banks. As the Federal Reserve tightens its monetary policy, market liquidity deficiencies may become more apparent.

3.2 Perspectives of regulatory bodies

Global regulators have generally dismissed the notion that higher capital requirements have been a significant driver of reduced market liquidity, as they point to other factors that have shifted market dynamics, such as the proliferation of electronic and high-frequency trading.

Regulators are also assessing recent dynamics of bond markets in relation to market liquidity to assess what changes, if any, may need to be made to the regulatory environment. Global oversight committees, such as the International Organization of Securities Commissions (IOSCO), the Bank for International Settlements (BIS) and the International Monetary Fund (IMF), have published research reports, as have national regulatory bodies, such as the Federal Reserve. Conclusions from the studies conducted so far have generally pointed to a lack of evidence of post-crisis regulations playing a major role in reduced liquidity, and in some cases, regulators have found a lack of evidence that liquidity is even constrained at all. For example, in the Joint Staff Report on the U.S. Treasury Market on October 15, 2014, the authors note that several metrics, such as Treasury bid-ask spreads, do not denote any stress in market liquidity.[7]

Federal Reserve officials have also argued against the claim that increased capital requirements reduced dealers' market-making capacity, which market participants have pinpointed as a primary indicator of reduced liquidity. The Federal Reserve Bank of New York President William Dudley has been one of the most vocal officials arguing against such a claim, stating that evidence pointing to deteriorating liquidity in bond market is "at best, mixed," and arguing that, even if liquidity has indeed been reduced, it is not clear whether post-crisis regulations are the primary cause.[8] He added that there are many other factors that are contributing to changes in market structure, including the increasing participation of high-frequency traders who have an option to quickly pull out of markets during times of stress.

Despite their skepticism, Federal Reserve officials have pledged to continue studying liquidity conditions, stating they would consider changing some regulations if they are found to have negative effects that outweigh their benefits in ensuring stable markets. Federal Reserve Deputy Director of the Office of Financial Stability Policy and Research Andreas Lehnert said recently that it is "reasonable" to look at post-

[5] Dimon, Jamie. "Dear Fellow Shareholders." Letter to JPM Shareholders. Apr. 9, 2015. MS. N.p.
[6] BlackRock, comp. "Addressing Market Liquidity." (n.d.): n. pag. Aug. 2015. Web.
[7] *Joint Staff Report: The US Treasury Market on October 15, 2014*. Rep. U.S. Department of the Treasury, Board of Governors of the Federal Reserve System, Federal Reserve Bank of New York, U.S. Securities and Exchange Commission, U.S. Commodity Futures Trading Commission. July 13, 2015.
[8] Dudley, William. "Regulation and Liquidity Provision." SIFMA Liquidity Forum, New York City. September 30, 2015.

crisis regulatory changes as a possible factor affecting liquidity, but also noted that markets have generally been resilient since 2008.[9]

[9] Borak, Donna. "New Laws' Effect on Market Liquidity Is 'Reasonable' Concern – Fed Economist." *The Wall Street Journal,* March 7, 2016. Web.

4. REVIEW OF U.S. BOND MARKET LIQUIDITY METRICS

Key takeaway

Metrics measuring liquidity show a mixed picture, suggesting that liquidity is under pressure, but not indicating conclusively that it is constrained to the point of causing a future crisis.

On the following pages, we evaluate a variety of liquidity metrics in both the U.S. Treasury bond market and the U.S. corporate bond market, in search of quantifiable indications that may support the anecdotal claims of constrained liquidity.

We analyze external data from sources such as the Securities Industry and Financial Markets Association (SIFMA) and the Federal Reserve Bank of New York, and we also assess internal trade data that is available within NSCC, given the clearinghouse's role in the clearing and settlement of fixed income transactions in the U.S.

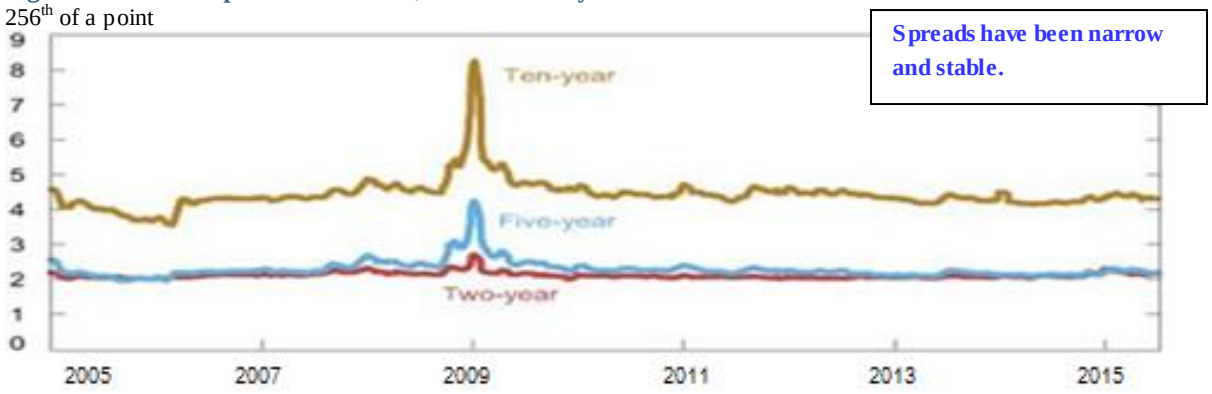
4.1. U.S. Treasury Market

Traditional measures of liquidity show a mixed picture

Bid-ask spreads show no problems but could be misleading due to the increasing participation of high-frequency trading (HFT) firms.

Although the incident on October 15, 2014, rekindled concerns over reduced market liquidity in the Treasury market, market liquidity, as captured by conventional measures, has not experienced significant deterioration. The bid-ask spread for the on-the-run 10-year Treasury, which is the difference between the prices at which investors are willing to buy or sell a bond and thus a popular gauge of liquidity, remains near the pre-crisis level (Figure 2). Recent research from the IMF also shows that the costs of buying a security and immediately selling it have generally remained below the levels seen in 2007.[10]

Figure 2: Bid-ask spread on the two-, five- and 10-year on-the-run Treasuries



Source: Federal Reserve Bank of New York

[10] Global Financial Stability Report (GFSR): Vulnerabilities, Legacies, and Policy Challenges. Rep. International Monetary Fund, Oct. 2015. Web.

However, bid-ask spreads are highly correlated with volatility and thus may be a poor indicator of potential liquidity in the future. In other words, the current low level of spreads could simply be a reflection of current calm market conditions, whereas spreads are likely to widen sharply when volatility increases, in which case liquidity may be scarcer than this metric currently suggests.

Bid-ask metrics also ignore the impact of significant changes in market structure, including the growing participation of HFT firms in the Treasury cash bond and futures markets. According to the Treasury Market Practices Group (TMPG), automated trading represents more than half of the overall trading volume in U.S. Treasury securities.[11]

The increased use of HFT strategies might be partially responsible for the narrower bid-ask spreads in recent years, as firms employing such strategies tend to submit orders close to prevailing market prices, but with small order sizes, thus keeping bid-ask spreads low. However, they may be creating an illusion of liquidity that could quickly disappear during times of stress, as they can easily pull out of markets, resulting in inconsistent liquidity.

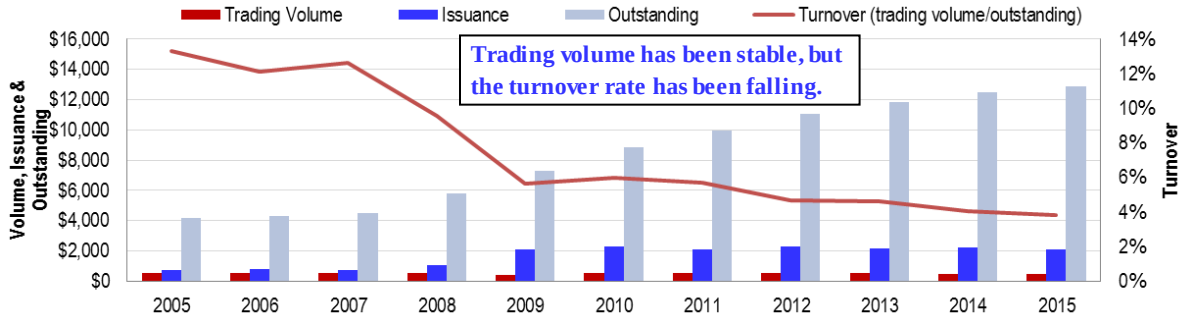
This argument criticizing HFT, however, is in dispute. Some banks ceased to operate their automated trading systems during the October 15, 2014, Flash Crash, while several HFT firms reported that they had only dialed down their exposure. According to the Treasury Department's joint staff paper on the Flash Crash, the 10 most active automated trading firms conducted more than 80% of the activity among those participants under its coverage in a 12-minute window. In that case, HFT firms could be steady suppliers of liquidity of the Treasury market, helping to fill some of the void left by banks' retreat. Still, many market participants and regulators continue to argue that HFT firms create a false impression of demand, making traders believe there are buyers and then pulling their orders.

Volumes remain stable, but have not kept pace with a surge in issuance

Treasury trading volumes have remained fairly stable over the past five years at around $500-550 billion per day (Figure 3).

Figure 3: Treasury trading volume, issuance, outstanding debt & turnover (2005-2015)

$ in billions



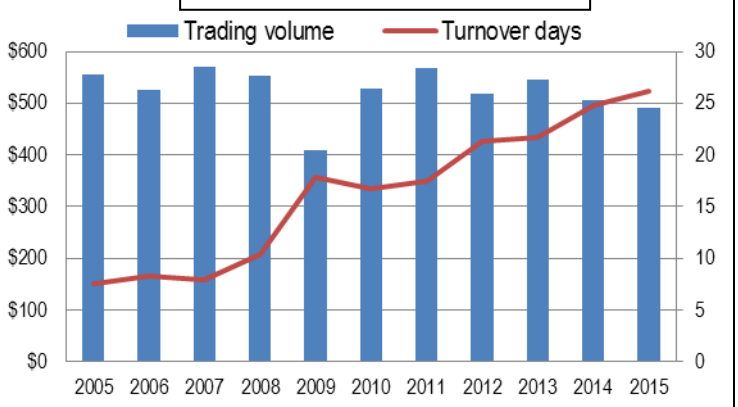
Source: SIFMA

However, this measure of liquidity ignores the surge in issuance and the significant increase in the amount of Treasuries outstanding in recent years. As shown in Figure 3 above, issuance of Treasuries has sharply increased in post-crisis years, reaching $2.2 trillion in annual issuance in 2014. Nonetheless, a smaller share of outstanding Treasuries is traded now with the turnover ratio (trading volume /

[11] *Automated Trading in Treasury Markets*. Rep. Treasury Market Practices Group, June 2015. Web.

outstanding) falling to just 4% in 2014 from 12% in 2007, as financial institutions and the Federal Reserve increasingly hold assets for regulatory or monetary policy purposes, not for trading. As a result, it now takes longer to turn over Treasuries; it took about 25 days to fully turn over the Treasury market in 2014, compared to only eight days in 2007 (Figure 4).

Figure 4: Trading volume & turnover days (2005-2015)



Source: SIFMA

Market depth has deteriorated, particularly during stressed periods

Another noticeable deterioration in market liquidity can be seen in reduced "market depth," which refers to the ability of investors to trade large positions of Treasuries easily without moving their price. To measure this, Federal Reserve economists took the average of the top three bid-and-ask quote sizes for on-the-run Treasuries. Figure 5 shows that market depth deteriorated markedly during times of stress, such as during the 2013 taper tantrum,[12] and it has fallen from its post-crisis highs, which is indicative of a more difficult trading environment. The average trade size of Treasuries has also markedly decreased in recent years, albeit in part due to the adoption of automated trading.

[12] The "2013 taper tantrum" refers to the dramatic increase in U.S. Treasury yields which resulted from the reaction of financial markets to the U.S. Federal Reserve's decision to begin reducing or "tapering" one of its bond-buying programs.

Figure 5: Market depth for on-the-run Treasury notes
$ in billions

Source: *The Treasury Department's Joint Staff Report on October 15, 2014*

Trading activity has shifted to futures rather than cash bond markets

Trading of U.S. Treasuries has also seen a marked shift over the past several years away from the cash bond market and toward the futures market. According to data from UBS, the average daily volume in the U.S. Treasury futures market represents 0.7 times the volume of cash Treasuries (as of mid-2015), which is up sharply from 0.5 times back in 2011.

The shift toward trading in the futures market could be both a symptom of illiquidity in the cash bond market and a catalyst for further deterioration in liquidity.

- Market participants are likely shifting to the futures market due to the view that this market provides more reliable liquidity than the cash bond market. Other factors, such as the more favorable balance sheet implications of utilizing futures, could also be contributing to this shift.
- The shift away from cash bond markets may also be creating a self-reinforcing problem. As trading activity migrates away from the cash bond market, potentially due to a search for better liquidity, the liquidity of the cash market may further deteriorate.

4.2. U.S. Corporate Bond Market

While liquidity concerns have emerged with respect to the fixed income market in general, these concerns have been most pronounced for corporate bonds. Although bid-ask spreads and other conventional measures of liquidity do not seem to show significant deterioration, other metrics, such as trade volumes, issuance activity, average trade sizes and the number of potential trade counterparties, paint a more nuanced picture.

Given NSCC's central role in the clearing and settling of U.S. corporate bonds, an analysis of its data can help provide additional insight into the liquidity of this market. The sections below describe an internal analysis of liquidity conditions in the U.S. corporate bond market based on aggregated NSCC data, which is reflective of interdealer trades. Our analysis focuses on the period from 2010 to 2015, given that the inception of this growing liquidity concern can primarily be traced to the years following the 2008 financial crisis.

During this five-year period, we observed the following trends:

- **Interdealer trade volumes have not kept pace with issuance activity:** Corporate bond issuance activity has substantially increased, while the total yearly trade volumes that have been submitted to NSCC have declined by 18%.
- **Trade size has decreased:** The average size of trades submitted to NSCC has decreased by 13%.
- **The number of counterparties has fallen:** The number of NSCC trade counterparties has fallen by 20%.
- **The CDS market has shrunk:** The average gross notional amount of CDS trades has decreased by roughly 50%.

Collectively, these observations suggest a potential deterioration of liquidity in the U.S. corporate bond market.

Interdealer trade volumes have not kept pace with issuance activity

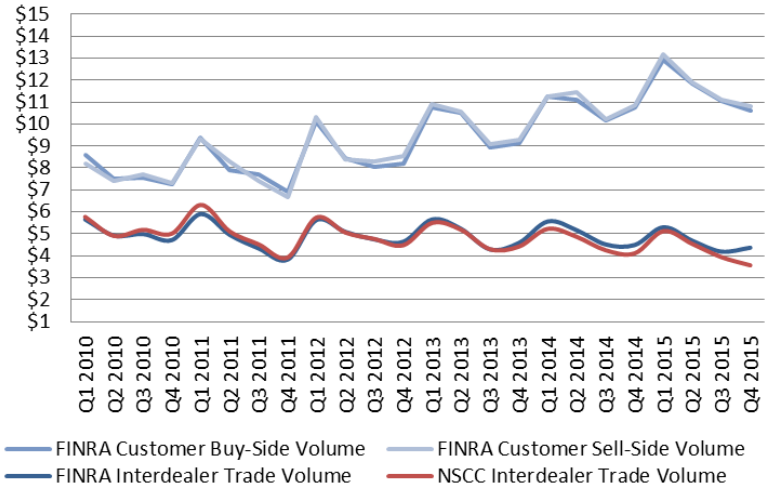
Over the past few years, the accommodative monetary policy employed by the U.S. Federal Reserve has motivated a significant increase in corporate bond issuance activity, as issuers have taken advantage of a low interest rate environment to issue a record amount of debt to fund M&A activities, stock buybacks and other activities.[13] The aggregate size of new corporate bond issuance reported by SIFMA increased from approximately $1 trillion in 2010 to roughly $1.5 trillion in 2015.

According to information published by the Financial Industry Regulatory Authority (FINRA), corporate bond trade volumes have increased over the past five years, both in terms of overall trade activity and in terms of customer buy-side and customer sell-side trading.[14] However, a more nuanced story emerges when we focus specifically on *interdealer* trade volumes of corporate bonds. As shown in Figure 6, average daily interdealer trade volumes reported to NSCC have steadily declined between 2010 and 2015.[15] Interdealer trade volumes reported to FINRA's TRACE (Trade Reporting and Compliance Engine) confirm this downward trend. Daily interdealer trade volumes have fallen from a peak of approximately $6 billion in 2011 to a low of approximately $4 billion in 2015.

[13] Riaz, K., Prager, R. Kahn, R. & Vedbrat, S. et al (2014). "The Liquidity Challenge: Exploring and Exploiting (Il)Liquidity." Blackrock Publications. Web.
[14] Mizrach, B. (2015). Analysis of Corporate Bond Liquidity. FINRA Research Note. 1-6. Web.
[15] NSCC internal data set consists of corporate bond trades with the following sub-issue type descriptions: corporate bonds, money market instrument (MMI) deposit notes, MMI medium-term bank notes, MMI medium term notes, non-CMO/ABS amortizing issue, convertible corporate debt, corporate debenture, corporate variable rate demand obligation (VRDO), corporate insured custodial receipts and corporate debt derivatives. This dataset consists of U.S. corporate bond interdealer trades that are submitted to NSCC; it excludes buy-side and comparison-only trades.

Overall, NSCC annual interdealer trading volumes declined by 18% in five years, dropping from more than $1.3 trillion in 2010 to roughly $1 trillion in 2015. Aside from a slight uptick from 2011 to 2012, this trend shows a steady decline.

Figure 6: Corporate bond average daily trade volume
$ in billions

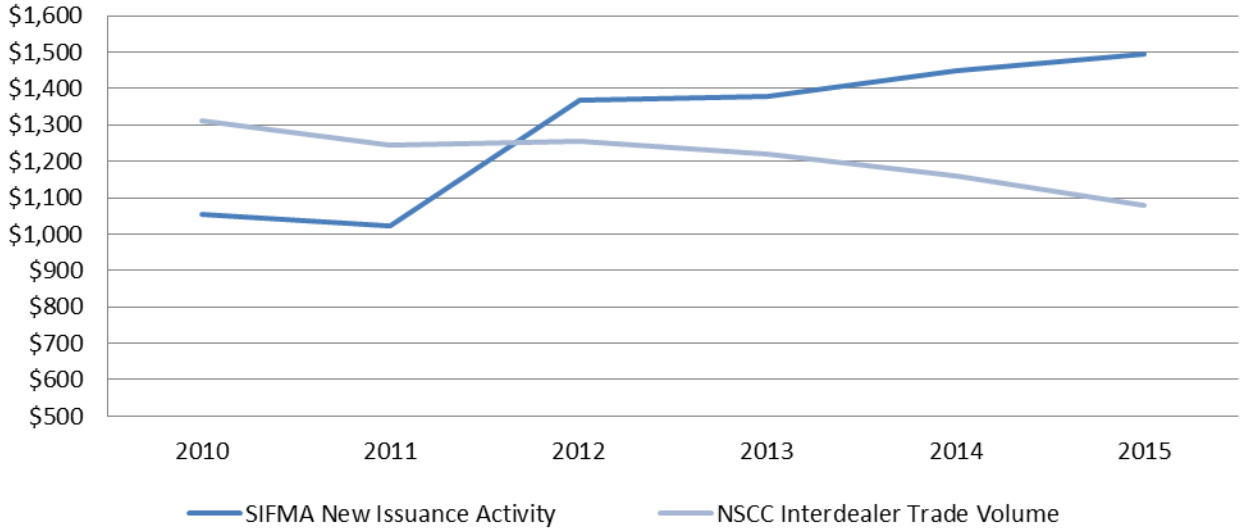


Source: FINRA's TRACE, NSCC internal interdealer trade data

It is important to note that not all types of U.S. corporate bond trades are cleared by NSCC, and thus not all trades are included in our internal data set. For example, retail activity and buy-side trades are typically settled outside of the clearinghouse, as they involve entities that are not NSCC Members. As such, the diverging trends illustrated in Figure 6 suggest that a growing portion of U.S. corporate bond trades relate to retail activity and buy-side trades as compared to the interdealer market, and that increases in trade volumes in the U.S. corporate bond market are being driven by activity outside of the clearinghouse. This suggests that a growing portion of bonds is sold more quickly to buy-and-hold end investors and is no longer part of the more liquid pool of securities that is available for secondary interdealer trading activity through NSCC.

In short, lower NSCC trading volumes point to decreased liquidity, especially as they occur against the backdrop of substantial increases in new issuance activity, as illustrated in Figure 7.

Figure 7: Annual corporate bond new issuance activity vs. annual NSCC interdealer trading volume
$ in billions



Source: SIFMA, NSCC internal data

Average trade size

Given that liquid markets allow for large quantities of securities to be traded with ease, average trade size is also useful as another measure of market liquidity.

- As shown in Figure 8, the average size of interdealer trades submitted to NSCC decreased by 13% between 2010 and 2015, declining from $336,973 in 2010 to $293,163 in 2015.
- In order to assess whether seasonality could affect this trend, we also evaluated trade size on a month-to-month basis. As shown in Figure 9, on a month-by-month basis, the average interdealer trade size was lower in 2015 than in 2010 for the vast majority of the months, which illustrates that the downward trend remains intact, irrespective of seasonal factors.

Figure 8: Corporate bond average trade amount
$ in thousands

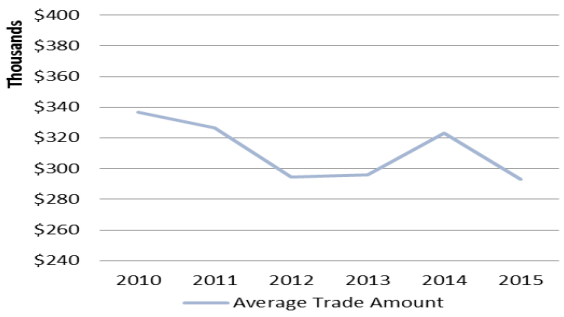
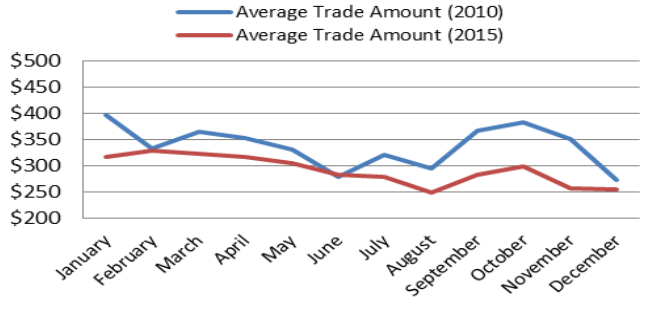


Figure 9: Seasonal trends in corporate bond trading
$ in thousands



Source: NSCC internal data

Although the smaller trade sizes may be partly due to structural shifts in trading that do not necessarily imply decreased market liquidity, anecdotal evidence does suggest that the ability of investors to transact

large amounts of corporate bonds without moving prices has diminished in recent years.[16] One asset manager quoted anonymously in a recent industry report stated, "What used to take an hour can take a day, what used to take a day can take a week, what used to take a week is barely possible."[17]

Liquidity concentration and bifurcation

Liquidity in the corporate bond market is highly concentrated – based on NSCC internal data, more than half of the total interdealer trade volume in a given year is concentrated in less than 10% of all traded CUSIPs.

Liquidity bifurcation is a trend where liquidity becomes increasingly concentrated in highly liquid securities, while diminishing in less liquid securities. According to the BIS, there are significant indicators that point to the emergence of liquidity bifurcation in market-making services.[18]

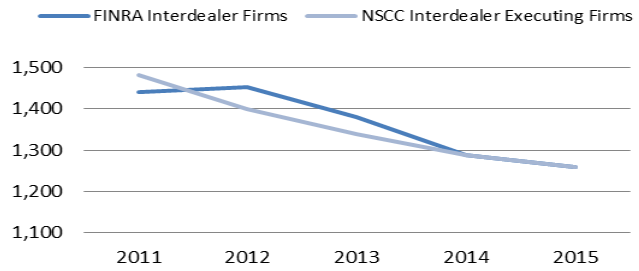
However, NSCC internal data does not provide evidence that liquidity bifurcation has worsened based on the overall trade activity over the past five years. On the contrary, we find that the top 10% of actively traded corporate bond CUSIPs represented less than 73% of trade volume submitted to NSCC in 2015, down from about 80% in 2010.

Trends in counterparty activity

Given that market liquidity is ultimately provided by trade counterparties, we also analyzed the number of counterparties at NSCC within the corporate bond market, as well as the concentration of activity within these counterparties.

As illustrated by Figure 10, the number of trade counterparties (as measured by the number of executing firms involved in interdealer trades submitted to NSCC) fell by 20% between 2010 and 2015. The fact that this decrease was not compensated by increased activity on the part of the remaining counterparties points to a lower level of market liquidity, as described in the previous section. The overall decrease of the number of counterparties also makes market liquidity more fragile and susceptible to the potential retrenchment of one or more players during times of stress. This downward trend in counterparties submitting interdealer trades to NSCC is also reflected in the number of unique firms that submitted interdealer trades to FINRA's TRACE.

Figure 10: Counterparties to corporate bond interdealer trades (2011-2015)



Source: FINRA's TRACE, NSCC internal data

This concern is particularly relevant given that most activity is concentrated within a limited number of trade counterparties. Additionally, this type of concentration seems to be increasing even further,

[16] Papanyan, S. (2015). Heightened Bond Liquidity Risk is the New Normal. U.S. Economic Watch. Web.
[17] Wood, Duncan. "GFMA, IIF, Isda Plan Liquidity Lobbying Push." *Risk.net*. N.p., July 10, 2015. Web.
[18] Fender, I. & Lewrick, U. (2015). Shifting Tides – Market Liquidity and Market-Making in Fixed Income Instruments. Bank for International Settlements. 100-103. Web.

according to NSCC data. The 50 most active trade counterparties accounted for 84% of interdealer trade volume submitted to NSCC in 2015, up from 78% in 2010.

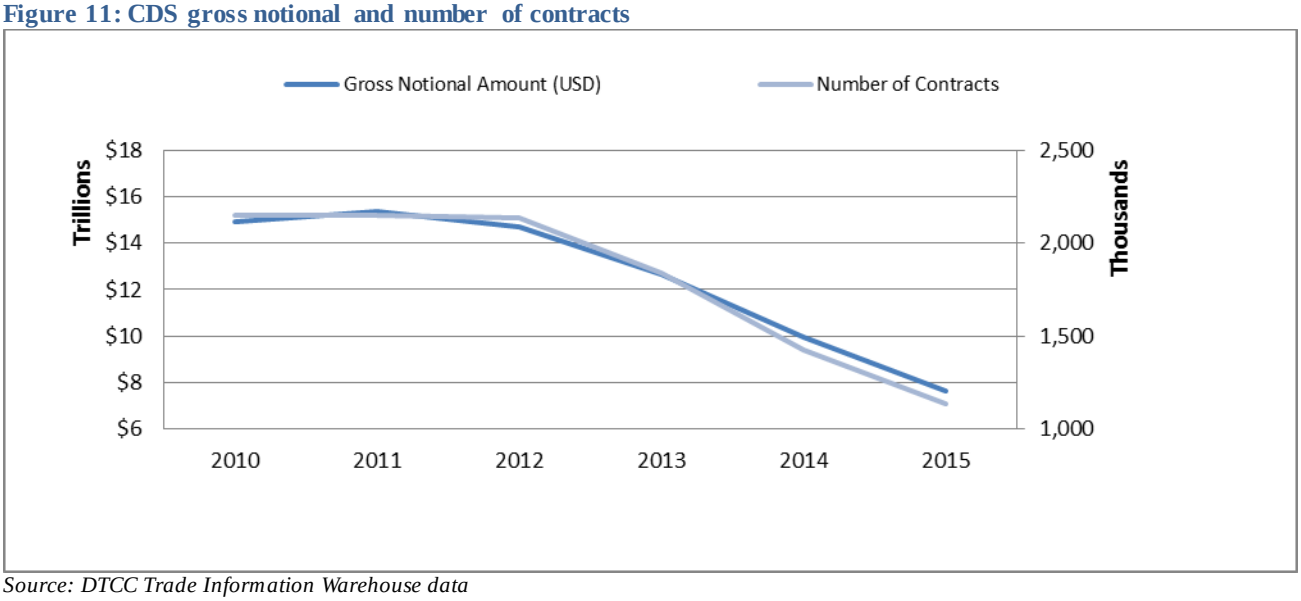
Shrinking CDS market is weighing on corporate bond market volumes

The market for CDS has contracted considerably since the 2008 financial crisis, a trend confirmed by various market participants.[19] According to a recent publication by the Kroll Bond Rating Agency, trade volume has fallen from approximately $20 trillion notional amount in 2010 to less than $9 trillion notional amount in 2015.[20]

Data from DTCC's Trade Information Warehouse, shown in Figure 11, confirms this trend. From 2010 to 2015, the average gross notional amount of CDS trades decreased by roughly 50%, from over $14 trillion to about $7 trillion. The net notional size of single-name CDS outstanding also declined to only $686 billion as of mid-2015, down almost 60% from $1.6 trillion in late 2008 (when DTCC first began reporting this position data). The number of contracts followed a similar downward trend, decreasing by 47% in the five-year period.

This retrenchment in the CDS market, as well as a similar contraction in the collateralized debt obligations (CDO) market, has weighed on corporate bond trading volumes by reducing the ability to conduct basis trading and hedge positions.

Figure 11: CDS gross notional and number of contracts



Source: DTCC Trade Information Warehouse data

[19] Oehmke, M. & Zawadowski, A. (2015). The Anatomy of the CDS Market. Columbia University Publication. Web.
[20] Whalen, R. C. & Scott, J. (2015). Can the Credit Default Swap Market be Salvaged? Issues for Borrowers and Investors. Kroll Bond Rating Agency Publication. Web.

5. STRUCTURAL CHANGES AFFECTING U.S. BOND MARKETS

Key takeaway

Fixed income markets have changed profoundly over the past decade due to new regulations and competitive pressures.

Several structural changes have occurred within fixed income markets over the past five to 10 years that have likely contributed to the current concerns over liquidity. Some of the most impactful changes include the proliferation of high-frequency trading, the shift toward electronic trading platforms, the rapid growth of fixed income mutual funds and ETFs, the changing ownership of U.S. Treasuries, the contraction of the repo market and the changing business models of banks. The regulatory environment has also changed significantly since the 2008 financial crisis, which has driven many of these structural changes.

As mentioned before, market participants and regulators disagree over which of these factors are most responsible for impacting liquidity and whether today's market is simply the "new normal" that market participants must adapt to, or whether it represents a systemic risk that must be addressed.

5.1. Post-financial crisis regulations

Industry professionals have largely blamed post-crisis regulations for placing an undue burden on fixed-income market participants and thus reducing their ability to provide market liquidity. Although regulators generally feel that post-crisis regulations may not be reducing liquidity, they do acknowledge that there has been a reallocation of capital driven by regulatory changes. Below, we have summarized some of the most significant regulatory changes that have increased the cost for banks to hold dealer inventory or that have prohibited certain market activities altogether.

Capital and Liquidity Requirements

- **Basel III** capital standards were published by the BIS and provide a global framework for bank capital adequacy standards. Basel III includes standards for capital requirements, leverage ratios and liquidity requirements (LCR), as well as other recommendations for stress tests, risk management practices, etc. Basel III introduced both stricter definitions of acceptable capital and higher risk-weighted asset requirements, as well as higher overall capital requirements, making banks set aside high-quality capital (such as Treasury securities and investment-grade corporate bonds) that would otherwise be available for market activity.[21] One example of these stricter capital requirements is the 5% equity-to-asset ratio for the largest banks, with no risk weighting. Prior versions of Basel capital frameworks did not include minimum leverage ratios.[22]

- **G-SIB surcharge:** The rule requires global systemically important bank holding companies (G-SIBs) to hold additional capital, ranging from 1.0 to 5.5% or more of a firm's total risk-weighted assets for U.S. G-SIBs, to reflect their systemic importance to the financial system.[23] In the U.S., this surcharge is being phased in and will be fully in place by January 2019. The U.S. framework for systemically important financial institutions (SIFIs) was introduced in the Dodd-Frank Act

[21] PriceWaterhouseCoopers LLC, comp. "The New Basel III Framework: Navigating Changes in Bank Capital Management." October 2010. Web.
[22] *Basel III leverage ratio framework and disclosure requirements*. Basel Committee on Banking Supervision, January 2014. Web.
[23] Board of Governors of the Federal Reserve System. "2015 Banking and Consumer Regulatory Policy". Press Release. Federal Register Notice. July 2015. Web.

passed by Congress in 2010. In 2009, the G20 also asked the Financial Stability Board (FSB) to designate and develop a framework for global SIFIs, with the first list published in November 2011.

- **Total loss absorption capacity (TLAC):** This requires large banks to issue ordinary shares, subordinated debt and other loss-absorbing securities equivalent to the minimum of 16% to 20% of their risk-weighted assets, and at least two times the Basel leverage requirement of 3% in order to help ensure that they can be wound down without taxpayer assistance.

- **Liquidity coverage ratio (LCR):** This requires banks with over $50 billion in assets to hold sufficient high-quality liquid assets (HQLA) to meet projected net short-term cash obligations over a 30-day stressed period in order to better prepare them for times of financial stress. The U.S. LCR is significantly more stringent than a similar proposal included in international Basel III standards. This rule will further push banks to hold assets such as U.S. Treasuries purely for collateral purposes rather than for trading.

Other Regulations Possibly Impacting Liquidity

- **Volcker Rule:** This rule prohibits banks from engaging in proprietary trading with their own accounts and limits their ownership of, and relationship with, hedge funds and private equity funds. This rule could hurt liquidity by removing banks as providers of liquidity, since they will no longer actively invest in securities. It could also weigh on market-making activity, as banks tread cautiously to avoid activity that could be qualified as proprietary trading rather than market making.

- **Stress testing and enhanced prudential regulation** more generally have not necessarily prohibited activity by banks, but they have forced banks to closely scrutinize their balance sheet usage, potentially leading to smaller bond inventories and less market making.

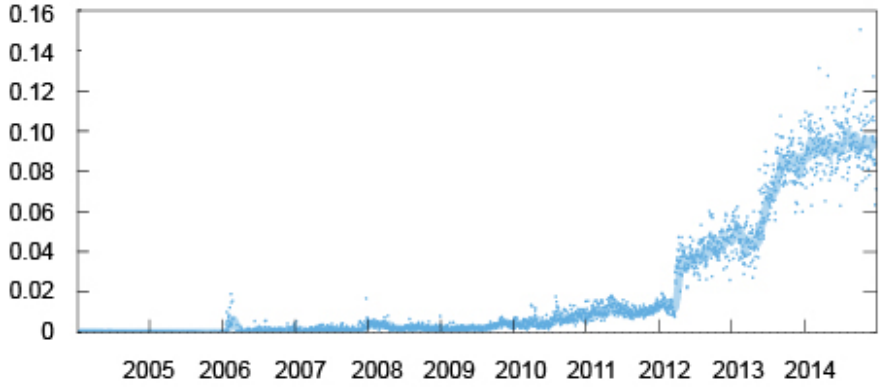
- **Regulations to enhance transparency:** It is reported that some market participants feel that requirements aimed at increasing transparency (e.g., requirements to report certain trades through FINRA's Trade Reporting and Compliance Engine (TRACE) system) have had a negative impact on liquidity.[24]

5.2. Proliferation of electronic and high-frequency trading

Treasury volume is increasingly driven by high-frequency trading and cross-market trading
Electronic trading represents a growing share of trading volume in the U.S. Treasury bond market, currently accounting for nearly 70% of volume which is up from approximately 50% five years ago.[25] This electronic trading has existed in the futures market since the 1990s, but it has taken on a growing role in the cash bond market as well, leading to a tight link between these two markets. According to a Federal Reserve Bank of New York analysis, cross-market activity between the cash bond and futures markets has risen significantly over the past decade and now represents around 8% of activity in the cash Treasury market on normal days, while it accounted for as much as 15% of trading during the October 15, 2014, Flash Crash (see Figure 12).

[24] Wholesale & Investment Banking Outlook - Liquidity Conundrum: Shifting Risks, What It Means. Rep. Morgan Stanley & Oliver Wyman, March 19, 2015. Web.
[25] *Electronic Trading in Fixed Income Markets*. *Bank for International Settlements*. January 2016. Web.

Figure 12: Cross-market activity
% of one-year cash market activity



Source: Federal Reserve Bank of New York. Note: Cross-market activity measured between 10-year and five-year Treasury cash markets at zero millisecond offsets

As a side effect, the rise in electronic trading has narrowed bid-ask spreads, reducing the profitability of market making – and thus making this activity less attractive for banks.

Mirage of liquidity

High-frequency trading may also create a "mirage of liquidity" for two reasons. First, HFT firms can quickly pull out of markets, causing liquidity to vanish suddenly, particularly during stressed periods, when it is needed most. High-frequency traders tend not to hold large inventories and thus have less incentive to provide liquidity during stressed periods. Second, the total actual liquidity available at various trade platforms (e.g., eSpeed, BrokerTec, CME) is likely less than the sum of the liquidity at each individual platform, as low-latency traders react to trades reaching any individual platform, causing them to adjust the price at which they would provide liquidity on another platform.[26]

On-the-run vs. off-the-run securities

The increasing role of electronic trading may also be exacerbating the liquidity disparity between on-the-run and off-the-run securities. While nearly all trading for on-the-run Treasuries in the interdealer market is done electronically, according to the Treasury Market Practices Group (TMPG), trading in off-the-run securities often takes place by phone.[27] In addition, principal trading firms (PTFs) do not typically trade off-the-run securities, as they do not have access to sufficient information on these securities. PTFs have pushed for more transparency in the off-the-run market, but this initiative has not made notable progress, as some market participants believe that this move would actually be detrimental to overall market liquidity. As a result, while electronic trading has likely provided a boost to liquidity for on-the-run securities, off-the-run securities have not seen a similar benefit.

Overall, the increase in electronic trading has arguably provided a boost to liquidity by improving order flow and competition. However, it has fundamentally shifted the dynamics of liquidity, potentially making liquidity more volatile and unpredictable, and possibly making the Treasury bond market more vulnerable to disruptions that have become increasingly common in equity and futures markets.

[26] Liberty Street Economics blog, "The Liquidity Mirage", October 9, 2015.
[27] *Automated Trading in Treasury Markets*. Rep. Treasury Market Practices Group, June 2015. Web.

Corporate bonds are shifting toward electronic trading platforms but face limitations

While transactions in large quantities of corporate bonds are still done mostly over the phone, smaller trades have been increasingly moving to electronic platforms. According to McKinsey and Greenwich Associates, electronic trading in U.S. investment grade bonds has more than doubled since 2009 to over 20% of total volume (although for high-yield corporate bonds, electronic trading accounts for only 10% of total trading).[28] Some investors also remain skeptical of electronic bond platforms, since posting a bid for a large amount of illiquid bonds could possibly move prices or disclose a potentially profitable trading opportunity to competitors. In addition, individual electronic trading platforms have been unable to attract large trading volumes, and many market participants note that the wide range of bond trading platforms has made it difficult to know where liquidity is concentrated.

5.3. Bond mutual funds and exchange-traded funds

Bond mutual funds and ETFs may be creating phantom liquidity and an unstable investor base

The relatively low turnover in the corporate bond market, combined with the potential lack of depth, is especially concerning given the rapid growth of corporate bond mutual funds and ETFs across a fairly small number of investment managers.

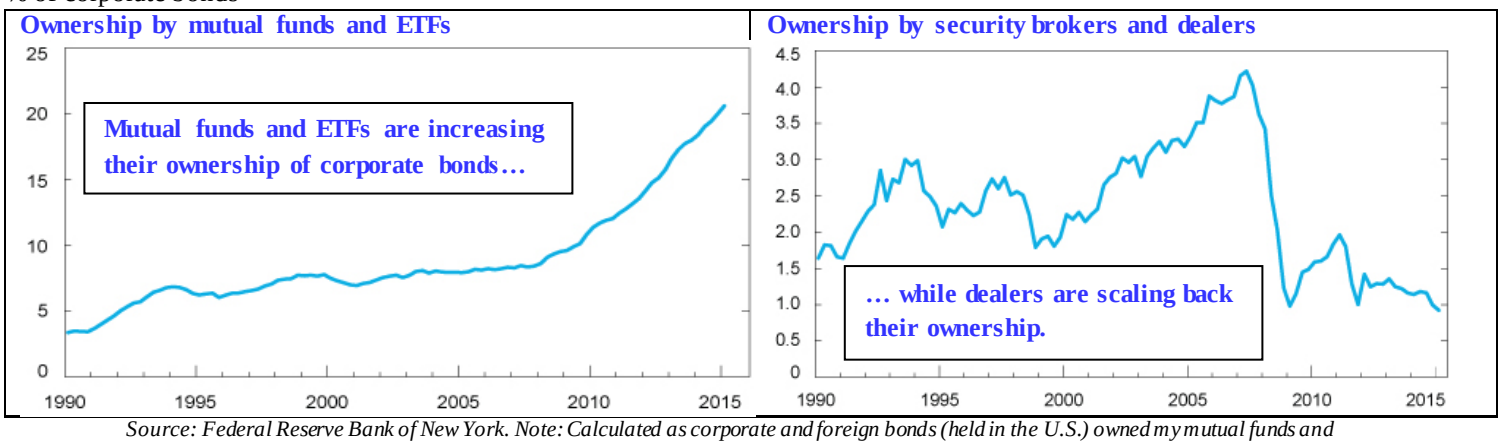
Bond mutual and exchange-traded funds now own about 20% of all corporate bonds, up from 8% in 2008 and only 4% in 1990, according to data from ICI and the Federal Reserve Bank of New York. This shift in ownership is particularly notable in the high yield space, which has seen persistent outflows from institutional investors, whereas mutual funds and retail investors have significantly increased their exposure.

Meanwhile, ownership by dealers has been falling sharply since the 2008 financial crisis as dealers look to reduce the size of their balance sheets. This is in contrast to the prior economic cycle, when dealers added bonds to their balance sheet during the 2001-2003 recession.

As a result, ownership of bonds has shifted away from dealers, who have historically been reliable providers of liquidity, toward asset managers, who may be users of liquidity, focused on maximizing investment returns rather than on maintaining the proper functioning of markets.

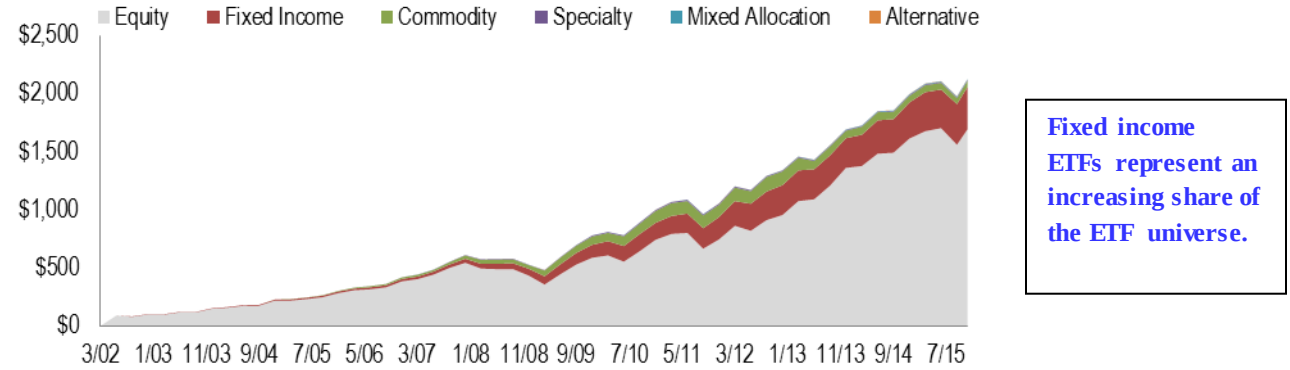
[28] *Corporate Bond E-Trading: Same Game, New Playing Field*. Publication. McKinsey & Company and Greenwich Associates, Aug. 2013. Web.

Figure 13: Ownership of corporate bonds
% of corporate bonds



Source: Federal Reserve Bank of New York. Note: Calculated as corporate and foreign bonds (held in the U.S.) owned my mutual funds and ETFs divided by total amount of corporate and foreign bonds (held in the U.S.) outstanding

Figure 14: ETP market cap by asset class focus
$ in billions



Source: Bloomberg

Liquidity & Maturity Mismatch

- **Liquidity Mismatch**
  Bond ETFs tend to be much more liquid than the underlying securities, raising concerns about a liquidity mismatch. For example, BlackRock's iShares iBoxx High Yield Corporate Bond ETF trades more than 20,000 times on average each day, while each of its top 10 bonds trades only 13 times a day on average.

- **Maturity Mismatch**
  Bond funds also present a maturity mismatch risk, similar to the risk that banks are exposed to when they borrow short-term funds to invest in longer-term assets. Bond funds essentially use ultra-short-term funding, given that investors can redeem their shares at any time, while they invest in long-term securities that often cannot be sold quickly due to their less liquid nature.

Risk of a Self-Reinforcing and Contagious Sell-off

- **Self-Reinforcing Sell-off**
  Bond funds can be exposed to a self-reinforcing flow-performance relationship, according to a Federal Reserve Bank of New York analysis, which shows that when bond returns are negative, investors typically sell their fund positions, thus amplifying the adverse price movements.

- **Cross-Ownership Contagion**
  The IMF has also raised concerns over the growing cross-ownership of the same bonds across several funds, which increases the likelihood of contagion in times of stress.

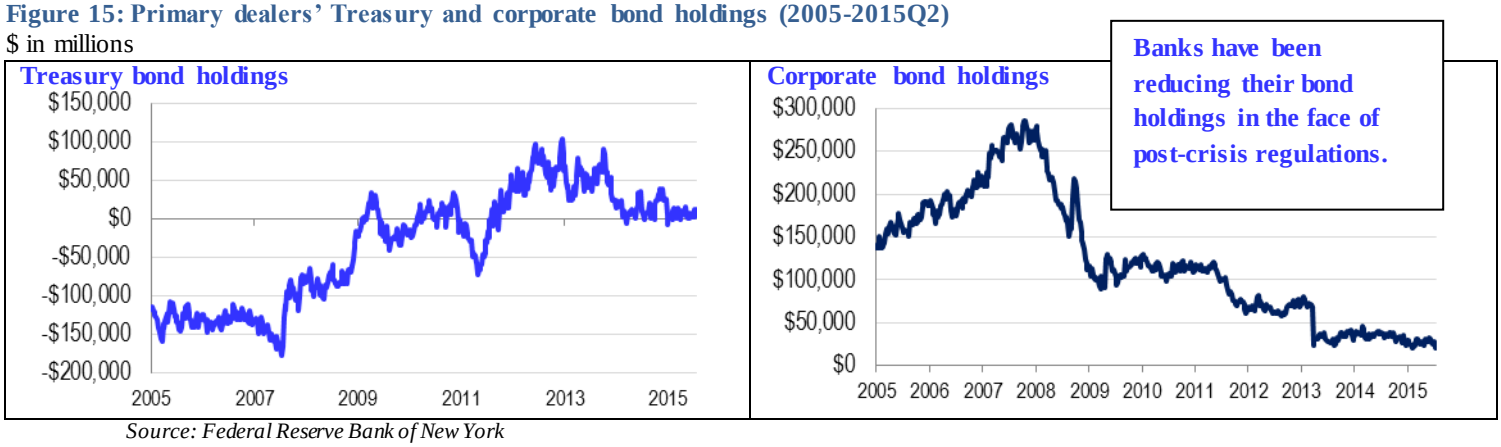
BlackRock has offered proposals for how to mitigate some of these risks from bond mutual funds and ETFs, for example, by standardizing provisions for in-kind redemptions, although these proposals have both benefits and drawbacks (see section 6.1 for further discussion).

All of these risks could materialize as the Federal Reserve raises interest rates, causing negative returns for bonds. This could trigger massive outflows from bond funds, which could further amplify the sell-off, possibly creating a contagion effect across funds holding similar assets.

5.4. Changing business models of banks

Primary dealers have reduced their bond holdings by more than two-thirds from pre-crisis highs
Primary dealers have both decreased their demand at Treasury auctions and lowered their stockpile of bonds, notably in response to higher capital requirements that have made it more costly for them to hold bonds in their trading books. This has been especially true for corporate bonds, as seen in Figure 15.

Figure 15: Primary dealers' Treasury and corporate bond holdings (2005-2015Q2)
$ in millions



Source: Federal Reserve Bank of New York

Higher central bank holdings of Treasuries have also reduced active trading in Treasuries and have lowered the need for available inventory from dealers. According to a Federal Reserve Bank of New York analysis, the size of banks' balance sheets is also cyclical, generally rising during boom times and shrinking during downturns. This cyclicality has likely contributed to the shrinkage in dealer inventory in the aftermath of the 2008 financial crisis, while banks have been reluctant to rebuild this inventory, whether due to new regulatory pressure or changing risk appetites.

Banks holding Treasuries as high-quality collateral, rather than trading inventory
Over the past several years, banks have been moving Treasuries out of available for sale (AFS) accounts and into held to maturity (HTM) accounts, allowing them to meet regulatory capital and liquidity requirements, while avoiding exposure to market volatility. However, this shift also weighs on market liquidity, as these securities are no longer available for trading purposes.

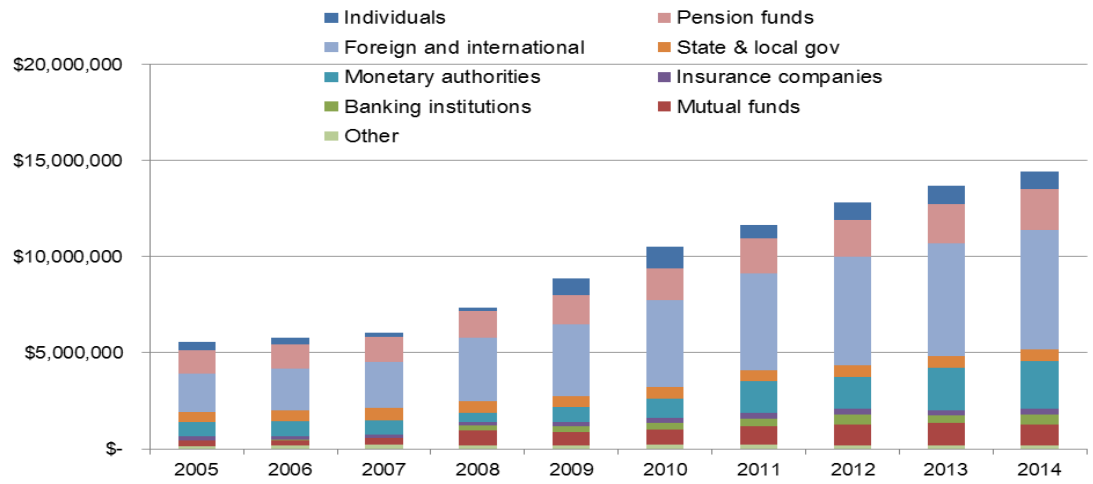
Liquidity is negatively affected by banks that offset shrinking profit margins by internalizing customer trades
In an effort to remain competitive in a trading environment of shrinking profit margins, banks have also turned to internalizing client trades, matching buy and sell orders between their own customers. Given that these trades do not reach the open markets, this trend also weighs on market liquidity.

5.5. Changing ownership of U.S. Treasuries

Foreign investors and the Federal Reserve have increased their share of ownership of Treasuries

Foreign investors' holdings of U.S. Treasuries have increased 215% over the past decade to $6.2 trillion, or approximately 50% of total Treasury holdings. The Federal Reserve holds about 20%, thanks to its three rounds of asset purchases. While banks have doubled their Treasury holdings since the 2008 financial crisis to $520 billion, they account for a relatively small share of the market (4%) and hold many bonds to meet capital requirements, rather than for trading purposes. Purchases of corporate bonds by foreigners have also doubled to $172.2 billion, so they now own more than a quarter of the U.S. corporate bond market.

Figure 16: Holders of U.S. Treasury securities (2005-2015Q3)
$ in millions



Source: SIFMA

A widening array of participants can make prices and provide liquidity across fixed income markets

Nonbank participants account for the majority of trading in on-the-run Treasuries. Some market participants argue that an increased participation of nonbank broker-dealers in a market-making role improves pricing, efficiency and resiliency – especially in the wholesale U.S. Treasury markets. In fact, according to a joint staff report by U.S. regulators, nonbank participants continued to provide liquidity and maintained tight bid-ask spreads on October 15, 2014, while banks withdrew completely from the market at times, thus exacerbating an acute shortage of liquidity.

5.6. Contraction of the repo market

A shrinking repo market is weighing on liquidity in the underlying collateral

Before the 2008 financial crisis, repos served as an inexpensive daily funding source for banks and short-term investors, helping them finance trading and market-making activities. However, the outstanding daily average amount of repo financing by primary dealers has noticeably fallen from $3.9 trillion in 2008 to $2.2 trillion in 2015 (Figure 17), partly due to regulatory efforts to reduce banks' reliance on short-term funding. The shrinking repo market poses a concern, given that higher repo costs will likely translate into constrained liquidity for the underlying securities (typically Treasuries, Agencies, and Agency MBS). This concern is due to the strong correlation between the size of the repo market and bond trading volumes (Figure 18).

Figure 17: Primary dealer average daily repo financing (2005-2015)
$ in billions

Repo activity has noticeably fallen since the 2008 crisis.

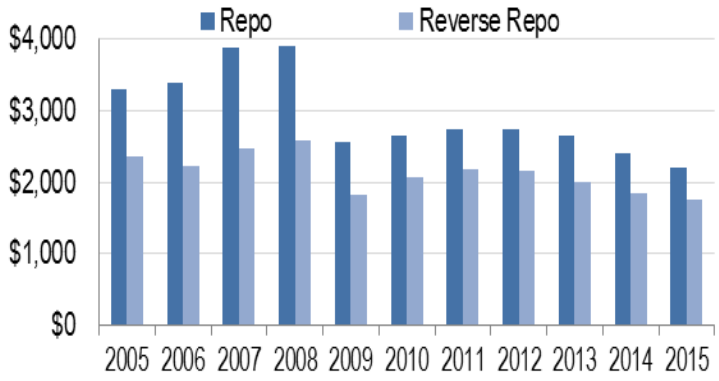
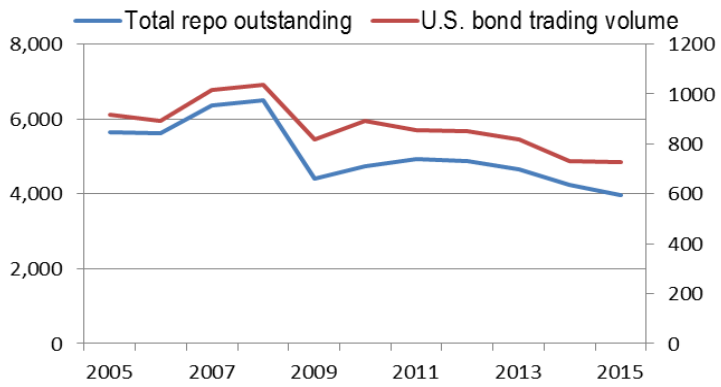


Figure 18: Total repo outstanding & U.S. bond trading volume (2005-2015)
$ in billions

Repo and bond trading activities are highly correlated.



Source: SIFMA

In order to address the twin challenge of rising repo costs and highly constrained dealer balance sheets, clearinghouses have an opportunity to reduce transaction and capital costs by matching, netting and offsetting trades with a confirmed counterparty. That is why, subject to regulatory approval, the Government Securities Division (GSD) of DTCC's Fixed Income Clearing Corporation (FICC) is planning to expand the scope of its tri-party repo services to encompass almost three-quarters of the tri-party repo market (as discussed later).

6. INDUSTRY-WIDE RESPONSE INITIATIVES

Key takeaway

Industry groups, regulators and DTCC are all taking an active role in assessing market liquidity risks and designing effective mitigants.

Several market participants have been involved in industry-wide efforts to address recent changes in U.S. bond markets, while regulators have also been engaging in a series of studies to assess the current state of market liquidity more closely.

6.1. Industry initiatives

Financial institutions and other stakeholders are taking actions to better adapt the fixed-income trading infrastructure to the new market environment. Some of these efforts are new, while others focus on trying to roll back existing regulations.

- Project Neptune is a not-for-profit utility that aims to promote corporate bond market liquidity by allowing sell-side participants to communicate their inventory to buy-side investors and setting an open standard protocol for data distribution.

- Some industry participants have recommended a delay in reporting large block trades to FINRA's TRACE platform, arguing that the current requirement to report most trades within 15 minutes of execution is too short to adequately conceal trading strategies from competitors – and claiming that trading large positions is too costly as a result.[29]

- BlackRock has been encouraging market participants to develop new strategies to adapt to the new market paradigm. From an internal perspective, the firm has adjusted its own internal strategies, such as trying to be a "price maker" rather than a "price taker." It has also increased the use of electronic trading venues and enhanced liquidity risk management tools. From an external perspective, the firm has proposed a three-pronged approach, including modernizing market structure, enhancing funds' "toolkit" and regulation, and evolving new and existing products:[30]
    - **Modernize market structure**: BlackRock has proposed many ideas, such as encouraging further use of electronic trading, establishing standardized benchmark bond issues to concentrate liquidity that is currently dispersed across numerous bond issues, expanding trading protocols and adjusting regulations on reporting of block trades (see prior bullet).
    - **Enhance fund toolkit and regulation**: BlackRock's proposals include requiring enhanced disclosure of liquidity risks and expanded use of liquidity stress testing; creating pricing mechanisms for subscriptions and redemptions to reflect the cost of liquidity; extending the use of redemption gates; using temporary borrowing as a backup source of liquidity; and standardizing in-kind redemptions of funds for large institutional

[29] *Wholesale & Investment Banking Outlook - Liquidity Conundrum: Shifting Risks, What It Means*. Rep. Morgan Stanley & Oliver Wyman, March 19, 2015. Web.
[30] BlackRock ViewPoint: "Addressing Market Liquidity." July 2015.

investors. The proposal for increased use of in-kind redemptions is notable given that it could help address concerns about the liquidity mismatch between funds and their underlying securities by allowing funds to meet customer withdrawals without having to sell the underlying securities. However, critics argue that this approach would simply shift the burden of liquidating the assets onto the investors rather than the fund structure, as investors would not receive cash and would continue to be exposed to a risky asset instead.

- **Evolving products**: BlackRock's proposals include creating a classification system for exchange-traded products (ETPs) and developing a product that could aggregate bond exposures from single issuers.

6.2. Regulatory initiatives

Global regulatory bodies have announced multiple initiatives to collect information and conduct research on liquidity in fixed-income markets. Most of these efforts are in the research phase, and it is uncertain if any new regulations will be introduced based on regulators' conclusions. The Securities and Exchange Commission (SEC) has proposed liquidity risk management requirements for open-ended funds (mutual funds and ETFs), but these rules would apply to the funds themselves and not to broader market activity.

We list below several of the most significant regulatory initiatives on market liquidity:

- In January 2016, the **U.S. Treasury** requested industry feedback on Treasury trading trends as the government accelerates its plans for more timely access to trading data. Plans for collecting more trade data have been published as well, although there is no timeline for regulatory changes that may come out of the Treasury's research.[31]

- **The Federal Reserve and the U.S. Treasury's Office of Financial Research** are conducting a pilot program to collect "permanent granular" data on bilateral repurchase agreements. This is part of an effort to enhance the transparency of bilateral repo trading, which represents approximately 60% of the $3 trillion repo market.[32]

- **The Financial Industry Regulatory Authority (FINRA)** has cited liquidity as one of its top examination priorities for 2016. It considers the adequacy of HFT firms' liquidity planning and controls an area of focus.[33]

- **The Securities and Exchange Commission (SEC)** proposed sweeping liquidity risk management rules for open-ended funds, including mutual funds and ETFs. These rules would require fund managers to classify the liquidity profile of a fund portfolio's assets and implement liquidity risk management programs accordingly.[34]

- **The International Organization of Securities Commissions (IOSCO)** has included bond market liquidity among its top four market risks for 2016, with a particular focus on corporate bond market liquidity. IOSCO stated that it needs additional data and monitoring to better

[31] *Notice Seeking Public Comment on the Evolution of the Treasury Market Structure.* Department of the Treasury, Federal Register, Vol. 81 No. 14, January 22, 2016.
[32] *The U.S. Bilateral Repo Market: Lessons from a New Survey*. Victoria Baklanova, Celia Caglio, Marco Cipriani, Adam Copeland. Office of Financial Research Brief Series, January 13, 2016. Web.
[33] *FINRA's 2016 Regulatory and Examination Priorities Letter.* Financial Industry Regulatory Authority. January 5, 2016. Web.
[34] *SEC Proposes Liquidity Management Rules for Mutual Funds and ETFs.* U.S. Securities and Exchange Commission. September 22, 2015. Web.

understand the state of the global corporate bond market, as current data is too limited and overly focused on the U.S.[35] In August 2016, IOSCO published a consultation report on its analysis of liquidity in the corporate bond market, in which it did not find substantial evidence suggesting that liquidity in the corporate bond market has deteriorated markedly.[36]

- **The Financial Stability Board (FSB)** issued a report ahead of the G20 Finance Ministers and Central Bank Governors meeting in Hangzhou, China, in September 2016, that includes further analysis on market liquidity.[37]

- **The Federal Reserve Bank of New York's Liberty Street Economics blog** began a series examining liquidity trends in fixed-income markets beginning in August 2015.

- **The European Commission** plans to conduct an assessment of post-financial crisis rules and their impact on liquidity in the corporate bond markets. This comprehensive review will help regulators take a more pragmatic approach when determining liquidity levels and new measures for regulatory frameworks such as MiFID II.

- **The Federal Reserve Bank of Atlanta's 21st Annual Financial Markets Conference** in May 2016 covered liquidity issues from an academic, regulatory and market participant point of view.[38]

6.3. DTCC initiatives

As the premier post-trade market infrastructure for the global financial services industry, DTCC has been leveraging its expertise to pursue several industry-wide and internal initiatives that enhance clearing and settlement processes. Some of these plans may provide structural improvements that contribute to further mitigating market liquidity risks, either directly or indirectly.

DTCC also continues to study the changing market infrastructure to assess the potential impact on margin requirements, as DTCC and others are evaluating whether to enhance margin requirements, for example, by including factors such as liquidity and concentration charges.

New FICC Service Offerings

FICC's GSD is proposing to offer a variety of services to the dealer community and buy-side firms that would allow designated securities financing transactions (SFT), including repo and securities lending transactions, to be supported via the clearinghouse. This would allow as many SFT transactions as possible to be matched, guaranteed and novated to a central counterparty, thereby reducing capital implications to the dealers and agent lending banks, and also reducing the potential for market disruption and fire sale risk through the centralized liquidation of a failed counterparty.

- **GSD's Centrally Cleared Institutional Tri-Party (CCIT) Service**
  GSD plans to file for regulatory approval to expand the scope of its tri-party repo services to cover approximately 70% of the $1.3 trillion tri-party repo market in eligible government-related securities.

[35] *IOSCO Securities Markets Risk Outlook 2016.* IOSCO Research Department Staff in cooperation with the IOSCO Committee on Emerging Risks. March 2016. Web.
[36] *Examination of Liquidity of the Secondary Corporate Bond Markets.* IOSCO. August 2016. Web.
[37] *Implementation and Effects of the G20 Financial Regulatory Reforms.* Financial Stability Board. August 31, 2016. Web.
[38] *21st Annual Financial Markets Conference – Getting a Grip on Liquidity: Markets, Institutions, and Central Banks – May 1-3, 2016.* Federal Reserve Bank of Atlanta. Web.

- DTCC plans to extend limited membership to buy-side firms – other than "40 Act" funds (whose participation in clearing is pending regulatory review) – for tri-party repo transactions using eligible government-related securities in which these firms are acting as cash lenders. Through its GCF Repo Service, FICC currently clears tri-party repos between the Federal Reserve's 23 primary dealers and other GSD Members.

- **Other SFT Client Clearing Initiatives**
  In terms of next steps, FICC is developing new services and expanding some of its existing services to extend limited membership to buy-side firms to also allow for two-directional SFT activity (i.e., cash lending and cash borrowing) and securities lending activity with GSD Members to be novated to FICC.

Collateral Management

A global mandate on the central clearing of the majority of over-the-counter (OTC) derivatives and the new margin requirements for non-cleared OTC derivatives, starting in September 2016, are expected to substantially increase demand for high-quality collateral. This could have a detrimental impact on liquidity as securities are locked up for use as collateral rather than active trading. This impact on liquidity will be exacerbated during periods of extreme market stress when the volume and value of margin calls may increase exponentially.

A white paper by DTCC, "Trends, Risks and Opportunities in Collateral Management," suggests the industry may address the issue of increasing demand for collateral by focusing on "collateral optimization," which is seen as essential to resolving the gap between collateral supply and demand. Collateral optimization can be achieved by: 1) identifying collateral held in various locations; 2) pooling collateral to meet various exposures; 3) allocating collateral in an efficient way; and 4) creating networks to facilitate the efficient flow of collateral between counterparties.

In order to ease the strain of this rising demand for collateral, DTCC and Euroclear created a joint venture, DTCC-Euroclear Global Collateral Ltd, in September 2014. This venture aims to develop and streamline margin settlement processes and enhance access to securities collateral worldwide. The joint venture's initiatives are expected to facilitate collateral mobility by eliminating the bottlenecks that delay and impede the movement of collateral across the globe. It intends to provide collateral solutions through two market utilities:

- The Margin Transit Utility (MTU) will enable straight-through processing of margin calls, which will enhance transparency around margin movements and recordkeeping, with aims to improve fail rates and thus help reducing the overall funding needs for participating firms.
- The Collateral Management Utility (CMU) will automate several collateral management tasks, including the efficient identification and allocation of collateral and the repositioning of inventories across settlement locations, making collateral available to participating firms regardless of time and place.

Blockchain Technology

Blockchain is the technology that underpins bitcoin and that works essentially as a secure, decentralized digital public database that could provide near-instantaneous settlement of transactions. It is one of the most talked-about technology innovations in the financial services industry today, and it is believed to have the potential to revolutionize certain parts of the settlement and clearing space.

From a market liquidity perspective, blockchain might be another way to address liquidity concerns in capital markets over the longer term, as it has the potential to free up billions in collateral that may no longer be required for margining purposes due to the instantaneous nature of trade matching.

While the technology is seen as unproven so far, DTCC believes blockchain may present a "once-in-a-generation" opportunity to modernize market infrastructure. As such, it has been engaging in a number of industry initiatives to explore various ways to utilize the technology across its business functions:

- DTCC published a white paper, "Embracing Disruption," in January 2016 calling for industry-wide collaboration on leveraging blockchain to modernize and streamline the current post-trade process.

- DTCC hosted a blockchain symposium in March 2016 titled "Blockchain: Tapping into the Real Potential" in an effort to facilitate discussion and collaboration among market participants to better adopt blockchain technology in the post-clearing and settlement space.

- DTCC also announced its participation in an over $50 million financing for Digital Asset Holdings, LLC, a developer of blockchain for the financial services industry. DTCC is partnering with Digital Asset Holdings to test blockchain technology in the multitrillion-dollar repo market. FICC is assessing the use of blockchain to track securities and cash flowing between firms in real time, which could reduce the amount of time that firms are exposed to counterparty risk, as well as the amount of money firms need to back their repo trades.

CONCLUSION

Liquidity in U.S. fixed income markets has become a top concern for market participants, and rightfully so, given the crucial nature of liquidity to a properly functioning market and the significant structural changes to financial markets over the past decade.

The debate on the drivers of constrained liquidity – and even on the more fundamental question of whether liquidity is constrained at all – is far from conclusive. Nevertheless, we believe that the extreme importance of liquidity and significant changes to market structure highlight a potential risk of future disruptions that the financial industry must work together to address.

Faced with this risk, DTCC has started working on several initiatives that may contribute to addressing some of these challenges. As these plans take shape, it is vital that we receive feedback from a wide variety of industry participants, regulators and other stakeholders to ensure that the solutions that are being designed take all relevant issues into account and that they are fully supported by the industry.

DTCC is also keenly aware of the need to tackle these market-wide challenges through close collaboration across the industry in order to identify and implement the most appropriate and effective response.

We hope that this discussion paper helps us achieve these goals by promoting an industry-wide discussion related to U.S. bond market liquidity. We view this as a practical and productive contribution to DTCC's key goal of further enhancing the resilience of the financial system.

We actively encourage our Members and other industry stakeholders to share their thoughts and participate in the ongoing dialogue we are looking to foster.

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BIBLIOGRAPHY

21st Annual Financial Markets Conference – Getting a Grip on Liquidity: Markets, Institutions, and Central Banks. (2016). Federal Reserve Bank of Atlanta.

Addressing Market Liquidity. (2015). BlackRock.

Automated Trading in Treasury Markets. (2015). Treasury Market Practices Group.

Baklanova, V., Caglio, Celia., Cipriani, M. & Copeland, A. (2016). The U.S. Bilateral Repo Market: Lessons from a New Survey. Office of Financial Research Brief Series.

Basel III leverage ratio framework and disclosure requirements. (2014). Basel Committee on Banking Supervision.

Bloomberg, (2015-2016). US On-The-Run Treasury Yield & ETP Market Cap by Asset Class Data.

Board of Governors of the Federal Reserve System. (2015). 2015 Banking and Consumer Regulatory Policy. Press Release. Federal Register Notice.

Borak, B. (2016). "New Laws' Effect on Market Liquidity Is 'Reasonable' Concern – Fed Economist." Wall Street Journal.

Carney, M. (2016). To G20 Finance Ministers and Central Bank Governors.

Corporate Bond E-Trading: Same Game, New Playing Field. Publication. (2013) McKinsey & Company & Greenwich Associates.

Dimon, J. (2015). Dear Fellow Shareholders. Letter to JPM Shareholders.

Duncan, W. (2015). GFMA, IIF, Isda Plan Liquidity Lobbying Push. Risk.net.

Electronic Trading in Fixed Income Markets. (2016). Bank for International Settlements.

Examination of Liquidity of the Secondary Corporate Bond Markets. (2016). IOSCO Consultation Report.

Federal Reserve Bank of New York. (2015). Primary Dealer Statistics. Treasury and Corporate Bond Data.

Fender, I. & Lewrick, U. (2015). Shifting Tides – Market Liquidity and Market-Making in Fixed Income Instruments. Bank for International Settlements, Quarterly Review, 100-103.

Financial Industry Regulatory Authority, Inc. (2016). Trade Reporting and Compliance Engine. Corporate Bond Data.

FINRA's 2016 Regulatory and Examination Priorities Letter. (2016). FINRA.

Global Financial Markets Liquidity Study. (2015). PricewaterhouseCoopers.

Global Financial Stability Report (GFSR): Vulnerabilities, Legacies, and Policy Challenges. (2015). International Monetary Fund.

Has U.S. Treasury Market Liquidity Deteriorated?. (2015). Liberty Street Economics Blog.

High-Frequency Cross-Market Trading in U.S. Treasury Markets. (2015). Liberty Street Economics Blog.

Implementation and Effects of the G20 Financial Regulatory Reforms. (2016). Financial Stability Board.

IOSCO Securities Markets Risk Outlook 2016. (2016). IOSCO Research Department Staff in cooperation with the IOSCO Committee on Emerging Risks.

Joint Staff Report: The US Treasury Market on October 15, 2014. (2015). U.S. Department of the Treasury, Board of Governors of the Federal Reserve System, Federal Reserve Bank of New York, U.S. Securities and Exchange Commission, U.S. Commodity Futures Trading Commission.

Mizrach, B. (2015). Analysis of Corporate Bond Liquidity. FINRA Research Note, 1-6.

Notice Seeking Public Comment on the Evolution of the Treasury Market Structure. (2016). U.S. Department of the Treasury. Federal Register Vol. 61 No. 14.

Oehmke, M. & Zawadowski, A. (2015). The Anatomy of the CDS Market. Joint Publication by Columbia University & Central European University.

Papanyan, S. (2015). Heightened Bond Liquidity Risks is the New Normal. U.S. Economic Watch.

Redemption Risk of Bond Mutual Funds and Dealer Positioning. (2015). Liberty Street Economics Blog.

Riaz, K., Prager, R. Kahn, R. & Vedbrat, S.,…Watt, E.C. (2014). The Liquidity Challenge: Exploring and Exploiting (IL)Liquidity. Blackrock Publications.

Roubini, N. (2015). The Liquidity Timebomb – Monetary Policies Have Created a Dangerous Paradox. The Guardian.

Sahay, R., Arora, V., Arvantis, T., Faruqee, H., N'Diaye, P., Mancini-Griffoli, T., & IMF Team. (2014). Emerging Market Volatility: Lessons from the Taper Tantrum. IMF Discussion Note.

SEC Proposes Liquidity Management Rules for Mutual Funds and ETFs. (2015). U.S. Securities and Exchange Commission.

SIFMA. (2016). SIFMA Statistics. U.S. Bond Market Issuance and Outstanding. U.S. Bond Market Trading Volume. U.S. Corporate Bond Issuance. U.S. corporate Bond Trading Volume. U.S. GCF Repo Index, Tri-party Repo, and Primary Dealer Financing (Repo/Reverse Repo). U.S. Corporate Bond Issuance.

The Liquidity Mirage. (2015). Liberty Street Economics Blog.

The New Basel III Framework: Navigating Changes in Bank Capital Management. (2010). PricewaterhouseCoopers.

Whalen, R. C. & Scott, J. (2015). Can the Credit Default Swap Market be Salvaged? Issues for Borrowers and Investors. Kroll Bond Rating Agency Publication.

Wholesale & Investment Banking Outlook – Liquidity Conundrum: Shifting Risks, What It Means. (2015). Morgan Stanley & Oliver Wyman.

William, D. (2015). Regulation and Liquidity Provision. SIFMA Liquidity Forum.

Wood, D. (2015). "GFMA, IIF, ISDA Plan Liquidity Lobbying Push." Risk.Net.