

Liquidity in Corporate Bond Markets Under Stressed Conditions

Final Report



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Contents

| Chapter | | Page |
|----------------|--|-------------|
| | Executive Summary | 1 |
| | | |
| 1 | Introduction | 4 |
| | | |
| 2 | Background | 8 |
| | | |
| 3 | Definition and Characteristics of Liquidity | 8 |
| | | |
| 4 | Liquidity during Normal Market Conditions | 10 |
| | | |
| 5 | Liquidity during Stressed Market Conditions | 12 |
| | | |
| 6 | Case Studies | 26 |
| | | |
| 7 | Summary of our Observations Concerning Behavior Under Stressed Conditions | 42 |
| | | |
| 8 | Conclusions | 44 |
| | | |
| 9 | References | 46 |

Executive Summary

Corporate bond market liquidity under normal (i.e. non-stressed) conditions is important for the efficient allocation of risk capital and has received much attention in the regulatory and academic communities. In recent years, corporate bond markets have evolved as a result of post-crisis financial regulations, changes in risk aversion of intermediaries, and patterns of supply and demand (themselves influenced by financial reforms and developments in monetary and fiscal policies in advanced economies).

- Post-crisis regulations and a reduction in risk appetite on the part of broker-dealers have led to changes in the nature of intermediation. Intermediaries now have both less capacity and less appetite to provide liquidity to traders and investors, and the proportion of their intermediation that is agency-based has increased. Market participants have indicated to us that this has made it more difficult to execute trades, including having to trade in smaller block sizes and encountering longer times for finding counterparties with whom to complete trades.¹
- Quantitative easing programs implemented by a number of central banks have injected significant amounts of cash into the global financial system, which has encouraged more borrowing and lending activity in corporate bond markets. This has caused an increase in bond market size, both in absolute terms and relative to the (reduced) capacity of market intermediaries to provide liquidity in these markets.² The ‘pipeline’ through which deals must be transacted is now smaller, both in absolute terms and relative to the size of the market.
- The prolonged low-interest-rate environment following the financial crisis has caused an increase in the number of ‘tourists’ in the corporate bond markets – investors who are not traditional corporate bond investors but who came into the market in order to ‘reach for yield’.³ This reach for yield may also have encouraged growth in corporate bond issuance by corporations domiciled in emerging markets, with total issuance (U.S.\$969 billion as of March 2018) now comparable to that of U.S. high-yield issuance (U.S.\$914 billion) and emerging-market sovereign issuance (U.S.\$913 billion).⁴

¹ In carrying out their study, the Project Team undertook extensive discussions with a broad range of market participants. A summary of the observations of these discussions can be found in Section 5.4 of this Report.

² In the document, we refer to this capacity of market intermediaries to provide liquidity as *principal-intermediation capacity*.

³ The term ‘tourist’ arose in our discussions with market participants as we compiled the Report.

⁴ NN Investment Partners Holdings, *Emerging Markets Corporate Debt is now a standalone market*, March 22, 2018; downloaded October 30, 2018. As this report focuses on corporate bond markets in the United States, Europe and Asia, these emerging-market issuances are included in our analysis only to the

Both regulators and policymakers may be concerned that these changes have affected the level of liquidity under normal conditions. A 2017 IOSCO report found no substantial evidence that liquidity in the secondary corporate bond markets between 2004 and 2015 had deteriorated markedly from historic norms for non-crisis periods.⁵ Corporate bond market liquidity under stressed conditions remains understudied, yet the above developments in corporate bond markets are likely to affect the way that bond market liquidity behaves in times of stress.⁶ The most significant consequence of post-crisis reforms and reduction in risk appetite is the decline in principal-intermediation capacity relative to the increased size of the market. That decline means that the lack of liquidity in times of stress is likely to be more acute compared to previous episodes of stressed conditions. This may result in more pronounced price movements in order for bond markets to clear. However, based on prior behavior of bond markets in stressed market conditions, a number of corporate bond market features may reduce the likelihood that price movements or dislocations in bond markets would spill over into broader economic stress.

- Liquidity management by issuers of corporate debt can significantly improve their capacity to continue operating through a temporary closure of primary markets and/or reduced liquidity in secondary markets. In preparing this report, we received information from market participants that corporate treasurers have been structuring their portfolios in order to minimize their exposure to roll-over risk.
- The resilience of corporate bond markets to sudden price movements is likely to be closely related to the extent of leveraged positions within the market. Market participants have told us that there are now fewer leveraged operators participating in the market, such as hedge funds and investment banks, and that their degree of leverage is also lower than before the crisis. This implies that there is less risk of pro-cyclical selling into weakness by these institutions.
- Unlike the short-term money markets, which are essential to the continuous functioning of the real economy, many corporations do not need daily access to the primary market for bond issuance to finance their activities.
- Historically, the corporate bond market has not triggered a chain reaction constituting systemic stress. Instead, during past instances of stressed conditions, stress in corporate bond markets was more likely to result from amplification of stress that has begun elsewhere, such as in the short-term money markets, the real economy, or the banking sector. But note the very important and eternal caveat that applies to financial market

extent that they were issued in these three regions. However, please note that the report does not cover emerging markets and what might be dynamics under stressed conditions that are unique to them.

⁵ IOSCO, 2017, Examination of Liquidity of the Secondary Corporate Bond Markets Final Report. FR05/2017, February 2017.

⁶ As discussed in the Introduction, below, in this report we identify stressed conditions as situations where a sudden and strong change in attitude towards one or more financial assets among market participants results in a significant increase in demand for liquidity on one side of a market, possibly at the same time as the supply of that liquidity on the other side becomes significantly constrained or disappears. As a result, the normal operation of the market is disturbed, some participants have difficulty finding the liquidity they need to trade into or out of their positions, and price movements become stronger as a result of these participants' need to raise or lower their bids and offers in order to find liquidity.

outcomes both here and in general, that past performance is not necessarily indicative of future results.

Our analysis indicates that, should bond markets suffer a stressful event leading to large price declines, the critical factor in determining how those markets react will be the extent to which some market participants may be willing, have the resources, and have the ability to provide sufficient demand-side liquidity to help stabilize markets. The extent of this participation would be driven by the firms' business models, aims of investing, investment horizons, investible resources and constraints on their trading activity. These participants may include mutual funds, active investors, pension funds and insurers, and hedge funds. Significant price declines and the resulting profitable opportunities may also attract distressed debt investors, private equity funds and issuers interested in buying back their own debt. Some sovereign wealth funds may also choose to participate in this buying.

The key constraints on these participants' provision of demand-side liquidity may be the need to satisfy regulatory limits and internal guidelines (such as mandates and investment committee approvals) and the availability of financing (which may have declined for levered market participants with prime brokers that are affected by post-crisis regulations). Intermediaries and banks are less likely to provide liquidity during times of stress because of post-crisis changes in regulation and risk appetite.

Some policymakers⁷ have expressed concern that sudden and heavy selling of corporate bonds by mutual funds seeking to meet large investor redemptions may cause problems in corporate bonds markets, which may then adversely affect other sectors of the financial system. However, our study indicates that, where mutual funds have well-developed liquidity management which includes planning for such stressed market conditions, and where they are willing to use tools available to them to limit the extent to which they meet clients' demands for redemptions, mutual funds are unlikely to be a source of either considerable selling or price volatility. During past episodes of stressed conditions affecting a large proportion of a corporate bond market, selling across the mutual fund industry has been modest as a proportion of assets under management (3-5 per cent at most).⁸ Selling by mutual funds under stressed conditions, even under post-crisis liquidity conditions, has not in the past been a source of problems within the market, nor of adverse externalities outside of the market.

Patterns of past behavior need to be treated with some caution. While the general pattern from major events in the past has been one of sound adaptation to conditions, as mutual funds grow, this pattern may not continue to hold. Furthermore, while the general pattern during previous episodes of market stress has been one of low net redemption levels, there have been cases where net redemptions at *individual* mutual funds have risen significantly, well above historical averages, and gates and/or suspensions have had to be used.

⁷ See footnote 10, below.

⁸ This estimate is drawn from a combination of information from market participants (p.31), and an analysis of behavior during a previous episode of market stress (p.38).

Due to the tools available to mutual fund asset managers to manage liquidity and redemptions, redemption requests by investors may not necessarily translate into selling in corporate bond markets. It can sometimes mean rotation between different categories of bonds, including into corporate bonds.

When assessing the complex dynamics of corporate bond markets during periods of stress, we should also recognize that mutual funds, along with other institutional investors such as pension funds and insurers, may be sources of *market-stabilizing demand*. These categories of market participants manage significant amounts of money, much of which is invested for the long term, and are the recipients of regular inflows of cash which they must allocate into markets. To the extent that they use these cash inflows to manage their liquidity requirements and to take advantage of mispriced assets, they are able to help to stabilize markets both during and soon after a disruptive and stressed event.

Of course, the question of how events may unfold under stressed conditions is necessarily speculative, and there is always the chance that future episodes of stressed conditions will develop in ways different to those of the past. As a result, our analysis ought only to be interpreted as an indication of possible behaviors and outcomes and as evidence of the factors which are likely to influence the resilience and stability of corporate bond markets in periods of stress. The different business models of corporate bond market investors that may perform a stabilizing role may also evolve, changing the behavior of such investors in periods of stress.

1. Introduction

An analysis of stressed conditions in corporate bond markets requires us to delve into the structure of corporate bond market liquidity and market participant behavior during stressed conditions.

From the outset, we recognize that there is no universal definition of stressed conditions. Prior research has identified such episodes based on individual bond level stress or based on events affecting the bond market as a whole. For example, on the one hand Bessembinder et al. (2018) define market stress as occurring on days when customer-dealer trading volume exceeds the six-month average for that bond by more than two standard deviations, while Bao et al. (2018) define a stressed market for a bond as arising when the bond is downgraded. On the other hand, Di Maggio et al. (2017) and Choi et al. (2018) identify the period around the collapse of Lehman Brothers as a time of market distress. Similarly, besides the collapse of Lehman Brothers, studies by the French *Autorité des marchés financiers* (AMF 2015) and the Spanish *Comisión Nacional del Mercado de Valores* (CNMV 2017) identify the European debt crises in 2010 and 2012 as also representing stressed market conditions.

In this report, we adopt an inclusive definition of market-wide stress. Specifically, we identify stressed conditions as situations where a sudden and strong change in attitude towards one or more financial assets among market participants results in a significant increase in demand for liquidity on one side of a market, possibly at the same time as the supply of that liquidity on the other side

becomes significantly constrained or disappears.⁹ As a result, the normal operation of the market is disturbed, some participants have difficulty finding the liquidity they need to trade out of their positions and/or into new positions, and price movements become stronger as a result of these participants' need to raise or lower their bids and offers in order to find liquidity.

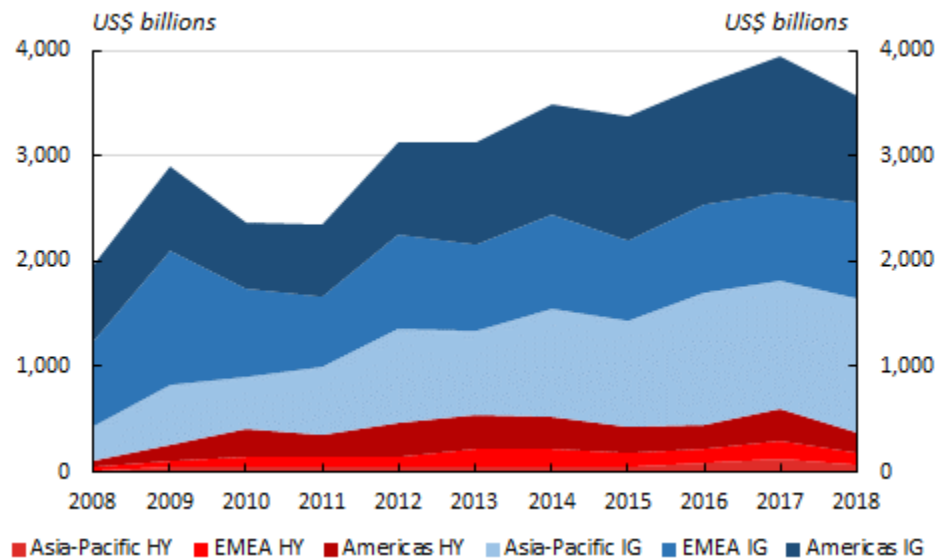
We note that this definition of stressed conditions is agnostic regarding the source of the stress, and how it manifests itself in the market, such as whether it spreads rapidly or slowly through the market following the initial manifestation, and the extent to which it spreads throughout the market. For example, it holds whether the stress arises in the market for a single asset affected by new information (such as the effect on participants' attitude to a financial asset, sector or country following a credit downgrade by a credit rating agency), arises in a market sector or group of assets affected by a change in conditions (such as the effects of monetary policy tightening on the U.S. bond markets in 1994), or manifests itself across a broad range of national and/or international assets affected by a sudden development (such as following the Russian sovereign default of 1998, or during the global financial crisis). In Section 6 we discuss case studies of market stress events that follow this definition.

Finally, we note that liquidity in secondary corporate bond markets is intertwined with capital raising in the primary market. For instance, the existence of sufficient secondary-market liquidity to allow investors to exit their primary-market purchases can facilitate primary issuance and placement success. However, since we are concerned about spillover effects that arise from significant liquidity demand during times of market stress, the focus of this note is on secondary markets.

We note also that liquidity in secondary corporate bond markets has been affected by the change in the structure of these markets, as a result of: post-crisis regulations of intermediaries which have reduced their capacity to provide liquidity in corporate bond markets; greater risk aversion on the part of these intermediaries; the gradual introduction of electronic trading in these markets; and significant growth in the size of these markets as a result of both central banks' quantitative easing policies and the reduction in rates of return on many assets that followed from these policies (Figure 1).

⁹ We note that this definition is similar to a definition used by the BIS: 'Another key distinction ... is between normal times ("fair weather" liquidity) and more stressed environments, when the functioning of markets is challenged by large order imbalances.' (BIS 2015, p.98)

Figure 1: Annual Corporate Bond Issuance, Investment Grade and High Yield, Americas, Europe, Middle East and Africa, and Asia-Pacific, 2008-2018



Source: Dealogic

This report focuses on whether corporate bond market liquidity remains as resilient as it might have been in the past and, if not, i) whether weakening resilience may mean that corporate bond markets in general will behave very differently in the future than in the past; and ii) whether certain segments of the corporate bond market may not replicate historical patterns observed in other bond markets. We discuss these topics in detail in the report.

Generally, the more quickly an investor wants to sell – that is, the greater her demand for immediacy – the higher will be the cost of liquidity and the larger will be the discount. Most of the time, investors seek to time their trades in a way that minimizes the price impact of the trades. However, the timing of investor trades can be forced or constrained by regulation, market structure, or the behavior and demands of their clients. As a result, some investors are unable to delay their trading and sell during unfavorable market conditions. Coval and Stafford (2007) and Choi and Shin (2018) show that fund fire sales can lead to significant price pressure despite liquidity sensitive trading, and that these effects can persist for some time.

Some existing research explores the degree to which mutual fund liquidity can impact liquidity of underlying securities and whether mutual fund fire sales can create price pressures in underlying bonds. We note that, although mutual funds are significant holders of corporate bonds, they are not the only significant investors in corporate bonds. The concerns outlined here with regard to mutual funds could be relevant to other significant holders of corporate bonds, although the specific reasons forcing other holders to sell might be different from those affecting mutual funds.

We pay particular attention to this example in the paper as it has been a particular concern of some regulators over the recent period.¹⁰

Since investors may be able to demand redemption of their funds more easily than fund managers can sell assets in relatively illiquid markets, there may be a risk that large-scale investor redemptions could lead to fund fire sales and depress prices of underlying assets relative to normal market conditions. To the extent that such losses materially and adversely affect other market participants, for example, because the securities were used as collateral, the initial demand for liquidity could potentially adversely affect other financial markets and the greater economy. Therefore, such redemptions could be a systemic risk concern.

O'Hara (1995) states 'Liquid markets are generally viewed as those which accommodate trading with the least effect on price.' Based on this notion, the corporate bond market is generally perceived to be less liquid than the equity market. Therefore, bond funds with significant mismatches between portfolio liquidity and investor liquidity, such as open-ended bond funds, may have a higher likelihood of engaging in asset fire sales and create price pressure.¹¹ On the other hand, some research suggests that in many circumstances bond funds can also act as absorbers of shocks to the market and interest rate environment, as these shocks propagate via investors to other markets and market participants (IMF-BIS-FSB 2018). Nevertheless, concerns remain that there may be particular stress scenarios, under which there is a higher risk of larger than usual asset sales by mutual funds.

In preparing this report, between June and November 2017 the Project Team conducted interviews, discussions and a roundtable with market participants, to gauge their understanding of current liquidity conditions in corporate bond markets, to shed some light on the empirical observations from the literature, and to gain their insights into how liquidity might evolve during future stressed market conditions. This report amalgamates the findings from these discussions with those of academic, regulatory and industry studies.

The note proceeds as follows. We present in Section 2 additional information to this note. In Section 3 we discuss market liquidity metrics and liquidity characteristics, and in Section 4, we summarize the main results of previous work on liquidity in corporate bond markets during normal markets. In Section 5 we discuss corporate bond market liquidity during stressed market conditions, and in Section 6 we present case studies of how liquidity evolved during past stressed conditions in secondary bond markets. In Section 7 we summarize our observations about the

¹⁰ For example, see Bank of England (2016), Bank of England (2017), Cetorelli et al. (2016), IMF (2015), BIS (2015), IOSCO (2018), Securities & Exchange Commission (2016). As well, in its *Risk Outlook for Autumn 2017*, Portugal's *Comissão do Mercado de Valores Mobiliários* notes the vulnerability of markets and products exposed to developments in corporate bond markets as their underlying investments respond to price volatility in those markets. The report also notes how a Portuguese issuer's default on its bonds caused significant losses to holders of structured retail products for which these bonds were the underlying investment.

¹¹ See, for example, the discussion of investor redemptions from equity and bond mutual funds after poor fund performance in Chen et al. (2010), and Goldstein et al. (2017).

behavior of important groups of investors and market participants during stressful conditions before we conclude in Section 8.

2. Background

Corporate bond markets are an important part of the global capital markets but, as mentioned above, there have been growing concerns about the functioning and liquidity of these markets. To address these concerns, in 2014 IOSCO embarked on a series of projects aimed at improving understanding and enhancing the functioning of these markets. A report examining liquidity in corporate bond markets was published in 2017¹² and some recommendations to improve regulatory reporting and transparency were published in 2018.¹³ In 2017 IOSCO's Board asked the Committee on Emerging Risks to study how liquidity in corporate bond markets might behave under conditions of market stress. The Board's objective was to improve IOSCO members' understanding of the behavior of corporate bond markets under stressed conditions by answering the questions:

- who might be forced to sell and who might sell opportunistically during times of market stress?;
- who might be buying under these conditions, and for what reasons?; and
- what are the implications of these behaviors for liquidity and pricing?

It is important to note that the question of how liquidity might behave in the corporate bond market under stressed conditions is necessarily speculative, and so no definitive answer is likely to emerge from our study. However, we can outline the types of behaviors that market participants are likely to engage in, given their current participation and behavior in bond markets, their past behavior in similar circumstances, changes in corporate bond markets which might diminish or heighten the relevance of past behavior and the incentives for differing types of market participants to buy or sell during market stress.

3. Definition and Characteristics of Liquidity

Market liquidity refers to the ability of buyers and sellers to transact in a market, within a given period of time, without causing a significant or sharp movement in price or otherwise disrupting the market. It incorporates such concepts as trade size, time to execution, and transaction costs (bid-ask spread and price impact of the trade). Market liquidity thus exists on a continuum, from abundant (ease of transacting, with no or minimal effect on prices, and high immediacy) to low (difficulty trading, with some or significant effect on prices, and low immediacy) to non-existent (inability to transact at any price despite delays). Liquid markets are thus generally viewed as those that can accommodate trading with little effect on prices (O'Hara 1995; Hasbrouck 2007), and

¹² IOSCO, 2017, Examination of Liquidity of the Secondary Corporate Bond Markets Final Report. FR05/2017, February 2017.

¹³ IOSCO, 2018, Regulatory Reporting and Public Transparency in the Secondary Corporate Bond Markets Final Report. FR05/2018, April 2018.

market liquidity is considered to be high if the temporary price impact as result of a trade, as identified in Kraus and Stoll (1972), is minimal.

Another type of liquidity in asset markets is funding liquidity. This refers to the ease with which market participants can obtain funding in a market, be it an equity or debt market, in order to execute a trade, maintain a position, or fund an asset. The two concepts are related, as pointed out in Brunnermeier and Pedersen (2009). The authors provide a model that links an asset's market liquidity and traders' funding liquidity and shows that, under certain conditions, changes in market liquidity and funding liquidity are mutually reinforcing, an outcome which can lead to the development of liquidity spirals. The model suggests that speculators' capital is a driver of market liquidity, and that a shock to market liquidity can lead to tightness in funding liquidity.

The focus of this report will be on market liquidity, but we expand the discussion, where appropriate, to the impact of funding liquidity on market liquidity.

Assessing liquidity requires metrics for its measurement. While the concept of funding liquidity can be directly mapped into empirically observable variables like repo rates, TED spread, or OIS spreads, the concept of market liquidity, because of its many facets, poses more challenges. Existing microstructure research has developed a large number of liquidity measures that reflect different aspects of market liquidity.¹⁴ They can broadly be grouped into measures of trading activity, transaction costs, and proxies for liquidity supply, and each metric has its benefits and shortcomings. For example, bid-ask spreads and depths, dealer counts, zero-trading days and turnover offer some information, but might not be sufficient for explaining temporary price impacts, especially for large orders. Other measures like effective spreads and imputed round-trip costs, or price impact measures like Kyle's lambda (Kyle, 1985) and Amihud's measure (Amihud, 2002) might be more informative about temporary price impacts but they need to be estimated using past data and hence only reflect past trading, and do not reflect trading that does not occur because of a lack of liquidity.

As discussed above, liquidity is the result of liquidity suppliers and liquidity demanders on both the buy-side and sell-sides of the market interacting. While broker-dealers have traditionally served as the main suppliers of liquidity in the corporate bond market on both the buy and sell sides, dealers have generally cut back in their market-making capacity as a result of post-crisis regulatory reforms, decline in dealer risk tolerance, and technological developments.¹⁵ 'Long only' long-term investors, such as mutual funds, insurance companies and pension funds, because of their need to allocate inflows from clients, have traditionally been suppliers of liquidity to those seeking to sell their bonds.

Participants' willingness to supply and demand liquidity can change depending on market circumstances as well as changes in their business models. For example, during periods of stressed market conditions, imbalances in liquidity can arise as a result of an increase in selling relative to buying. The resulting drop in prices offers opportunities for buyers to profit from taking on this liquidity risk, with the profits from the resulting liquidity premium materializing when conditions stabilize, and those prices eventually recover. Under these stressed conditions, actively managed

¹⁴ See, for example, Schestag et al. (2016), and Cambón et al. (2017).

¹⁵ See Committee on the Global Financial System (2016), Fixed income market liquidity.

funds can increase their supply of liquidity to investors seeking to sell their assets. Other investors, such as private-equity and distressed-asset investors, might also offer liquidity opportunistically, to take advantage of such mispricing. We discuss in more detail below the dynamics of liquidity supply and demand under stressed conditions.

4. Liquidity during Normal Market Conditions

Numerous studies and reports have analyzed liquidity in the corporate bond market.¹⁶ Most of these have focused on whether liquidity has deteriorated relative to the period before the global financial crisis, without distinguishing between normal times and stressed markets conditions. Since the focus of this report is on stressed market conditions, in this section we only briefly summarize the main results of our research, including the IOSCO report *Examination of Liquidity of the Secondary Corporate Bond Markets*, published in 2017. We also incorporate into our summary the views expressed by market participants during our outreach.

Since the global financial crisis, there have been meaningful changes to the characteristics and structure of the secondary markets for corporate bonds, including changing dealer inventory levels, shifts in technology, and changes in the ways that participants interact with intermediaries. Prior to this event, broker-dealers and hedge funds were the most important providers of market liquidity in corporate bond markets.

In the course of our discussions, market participants suggested that a combination of new regulations introduced since the global financial crisis, including the Volcker Rule in the U.S. and the Liikanen and Vickers reforms in the EU and UK, together with an increase in risk aversion, have curtailed their participation in corporate bond markets. In particular, broker-dealers have significantly reduced their inventories of corporate bonds, have concentrated their holdings in higher-grade and more liquid corporate bonds, and have increased the proportion of agency-type trades that they execute for their customers relative to principal-type trades.¹⁷ Some of them have begun focusing their activities away from supporting liquidity and trading in secondary markets in favor of underwriting new issues of bonds in the primary market. Their former role in providing liquidity appears to some extent to be passing to large asset managers, hedge funds, and independent intermediaries. Furthermore, market participants noted that, because a general increase in risk aversion in the banking sector has led to a strong reduction in lending to hedge

¹⁶ See, for example: French Autorité des marchés financiers, 2015; Mizrach, 2015, Analysis of Corporate Bond Liquidity, FINRA; Adrian et al., 2015, Has Liquidity Risk in the Corporate Bond Market Increased? FRBNY; Aquilina and Suntheim, 2016, Liquidity in the UK Corporate Bond Market: Evidence from Trade Data, FCA, 2016; IOSCO, 2017, Examination of Liquidity of the Secondary Corporate Bond Markets; Suntheim and Allan, 2017, New Evidence on Liquidity in UK Corporate Bond Markets, FCA, 2017; Staff of the Division of Economic and Risk Analysis of the U.S. Securities and Exchange Commission, 2017, Report to Congress: Access to Capital and Market Liquidity; Cambón et al., 2017, Measuring Liquidity of Spanish Debt; European Systemic Risk Board, 2016, Market Liquidity and Market-making; European Commission, 2017, Drivers of Corporate Bond Market Liquidity in the European Union; Adrian et al., 2017, Dealer Balance Sheets and Bond Liquidity Provision.

¹⁷ For an overview of these developments, see BIS (2015).

funds, both the number of hedge funds operating in corporate bond markets and their degree of leverage have decreased sharply, causing them to curtail their provision of liquidity in the corporate bond market. Due to the insufficient passage of time, it is difficult to discern whether this is a temporary (cyclical) or a permanent (long-term) phenomenon.

Some market participants have mentioned several additional factors related to their ability to either transfer or hedge the exposure of positions taken in the corporate bond market, which ultimately affected their willingness provide liquidity.¹⁸ For example, the falling size of executable orders has meant that large sell and buy orders have now to be broken up into these smaller slices before they can be traded. Combined with an increase in agency trading, this has resulted in recent years in increases in the time taken to execute transactions and hence extended exposure to the risk of adverse market movements. Furthermore, the reduction in size and coverage of the single-name credit-default swap (CDS) market has constrained market-liquidity providers' access to an important hedging tool and has, in turn, heightened their reluctance to take risks when providing liquidity in these markets. Some market participants expressed the view that, in the event of an unexpected or significant market event, such as an abrupt interest rate rise, investors could face a possible rush to a crowded exit to sell their positions, and that, under this scenario, where markets are increasingly illiquid, prices would be pushed further down, perhaps falling rapidly, as the market seeks new equilibrium levels for interest-rates and the transfer of credit-risk.

These stylized facts are largely supported by academic studies and reports, but whether they imply lower levels of liquidity and whether there is a causal relationship of increased regulation leading to lower levels of liquidity is less clear.

The IOSCO report found that, while some measures of liquidity, such as turnover ratio, dealer inventories, and block-trade size might indicate potential signs of lower liquidity, other measures, such as bifurcation of trading, average trade size, and the average number of counterparties or intermediaries, revealed mixed results, while others, such as trading volume, bid-offer spreads, and price-impact measures indicated improving liquidity. The authors' overall conclusion was that their research did not reveal substantial evidence that liquidity in secondary corporate bond markets in non-crisis periods had deteriorated markedly from historical norms.

The Staff of the Division of Economic and Risk Analysis of the U.S. Securities and Exchange Commission Report on Access to Capital and Market Liquidity (SEC Staff 2017) report that dealers in the corporate bond markets have, in aggregate, reduced their capital commitment since the 2007 peak. The report concludes that many of the observed changes in liquidity measures are consistent with the combined impacts of new rules and regulations, electrification of markets, changes in macroeconomic conditions, and post-crisis changes in dealer risk preferences. Furthermore, empirical data-driven analyses of liquidity in secondary corporate bond markets show mixed results, with some liquidity indicators having improved since the financial crisis, some having deteriorated, and some having stayed constant.

The disagreement between market participants' observations and the observations of some empirical studies may be explained by at least three factors, First, the methods used to measure liquidity in some studies might not be suitable for a market in which the way transactions are

¹⁸ See discussion of market participant outreach in Section 5.4, below.

conducted has changed. For example, market participants have noted that the move away from principal-based trading and towards agency-based trading is tightening bid-offer spreads because it takes the liquidity premium out of bid-ask spreads; yet agency-based trades are slower to transact than the more immediate principal-based trades. For these reasons, it appears that some traditional measures of liquidity are able to show improving or stable liquidity conditions even while liquidity, as measured by the ease and speed of transacting, may be deteriorating. Second, data on some aspects of liquidity is not available and is, thus, not readily amenable to quantification in empirical studies. For example, market participants are finding that it is difficult to buy and sell large blocks of bonds, and there is no data about transaction activity and block trading that does not occur because market participants are unable to find counterparties to the trade. Third, large sample analysis may not reflect the behaviors and experiences of market participants in all market segments or parts of the distribution. Where empirical studies observe improvements in liquidity metrics, the findings do not necessarily imply that groups of market participants may not experience a deterioration in liquidity. Moreover, even if measured liquidity is stable or improving during normal market conditions, changes in the business models of broker-dealers may result in a reduced resilience in future episodes of stress compared to past episodes of stress conditions.

To summarize, some market participants expressed concerns that liquidity has deteriorated relative to the pre-crisis period, while data-driven analyses show mixed results with some liquidity indicators having improved since the financial crisis, some having deteriorated, and some staying the same. Furthermore, while liquidity conditions have evolved inconsistently across all bonds, our research generally suggests that trading activity and transaction cost measures in recent years have either improved or remained steady. However, these measures of liquidity do not capture transactions that did not occur because market participants could not find a counterparty to the trades and may not paint a full picture of liquidity. Importantly, we note that both market participants and empirical studies agree on many liquidity trends, including a large decline in the willingness of dealers to provide liquidity, a decline in turnover, and a deterioration of immediacy and related costs. In addition, market participants are finding it more difficult to buy and sell quickly in large blocks. These effects may have implications for the resilience of corporate bond market liquidity.

5. Liquidity during Stressed Market Conditions

The question of what might happen to liquidity in the corporate bond market under stressed conditions is necessarily speculative. We have only a limited understanding of how market participants might behave beyond their behavior during normal times, and this behavior may not be the same as was observed during similar occurrences of stressed conditions in the past. Nevertheless, academic studies and a review of past episodes of stressed market conditions can be helpful in pointing to important characteristic behaviors and outcomes during times of stress. In this section, we first discuss the few academic papers that explored the behavior of the traditional liquidity suppliers (broker-dealers and hedge-funds) during past episodes of stress. We then discuss policy and regulatory studies of stressed market conditions. Finally, against this backdrop, we discuss how market participants may behave in stressed conditions given their current participation and behavior in bond markets and their incentives for either buying or selling during market stress.

5.1. Academic Studies

While many academic papers study bond market liquidity, only a few explore the behavior of liquidity during stressed conditions, and these generally analyze the behavior of broker-dealers. We discuss these studies below.

In a study of the relationship between liquidity and price, Kraus and Stoll (1972) divided the total price impact, the difference between the transaction price and the price prior to the trade, into a permanent and temporary component. The permanent price impact represents new information that will be permanently incorporated into a security's price, while the temporary price impact reflects the degree of illiquidity in that market. Liquidity in this case is related to the notion that a trader might be willing to delay transacting to receive a better execution price than would be available should she demand immediate execution (Grossman and Miller 1988). Because of such liquidity concerns, traders optimize the timing of their trades to minimize the impact of liquidity constraints. However, this timing might be affected by regulation or market structure, or accelerated by the need for immediacy, so that investors are forced to sell to obtain cash without being able to delay trading. For example, U.S. open-ended mutual funds operating under the regulatory mandate of the 1940 Investment Company Act are constrained in their choice of timing because they need to satisfy investor redemption demands within seven days.¹⁹ Similarly, funds operating under the UCITS Directive in the European Union are required to meet redemption requests within ten days, and under the U.S. Federal Reserve Board's Regulation T leveraged investors are required to satisfy margin calls within four business days. The fundamental issue here is that forced sales, even if unrelated to the arrival of new information, can lead to depressed prices below fundamental values for an extended period of time (Coval and Stafford 2007).

Bessembinder et al. (2018) study changes in market liquidity before and after the financial crisis. They find that dealer capital commitment, turnover, the frequency of large blocks, and trade size have all declined during and after the financial crisis – an effect driven by the behavior of bank-affiliated dealers. In their analysis of stressed conditions they do not focus on the financial crisis as a stress event. Instead, they define times of market stress at the individual bond level as occurring on any day when customer-dealer trading volume exceeds the six-month average for a bond by more than two standard deviations. Analyzing only the most active dealers on such days, they observe that dealers' willingness to commit capital intraday during market stress is slightly larger in recent years than pre-crisis, which would imply that liquidity has improved. However, they also show that dealers are less willing to commit capital for overnight inventory at levels similar to levels observed during the financial crisis. The paper concludes that bank-affiliated dealers are less likely to commit capital to absorb customer demand and points to post-crisis banking regulations as a likely cause.

Similarly, Bao et al. (2018) define stress events at the bond level as occurring when a bond is downgraded from BBB to BB, since such downgrades have been shown to result in regulation-induced sales by insurance companies. Using a differences-in-differences estimation, they compare the illiquidity of bonds recently downgraded to speculative grade bonds with that of

¹⁹ For example, Jiang et al. (2017) show that, when aggregate uncertainty is high, bond funds tend to sell liquid and illiquid portfolio holdings proportionally. This, in turn, creates price pressure in the corporate bond market. See also section 22(e) of the U.S. Investment Company Act of 1940.

baseline speculative grade bonds (first difference) before and after the Volcker Rule (second difference). The paper shows a significant deterioration of bond liquidity in post-Volcker stress periods. The paper also documents a reduction in the willingness of Volcker-affected dealers to provide liquidity (measured by the relative fraction of dealer-customer trades, agency trades, and capital commitment), and only a weak increase in the liquidity provision by dealers unaffected by the regulation. They conclude that, as a result of the Volcker rule, bonds have become less liquid during times of stress.

Di Maggio et al. (2017) use the collapse of Lehman Brothers and the consequent shock to dealer networks to study the role of dealers and their trading relationships in times of stress. The paper finds that dealers' trading relationships in the network significantly influenced their trading behavior and transaction costs. In particular, the core dealers charged higher spreads to peripheral dealers and counterparties, while dealers overall were more likely to provide liquidity to those counterparties with whom they had the closest relationships. Also, dealers' inventory reductions were more marked for those bonds that clients were selling more aggressively. In general, dealers' inability or unwillingness to provide liquidity partly contributed to higher transaction costs and market illiquidity during times of stress after the collapse of Lehman Brothers. It should be noted that, since the paper makes strong assumptions about dealer positions in the primary market due to a lack of data on dealer inventory, the results are likely to be sensitive to such assumptions.

Goldstein and Hotchkiss (2018) use a comprehensive sample of U.S. corporate bonds and do not exclude inactively traded securities. The paper's main insight is that dealers endogenously change their behavior depending on the expected liquidity in corporate bonds. Specifically, both under normal conditions and during times of stress, dealers are less likely to take less-active bonds into inventory and are more likely to trade on an agency basis. The paper estimates an endogenous switching regression model and finds that dealers balance search and inventory costs such that dealer roundtrip costs do not increase with expected illiquidity. These results are important in interpreting a number of recent studies that seek to explain observed trading costs for corporate bonds, either cross-sectionally or over time, and in explaining changes in dealer activity in times of stress when overall market liquidity declines. The paper shows that dealers are less likely to take on inventory risk and were, both statistically and economically, significantly more likely to offset trades on the same day during episodes of financial crisis and VIX spikes. Further, this behavior persists across credit quality categories: in times of severe market stress when dealers are less willing to commit capital, even higher-rated bonds may be traded conditional on dealers' ability to offset the trade. The paper also finds that dealers continue to be somewhat more likely to engage in offsets post-crisis period relative to the pre-crisis period.

Choi et al. (2018) examine dealer provision under mispricing between corporate bonds and credit default swaps and study how liquidity demand from unwinding CDS-bond basis trades influences mispricing in corporate bonds. They find that dealers bought more bonds and traded against widening price dislocations when bond prices fell following the collapse of Lehman Brothers. Specifically, dealers generally increased liquidity provision as bond prices became more distressed relative to CDS spreads. However, crucially, as dealers suffered losses on inventory positions, funding liquidity dried up, and mispricing widened, their dealer liquidity provision declined. In addition, declines during the crisis were concentrated in bonds with available CDS contracts and active basis trading, which suggest that the unwinding of CDS-bond basis trading by hedge funds and other highly leveraged traders may have been the main cause of these price

declines. While the paper finds that dealers did not become liquidity seekers when levered non-dealer arbitrageurs destabilized the market, the paper acknowledges that this observation may only be applicable to the sample period (2005-2009). We recognize that the regulatory landscape and risk aversion has changed significantly since this time and that the observations that dealers offer liquidity during extreme market stress might no longer hold.

The argument by Choi et al. (2018) that dealers supplied liquidity during the global financial crisis receives support from Dick-Nielsen and Rossi (2019). Specifically, Dick-Nielsen and Rossi (2019) use index exclusions (bonds being dropped from the Barclays Capital investment-grade corporate bond index) as a natural experiment and measure the demand for and cost of immediacy over time. They show that dealers absorbed selling pressure and provided immediacy in such bonds during the financial crisis, although their willingness to provide immediacy has declined since the financial crisis and the cost of immediacy has since doubled.

We also note that bank and non-bank liquidity providers may compete for intermediation business, and the decline in the role of traditional liquidity providers (such as dealers) may allow other groups of market participants (such as asset managers, hedge funds, etc.) to play a greater role in supplying liquidity where profitable during times of stress. Since they may compete in liquidity provision, the two groups of market participants may, at times, have opposite views on the trends and risks. Where banks may have become less competitive in providing liquidity, nonbank intermediaries may have stepped in, but only partially (see, e.g., Bao et al. (2018), and Anderson and Stulz (2017)).

One of the reasons why non-bank intermediaries have only partly offset the decline in bank liquidity provision, including in times of stress, may be the post-crisis regulations themselves. Namely, post-crisis reforms may have reduced the ability of non-bank intermediaries to obtain bank financing for their liquidity provision and arbitrage trades. A recent study by Boyarchenko et al. (2018) empirically tests the hypothesis that post-crisis bank regulations (including the Volcker Rule, the supplementary leverage ratio, the liquidity coverage ratio, and the net stable funding ratio) have impacted the ability of nonbank intermediaries to arbitrage away mispricing. The paper presents two main results. First, they calculate the implied profitability of a variety of classic arbitrage trades, including on-the-run/off-the-run trades, Treasury-interest swap trades, CDS-bond basis trades, and single name-index CDS trades. They show that such arbitrage trades are considerably less profitable for regulated entities under Basel III than under Basel II. Second, they perform a differences-in-differences estimation and examine changes in the behavior of hedge funds that do and do not use a global systemically important bank (G-SIB) prime broker. They show that levered hedge funds that rely on G-SIB prime brokers experience lower abnormal returns and a decline in assets under management compared to levered funds that use non-G-SIB prime brokers. The paper concludes that the effects of post-crisis regulations impact not only the willingness and ability of banks to intermediate trading, but also of private funds that rely on banks to fund their arbitrage strategies.

While there seems to be a lack of consensus in this narrow academic literature, recent research indicates that dealers, especially dealers affected by financial regulations, are now even less likely to lean against the wind in times of market stress, and that alternative liquidity providers may also not step in to supply liquidity during such events.

With regard to the behavior of mutual funds, Choi and Shin (2018) consider whether investor redemptions from corporate mutual funds may create price pressure in corporate bond markets. The paper has three main observations. First, the paper shows that, in contrast to equity mutual funds, corporate bond funds actively rely on cash buffers and selectively trade liquid securities to meet investors' demand. As a result, trading driven by investor redemptions is most pronounced in liquid bonds and is concentrated in those funds with low cash holdings. Secondly, the paper documents that outflows cause significant price impacts for bonds held by low-cash funds, as well as for small-issue-size and high-yield bonds. These price impacts sometimes last for a few months before recovering in the following quarter. The paper finds no price impacts of outflows on corporate bonds held by funds with large holdings of cash and cash-like securities. Thirdly, corporate bond funds with low cash holdings (defined as funds with cash levels of less than 5 per cent of their assets) accounted for 55 per cent of the sector's holdings of corporate bonds in the United States in 2014. This suggests that the way mutual funds manage liquidity risk may affect the impact of increased investor redemptions on the liquidity of underlying bonds.

5.2. Regulatory Studies

While several regulators have studied corporate bond market liquidity, only a few studies have specifically analyzed the behavior of liquidity under stressed conditions. In this section, we focus on these studies.

The French Autorité des marchés financiers (AMF 2015) released a study in 2015 of the changes in liquidity in the French markets for both government and corporate bonds. Using a new composite indicator of liquidity the authors find that central banks' policies of holding interest rates below market-clearing levels for a prolonged period has affected bond markets by encouraging asset owners to diversify away from bonds to higher-yielding assets. This has had the effect of lowering price volatility, which in turn has reduced returns to intermediaries who profit from volatility, and of raising the cost of intermediation to asset purchasers, relative to the artificially low yields on offer, with the effect of discouraging turnover. The authors further find that liquidity is negatively correlated with risk aversion, and thus is likely to change when risk aversion changes, implying that liquidity will likely deteriorate in the event of a crisis and then recover as conditions improve, as it did during both the global financial crisis and in 2011-12.

The Financial Conduct Authority (FCA 2016) analyzed liquidity in corporate bond markets in the UK for the period 2008-2014. Using a series of common measures of liquidity, the authors find that liquidity during normal conditions does not appear to have deteriorated in that time period. They further point out that they see no evidence from that period that liquidity is at a greater danger of evaporating during market stress. However, in a follow-up study, using data from one market participant, they find, from 2014-15 onward, an increase in the amount of time it takes to trade and an increase in the amount of failed or rejected trades (FCA 2017).

A 2017 study by the Bank of England (BoE 2017) developed a model for simulating stressed conditions in the financial system and gauging their effects on financial stability. The authors examine the resilience of liquidity in European corporate bond markets to a sudden increase in redemptions by investors in open-ended investment funds. The stress simulation indicates that, under conditions of severe stress, in which investor redemption requests can cause rounds of asset sales by funds and cause intermediaries and other liquidity providers to retreat from providing liquidity, investor behavior can result in material increases in spreads in European corporate bond

markets and, in the extreme, in dislocation of European corporate bond markets, defined as a market breaking point following which prices fall considerably. Although the authors indicate that this outcome presents a threat to financial stability, they do note that the stress simulation is partial both in nature and in scope. In addition, their model assumes that institutional investors are slow to respond to asset sales by funds, and that modeling this behavior might be important for gaining more insight into price dynamics in corporate bond markets. Further, the study recognizes that other investors, such as insurance companies, may exhibit offsetting behaviors not explicitly captured in the model.

Cambón et al. (CNMV 2017) prepared a study of the performance of the Spanish debt market under stressed conditions. The study uses a new synthetic liquidity indicator computed between 2005 and 2016 that reflects several dimensions of liquidity (depth, breadth, transaction costs and resilience). The liquidity indicator suggests that periods of high stress in Spanish financial markets have in the past always been accompanied by poor liquidity conditions. However, the opposite is not always true: there have been episodes of significant worsening in liquidity which occur in the absence of a general increase in market stress. Generally, the worst liquidity conditions in the market were experienced at the end of 2008 during the global financial crisis, with other peaks of illiquidity related to episodes of uncertainty in the context of the European sovereign debt crises in 2010 and 2012. The authors further point out that the drivers of illiquidity have changed significantly over time, especially during periods of stress. While at the end of 2008, the worsening in liquidity conditions originated in the deterioration of market depth and resilience mainly for bonds issued by the financial sector, during the European debt crises liquidity conditions were more related to the increase of transaction costs and, to a lesser extent, to depth and resilience weakness. Government and financial debt were the main drivers for the reduction in liquidity. The paper also compared the synthetic liquidity indicator with the proportion of illiquid assets in mutual fund portfolios. While they were positively correlated through 2014, the liquidity indicator points to deterioration in liquidity in the Spanish bond market even as the proportion of illiquid assets in the Spanish fund portfolio remains stable. The increasing allocation of Spanish mutual funds to foreign debt could partially explain this fact. Finally, the study raises a general concern related to the strong dependence of the results on the type of bonds, methodology and time period considered.

The Spanish CNMV is also in the process of producing a report into Spain's experience during the European sovereign debt crisis of 2012. In the late Spring and Summer of 2012, the Spanish markets experienced a high level of stress as Europe's sovereign debt crisis unfolded. During that time a widespread credit rating downgrading that affected both the Spanish government and financial institutions occurred, and the risk premium of the Spanish sovereign bond soared above 600 basis points, reflecting strong concerns among investors about public debt sustainability. The numbers recorded for the bond segment of Spain's Financial Markets Stress Index reached an absolute maximum level of stress. As the funds management industry has recently become more important in Spain, and the low interest rate environment might have pushed managers to invest in more illiquid assets, the CNMV's study aims to shed more light on which characteristics make a fund more prone to suffering redemptions in times of financial stress. Some interesting preliminary observations from this study show: that the worst flow performing funds in Spain, in terms of flow, hoarded ultra-liquid assets and increased cash buffers during the weeks of the crisis; and that recent past flow volatility was a key determinant in explaining contemporaneous net flows. Finally, econometric analysis reveals that a decrease in the cash buffer affected net flows

negatively, which would explain why Spanish funds experiencing the largest outflows had incentives to increase their cash holdings, as doing so could curb future outflows.

A study by Fancello, Gentile, Linciano and Modena (CONSOB 2014) focuses on the liquidity of both financial and non-financial corporate bonds traded on three Italian retail bond markets (DomesticMOT, a retail regulated market operated by Borsa Italiana, and ExtraMOT and EuroTLX, two multilateral trading facilities) in the period 2010-2013, during which the European sovereign debt crisis occurred. One of the main aims of the analysis is to assess whether fragmentation of trading across venues, as a result of competition among platforms introduced by MiFID I has adversely affected liquidity or not. While the study provides mixed evidence for this, failing to point out a clear-cut effect of trade fragmentation on bond liquidity, it also finds that the sovereign debt crisis had a negative impact on the probability of trading, and, considering industry sectors, that bank bonds appeared on average to be less liquid than non-financial bonds, irrespective of the venue on which they traded. Also, complex/structured bonds are estimated to be less frequently traded with respect to plain vanilla ones at least on the regulated market.

A comprehensive study on corporate bond markets was published by the European Commission in 2017. The study is in two parts: a main report which explored the drivers of corporate bond market liquidity in the EU (European Commission, 2017, Drivers of Corporate Bond Market Liquidity in the European Union ('Drivers')); and a supporting analysis of the European corporate bond markets provided by a group of industry experts (European Commission Expert Group on Corporate Bond Markets, 2017, Analysis of European Corporate Bond Markets ('Analysis')). The study provides strong evidence of a slowdown in a variety of activity-based liquidity indicators.²⁰ One of the study's observations is that, both during and since the European sovereign debt crisis, issuers' ability to access euro primary corporate bond markets became much more difficult for limited periods of time, to the point that markets could suddenly and temporarily 'close' for high-yield issuers and also a significant proportion of investment-grade issuers.²¹

During these periods of market distress in the European corporate bond markets, the authors of the Analysis note that risk aversion increases, and that the premia attaching to new issues multiply on top of widening credit spreads, with this outcome possibly indicating not just a risk aversion premium but also the application of a substantial liquidity premium to these bonds.²² The authors of the Analysis also note that under these conditions investors who traditionally buy corporate bonds in the European corporate bond markets tend to postpone their purchases, becoming much more selective and in some cases even becoming sellers of corporate bonds.²³ In general during stressed conditions in European corporate bond markets, the authors of the Analysis observe that liquidity tends to be lower, while premia tend to rise substantially and become very volatile.²⁴

²⁰ Drivers, p.9.

²¹ Analysis, p.12.

²² Analysis, p.13.

²³ Analysis, p.13.

²⁴ Analysis, p.14.

A report by the Staff of the Division of Economic and Risk Analysis of the U.S. Securities and Exchange Commission on Access to Capital and Market Liquidity (SEC Staff 2017) empirically analyzes liquidity in the corporate bond market in normal times and reviews some existing research on liquidity during times of stress. The authors observe that evidence available at the time on dealer activity in times of stress is mixed and varies with the definition of stress. They indicate that during times of severe market stress, dealers may not always lean into the wind, but instead make larger cuts in their inventories of bonds that are aggressively sold by their customers. The authors state that this evidence supports an observation that dealers may decrease liquidity provision in times of severe market stress and noted a need for further research into the role of dealers during stressed times.

A study by De Renzis, Guagliano and Loiacono (ESMA, 2018) examines European sovereign and corporate bond markets and finds significant differences between liquidity in sovereign and corporate bonds. The authors identify several stress episodes in which there was evidence of deteriorating secondary market liquidity for corporate bonds, especially between 2014 and 2016. They also suggest that bond issue size significantly affects their liquidity in periods of stress. Furthermore, the authors establish a correlation between increased stress in financial markets and a deterioration in market liquidity. The study notes that corporate bond markets are exposed to liquidity shocks in both equity and sovereign bond markets, and thus there could be challenges to financial stability. However, the authors do not examine whether and how developments in corporate bond markets might give rise to these challenges to financial stability.

5.3. Industry Studies

Several investment companies have published articles on the behavior of market participants and liquidity under stressed conditions.

In a series of studies, for example, BlackRock (2014) notes that more liquid bonds often underperform for short periods during market stress, such as the Lehman Brothers default and the 2013 ‘taper tantrum’, because at these times liquidity-strapped investors tend to sell the most liquid assets in their inventory to raise cash. The prices of less liquid assets usually follow after. Furthermore, BlackRock (2016b) supports the view that during market stress there could even be significant structural support for corporate bond demand from institutional buyers. Specifically, insurance and pension companies, because of their relatively fixed asset allocation, regulatory and tax constraints, and liability management, are likely to be liquidity providers even under stressed conditions, especially for corporate bonds that might become undervalued.

Turning to the behavior of investment funds, the authors note that during the same episodes of stress, high-yield corporate bond exchange-traded funds (ETFs) posted record trade volumes even while liquidity in the underlying market declined. In this regard, BlackRock (2015) specifically discusses the benefits of bond ETFs for market liquidity including during market stress. The authors suggest that ETFs provide both market liquidity and price discovery to investors, even when the markets for the underlying bonds are under stress. BlackRock also suggests that ETFs are able to do so because ETF trades occurring on exchanges match buyers and sellers without necessarily requiring or leading to direct trading of the ETF’s underlying holdings. Also, BlackRock expresses the view that ETFs are not subject to ‘run risk’ by investors, mainly because they do not give a ‘first mover advantage’ to investors considering redeeming their shares, since ETF creations and redemptions generally occur through in-kind transactions, rather than via cash

transactions. These views of BlackRock are particularly relevant to scenarios in which there is stress in the corporate bond market to which an ETF is exposed, but where this stress has not created a loss of confidence in the ETFs themselves.

With regard to how mutual funds behave in periods of market stress, BlackRock (2017) reiterates the widespread observation in industry studies that in past episodes of stressed conditions mutual funds have not demonstrated runs, fire sales, or mass redemptions. And even during periods of significantly elevated redemption levels, bond funds have been able to meet demands for liquidity without causing market disruptions. BlackRock (2016b) notes that the net inflows of cash received by open-end bond mutual funds provide portfolio managers with the ability to shift the overall shape of the portfolio with this cash, rather than by having to sell securities.

BlackRock (2017) notes that fund managers carefully consider their liquidity risk management. Risk-management issues that they consider include: asset classes and the market conditions for those asset classes, the tools available for a specific fund, redemption terms, liquidity of the underlying asset class, current market conditions, types of investors and their redemption patterns, and backup measures available to the fund.

In a report by Goldman Sachs (2015), employees of the firm, other market participants, and academics share key insights into the functioning of corporate bond markets. In particular, the report points out that the behavior of market participants is being shaped by a number of new regulations, including Dodd-Frank, the Volcker Rule, Basel III, and changes to the treatment of single-name CDS products. The result is that, compared to the time before the financial crisis, intermediaries now have reduced capacity to expand their balance sheets in response to client demand, for example during a time of market stress, as doing so would now cause them quickly to run into regulatory constraints. Furthermore, the report voices concerns that the inability of banks to expand their balance sheets will prevent other market participants, such as hedge funds, from being able to provide market liquidity rapidly in response to market conditions. These issues in turn could lead to more severe and more extended price dislocations than during previous episodes of market stress, with potential adverse consequences for financial stability and the real economy. The report also points out that any price adjustment may be non-linear, so that, as the size of the liquidity imbalance grows, the price dislocations would grow more extreme and prices would take longer to normalize. If these adverse developments were to lead intermediaries to pull back their funding from markets, the report concludes that a negative price-liquidity spiral could develop, which in turn could constrain other participants, such as asset managers, from entering these markets and providing liquidity.

5.4. Market Participant Outreach

Between June and November 2017, the Project Team discussed corporate bond market liquidity, under both current and stressed conditions, with a number of market participants, including fund managers, pension funds, intermediaries, investment banks, ratings agencies,

issuers, industry representative groups and regulators, across Europe, the United States and Asia.²⁵ Those market participants were forthcoming with us regarding their views of the likely behavior of liquidity and liquidity providers under stressed conditions.

Unless otherwise indicated, all of the statements regarding the beliefs and likely behaviors of market participants reflect only our discussions with those we consulted, as described below.

An important observation that the Project Team drew from the discussions is that, generally, market participants expect liquidity outcomes during market stress to depend heavily on the scenario or situation that they find themselves in. It is understood by market participants that a ‘fire sale’ by a participant, such as a single mutual fund in need of quick cash to meet redemptions, may likely be an opportunity to buy good assets cheaply and, hence, liquidity is likely to be readily available in this scenario. However, a general repricing of risk and assets, for example as a result of tighter monetary policy, or increased geopolitical risk, may cause a more widespread reassessment of portfolio exposures, with a consequently greater likelihood of negative impact on market liquidity.

Some market participants noted that we should be careful to distinguish between market credit events and liquidity issues: prices ‘gapping’ on credit or other information may be rational behavior in the circumstances. According to these market participants, that this doesn’t necessarily mean that a liquidity issue exists in the market.²⁶

The general belief among market participants is that market liquidity will be lower during stressed conditions but will not evaporate entirely. Liquidity will be available to sellers, but at a price directly related to the degree of disruption in the market.

Market participants also believe that liquidity for many bonds is currently much reduced compared to conditions before the global financial crisis, and that prices are also now much more sensitive to selling in volume. This feedback is consistent with the Goldman Sachs paper and those regulatory studies which suggest that the structure and resilience of market liquidity may have significantly changed in recent years.

However, market participants are generally strongly aware that markets have in the past handled illiquid conditions well: in almost all instances bond and credit markets continued to price and allocate assets, and market participants are also aware that even when markets were almost completely closed during the global financial crisis those issuers who had to raise or re-finance

²⁵ In all, the Project Team held 21 meetings, a number with multiple participants, and one roundtable discussion, again with multiple participants. In all, the Project Team held discussions with around 70 market participants across North America, Europe and Asia, representing fund managers, pension funds, investment banks (traders and syndicate managers), credit rating agencies, market makers, industry organizations, corporate issuers and academics, including some of the most significant and largest businesses in each industry.

²⁶ While changes in market prices usually result from trading activity, assets can be repriced without corresponding trading. Gapping generally refers to a change in the price without corresponding transaction activity (for example, at the open of trading on a stock exchange, reflecting information that arrived outside of trading hours). Illiquidity can still impact the size of the ‘gap’ by, for example, exacerbating price movements from some information event.

debt capital were able to find buyers for their bonds. Overall, market participants were confident that they will do so again during the next stress event.

5.4.1 Possible behavior by market participants

In the United States and Europe

The consulted market participants were aware that a significant portion of corporate bond holdings are either acquired by investors, who have significant discretion over asset class choice, including whether to enter the corporate bond market, or by intermediaries that have been given broad discretion by original investors or are managers of active investment strategies. Thus, these investors may, at any time, leave the corporate bond market and move to other asset classes. In addition, retail investors invest in the market via mutual funds and ETFs. Fund managers and intermediaries expressed concerns that those most likely to sell into weakness would be a portion of this group or what some called ‘tourists’. These were defined as investors who have been encouraged to ‘reach for yield’ in corporate bond markets, and especially in the high-yield market, by the extended period of ultra-accommodative monetary policy and active central bank suppression of yields on government and investment-grade corporate bonds. Market participants mentioned the emergence in recent years of portfolio managers who had once primarily bought investment-grade bonds but who had begun migrating into high-yield and shorter-dated markets.

In the views of the market participants that we interviewed, this lack of experience tends to be accompanied by a lack of sophistication in the assessment of market liquidity issues. Some argued that one indication of this increased lack of sophistication among certain investors was over-reactions to idiosyncratic price changes in corporate debt, indicating a lack of fundamental analysis to credit determination and pricing for some corporate debt. A concern among market participants is that, when high-yield bonds begin behaving ‘like high-yield again’, in pricing, liquidity and volatility, these managers may be the first to sell. Thus, there is concern about a potential reduction in resilience in corporate bond markets because of a changing profile of investors.

According to some market participants, other possible sources of pro-cyclical selling in the event of market stress include those investors or asset managers who follow the lead of algorithms that follow indices and market-signals. Some market participants also noted that, should these investors’ and asset managers’ algorithms tell them to sell into weakness, they will join in the selling once prices begin to fall. One market participant told us that this type of buying and selling is an increasingly prevalent feature of the market.

Some funds managers noted that a bank ‘forced selling’ scenario is less likely now than during the pre-crisis period. The banking sector is seen as being better capitalized, and some market participants told us that there is less leverage in the market. Partly for this reason, there was also a view that a forced selling situation is now also less likely for hedge funds, as a result of their having: lowered their degree of leverage; increased the tenor of their lending (making them less reliant on short-dated credit and so less vulnerable to margin calls); and over-collateralized their investments. On the other hand, there was also a view that fewer intermediaries are willing to take a position in the market, and they are more careful about which bonds they keep on their books, largely because regulations which require more capital of intermediaries holding bonds on their balance sheets beyond stated maximum durations have encouraged them to hold only the most liquid bonds in their inventories.

While large asset managers we spoke to acknowledged that they may have the ability to affect markets with their selling under both normal and stressed conditions, some noted that they have good reasons not to do so – including because they do not want to lower prices for the products that they are managing on behalf of their clients. Out of the three fund managers interviewed, two large fund managers told us that firms in their industry now have sophisticated liquidity-management strategies and structures, which are designed to help them to minimize the market and price impacts of their selling in all types of markets. They conduct stress simulations to prepare for illiquid markets as well as monitoring and managing their liquidity risk to make sure they can meet investor redemptions, incorporating the observations from their simulations into their risk management frameworks. A large European asset manager indicated that they might meet customer redemptions through their cash buffers, with cash inflows arriving from other customers, or by using their own balance sheet to buy out exiting clients – a technique which allows asset managers to go ‘long’ on assets that have been temporarily mispriced, protecting other clients and preventing a flood of supply from being placed into stressed markets. Depending on the jurisdiction, managers also may be able to use repo funding, ‘swing pricing’ and ‘side pockets’ to manage liquidity risk.

Moreover, asset managers also emphasized to us that the mutual funds industry has a history of investors not over-reacting to stress. In the past, redemptions have tended to increase only modestly, from 1-2 per cent of assets under management per month under normal conditions to about 3-4 per cent during times of stress. And they told us they are likely to have to enter markets as buyers in order to allocate the inflows of retirement funds that flow regularly into their accounts. These observations continue to support their view that counter-cyclical buying should help to stabilize markets and provide liquidity during market stress.

Active and institutional asset managers see themselves as potentially providing discretionary liquidity when prices become favorable, for whatever reason. They emphasized that, so long as the assets are not impaired, and uncertainty is not so high as to induce a general ‘risk off’ attitude, a fall in prices would give them a chance to improve returns for their clients. One participant noted that, in the United States, about 85 per cent of bond assets are actively managed, and these managers will buy if they see a favorable mispricing. However, their participation may be slowed by their mandates, need for approvals by investment committees, and the availability of cash. Pension fund managers are somewhat constrained from taking on more risk by the interaction between the cash at their disposal and regulatory requirements, such as the requirement for asset managers to invest at a minimum a certain proportion of their fund’s portfolio in particular asset classes, such as government bonds, long-term assets or inflation-protected assets. Also, internal governance now tends to be stricter than before the global financial crisis, which restricts managers’ freedom of action under stress. Some market participants estimate that it could take 3-12 months for funds to enter markets in strength, owing to their need to act in accordance with their mandates and internal risk-control frameworks.

One participant from an investment bank suggested that, during a stressed situation created by a general sell-off, funds will likely begin buying when three conditions are met: first, they become underweight in their allocation to corporate bonds, which would possibly trigger an automatic portfolio rebalancing mechanism; second, they have spare risk capital, in the form of unallocated cash, on their balance sheet; and third, there is a system-wide ‘turnaround condition’ – most likely a central bank agreeing to backstop the markets.

Lastly, some of the market participants we spoke to noted that increased transparency regarding transactions and balance sheets mean that those trading in the markets are now much more careful about taking risks – others, including competitors, are watching and assessing their actions.

From our discussions with market participants, our understanding of who would be buying in the market, in a situation of stress, is: asset managers and hedge funds who will seek to take advantage of mispriced assets (although they also noted that there are fewer hedge funds operating in markets now than before the global financial crisis, and those that remain carry less leverage); distressed-asset investors and private equity companies, who would take advantage of bargains offered by severe mispricing; and the issuers themselves, seeking to take advantage of below-par prices to buy back their own debt. The timing of pension funds' and insurers' participation will, as mentioned above, be constrained by their need to have their decisions approved by investment committees. Sovereign wealth funds may also be able to participate, providing that they have financing available for their purchases and, again, can gain approval from their investment committees. This availability of financing may depend on prevailing macroeconomic conditions, which influence their sources of funding (for example, revenues from commodities sales).

From our discussions, we drew the conclusion that, of the participants listed above, hedge funds, distressed-asset investors, private equity companies and many managers of active investment strategies tend to have the most flexible mandates, tend to suffer least from liquidity mismatches, and usually have both the self-confidence and the spare risk capital funds available to deploy into falling and/or dislocated markets. However, participants noted that banks are now less likely to finance these investors' transactions than before the global financial crisis, as a result of the regulatory changes discussed above. Also, the availability of financing in the repo market for market participants and of CDS for hedging risks will depend on conditions in those markets. So, participation could be limited by these factors (see below).

Overall, market participants' perceptions of corporate bond market liquidity from the United States and Europe are complex. Managers of corporate bond portfolios emphasized the tendency towards stability of their corporate bond holdings. Some participants commented on the reduced capacity and willingness of corporate bond market liquidity providers to participate in the market. It was also noted that there is the risk that non-specialist investors in corporate bonds will sell rapidly and in large volumes should market conditions deteriorate. Market participants' views on whether managers of corporate bond portfolios would be actively counter-cyclical are also mixed. While there is a general view that they would be, there is also an awareness that their activity may depend on their capacity to do so, and that their participation may be delayed and would be influenced by their investment mandates and the prevailing circumstances. At the same time, other, less constrained and more nimble participants would be likely to take advantage of mispricings and so provide liquidity to sellers. Some market participants differentiated in some of their responses between periods of limited stress and periods where a generalized 'risk-off' stance applied.

In Asia

Our interlocutors indicated that market participants in Asia may to some degree respond differently to stressed conditions than might market participants in the United States and Europe. This is partly a result of the region's local investor base having increased in importance in recent

years, relative to institutional investors from U.S. and European markets, as the regional population has become wealthier, and also of that investor base being different in some respects to U.S. and European investors.

A number of market participants operating in Asia told us that, while Asian markets are enduring similar changes to market structure as are occurring in western corporate bond markets – such as strong growth in market size and the narrowing of the intermediation ‘pipeline’ – Asian investors in these markets – institutional, high net-worth and retail – tend to behave in a more conservative manner, described as ‘sticky’. This ‘sticky’ behavior manifests itself in: having a long-term perspective; reacting slowly to market events, seeing bonds as income-producing and not trading assets, to be held through economic and pricing cycles; and not selling into weakness, so as to avoid realizing losses on assets and also to avoid the costs associated with having to buy these assets back later – as one participant described it, ‘they don’t hit the panic button’. Our interlocutors were confident that these investors would be likely to take advantage of falls in prices and so ‘provide bids in the order book’ during stressed conditions. The stabilizing effects of this behavior are complemented by the fairly heavy skew in Asian markets towards investment-grade issuance.

On the other hand, there are some factors unique to Asia which, they thought, may tend to increase price volatility during stressed conditions. One of these is the strong increase in Chinese issuance in Asian markets, which leaves these markets vulnerable to adverse developments in in that country’s economy and financial markets. Also, market participants spoke of a noticeable increase in the amount of leverage and structured products used in Asian markets, as a way for investors to increase the returns earned on low-yielding assets, and that this was the first time that these products had been seen in Asian markets. As well, interlocutors noted that Asian corporate bond markets and investors hadn’t yet had to deal with a significant liquidity shock.

These factors were taken to introduce uncertainty into participants’ expectations for how Asian corporate bond markets and investors might respond to stressed conditions. As one participant from an intermediary noted: ‘When a real sell-off happens, we don’t know what will happen, and which intermediaries will stay in the market and facilitate trading.’

5.4.2 Structural factors influencing the provision of liquidity in stressed conditions

Market participants noted that the reduction in liquidity provision by intermediaries has narrowed the ‘pipeline’ for transactions, both in absolute terms and relative to the size of the market. As a result, intermediaries have both less capacity and less appetite to accommodate a significant increase in selling should investors begin ‘rushing for the exits’. One market participant noted that the change in the behavior of market participants meant that there were now far fewer participants able to step in and stabilize corporate bond markets when prices moved, meaning that the market now requires stronger moves in order to encourage market participants to provide demand-side liquidity. The pipeline may be further narrowed by intermediaries pulling back from providing liquidity in markets during times of stress, as has been observed in previous episodes of price volatility.

Some intermediaries noted that the decline of the single-name CDS market, compared to prior to the last crisis, is likely to reduce the risk appetite on the buy-side during market stress, as these

instruments are useful tools for helping to manage the risk of exposures. The implication that we drew from these observations was that, without these instruments to hedge their risk, market participants are less likely to buy into falling or depressed markets.

Also, key to developments under stressed conditions will be the behavior of those issuing funding in the repo markets, and the margining that they demand of those to whom they have offered funding. If markets suffer stress for three or four days but then recover, then some market participants believe that the repo markets can handle this – margin payments are made, prices adjust, and activity returns to normal. However, these same participants noted that, should the situation last longer than this, then ‘everything gets marked down’, margin calls are made across all products, traders have to liquidate assets into the market to meet these calls, and heavy selling ensues.

5.4.3 Stressed conditions and the financing of real economic activity

With regard to the possibility of illiquid corporate bond markets causing problems for companies seeking to fund their real-economy activities, market participants told us that many issuers now manage their liquidity so that they would be able to survive a disruption of primary corporate bond markets for 3-6 months. They have quite liquid balance sheets, their duration profile is healthy, they have diversified their funding sources, and they monitor and manage their liquidity risks. This suggests that periods of stress in corporate bond markets, even of serious stress, are unlikely to have a significant effect on the funding of real economic activity unless disruption to corporate bond markets were to continue for a number of months.

6. Case Studies

In addition to reviewing the literature and summarizing the discussion from the industry outreach, we have also researched the behavior of market participants and market liquidity during various past episodes of stressed market conditions. We recognize that future episodes of stressed conditions in financial markets will not necessarily reflect those of past episodes, and we have discussed at length above why this may be the case. Moreover, it is difficult to assess the impact of such events on the perceptions and liquidity risk management strategies of the holders of corporate bonds. We note that many of the episodes explored below occurred following the financial crisis, under the new liquidity conditions that have prevailed since then. These episodes appear to indicate that these markets and their participants may generally be able to cope with episodes of stress without creating negative externalities for other markets and participants.

With those caveats in mind, the main observations of our research are threefold. First, during none of the episodes did it seem that market volatility was caused by, or systemically exacerbated or aggravated by, the sale of assets by investors, including investors in bond mutual funds. Second, investors differentiate between different types of bonds and bond funds, and move their investments between different bond funds, depending on financial conditions. Third, some investors, including institutional investors, buy bonds even during stressed conditions.

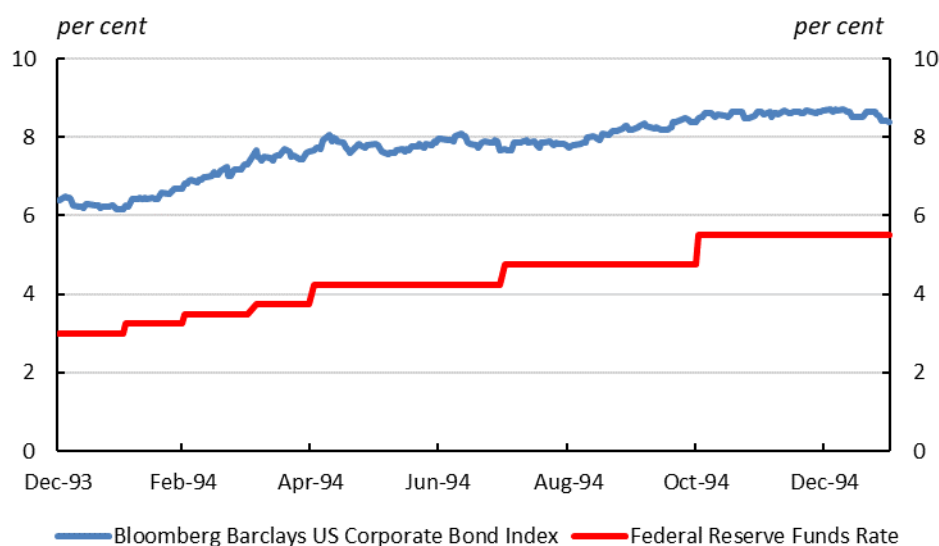
6.1. Federal Reserve Rate Hikes, 1994

In February 1994, the U.S. Federal Reserve began raising official interest rates from the 3.0 per cent rate that had prevailed since September 1992. After increasing the policy rate in

0.25 percentage points increments in February, March and April, the Federal Reserve raised this rate by 0.5 percentage points in May 1994 and again in August 1994, and then by 0.75 percentage points in November 1995.²⁷

Bond market investors responded immediately by repricing both government and corporate bonds, causing yields to rise significantly. The yield on the Bloomberg Barclays U.S. Corporate Bond Index rose almost continuously from a level of 6.17 per cent on January 31, 1994 to 7.24 per cent on March 21, before spiking higher to 7.67 per cent on April 4, and again to 8.0 per cent on April 11. The yield then moderated somewhat until early September, when it began rising again, reaching a maximum of 8.72 per cent on the first day of trading in 1995 (January 3). Overall, the yield on this index rose by 41 per cent from January 1994 to January 1995, in response to an 83 per cent increase in the Federal Reserve’s policy rate (Figure 2).²⁸

Figure 2: Movements in Federal Reserve Target Rate and Yield of Bloomberg Barclays U.S. Corporate Bond Index, December 1993 to January 1995



Source: Bloomberg

The falls in bond prices created the greatest bond market losses to that time – investors lost an estimated U.S.\$600 billion on their bond investments between January and September 1994, and

²⁷ Data taken from the US Federal Reserve; https://www.federalreserve.gov/monetarypolicy/openmarket_archive.htm (downloaded September 24, 2018).

²⁸ Data taken from Bloomberg, Bloomberg Barclays US Corporate Bond Index, Bloomberg code: LUACTRUU.

losses were to mount to over U.S.\$1 trillion by the end of the year.^{29, 30} The speed of the movement in bond prices and yields, and the size of the losses, surprised market participants. Losses were borne by all categories of investors – hedge funds, investment banks and broker-dealers, insurers (both life and property & casualty), and investors in mutual funds. Casualties of the losses included: hedge fund Askin Capital Management, which closed down as a result of its losses³¹; the senior partner at Goldman Sachs, Stephen Friedman, who resigned in the wake of losses borne by the investment bank³²; and the ratepayers of California’s Orange County, which declared bankruptcy after finding itself on the wrong side of a derivatives transaction gone awry.³³

The source of the sudden and strong re-pricing was that, despite accumulating signs of a strengthening economy, many market participants and investors had not prepared themselves for the Federal Reserve to begin raising interest rates. One trader described the situation as ‘Armageddon’: ‘Everyone got crushed heading towards the exit at the same time.’³⁴ Another reflected: ‘It’s hard to convey just how hard people got crushed by the rate hikes and higher yields across the bond market ... There was total dislocation. No one in ’94 was prepared for the rate hikes and a lot of people got exposed by the severity of the Fed’s tightening that year.’³⁵

The volatility in bond markets encouraged what were, to that date, the largest outflows from bond mutual funds, as a percentage of total bond fund assets under management (AUM) in the ten largest categories of bond mutual funds. In the last three months of 1994 alone, outflows represented 5 per cent of bond mutual fund AUM. The outflows were broad-based, encompassing many categories of fund – government, corporate, and short-, intermediate- and long-term. However, there were also net inflows into other categories, as investors re-balanced their portfolios. Overall, however, in net terms money flowed out of bond mutual funds during 1994.³⁶

While these incidents created stress in bond markets, the strong changes in prices, and the consequent adjustment and selling of bond mutual fund portfolios, did not cause systemic problems to arise in either the financial system or the real economy.

²⁹ Al Ehrbar, ‘The great bond market massacre’, *Fortune*, 1994.

³⁰ Angela Koch, ‘The Lessons of 1994’, *US Money Reserve*, May 23, 2017.

³¹ Al Ehrbar, ‘The great bond market massacre’, *Fortune*, 1994.

³² Michael Mackenzie, Robin Wigglesworth and Stephen Foley, ‘Markets: The ghosts of ‘94’, *Financial Times*, March 19, 2013.

³³ Angela Koch, ‘The Lessons of 1994’, *US Money Reserve*, May 23, 2017.

³⁴ Paul Griffiths, head of fixed income at Aberdeen Asset Management, quoted in Michael Mackenzie, Robin Wigglesworth and Stephen Foley, ‘Markets: The ghosts of ‘94’, *Financial Times*, March 19, 2013.

³⁵ Rick Klingman, quoted in Michael Mackenzie, Robin Wigglesworth and Stephen Foley, ‘Markets: The ghosts of ‘94’, *Financial Times*, March 19, 2013.

³⁶ BlackRock Viewpoint, 2016a, p.7.

- In the year after the increases to the policy rate, the U.S. unemployment rate was lower and inflation was falling, while the U.S. economy and equities market were poised to begin a period of strong growth.³⁷
- The financial markets continued their work of providing funding to the real economy. The larger, systemically-important financial institutions continued to operate.
- The financial markets and the economy both absorbed and adjusted to the re-pricing of money and financial instruments.
- Interestingly, the equity market remained calm all through the bond market repricing. The S&P 500 index remained flat through the whole year, showing little volatility, and ended the year at a level of 459.27 – just six points below where it began the year, at 465.44.
- Bond mutual funds were well able to manage the increased inflows and outflows of money. There were no signs that sales of bonds by mutual funds either instigated selloffs in bond markets or exacerbated and aggravated selloffs that had already begun.

6.2. Global Financial Crisis, 2008-09

The global financial crisis was the culmination of a steady deterioration in the market for U.S. sub-prime debt, which in turn adversely affected bank solvency, leading to a loss of confidence in the financial system and the seizing up of the commercial short-term money markets. The consequences for corporate health and economic activity in both the U.S. and the rest of the world were severe. Equity market valuations world-wide fell precipitously, with the U.S. S&P 500 index falling by 47 per cent from September 2, 2008 to March 9, 2009. The U.S. economy contracted by 3.6 per cent from end June 2008 to end-March 2009. BlackRock has described the crisis as ‘the most profound market stress event since the Great Depression’.³⁸

Our research suggests that the behavior of investors and issuers in the corporate bond market did not contribute to either the initiation or the extent of the global financial crisis. Instead, investors and issuers were rather casualties of the crisis, as their markets experienced prolonged and severe stress during the crisis. Even the primary markets for investment-grade bonds ‘seized up’ and ceased to function, so that it became tremendously difficult for companies to price and issue bonds. Corporate treasuries at the better placed investment-grade issuers seeking to issue debt were required to construct implied bond prices from a combination of CDS prices and to conduct ‘soft sounding’ meetings with prospective investors in order to price their bonds before issuing them. While this approach allowed some degree of issuance to continue during the worst days of the crisis, it was clearly sub-optimal and imposed significant costs on issuers compared to the ordinary processes of pricing and issuance.

Movements in the prices of corporate bond ETFs give an indication of the scale of the forces acting on bond markets. Between the end of August and October 10, the price of the LQD

³⁷ Steven C. Johnson, ‘Fears of a 1994 bond market flashback’, *Reuters*, March 18, 2013.

³⁸ BlackRock Viewpoint, 2016a.

investment-grade ETF fell by 19.1 per cent, before rising by early January 2009 to its pre-crisis value and then again falling 10.4 per cent below its end-August value by March 9, the date of the nadir of asset market valuations during the crisis. The HYG speculative-grade ETF suffered even more, losing 31.4 per cent of its value by November 20 before recovering to be 13.3 per cent below its end-August value by early January, only to then fall again, to two-thirds of its end-August value on March 9, from where it began its recovery (Figure 3).³⁹

Figure 3: Movements in the prices of the LQD and HYG Bond ETFs, June 2008 to June 2009



Source: Bloomberg

Turning to mutual funds, bond mutual funds continued to perform as normal during the crisis: funds were able to provide liquidity to investors seeking to redeem or rebalance their investments as required. Interestingly, the net *outflows* from the ten-largest categories of bond mutual funds of around U.S.\$35 billion between end-September and end-December 2008 were more than matched by net *inflows* into these funds of around U.S.\$40 billion in the three months between end-December 2008 and end-March 2009. The data indicate that investors were re-balancing towards relatively safe-haven bonds, such as government and municipal bonds.⁴⁰

Bond ETFs, while experiencing significant price falls, continued to trade even while the broader bond market experienced difficulties. Their operation allowed buyers and sellers to find liquidity as they needed it, and also provided a degree of continuous price information when the disruption in other parts of the market meant that pricing broke down for many types of bonds.⁴¹

The potential impacts of a freeze in primary bond markets, the resulting fall in ETF prices, and the use of emergency liquidity management tools by individual investment funds in such

³⁹ Data taken from Bloomberg.

⁴⁰ BlackRock Viewpoint, 2016a, p.8.

⁴¹ BlackRock Viewpoint, 2015, p.5.

circumstances remain areas for future study. But the 2008 crisis demonstrated that corporate bond markets register and pass on shocks which have originated elsewhere, while still maintaining their core secondary market functionality, including in times of severe stress. We note that, during the global financial crisis, activity in the global secondary bond market was facilitated by an active bond fund market, and corporate bond markets were more resilient than other markets at that time. These observations would, to a degree, be consistent with the perceptions of market participants outlined in Section 5. However, as discussed above, post-crisis regulatory changes and shifts in broker-dealer risk preferences changed the business models of many broker-dealers. As a result, in future times of severe stress corporate bond markets may not respond in the same way and corporate bond market liquidity may be considerably worse than what has been outlined in other parts of this document.

6.3. Great East Japan Earthquake, 2011

On March 11, 2011, an earthquake struck the seabed off the east coast of Japan's north-east region of Tōhoku. While the earthquake caused some damage to the Japanese mainland, the most serious damage was caused by a subsequent tsunami caused by the earthquake, including the meltdown of reactors, and violent explosions, at the Fukushima Dai-Ichi nuclear power plant.

Investors in Japanese markets responded strongly to these events. The Nikkei stock average fell by 16.1 per cent over the following two business days, while yields on Japanese government bonds fell by 9.7 basis points from 1.310 per cent to 1.213 per cent in the following week. In bond markets overall, liquidity dried up significantly in response to the crisis. Although the funds-supplying operations of JPY 21.8 trillion by the Bank of Japan into financial markets on March 14 may have assisted bond investors' trading, the illiquidity spike was still significant, and liquidity did not return close to normal levels until June 2011.⁴²

Despite these adverse conditions in bond-market liquidity, no systemic problems arose from sales of bonds or interests in bond funds.

6.4. Taper Tantrum, 2013

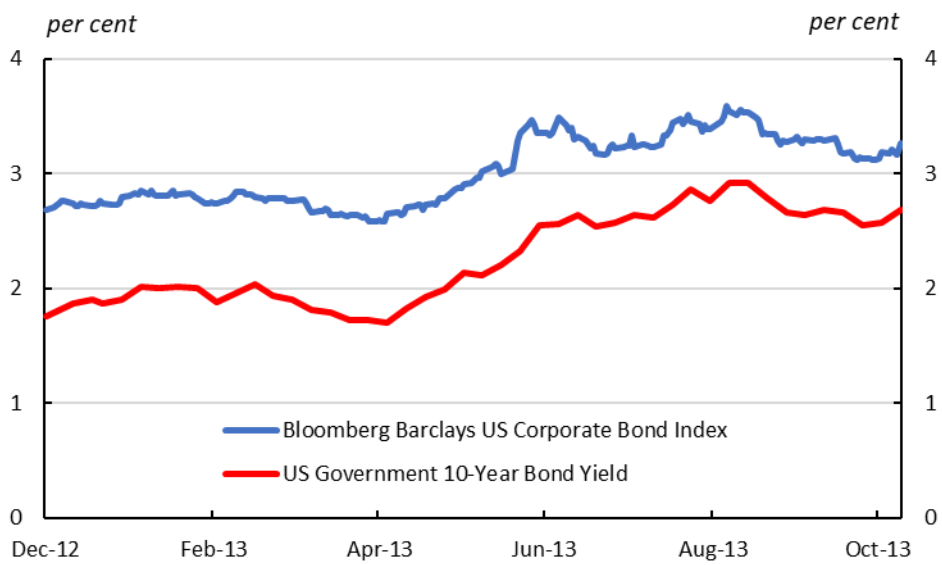
On May 22, 2013, then Federal Reserve chairman Ben Bernanke mentioned in testimony to the U.S. Congress that, once there was consistent evidence that employment conditions were improving in the U.S., the Federal Reserve would begin gradually reducing the size of its monthly injections of money into financial markets through its program of quantitative easing. At that time, the Federal Reserve was purchasing U.S.\$85 billion of bonds per month.

Investors were surprised by this announcement and reacted quite strongly to it. The ten-year yield on U.S. government treasuries, which at the close the day before the announcement stood at 1.93 per cent, rose by 11 basis points to 2.04 per cent that day, as investors repriced bonds in reaction to the news. Yields continued to rise gradually until June 19, when the chairman made a statement to clarify his remarks before Congress which repeated his essential points. Yields rose a further 17 basis points that day, and then continued to rise in fits and starts until reaching 2.9 per cent in early September.

⁴² Markit, 2014, p.7.

Yields on corporate bonds followed developments in treasuries, with the yield on the Bloomberg Barclays U.S. Corporate Bond Index rising by 86 basis points from 2.73 per cent on May 21 to 3.59 per cent in early September (Figure 4).

Figure 4: Movements in U.S. Government 10-Year Bond Yields and the Bloomberg Barclays U.S. Corporate Bond Index, December 2012 to October 2013



Source: Bloomberg

Bond mutual funds were caught up in the selling and were required to manage the liquidity needs arising from investors' seeking to re-balance their portfolios away from emerging-market and intermediate-term exposure and towards bank loans, short-term bonds and 'non traditional' bonds, all of which were expected either to benefit from rising interest rates or to have lower interest rate risk. The Dutch National Bank's analysis of the episode showed that in Europe, from the beginning of March to the end of June, investment funds sold around €6.6 billion of euro-area corporate bonds, or around 3.6 per cent of their initial portfolios. Money-market funds sold around 9 per cent of their initial corporate bond portfolios. On the other side of the market, insurance companies, pension funds, banks and non-financial corporations were net purchasers of corporate bonds in the same time period.⁴³

Overall, managers of bond mutual funds were able to manage the liquidity requirements of both the re-balancing and the net outflow from their funds⁴⁴, while institutional investors provided liquidity to investors seeking to exit the market. As well, bond ETFs continued to provide investors with liquidity through the re-pricing and re-balancing event, including in high-yield bonds.⁴⁵

⁴³ DNB, 2016, pp.14-16.

⁴⁴ BlackRock 2016a, p.9.

⁴⁵ BlackRock, 2015, p.5.

6.5. Bill Gross' departure from PIMCO, 2014

In September 2014, well-known asset manager Bill Gross suddenly resigned from PIMCO, the investment management company that he had helped to found and where he had worked for over four decades, achieving the success for which he and PIMCO were known. Investors in PIMCO funds immediately began withdrawing money from the company's flagship Total Return Bond fund: investor withdrawals totaled around U.S.\$23 billion in September, around U.S.\$27.5 billion in October, U.S.\$9.5 billion in November and U.S.\$19.4 billion in December. By the end of 2014, the fund's assets under management, at U.S.\$143.4 billion, were half of the U.S.\$293 billion that they had been at their peak in June 2013.⁴⁶ The net outflows from this and other PIMCO funds would continue for another two years, until November 2016.⁴⁷

Bond markets were able to manage these significant redemption requests from a single fund manager without any apparent disturbance to their functioning, liquidity and pricing. During this time, as with previous episodes of market stress, market participants observed a strong increase in trading in bond ETFs, as investors used ETFs to manage their exposure to fixed income assets.⁴⁸

6.6. Energy-Sector and High-Yield Sell-Off, Third Avenue Capital, 2015

In the second half of 2015, there was a significant fall in the prices of commodities, most notably that of oil. The U.S. Federal Reserve Bank of St Louis' commodity price index fell by 19.6 per cent from June 30, 2015 to December 31, 2015, and the West Texas Intermediate price of oil dropped by 40 per cent from its peak of U.S.\$61.43/bbl on June 10, 2015 to U.S.\$37.04/bbl at year-end 2015. This development followed the cessation of the U.S. Federal Reserve's third round of quantitative easing, in October 2014, and the slowing of growth in the Federal Reserve's balance sheet to zero in March 2015. What was effectively a tightening of monetary policy may have contributed to creating the conditions that led to the sell-off.

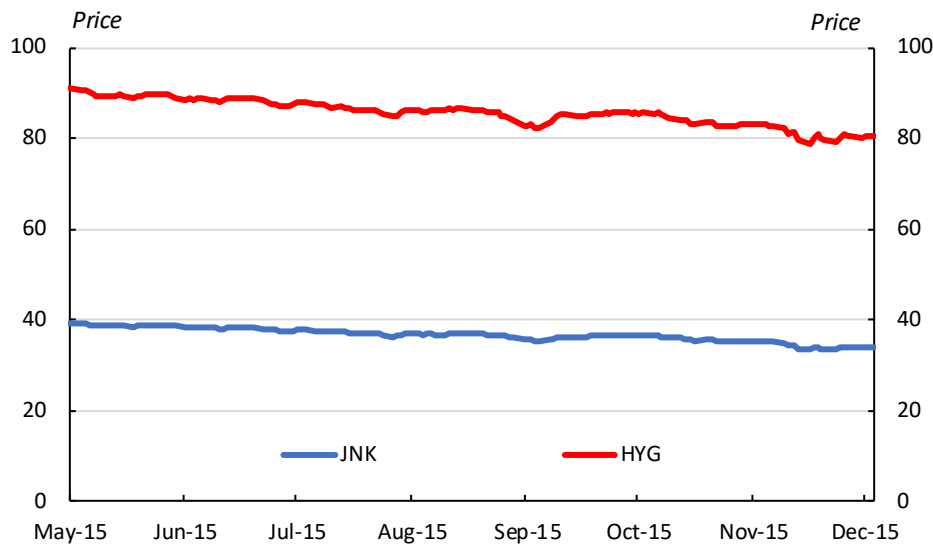
The fall in commodity prices placed pressure on the finances of U.S. energy and metals & mining companies, which was in turn reflected in falling prices for their bonds, sharply raising the yields of the bond indices in which they participated. The decline was most noticeable in U.S. high-yield corporate bond indices, which began declining in July 2015 and continued declining through the second half before falling strongly in November and December 2015. The market prices of the HYG and JNK high-yield U.S. corporate bond ETFs fell by 9.3 per cent and 11.8 per cent respectively between end-June and end-December 2015 (Figure 5).

⁴⁶ Stephen Foley, 'Investors pull \$19.4 billion from Pimco fund', *Financial Times*, January 2, 2015.

⁴⁷ Ben Martin, 'Bond giant Pimco staunches flow of investor money', *The Telegraph*, November 11, 2016.

⁴⁸ BlackRock 2016b, pp.15-16.

Figure 5: Movements in the prices of the HYG and JNK Bond ETFs, May 2015 to December 2015



Source: Bloomberg

In the three months to end-September 2015 investors in bonds issued by U.S. energy companies increased their selling of these bonds across all categories. In the three months to end-December 2015, investors continued to sell their bonds in net terms, however there was some rotation from the high-yield, bank loan and ‘nontraditional’ bond categories into intermediate-term bond funds. This rotation out of bank loan and ‘non traditional’ bond funds and into intermediate-term bond funds continued in the three months to end-March 2016, accompanied by a return to net buying of high-yield bond funds, so that in net terms there was a strong increase in bond-fund investments in these three months.⁴⁹ It is notable that, while mutual fund investors redeemed U.S.\$9.4 million from high yield bond funds from the beginning of November to December 9, 2015, or around 2.6 per cent of their assets, several institutional investors saw the fall in prices as a buying opportunity, and took advantage of the sell-off to add to their high yield allocations.⁵⁰ Also, secondary-market trading of bond ETFs, and especially high-yield bond ETFs, contributed liquidity to bond markets, by providing investors with a means for either reducing or increasing their exposure to corporate bonds. These ETFs also provided the market with a means of price discovery, which had been somewhat impaired by the volatility prevailing in corporate bond markets.⁵¹

⁴⁹ BlackRock 2016a, p.10.

⁵⁰ BlackRock Viewpoint, 2017, p.8; Sean Collins, ‘High-Yield Bond Mutual Fund Flows: Some Perspective’, Investment Company Institute, December 16, 2015, p.1.

⁵¹ Shelly Antoniewicz, ‘High-Yield Bond ETFs: A Source of Liquidity’, Investment Company Institute, December 22, 2015.

The pressures created by the sell-off in corporate bonds proved too much for the Third Avenue Focused Credit Fund, managed by Third Avenue Capital. An open-end mutual fund which invested in highly illiquid, distressed, unrated and ultra-low-rated credits to a greater extent than other high-yield funds, the increasingly illiquid trading environment was too taxing for it. This is despite the fact that the fund maintained a ‘liquidity buffer’, with 20 per cent of its assets held in cash. The fund’s managers announced on December 12 that they would begin liquidating the fund and were ceasing investor redemptions. Remaining investors received a cash distribution on December 16 and continued to receive periodic distributions from the liquidating trust until it was exhausted.⁵² Note that, because of its abnormally risky asset profile, this fund was not representative of other high-yield bond funds, and also that its failure did not lead to a general ‘rush for the exits’ among bond-fund investors. Certain industry observers noted that these investors were able to discern that Third Avenue Capital’s troubles were unique to the fund. Rather than treating all funds and investment strategies as being the same, they were able to distinguish among them, and to make investment and allocation decisions based on this knowledge.⁵³

6.7. United Kingdom ‘Brexit’ vote, June 23, 2016

On June 23, 2016, citizens of the United Kingdom were asked to vote on whether or not to remain in or to leave the European Union. Although the general expectation, drawn from opinion polling, was that a majority of the electorate would vote to ‘remain’, the results revealed that the ‘leave’ vote accounted for 51.89 per cent of all votes.

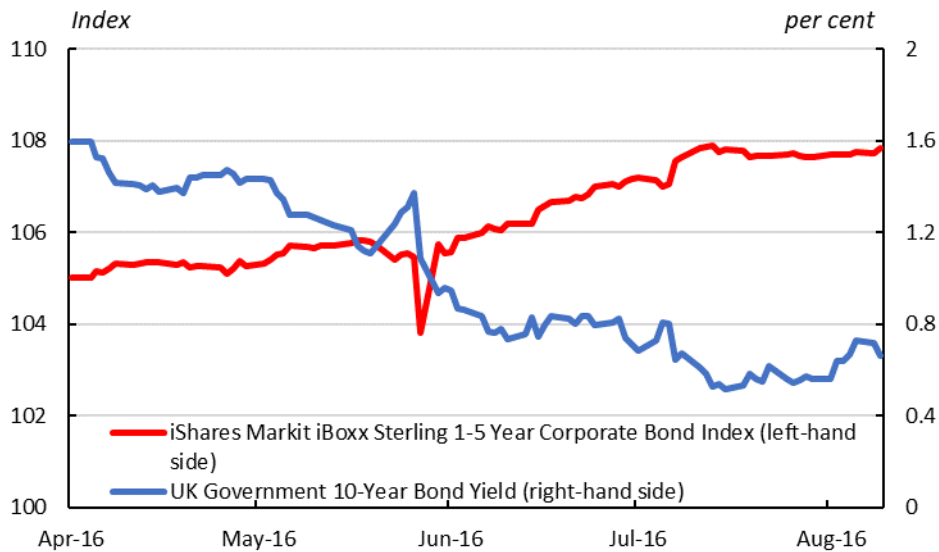
The surprise result had a strong effect on financial markets. By the end of the following day, the value of sterling had fallen 8.1 per cent, and would continue to fall gradually through the rest of the year. The UK’s FTSE 100 equity market index also fell, ending June 24 and June 27 down 3.1 per cent and 5.6 per cent respectively, before staging a recovery.

UK government bonds appear to have benefited from strong ‘safe haven’ flows: after an initial spike in yield following the announcement of the result, the yield on Bloomberg’s generic 10-year government bond index fell from 1.373 per cent at the close of trading on June 23 to 1.086 per cent at close of trading the following day, a fall of 20.9 per cent. Yields continued to fall for the next seven weeks. However, despite this, investor reaction in corporate bond markets was more subdued. The Markit IBOXX index of UK corporate bonds fell by 1.6 per cent by the end of June 24, before recovering on June 27 to be 0.3 per cent above the closing value of June 23 and then continuing to strengthen for the following six weeks, to be 2.3 per cent above the June 23 closing value on August 9 (Figure 6).

⁵² Amy Feldman, ‘Third Avenue Focused Credit Closes’, *Barron’s*, December 12, 2015.

⁵³ BlackRock Viewpoint, 2016a, pp.10-11. Note that on July 4 and 5, 2017 three UK real estate funds announced temporary suspensions in light of a massive increase in investor redemptions because of high levels of uncertainty in the U.K. commercial property market.

Figure 6: Movements in UK Government 10-Year Bond Yields and the iShares Markit iBoxx Sterling 1-5 Year Corporate Bond Index, April 2016 to August 2016



Source: Bloomberg

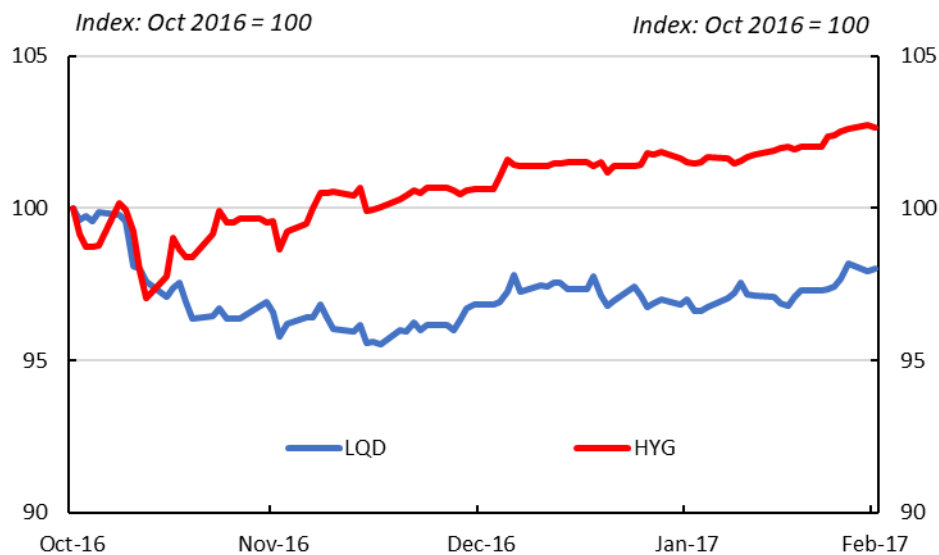
These outcomes in corporate bond markets following the Brexit surprise indicate that investors in these markets are unlikely to overreact to surprise economic, financial and political developments, and that corporate bond markets need not necessarily suffer from strong volatility even when the markets for other financial assets are doing so.

6.8. Post U.S. Election Sell-Off, Late 2016 – Early 2017

Following the election of President Donald Trump on November 8, investors in financial markets repriced assets significantly and rapidly. The U.S. S&P 500 stock market index dived on the news before suddenly reversing and rising strongly, increasing by 6.9 per cent over the twelve weeks to end-January. Bond yields also rose strongly, possibly as a result of investors rotating away from bonds into strongly-rising equities. Three days after the election, the market prices of the LQD investment-grade and HYG high-yield U.S. corporate bond ETFs had fallen by 2.0 per cent and 2.9 per cent respectively. While the HYG ETF would recover its value over the next month and continue to strengthen in price thereafter, by mid-March 2017 the LQD ETF had lost 4 per cent of its pre-election value, and only slowly recovered in price thereafter (Figure 7).⁵⁴ On December 14, the U.S. Federal Reserve announced a 0.25 percentage point increase in policy interest rates, compounding the adverse conditions for investors in bond funds.

⁵⁴ Data courtesy of Bloomberg.

Figure 7: Movements in the prices of the LQD and HYG Bond ETFs, October 2016 to February 2017



Source: Bloomberg

However, these conditions did not cause any problems with pricing or liquidity in the market for corporate bonds, nor did strong rotations out of U.S. bond mutual funds cause liquidity and redemption problems for these investors.

6.9. Liquidity in China's bond markets, late 2016

China's bond market experienced an adjustment at the end of 2016 after nearly three years of buoyant growth. The CSI Aggregate Bond Index (Net Price) rose from 94.28 on January 6, 2014 to a peak of 105.01 on October 21, 2016, an increase of 11 per cent. From October 24, 2016 the market began to adjust, with the Index recording its lowest level of the year on December 20, 2016, after a decrease of 4.2 per cent. The bond market then stabilized and recovered. When the market fell, liquidity contracted, especially on November 30, 2016, and the weighted average interest rate of the 7-day interbank pledged repo (R007) reached 3.5 per cent. The 10-year treasury bond yield rose from 2.7 per cent on October 21 to 3.4 per cent on December 20, and the 5-year AAA corporate bond yield rose from 3.11 per cent to 4.28 per cent in the same period.

Multiple factors, both domestic and international, contributed to this adjustment:

- there was an inherent need for an adjustment after several years of continuous growth;
- liquidity was tightening as a result of the central bank's open market operations and expectations that U.S. Federal Reserve may increase its policy interest rate;
- from the second half of 2015, funds flowing into the bond market surged due to increased use of leverage, causing bond yields to fall but also increasing market vulnerability;
- in order to prevent financial risks from arising and to maintain orderly market operations, China's financial regulatory authorities introduced a number of regulatory policies during the second half of 2016; in order to meet these regulatory requirements,

financial institutions reduced their exposure to bonds, leading to tighter liquidity in the bond market;

- news of the illegal operations of a financial institution aggravated existing uncertainty and risk aversion among market participants.

As credit risk and liquidity risk rose, market participants began deleveraging, which accelerated the downward trajectory of bond prices.

In response to these circumstances, China's financial regulatory authorities took joint measures to stabilize market confidence. These measures included:

- timely and proper handling of the illegal conduct of the intermediary and urging market participants to enhance their internal controls;
- further improving the structure of liquidity distribution and reducing the divergence of liquidity between banks and non-bank financial institutions; and
- maintaining market liquidity through open market operations.

By December 31, 2016, the R007 weighted average interest rate had fallen to 2.7 per cent and funding liquidity had returned to normal. The adjustment in China's bond market did not create any risks to the financial system, and its impact on the real economy was limited.

6.10. Argentinian Financial Stress, April-October 2018

During 2018, Argentine financial markets experienced illiquidity and financial stress. These conditions significantly affected the nation's bond markets, both corporate and sovereign. There was also a significant volume of redemptions from open-ended mutual funds.

This episode of financial stress was largely a result of the following factors:

- Monetary policy tightened in the United States, where the policy rate rose from 1.5 per cent in December 2017 to 2.5 per cent in December 2018, with expectations at the time of further increases. This resulted in a strengthening of the U.S. dollar relative to other currencies, including the Argentine peso.
- Between 2016 and 2018 there was a sustained increase in the stock of short-term bills – most with a maturity of less than three months – denominated in pesos and issued by the Banco Central de la República Argentina (LEBACs). The stock of LEBACs rose to around ARS 1,200,000 million (approximately U.S.D 60,000 million), equivalent to around 150 per cent of the monetary base and almost 100 per cent of the central bank's international reserves.
- The introduction of income tax on financial income, including on income earned on LEBACs, which encouraged sales of these assets and possibly also of sovereign bonds.
- A number of other adverse developments – a severe drought which impaired agricultural output, ongoing disputes over international trade, and the prosecution of senior political figures from a former administration on charges of bribery and corruption (the *Cuadernos* case).

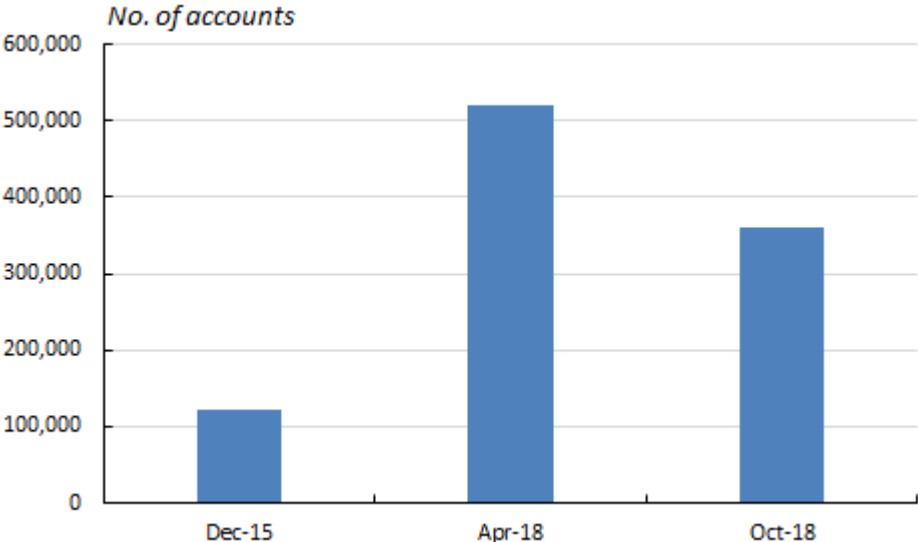
From April 2018, Argentinians reacted to these developments by substituting U.S. dollars for their Argentinian pesos, obliging the central bank to sell around U.S.D 13,000 million of its

international reserves between January and August 2018. This was equivalent to around 20 per cent of those reserves. This substitution of U.S. dollars for pesos caused a strong devaluation of the peso against the U.S. dollar. The exchange rate fell from ARS 18.77 per U.S. dollar in January 2018 to ARS 36.19 per U.S. dollar in October 2018, a devaluation of 93 per cent. The rate of inflation rose from 17 per cent at end-2017 to 45 per cent by end-2018, and GDP contracted by 2.4 per cent in 2018.

As a result of these macroeconomic and financial developments, Argentina’s bond and stock markets experienced financial stress, increased risk aversion, reduced exposure to local bonds, and a fall in the duration of bond portfolios. These shocks manifested themselves in a change in the composition of investment portfolios, as investors switched from peso-denominated assets to U.S.-dollar-denominated assets.

Argentine mutual funds were particularly affected by the stress. From January 2016 Argentinian investors’ participation in *fondos comunes de inversión* (FCIs – open-ended mutual funds) had increased strongly. In April 2018 the number of accounts held at FCIs was around five times higher than at the end of 2015 (Figure 8). Also, by the beginning of 2018 almost 50 per cent of FCI assets were peso-denominated LEBACs.

Figure 8: Evolution of the Number of Individual Accounts with FCIs, December 2015, April 2018 and October 2018



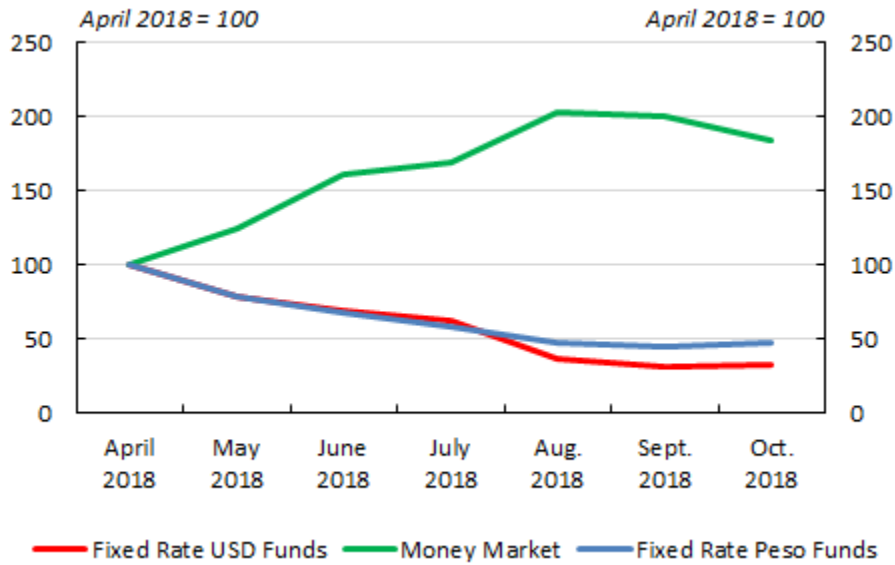
Source: Comisión Nacional de Valores, República Argentina

Between April and September 2018, FCIs experienced significant redemptions of client funds. Those invested in peso-denominated fixed income funds converted their holdings to U.S.-dollar-denominated assets. Between May and October 2018, these funds experienced redemptions equivalent to 53 per cent of their end-April peso-denominated stock of assets under management (Figure 9, Figure 10).

In addition, risk aversion, a perception of increased default risk, and the higher rates offered on Argentine bonds caused some investors to redeem their holdings in U.S.-dollar-denominated

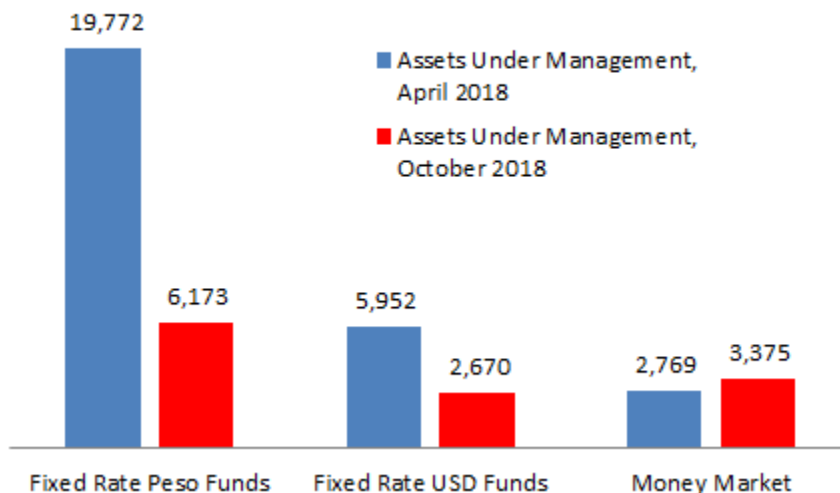
fixed-income funds. Between May and October 2018, these funds experienced redemptions equivalent to 67 per cent of their end-April U.S.-dollar-denominated stock of assets (Figure 9, Figure 10).

Figure 9: Evolution of the Balance of Redemptions and Subscriptions in FCIs, April to October 2018, in Pesos



Source: Comisión Nacional de Valores, República Argentina

Figure 10: Evolution of FCI Assets Under Management, April to October 2018, in U.S. Dollars



Source: Comisión Nacional de Valores, República Argentina

These redemptions coincided with a plan by the central bank to reduce, progressively and systematically, the stock of high-interest-rate, short-term LEBACs. Together, these developments

created a strong liquidation of peso-denominated assets in favor of other dollarized assets and physical U.S. dollar holdings. The result was a vicious cycle in redemptions from FCIs followed by price decreases in bonds and other securities, then an increase in the Emerging Market Currency Index, then more redemptions, and so on.

The vicious cycle was aggravated by FCI managers deciding, where possible, to retain their most liquid assets and to dispose of illiquid assets, such as corporate bonds, and some sovereign and provincial government bonds. Most affected were bonds issued by Argentine provinces, followed by sovereign bonds issued under Argentine law and sovereign bonds issued under New York State law. U.S.-dollar-denominated corporate bonds experienced the most modest price falls, reflecting a perception of their having lower risk of default than provincial or sovereign bonds.

The FCIs' portfolio valuations and the net asset values of their shares were significantly affected by the vicious cycle. In the period under consideration, the value of shares in peso-denominated fixed-income FCIs fell by 27 per cent in U.S.-dollar terms, while the value of shares in U.S.-dollar-denominated fixed-income FCIs fell by 6 per cent in U.S.-dollar terms.

The impact of the financial stress of 2018 on the value of the assets under management in FCIs and prices of corporate bonds and sovereign bonds was significant. Nevertheless, it is important to note that no situation of illiquidity arose at any of the FCIs despite the severe stress experienced in the financial markets, the vicious cycle in prices and redemptions, and the level of client redemptions exceeding both the FCIs' liquidity reserves and their holdings of liquid assets. During this period of stressed conditions, the funds were able to meet their clients' redemptions, there was no need for payment via distribution of securities in kind, there were no situations requiring investor bailouts, and no FCI defaulted on its obligations.

By the end of September 2018, the values of FCI shares had improved somewhat, and the proportion of holdings of liquid assets in both types of fixed income funds (U.S.-dollar denominated and ARS denominated) had increased.

6.11. Summary

These ten episodes of bond market stress experienced over the last twenty-five years demonstrate that bond markets, including corporate bond markets, have shown signs of significant resilience and even counter-cyclical behavior. In each of the episodes bond markets, including corporate bond markets, showed themselves to be resilient to developments to a significant degree; a particular investor class, bond mutual funds, demonstrated that they were able to handle significant requests for liquidity over extended durations; when a bond mutual fund failed for idiosyncratic reasons, its failure caused no wider problems either for other bond funds or for the underlying bonds; issuers of corporate bonds were able to survive the extended closure of bond markets during the global financial crisis; and bond ETFs played an important role during episodes of stress in enabling the ongoing functioning of price discovery and liquidity provision.

This suggests that, firstly, periods of stress are relatively common in corporate bond markets and have consistently not proven to be strong amplifiers of stress starting elsewhere; and secondly, while significant price declines are likely and have often occurred, corporate bond markets have rarely seized up, even in the face of significant selling pressure.

The case studies support the view that corporate bond markets are complex structures with a wide variety of participants, each with different objectives, time horizons and liquidity requirements, all of which influence these participants' behavior. Changes in the composition and business models of market participants will necessarily influence both overall behavior and outcomes in those markets, and so as we noted at the beginning of this section, we must interpret these outcomes with caution. The key lesson of the case studies is the importance for market participants, and especially for asset managers, to avoid complacency and to institute and maintain sound liquidity-risk-management practices.

To this end, holistic modelling of corporate bond market liquidity in periods of market stress, taking into account the business models of the various market participants, would be a useful academic contribution to encouraging robust and targeted liquidity risk management by corporate bond market participants.

7. Summary of our Observations Concerning Behavior Under Stressed Conditions

In order to clarify further how participants in corporate bond markets might behave under stressed conditions and, thus, how changes in market liquidity might unfold, below we summarize our observations regarding the behavior of the various participants in these markets. This summary draws on information provided through our market outreach and academic research, and outlines:

- which broad categories of market participants are involved in corporate bond markets;
- their approaches to investing;
- their capacity to invest in markets, and their relative sophistication; and
- their likely responses to stressed conditions, including their ability (if any) to stabilize markets.

Our summary observations are:

Pre-existing liquidity and market conditions are likely to result in larger than usual volatility in prices when markets and investors are experiencing stress. As market participants have told us in our outreach, the market liquidity 'pipeline' for transactions has narrowed relative to the size of the market. Should intermediaries respond to stressed conditions by further restricting their liquidity provision, as is likely, it may be more difficult for those seeking immediacy to find liquidity, raising the risk that prices will have to fall strongly in order to encourage the buy-side to provide liquidity. This observation is consistent with the observations of Steins Bisschop, Boermans and Frost (DNB, 2016), that the degree of yield shock experienced by a bond in stressed conditions is directly related to that bond's degree of illiquidity, and that bond illiquidity is a significant driver of price shocks across time.⁵⁵

Hedge funds and other sophisticated speculative investors generally combine a short-term approach to investing with a high tolerance for risk. Such participants are most likely to be able to identify significant mispricings in corporate bonds, and therefore both to begin selling out of

⁵⁵ DNB, 2016, pp.35, 37.

markets, and begin buying oversold bonds, before other participants. Note that their significantly-reduced leverage compared to before the financial crisis, as indicated by market participants in their discussion with us, implies that their pro-cyclical selling during market stress is likely to be muted – they are much more likely to be ‘opportunistic’ than ‘distressed’ sellers. Should asset prices overshoot the downside, hedge funds are likely to begin providing buy-side liquidity, which may partly dampen the selling pressure – although note again that their role and access to funding is much smaller now than before the crisis.

Those most likely to sell in the wake of hedge funds are likely to be the ‘tourists’ among mutual fund and retail investors who entered the markets in search of yield and who are unused to volatile conditions in corporate bond markets, and also investors and asset managers who follow index-tracking and market-signals strategies and whose algorithms are likely to instruct them to sell into weakness. The increased presence of these types of market participants in corporate bond markets means that selling could be abnormally heavy during the first stage of the next bout of market stress.

Extrapolating from their behavior in previous episodes of market stress, there is also likely to be some selling by mutual-fund investors, as they rebalance their portfolios towards safer assets. One IOSCO member noted to us that some mutual funds, especially those that are index-linked, are experiencing less flexibility with regards to how and when they liquidate bonds from their portfolios, as a result of being constrained by their mandates and their need to follow indices. This strategic constraint may further limit mutual funds’ actions when bonds are listed on exchanges, which tend to facilitate faster trading than over-the-counter principal-based and agency-based trading. On the positive side, selling by mutual funds tends to be relatively small as a proportion of overall mutual fund assets. Also, mutual fund investors and managers tend to reallocate their money between different types of bonds, so that net selling of bonds is in many cases lower than their total selling. Lastly, they also tend to participate enthusiastically in bond purchases once market stress has passed, providing demand-side liquidity to markets as conditions recover.

A ‘forced selling’ situation among banks is less likely than before the crisis. The banking sector is now better capitalized, and there is less leverage in the market. Fewer intermediaries are willing to take a position in the market, and they are more careful about which bonds they keep on their books. Regulations which require more capital of intermediaries holding bonds on their balance sheets beyond stated maximum durations have encouraged them to hold only the most liquid bonds in their inventories. Other participants exposed to possible forced selling are insurers and mutual funds which may be obliged to sell any bonds in their portfolios which have been downgraded by ratings agencies.

Institutional investors, such as mutual funds, pension funds, insurers (net of sales of downgraded bonds) and sovereign wealth funds, are likely to be able to provide significant structural demand-side support to corporate bond markets during stressed conditions, as a result of regular inflows of income, such as from investors or sales of commodities, which must be allocated into markets, often in certain proportions to different assets. Pension funds, insurers and sovereign wealth funds may be constrained by regulation and their own mandates and internal risk-management protocols from taking full discretionary advantage of lower prices during market stress. However, some of their asset managers may have discretion and capacity to buy any bargains that they identify and, so, improve returns for their investors and shareholders. This

behavior should help to stabilize the markets to some degree during an episode of stress, and to assist in its recovery once the stress has passed.

Managers of passive, index-tracking, and actively managed mutual funds now have quite sophisticated liquidity-management systems and strategies in place to manage redemptions, which allow them to minimize the market and price impacts of their selling. Thus, they are likely to be able to manage redemptions by fund investors without having to increase significantly their selling in the secondary markets for corporate bonds. While there is likely to be net selling of bond mutual fund holdings by investors, due to the way that asset managers manage their liquidity and assets this may not necessarily lead to proportionate sales of corporate bonds, and any selling is likely to be partially or wholly reversed in the following quarter. Note that the strategies and tools available to manage redemptions may differ across countries.

Should worse come to worst and market stress intensify to the point of causing significant declines in valuations, the market liquidity providers of last resort are likely to be distressed-debt investors, hedge funds and private equity seeking out and buying mispriced corporate bonds, corporations buying back their own debt at significant discounts, sovereign wealth funds, and, *in extremis*, central banks. The degree and timing of these participants' involvement in markets will be influenced by the breadth and severity of market stress.

One area of concern is the *capacity* of these market participants to provide buy-side liquidity during market stress. Post-crisis regulations and increased risk aversion caused intermediaries and banks to reduce the size of, and increase the cost of providing access to, their balance sheets. This means that traditional buyers of assets during market stress, such as hedge funds, may be constrained in their ability to do so. Should market participants' capacity to provide liquidity to markets during market stress be constrained, price dislocations are likely to be more severe, and more prolonged, than what history may suggest.

We note that, while price volatility under stressed conditions is expected, the risk of a procyclical-selling cycle developing from within the corporate bond market, causing severe price falls and market disruption, and creating negative externalities for the markets for other financial assets is low. Most market participants appear to be sufficiently sophisticated and well-resourced to be able to manage situations of increased stress.

8. Conclusions

Since the global financial crisis, significant growth in the corporate bond market has been accompanied by concerns about the reduced availability of market liquidity. As a result, there is some concern in the policy-making community that a significant sell-off of corporate bonds by investors could result in price volatility and temporarily depressed prices. This might adversely affect investors and markets, and also, possibly, the operation of the financial system. This report has studied this possibility through the lens of liquidity in corporate bond markets under stressed conditions.

Significant structural changes that have taken place in corporate bond markets since the 2008 financial crisis and the ensuing financial reforms have likely reduced the ability of traditional liquidity suppliers to lean against the wind. Our research suggests that intermediaries have reduced

their supply of liquidity and increased the number of agency-based transactions they conduct for their clients relative to principal-based transactions, in both normal times and times of stress. While we have not examined whether post-crisis regulations have improved the resilience of the banking system, post-crisis financial reforms may have curtailed the ability of intermediaries to provide liquidity to their clients. This change in participation will likely negatively impact their ability and willingness to offer liquidity during market stress.

This shift in the behavior of intermediaries coincides with a significant increase in the size of the market (as a result of central bank quantitative easing and the reduction in rates of return on many assets that followed from these policies). As a consequence, during market stress, the prices of both investment-grade and high-yield bonds in the United States and Europe, and possibly also in Asia, may experience strong volatility. The bonds may also trade at depressed prices, as the more speculative investors sell their corporate bonds in favor of ‘safe haven’ assets. The severity and duration of the volatility and depressed prices are likely to be influenced by the nature and severity of the macroeconomic or financial event which creates the stressed conditions, and the breadth of investor selling.

On the positive side, our research indicates that asset managers, including managers of mutual funds, appear to recognize the problem and believe they have liquidity risk management arrangements that should allow them to handle an increase in redemption requests from their clients, without having to conduct ‘fire sales’ of their corporate bond assets.⁵⁶ The research also indicates that there may be fewer leveraged operators, such as hedge funds and investment banks, operating in the market, and those that remain are significantly less leveraged than before the financial crisis. As a result, there may be less risk of pro-cyclical selling into weakness by these institutions. Furthermore, our research suggests that there are many market participants, including both large, well-funded, sophisticated asset managers and smaller, more nimble and opportunistic investment funds, who may have an incentive to provide market liquidity to sellers through counter-cyclical buying at relatively attractive prices.

However, managers of corporate bond portfolios may not necessarily buy into weakness and be actively counter-cyclical, particularly in times of severe stress. Asset managers may not be able to participate swiftly following a fall in prices. The ability of smaller, more opportunistic, and levered investment funds to counteract the selling pressure may be limited by their access to funding from prime brokers, many of which are subject to stricter regulations post-crisis.

Finally, the case studies of previous episodes of market stress show that episodes of severe re-pricing and illiquidity can cause some disruption to corporate bond markets. However, in those cases examined, there is no indication that corporate bond market stress generated severe systemic adverse effects on other parts of the financial system and disruption of financial stability.

As pointed out above, the question of how liquidity might behave in the corporate bond market under stressed conditions is necessarily speculative. Future episodes of stressed conditions may

⁵⁶ As was noted in the foreword to IOSCO’s recommendations for liquidity risk management, IOSCO intends to conduct an assessment of the implementation of its guidance on liquidity risk management of investment funds around 2 to 3 years after initial implementation has been completed. This assessment should provide useful additional information in relation to this theme.

develop in ways different to those of the past, so our analysis ought only to be interpreted as an indication of likely behaviors and outcomes. Nevertheless, our research suggests that two critical variables in this regard are likely to be:

- the quality of the liquidity risk management of all market participants, including of mutual funds, which may be required to meet redemptions during stressed conditions, and
- the ability of various asset managers and investment funds to take advantage of asset mispricing.

Both of these effects can assist markets' coping with stressed conditions, may work to dampen temporary price pressures, and may help to stabilize markets in troubled times.

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