

AUTHORS



Jamil Baz
Managing Director, Head of
Client Solutions and Analytics



Josh Davis
Managing Director
Head of Client Analytics



Courtney Garcia
Executive Vice President
Portfolio Risk Manager



Lloyd Han
Quantitative Research Analyst
Client Solutions and Analytics



Sean Klein
Executive Vice President
Client Solutions and Analytics

Seven Lessons in Liquidity

Executive Summary

- Elevated valuations have pushed investors toward higher-yielding, often less liquid assets.
- This shift and the public collapse of several well-known investment funds have made liquidity risk more important than ever.
- However, the process of characterizing liquidity risk is far from straightforward, and conventional wisdom can be dangerously misleading.
- In this piece, we describe seven lessons in liquidity that may help investors and managers prepare for the next crisis.

INTRODUCTION

"Revenue is vanity, profit is sanity, but cash is king." – Anonymous

Secular declines in interest rates have led to high valuations and lower expected yields across most asset classes. This has pushed investors toward higher-yielding, often less liquid investments. Unsurprisingly, this shift has prompted an increase in liquidity concerns among market participants, while recent events, including the public collapse of several well-known investment funds, have further focused attention on the importance of liquidity management. Measuring, modeling and monitoring liquidity risk is challenging and rife with potential misconceptions. This piece outlines seven lessons in liquidity and dispels some misleading conventional wisdom.

LESSON 1: REGULATION GIVETH, REGULATION TAKETH AWAY

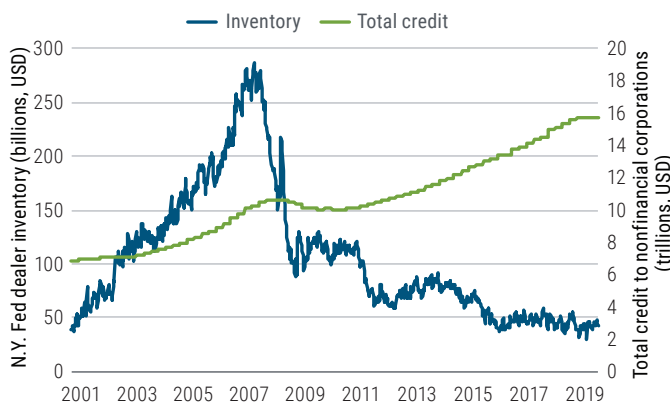
"Regulation in many cases is the wolf in sheep's clothing." – Henry Paulson

After the financial crisis, new global standards increased the level of capital in the banking system and applied more restrictive criteria to calculate the risk on bank balance sheets. The results have been substantial. In the decade since the crisis, high quality loss-absorbing capital at banks has more than doubled. Tier 1 capital ratios have increased from below 6% in 2007–2008 to 12% today.¹

¹ Board of Governors of the Federal Reserve System, Comprehensive Capital Analysis and Review 2019: Assessment Framework and Results (June 2019)

These changes have not come without costs. Increased capital charges have reduced banks' willingness to hold certain assets. Dealer inventories – securities that institutions hold to facilitate market making – have fallen substantially. Exhibit 1 shows inventories of structured and corporate credit were slowly increasing until the financial crisis, when they sharply fell, from nearly \$300 billion to only \$50 billion at the end of 2018. Should the market need immediate liquidity, this limited market-making capacity is concerning – and even more concerning given the large increase in credit over the same period: Total credit to nonfinancial corporates has risen nearly \$6 trillion from its postcrisis low (60%). With dealers holding fewer of these assets for trading, it becomes harder to find active trading partners.

Exhibit 1: Not on my balance sheet



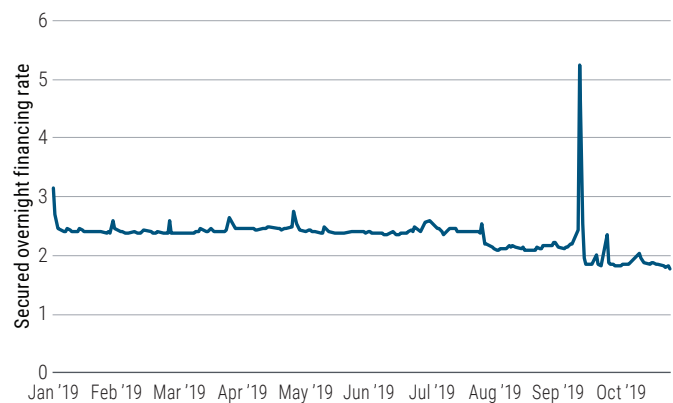
Source: PIMCO as of September 2019. Dealer inventories represent corporate and structured inventories from the Federal Reserve Bank of New York; total credit to nonfinancial corporations from the Federal Reserve Bank of St. Louis.

The market has tried to accommodate the new standards by changing how it trades, but to little effect. Intermediaries and investors have been increasing the number of cash corporate bonds transacted as portfolio or basket trades, in which the underlying cash bonds have similar characteristics to credit index products. In principle, these transactions allow dealers to more efficiently hedge market risk with index derivatives or exchange-traded funds (ETFs) and should thus increase their ability to hold corporate debt. Despite this development, overall inventories of these products have continued to shrink.

The consequences of restricted balance sheets are not merely theoretical, as we show in Exhibit 2. On 16 September 2019 and 17 September 2019, the rate on overnight repurchase agreements (repos) secured by U.S. Treasuries soared from just over 2% to more than 5.25%.² Intraday, the rates on loans secured by agency mortgages briefly exceeded 10%!

The intraday-high rates were found only on companies essentially in default: the ICE BofAML US High Yield CCC and below index on 17 September 2019 yielded 11.65%. Yet numerous banks were unwilling to provide collateralized lending at these rates. At a minimum, this shows that excess reserves were significantly less abundant than previously thought.

Exhibit 2: Water, water everywhere, nor any drop to drink



Source: Bank of New York Mellon, JPMorgan Chase and DTCC Solutions as of October 2019

There are plenty of competing explanations for this distortion, such as end-of-quarter corporate tax payments, settlement of a Treasury auction and other aberrant liquidity needs. However, it is also reasonable to believe that bank capital requirements and related excess cash reserves at the Federal Reserve exacerbate recurrent liquidity shortages.

In short, bank balance sheets are safer in part because some of their risk has been transferred to investors. Banks are more robust and less likely to propagate credit shocks to other sectors, but they appear less likely to act as intermediaries, thus reducing market liquidity. Regulations can hurt by helping.

LESSON 2: DON'T BUY WITH BUY AND HOLD

"I don't care to belong to any club that will have me as a member."
– Groucho Marx

Ideally, you want to know who else holds the securities in your portfolio. If buy-and-hold investors are a large fraction of the market for assets that you own, your ability to find active trading partners in those securities will be limited. For example, pensions and insurance companies use investment grade (IG) bonds to hedge their long-term liabilities. This makes them large passive holders of these securities: Since 2011, insurance companies have held an average 32% of all outstanding IG corporate debt.³

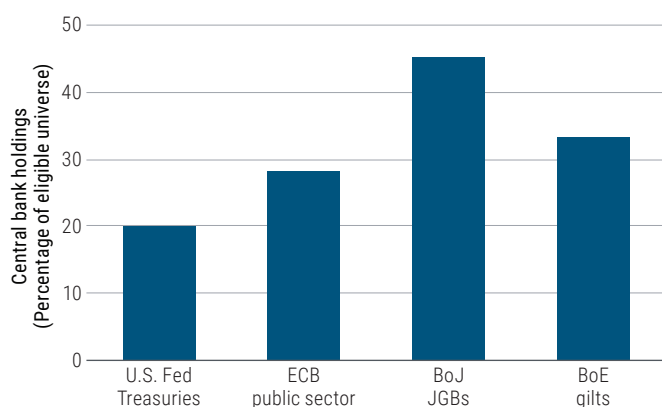
2 New York Fed Secured Overnight Financing Rate

3 Thomson Reuters eMAXX

When no one is trading securities, it is harmful to the securities' liquidity. This effect is most stark during periods of increased market volatility, which tend to coincide with higher liquidity costs. Indeed, Dick-Nielsen and Rossi (2018) find that spreads widen more after rating downgrades when there are more insurers holding the underlying security. Instead of exacerbating liquidity issues with passive positioning, successful active managers can exploit security-level mismatches in liquidity to the benefit of their clients.

Increasing concentration is not limited to insurers. The past decade has seen a shift in central banks' approach to monetary policy. As yields have approached zero, bank balance sheets have become swollen with assets and have driven up prices. Almost \$15 trillion of outstanding debt worldwide now features negative yields.⁴ As a consequence, there is increasingly concentrated ownership of securities that typically have been considered safe and liquid, such as sovereign debt (see Exhibit 3). The effect is particularly stark in Japan, where the central bank now owns more than 40% of government bonds and 77.5% of ETFs.⁵

Exhibit 3: Who owns those bonds?



Source: Large central bank balance sheets and market functioning from the Bank for International Settlements as of October 2019. Public sector defined by the ECB as central government bonds and bonds issued by recognized agencies, regional and local governments, international organizations and multilateral development banks located in the euro area.

Increasing buy-and-hold ownership in corporate credit over the past decade has demonstrably reduced the amount of available liquidity. At the same time, central banks have taken large, persistent positions in many markets. The liquidity effect of their purchases on markets for the underlying assets has not been tested.

LESSON 3: YOU NEED MORE LIQUIDITY THAN YOU NEED

"Precision beats power; timing beats speed." – Anonymous

Liquidity is more than a defensive concern. Ideally, asset managers want to go on the offensive to take advantage of bouts of volatility to extract returns for their clients.

Liquidity events can lead to fire sales, in which organizations have to sell at depressed prices to raise needed cash. Fire sales can simultaneously exacerbate liquidity squeezes and provide an array of high-Sharpe-ratio opportunities. Above, we highlighted a recent period when junk bond-like levels of return could briefly be achieved with U.S. government-level risk. There are plenty of similar examples of liquidity-related anomalies.

In line with his famous adage that investors should "be fearful when others are greedy and greedy when others are fearful," Warren Buffett was one of the few liquidity providers during the financial crisis. For example, at the absolute height of the crisis, after the failure of Lehman Brothers, Buffett invested \$5 billion in a combination of preferred shares and warrants of Goldman Sachs. The preferred shares yielded 10% and, as a result, were bought back by Goldman as soon as possible. Within two years, the preferred shares had earned Buffett \$3.7 billion, and in 2013 the warrants were converted into an additional \$2 billion in cash plus a stake in the bank that is currently worth \$3.1 billion. All in all, Buffett saw a 176% return on his investment.

The crisis presented so many opportunities for profit that even the U.S. government played the part of an opportunistic investor, albeit a less than willing one. The Treasury Department purchased "distressed" assets as part of the Troubled Asset Relief Program (TARP). Under this authority, the government made substantial investments in the economy, particularly in the banking and credit sectors, and although it was not a goal of the program, the financial sector's share of TARP sent billions in profits back to Uncle Sam. TARP's efforts for banks generated a \$24.3 billion return on a \$245 billion investment (9.9%); those for credit programs produced a \$3.3 billion return on a \$19 billion investment (17.3%).⁶ Even the investment in American International Group (AIG) – which was clearly not intended to be profitable given that the company was losing over half a billion dollars per day at that time – ended with \$22.7 billion more in cash collected than disbursed.^{7,8}

4 IMF Global Financial Stability Report October 2019

5 Leika Kihara, "Kuroda defends Japan central bank's ETF buying, sees no near-term exit," Reuters (6 December 2018)

6 TARP monthly report to Congress, October 2019

7 On 2 March 2009, AIG reported losses of \$61.7 billion for fourth-quarter 2008

8 Troubled Asset Relief Program Citizens' Report, Fiscal Year 2013. U.S. Department of the Treasury Office of Financial Stability

Typically, there are two polar forms of financial market structure: high liquidity/low returns or low liquidity/high returns. In an illiquid market, a successful manager should actively provide liquidity and reap high – sometimes very high – returns.

LESSON 4: DON'T FIGHT THE LAST WAR

"If humans fight the last war, nature fights the next one."

– Nassim Nicholas Taleb

The nonagency mortgage is the poster child of the 2008–2009 crisis and, as such, is seared in the financial industry's collective memory as high risk and fragile. However, assets that were brittle in the past may be among the most robust today. "Past performance is not an indicator of future results," it turns out, is more than a cliché.

Indeed, since the crisis the nonagency market has benefited from a combination of increasing asset values, seasoning and generally stronger fundamentals. New regulations on nonagency mortgages have made them significantly less appealing to many financial institutions, though the underlying mortgages are much less likely to default. As we show in Exhibit 4, loan-to-value (LTV) ratios on mortgages in precrisis structured products have steadily fallen since 2012. With current collateral values (LTVs of around 60%), home prices would need to fall by 50% or more for LTVs on these mortgages to reach their precrisis highs. Not all assets have seen this improvement, however. Nonfinancial corporate leverage (debt-to-equity) has increased over the same time period, weakening the resilience of this sector.

Using a simple Merton distance-to-default (DD) model, a mortgage was 30% closer to default than a corporate bond in 2007. In contrast, using 2019 balance sheets, the same mortgage is now 40% further from default (see Appendix for details).

There is every reason to think that evolving credit quality will affect liquidity. Sharif et al. (2018) estimate that the liquidity cost of corporate bonds, 42 basis points (bps) in normal times, increases over eight times during crisis periods (to 339 bps). Unsurprisingly, these costs are correlated with default risk: Bonds with lower credit ratings have even higher trading costs.

The past decade has seen substantial changes in credit quality and risk across sectors. Do not fight the last war.

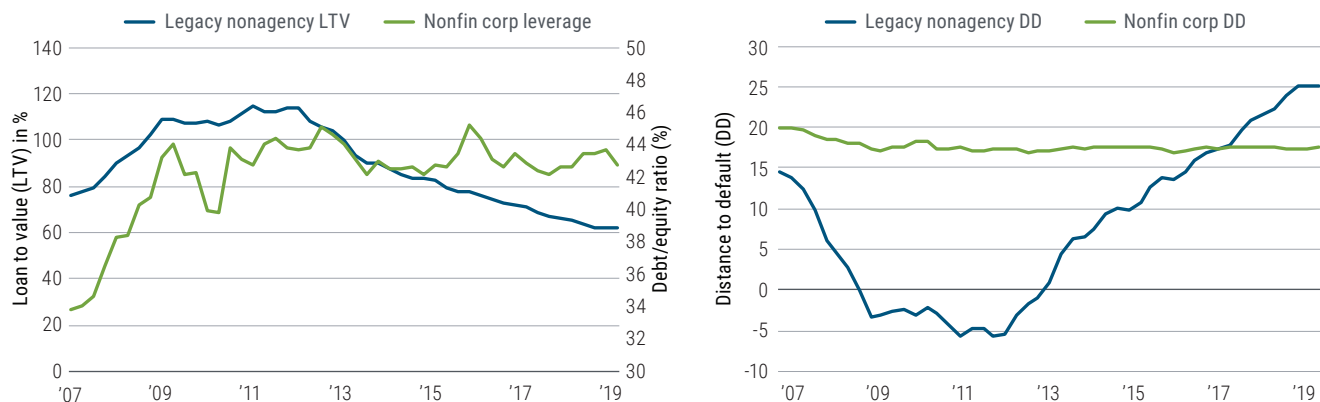
LESSON 5: SOMETIMES BIGGER IS BETTER

"You're gonna need a bigger boat." – Roy Scheider, *Jaws*

Asset managers' resilience in illiquid markets is related to their size: Larger firms enjoy access to more diverse investors, counterparties and assets, all of which benefit them when the market is stressed.

Managing liquidity is easier in a larger fund with many investors. To take a simple example, consider a fund whose investors each have a 20% chance of withdrawing their money on any given day. While the fund will average 20% outflows, the range around this number will be heavily influenced by the number of investors in the fund. If investors behave independently of one another (unlikely in a liquidity crisis), a fund with 10 investors will have a 12% probability of experiencing outflows of more than 30%.

Exhibit 4: Past performance is not an indicator of future results



Source: PIMCO, Federal Reserve Economic Data, Bloomberg Finance, Capital IQ and Citigroup Index as of March 2019. LTV used for nonagency mortgages; debt as percentage of market value used for nonfinancial corporates.

With 1,000 investors, this probability falls to essentially zero (see Appendix for details). Although this model is highly stylized and should not be taken literally, more investors usually mean more predictable funding needs.

Just as more investors benefit from one another, so do more diverse counterparties. A fund must be robust to liquidity issues at its trading partners. More counterparties mean that any run is more likely to affect a smaller portion of them. Indeed, the Federal Reserve's definition of a "liquid and readily marketable" security spends as many points discussing the diversity of the market makers as it does the features of the security.⁹ Today, 24 primary dealers trade directly with the New York Federal Reserve. This is down 50% from the late 1980s, and even this statistic overstates the actual diversity: The top five firms handle 58% of all trading, and the top 10 more than 85%.¹⁰ It is no wonder that the U.S. Treasury has been relaxing primary dealer requirements to attract more counterparties to this market.¹¹

Finally, a larger manager is more likely to have access to more diverse assets. Liquidity issues in specific asset classes will be less problematic for a manager with many options. Although the repo market is perceived as safe 99.99% of the time, you would have had a rough time in September 2008 or September 2019 if it were your only source of funding. Access to more markets provides access to more options. A larger manager is better positioned to intelligently (and, one hopes, profitably,) trade in more varied instruments and access more diverse funding.

The liquidity advantage of a large asset manager is not theoretical. According to the International Monetary Fund's analysis of fixed income funds, "larger funds are less susceptible to liquidity shortfalls and tend to face smaller shortfalls than smaller funds," in part because they "typically face lower redemption stress" and hold "diversified portfolios [that] provide them with more ample liquidity," for all of the reasons discussed above.¹² Size has implications beyond survival: Access and expertise in many markets provide more frequent opportunities for excess returns. If one market is

thirsting for liquidity and other markets are relatively unaffected, a large active manager is in a better position to intermediate the different liquidity needs. This will help that manager survive liquidity crises and try to provide handsomely to its investors while doing so.

LESSON 6: OUT OF COMPLEXITY, FIND SIMPLICITY

"Simplicity is complexity resolved." – Constantin Brancusi

Derivative markets are sometimes thought of as complex or even esoteric, and some investors are wary of them. This stigma can spill over into their views on the liquidity of derivatives. However, standardized derivative contracts can be a reliable source of funding.

When investors gain exposure to commodities, they rarely have truckloads of oil barrels or pork bellies delivered to their front doors. Instead, they trade in futures, where their gains or losses are based on movements in the prices of those goods, and not in the physical commodities themselves. Just as the futures market facilitates liquid trading of these assets, there are standardized derivative contracts, which improve liquidity in many other markets. The most widely used of these derivatives are government bond futures and interest rate swaps, liquid means of adjusting duration and targeting specific areas of yield curve exposure. There are two additional examples in the mortgage and corporate debt markets.

Within agency mortgage-backed securities (MBS), the "to be announced" (TBA) market allows for the trading of agency mortgage exposure without requiring the purchase of specific mortgages. Instead, the investor commits to purchasing pools of mortgages with certain characteristics at a future date. Similar to commodity futures, TBA contracts require less capital than if the investor was purchasing the underlying mortgages in cash. They are far more liquid as well: Daily volumes in the secondary market for TBAs are almost 10 times higher than those for specified pools of loans (Gao et al. 2017).

In the corporate debt market, a credit default swap (CDS) contract allows investors to take exposure to the credit risk of an issuer without purchasing the underlying bond. The Credit Default Swap Index (CDX) consists of a portfolio of CDS contracts, which traders use to adjust their exposure to the broader corporate IG credit market. Similar to TBA contracts, CDS and CDX contracts require less capital than buying cash bonds, and the liquidity of the CDX contracts allows portfolio managers to gain or reduce credit exposure for a fraction of the transaction costs of individual cash bonds or even a broad

9 12 CFR § 249.3. Liquid and readily-marketable means, with respect to a security, that the security is traded in an active secondary market with:

- (1) More than two committed market makers;
- (2) A large number of non-market maker participants on both the buying and selling sides of transactions;
- (3) Timely and observable market prices; and
- (4) A high trading volume

10 Greenwich Associates, "U.S. Institutional Investors Increasingly Willing to Look Beyond Primary Dealers for Treasury Trades," 1 November 2016

11 Katy Burne, "Fed Moves to Expand Pool of Primary Dealers," *Wall Street Journal*, November 2016

12 International Monetary Fund, "Global Financial Stability Report," chapter 3 (2019)

basket of names. Recent indications show a 2 bps–3 bps bid-offer spread for liquid investment grade cash bonds, compared with $\frac{1}{4}$ bps– $\frac{1}{2}$ bps for even larger-size blocks of the IG CDX contact. The CDX index has historically traded with tighter spreads during crisis periods as well: Cash-bond spreads widened almost twice as much as CDX during the 2008 crisis (Boyarchenko et al. 2018). If investors had to sell at the height of the crisis, they likely would have been better off holding the simpler bond and adjusting their exposure with CDS.

Derivatives can provide capital-efficient and liquid exposure in a variety of markets. TBA and CDX can give investors liquidity. Despite their reputation for complexity, certain derivatives are simpler and more liquid than cash purchases.

LESSON 7: FOCUS ON THE SOLUTIONS, NOT THE PROBLEMS

“Victory comes from finding opportunities in problems.”

– Sun Tzu

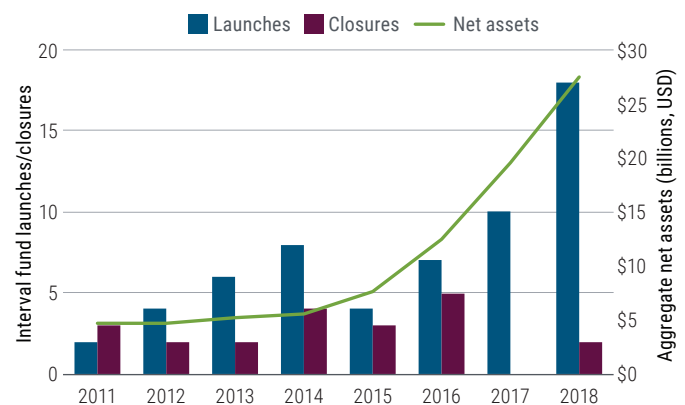
Liquidity events can have potentially systemic impacts. The market is constantly searching for solutions, and several developments may help keep investors out of harm’s way.

Central banks support liquidity mainly through banks and primary dealers. As we have seen, this is usually effective – except, of course, when those same intermediaries have their own liquidity issues and elect not to lend. If banks want to avoid intermediating liquidity on their balance sheets, one potential solution is the simple provision of collateralized lending from their balance sheets. A particularly salient example: sponsored repo transactions, in which banks intermediate repo needs for nondealers without the costly capital charges explained in Lesson 1. In exchange, they guarantee the pledges of the sponsored members. Unsurprisingly, these transactions have rapidly increased in popularity. From June 2017 through December 2018, they grew from essentially zero to more than \$100 billion.¹³

One potential way to deliver more liquidity is to allow for more flexible collateral. The European Central Bank allows certain credit-risky bonds and asset-backed securities to be used in repos. The increased flexibility permits an additional €7 trillion of nongovernment assets to serve as a potential lifeline when liquidity needs arise.¹⁴

Finally, managers can match the liquidity profile of their assets to specific funds. Unlisted vehicles can provide liquidity to investors at specific intervals. Interval funds typically allow partial redemptions quarterly, semiannually or annually. In the same spirit, tender offer funds allow redemptions only at the discretion of the board. These funds mitigate the asset manager’s risk of redemptions and potential forced selling of illiquid assets. It is no wonder that these products have proliferated as liquidity concerns have mounted. In Exhibit 5, we show interval fund assets have grown at a 40% annualized rate since 2015.

Exhibit 5: (II)liquidity for sale



Source: Interval Fund Tracker as of December 2018.

Investors are burdened with reduced liquidity in these funds, but willingly. In exchange, they receive attractive tax reporting, exposure to alternative assets and potential for higher returns. Baz, Stracke and Sapra (2019) estimate that investors could earn an additional 2% annually for holding illiquid assets.

Every problem presents an opportunity. The market has responded to growing liquidity concerns in several ways, including increased repo arrangements outside of primary dealers, public provision of liquidity using more flexible collateral and a proliferation of unlisted vehicles to help control a manager’s liquidity profile.

¹³ Katy Burne, “Sponsored Repos Are Surging,” Bank of New York Mellon as of June 2019

¹⁴ Eurosystem Collateral Data from European Central Bank as of September 2019

CONCLUSION

Liquidity concerns are top of mind for many market participants. We all know there will be another crisis, but its features and timing are impossible to predict. Market disruptions are both inevitable and unpredictable. However, there are several lessons we can learn from the markets today that may challenge conventional wisdom whenever and wherever the next downturn should appear.

- Transferring risk is easy, but removing it is hard. Recent improvements in liquidity and solvency in the financial sector have had a chilling effect on market-making activity in many assets.
- You should know who else owns your assets. Concentrated buy-and-hold ownership can exacerbate liquidity events, and expanding central bank balance sheets may affect liquidity in unexpected ways.
- It is not enough to simply survive liquidity events. Successful asset managers should be positioned to provide liquidity under stress to add value for their clients.
- Credit conditions have materially changed since the last crisis. The riskiest assets of the past may be among the most resilient today.
- Bigger can be better. More diverse investors, counterparties and investment opportunities combine to offer larger asset managers more ways to isolate or entirely avoid liquidity crises.
- Simple assets are not necessarily the easiest to trade. Derivative markets can provide potentially more reliable and more liquid exposure than individual assets.
- Financial markets are relentlessly creative. Nascent efforts to manage liquidity risks include relaxed collateral requirements, rapid expansion of repo market access and the growing appeal of funds that reduce liquidity for end investors.

Finally, even the best strategies will fail if they are exploited simultaneously by all market participants. The most pernicious risk may be a comfortable consensus. When everyone is agreeing with you, you need to be ready to disagree with yourself.

APPENDIX

Distance-to-default (DD) model

The Kealhofer–Merton–Vasicek model of corporate debt, based on Merton (1974), assumes that the equity of a company can be modeled as a call option on the value of the company. Assume the company value follows a geometric Brownian motion.

$$dV_t = \mu V_t dt + \sigma dW_t. \quad (\text{A.1})$$

The distance-to-default (DD) measure is defined as the distance between the expected forward value of the asset and the default point. Applying the Black–Scholes option pricing formula, it can be computed as

$$DD(t) = \frac{\ln\left(\frac{V_0}{D}\right) + (r - \frac{1}{2}\sigma^2)(T-t)}{\sigma\sqrt{T-t}} \quad (\text{A.2})$$

where V_0 is the initial value of the company, r is the risk-free rate, σ is the volatility of company value and T is the expiry. In Exhibit 4, we calculate distance-to-default measures setting $r=2\%$, $T=1$ and $t=0$. For mortgages, we set $\sigma=2\%$ for the volatility of house prices and an asset volatility of $\sigma=7\%$ for nonfinancial corporates, in line with results from Shiller et al. (2019) and Choi and Richardson (2016).

Binomial model of investor redemption

We model investors as each having a $p\%$ chance of withdrawing their money on any given day. If investors are independent, for a fund of n investors the number of investors who redeem will follow a binomial distribution. We can compute the probability of observing $X \geq j$ investors withdraw as

$$Prob(X \geq j) = \sum_{k=j}^n \binom{n}{k} p^k (1-p)^{n-k}. \quad (\text{A.3})$$

Fixing $p=0.2$, we compute this probability for two pairs of values for j and n . We pick $j=3$ and $n=10$ to represent a small fund and set $j=300$ and $n=1,000$ to represent a large fund. The ratio of j to n is held fixed for both examples to represent 30% of fund value being redeemed.

REFERENCES

"A Primer on Sponsored Repo." J.P. Morgan (April 16, 2019).
<https://www.jpmorgan.com/global/research/sponsored-repo>

Baz, Jamil, Christian Stracke and Steve Sapra. "Valuing a Lost Opportunity: An Alternative Perspective on the Illiquidity Discount." PIMCO *Quantitative Research and Analytics* (July 2019).

Boyarchenko, Nina, Pooja Gupta, Nick Steele and Jacqueline Yen. "Trends in Credit Basis Spreads." *Economic Policy Review* (October 2018).

Choi, Jaewon and Matthew Richardson. "The Volatility of a Firm's Assets and the Leverage Effect." *Journal of Financial Economics* (August 2016).

Diamond, Douglas W. and Philip H. Dybvig. "Bank Runs, Deposit Insurance, and Liquidity." *Journal of Political Economy* (June 1983).

Dick-Nielsen, Jens and Marco Rossi. "The Cost of Immediacy for Corporate Bonds" (February 19, 2018).
<https://ssrn.com/abstract=2139403>

Gao, Pengjie, Paul Schultz and Zhaogang Song. "Liquidity in a Market for Unique Assets: Specified Pool and To-Be-Announced Trading in the Mortgage-Backed Securities Market." *Journal of Finance* (June 2017).

Merton, Robert C. "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." *Journal of Finance* (May 1974).

Sharif, Masoud, Angie Zheng, Rama S. Nambimadom and Ravi K. Mattu. "Liquidity in Corporate Credit Markets." PIMCO *Quantitative Research and Analytics* (August 2018).

Shiller, Robert J., Rafal M. Wojakowski, M. Shahid Ebrahim and Mark B. Shackleton. "Continuous Workout Mortgages: Efficient Pricing and Systemic Implications." *Journal of Economic Behavior & Organization* (January 2019).

2004 Chairman's Letter, Berkshire Hathaway.
<http://www.berkshirehathaway.com/letters/2004.html>.

World Economic Outlook: Global Manufacturing Downturn, Rising Trade Barriers. International Monetary Fund (October 2019).

All investments contain risk and may lose value. Investing in the **bond market** is subject to risks, including market, interest rate, issuer, credit, inflation risk, and liquidity risk. The value of most bonds and bond strategies are impacted by changes in interest rates. Bonds and bond strategies with longer durations tend to be more sensitive and volatile than those with shorter durations; bond prices generally fall as interest rates rise, and low interest rate environments increase this risk. Reductions in bond counterparty capacity may contribute to decreased market liquidity and increased price volatility. Bond investments may be worth more or less than the original cost when redeemed. **Corporate debt securities** are subject to the risk of the issuer's inability to meet principal and interest payments on the obligation and may also be subject to price volatility due to factors such as interest rate sensitivity, market perception of the creditworthiness of the issuer and general market liquidity. **Equities** may decline in value due to both real and perceived general market, economic and industry conditions. Investing in **foreign-denominated and/or -domiciled securities** may involve heightened risk due to currency fluctuations, and economic and political risks, which may be enhanced in emerging markets. **High yield, lower-rated securities** involve greater risk than higher-rated securities; portfolios that invest in them may be subject to greater levels of credit and liquidity risk than portfolios that do not. Investments in **illiquid securities** may reduce the returns of a portfolio because it may be not be able to sell the securities at an advantageous time or price. **Mortgage- and asset-backed securities** may be sensitive to changes in interest rates, subject to early repayment risk, and while generally supported by a government, government-agency or private guarantor, there is no assurance that the guarantor will meet its obligations.

Sovereign securities are generally backed by the issuing government. Obligations of U.S. government agencies and authorities are supported by varying degrees, but are generally not backed by the full faith of the U.S. government. Portfolios that invest in such securities are not guaranteed and will fluctuate in value. An investment in an **interval fund or tender offer fund** is not suitable for all investors. There is no secondary market for its shares so the funds are subject to liquidity risk, as there is no guarantee that an investor would be able to tender all of their requested shares at an advantageous time or price. **Credit default swap (CDS)** is an over-the-counter (OTC) agreement between two parties to transfer the credit exposure of fixed income securities; CDS is the most widely used credit derivative instrument. **Derivatives and commodity-linked derivatives** may involve certain costs and risks, such as liquidity, interest rate, market, credit, management and the risk that a position could not be closed when most advantageous. Commodity-linked derivative instruments may involve additional costs and risks such as changes in commodity index volatility or factors affecting a particular industry or commodity, such as drought, floods, weather, livestock disease, embargoes, tariffs and international economic, political and regulatory developments. Investing in derivatives could lose more than the amount invested. **Management risk** is the risk that the investment techniques and risk analyses applied by PIMCO will not produce the desired results, and that certain policies or developments may affect the investment techniques available to PIMCO in connection with managing a strategy.

HYPOTHETICAL PERFORMANCE RESULTS HAVE MANY INHERENT LIMITATIONS, SOME OF WHICH ARE DESCRIBED BELOW. NO REPRESENTATION IS BEING MADE THAT ANY ACCOUNT WILL OR IS LIKELY TO ACHIEVE PROFITS OR LOSSES SIMILAR TO THOSE SHOWN. IN FACT, THERE ARE FREQUENTLY SHARP DIFFERENCES BETWEEN HYPOTHETICAL PERFORMANCE RESULTS AND THE ACTUAL RESULTS SUBSEQUENTLY ACHIEVED BY ANY PARTICULAR TRADING PROGRAM.

ONE OF THE LIMITATIONS OF HYPOTHETICAL PERFORMANCE RESULTS IS THAT THEY ARE GENERALLY PREPARED WITH THE BENEFIT OF HINDSIGHT. IN ADDITION, HYPOTHETICAL TRADING DOES NOT INVOLVE FINANCIAL RISK, AND NO HYPOTHETICAL TRADING RECORD CAN COMPLETELY ACCOUNT FOR THE IMPACT OF FINANCIAL RISK IN ACTUAL TRADING. FOR EXAMPLE, THE ABILITY TO WITHSTAND LOSSES OR TO ADHERE TO A PARTICULAR TRADING PROGRAM IN SPITE OF TRADING LOSSES ARE MATERIAL POINTS WHICH CAN ALSO ADVERSELY AFFECT ACTUAL TRADING RESULTS. THERE ARE NUMEROUS OTHER FACTORS RELATED TO THE MARKETS IN GENERAL OR TO THE IMPLEMENTATION OF ANY SPECIFIC TRADING PROGRAM WHICH CANNOT BE FULLY ACCOUNTED FOR IN THE PREPARATION OF HYPOTHETICAL PERFORMANCE RESULTS AND ALL OF WHICH CAN ADVERSELY AFFECT ACTUAL TRADING RESULTS.

Statements concerning financial market trends are based on current market conditions, which will fluctuate. Forecasts, estimates and certain information contained herein are based upon proprietary research and should not be considered as investment advice or a recommendation of any particular security, strategy or investment product.

This material contains the current opinions of the manager and such opinions are subject to change without notice. This material is distributed for informational purposes only. Information contained herein has been obtained from sources believed to be reliable, but not guaranteed.

PIMCO as a general matter provides services to qualified institutions, financial intermediaries and institutional investors. Individual investors should contact their own financial professional to determine the most appropriate investment options for their financial situation. This is not an offer to any person in any jurisdiction where unlawful or unauthorized. | **Pacific Investment Management Company LLC**, 650 Newport Center Drive, Newport Beach, CA 92660 is regulated by the United States Securities and Exchange Commission. | **PIMCO Europe Ltd** (Company No. 2604517) and PIMCO Europe Ltd - Italy (Company No. 07533910969) are authorised and regulated by the Financial Conduct Authority (12 Endeavour Square, London E20 1JN) in the UK. The Italy branch is additionally regulated by the Commissione Nazionale per le Società e la Borsa (CONSOB) in accordance with Article 27 of the Italian Consolidated Financial Act. PIMCO Europe Ltd services are available only to professional clients as defined in the Financial Conduct Authority's Handbook and are not available to individual investors, who should not rely on this communication. | **PIMCO Deutschland GmbH** (Company No. 192083, Seidlstr. 24-24a, 80335 Munich, Germany), PIMCO Deutschland GmbH Italian Branch (Company No. 10005170963) and PIMCO Deutschland GmbH Spanish Branch (N.I.F. W2765338E) are authorised and regulated by the German Federal Financial Supervisory Authority (BaFin) (Marie-Curie-Str. 24-28, 60439 Frankfurt am Main) in Germany in accordance with Section 32 of the German Banking Act (KWG). The Italian Branch and Spanish Branch are additionally supervised by the Commissione Nazionale per le Società e la Borsa (CONSOB) in accordance with Article 27 of the Italian Consolidated Financial Act and the Comisión Nacional del Mercado de Valores (CNMV) in accordance with obligations stipulated in articles 168 and 203 to 224, as well as obligations contained in Title V, Section I of the Law on the Securities Market (LSM) and in articles 111, 114 and 117 of Royal Decree 217/2008, respectively. The services provided by PIMCO Deutschland GmbH are available only to professional clients as defined in Section 67 para. 2 German Securities Trading Act (WpHG). They are not available to individual investors, who should not rely on this communication. | **PIMCO (Schweiz) GmbH** (registered in Switzerland, Company No. CH-020.4.038.582-2), Brandschenkestrasse 41, 8002 Zurich, Switzerland, Tel: +41 44 512 49 10. The services provided by PIMCO (Schweiz) GmbH are not available to individual investors, who should not rely on this communication but contact their financial adviser. | **PIMCO Asia Pte Ltd** (Registration No. 199804652K) is regulated by the Monetary Authority of Singapore as a holder of a capital markets services licence and an exempt financial adviser. The asset management services and investment products are not available to persons where provision of such services and products is unauthorised. | **PIMCO Asia Limited** is licensed by the Securities and Futures Commission for Types 1, 4 and 9 regulated activities under the Securities and Futures Ordinance. The asset management services and investment products are not available to persons where provision of such services and products is unauthorised. | **PIMCO Australia Pty Ltd** ABN 54 084 280 508, AFSL 246862. This publication has been prepared without taking into account the objectives, financial situation or needs of investors. Before making an investment decision, investors should obtain professional advice and consider whether the information contained herein is appropriate having regard to their objectives, financial situation and needs. | **PIMCO Japan Ltd**, Financial Instruments Business Registration Number is Director of Kanto Local Finance Bureau (Financial Instruments Firm) No. 382. PIMCO Japan Ltd is a member of Japan Investment Advisers Association and The Investment Trusts Association, Japan. All investments contain risk. There is no guarantee that the principal amount of the investment will be preserved, or that a certain return will be realized; the investment could suffer a loss. All profits and losses incur to the investor. The amounts, maximum amounts and calculation methodologies of each type of fee and expense and their total amounts will vary depending on the investment strategy, the status of investment performance, period of management and outstanding balance of assets and thus such fees and expenses cannot be set forth herein. | **PIMCO Taiwan Limited** is managed and operated independently. The reference number of business license of the company approved by the competent authority is (107) FSC SICE Reg. No.001. 40F., No.68, Sec. 5, Zhongxiao E. Rd., Xinyi Dist., Taipei City 110, Taiwan (R.O.C.), Tel: +886 2 8729-5500. | **PIMCO Canada Corp.** (199 Bay Street, Suite 2050, Commerce Court Station, P.O. Box 363, Toronto, ON, M5L 1G2) services and products may only be available in certain provinces or territories of Canada and only through dealers authorized for that purpose. | **PIMCO Latin America** Av. Brigadeiro Faria Lima 3477, Torre A, 5º andar São Paulo, Brazil 04538-133. | No part of this publication may be reproduced in any form, or referred to in any other publication, without express written permission. PIMCO is a trademark of Allianz Asset Management of America L.P. in the United States and throughout the world. ©2020, PIMCO.