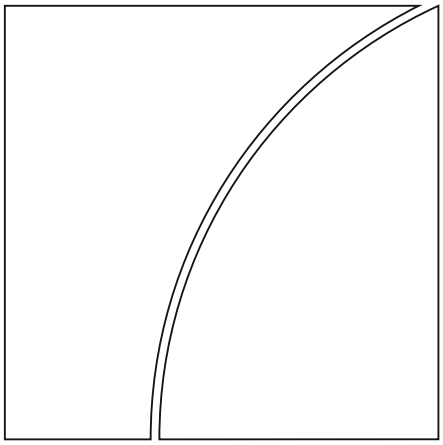
Committee on the Global Financial System



CGFS Papers

No 55

Fixed income market liquidity

Report submitted by a Study Group established by the Committee on the Global Financial System

The Group was chaired by Denis Beau (Bank of France)

January 2016

JEL Classification: D47, G12, G15

BANK FOR INTERNATIONAL SETTLEMENTS

This publication is available on the BIS website (www.bis.org).

ISBN 978-92-9197-419-1 (online)

Preface

Fixed income market liquidity plays a crucial role in the conduct of monetary policy and the stability of the financial system. Therefore, central banks have a vital interest in monitoring liquidity conditions as well as the drivers that affect their robustness during episodes of market stress.

The Committee on the Global Financial System (CGFS) monitors structural developments in fixed income markets on a regular basis. In November 2014, it published a report entitled *Market-making and proprietary trading: industry trends, drivers and policy implications* (CGFS Publications, no 52). Recent market events argued in favour of updating the initial assessment in that report, and of expanding the analysis to evaluate the robustness of market liquidity and its underlying drivers. To pursue this effort, the CGFS decided to reconvene the original Study Group under the chairmanship of Denis Beau (Bank of France).

The following report summarises the Group's main findings. It highlights that fixed income markets are in a state of transition. Dealers have continued to cut back their market-making capacity in many jurisdictions. Demand for market-making services, in turn, continues to grow. The effects of these diverging trends have, thus far, not manifested themselves in the price of immediacy services, but rather they are reflected in possibly increasingly fragile liquidity conditions. Key drivers of current trends in liquidity include the expansion of electronic trading, dealer deleveraging, arguably reinforced by regulatory reform, and unconventional monetary policies. Given the transitional state of fixed income markets, regulators appear to be facing a short-term trade-off between less risk-taking by banks and more resilient market liquidity. Yet, in the medium term, measures to bolster market intermediaries' risk-absorption capacity will strengthen systemic stability, including through a more sustainable supply of immediacy services. To help ensure a smooth transition, the report argues for a close monitoring of liquidity conditions as well as an ongoing assessment of how new liquidity providers and trading platforms are affecting the distribution of risks among market participants.

I hope that this work can contribute to the ongoing discussion about the changing nature of fixed income market liquidity, and can serve as a resource for policymakers as well as market practitioners interested in the broader implications of these changes.

William C Dudley

Chairman, Committee on the Global Financial System
President, Federal Reserve Bank of New York

Contents

Executive summary

1. Tensions between reduced supply of and rising demand for liquidity

Reduced supply vs rising demand. Overall, the main trends identified by the CGFS's initial assessment remain in action. Dealers have continued to lower their market-making capacity and willingness in many jurisdictions, focusing on activities that require less capital. Demand for market-making services, in turn, continues to grow given the expansion of primary bond markets and increased bond holdings by market participants who rely on dealers' immediacy services (eg asset managers). The impact of diverging trends in liquidity supply and demand differs across bond markets.

Liquidity increasingly fragile in benchmark bond markets? For benchmark sovereign bonds, liquidity appears little changed, judging by a variety of market-based metrics. Some signs do, however, point to greater fragility in liquidity conditions. While it is difficult to identify the drivers of this fragility (see below), recent episodes of market stress suggest that, in some markets, the rise of algorithmic trading may have had an impact on liquidity.

Liquidity bifurcation continues. For other markets, such as those for off-the-run sovereign bonds and corporate bonds, there is evidence of bifurcation, with liquidity deteriorating most in those market segments that have historically been less deep than others. In these segments, the reduction in dealers' market-making capacity seems to have had a greater impact on liquidity, given the limited availability of substitutes to their services.

Adjustment mainly through quantities, not prices. The above trends potentially imply upward pressure on trading costs and, ultimately, higher costs of financing in primary markets. Yet, price-based metrics of these costs, such as bid-ask spreads and liquidity premia, provide little evidence of any significant changes thus far. One reason, as suggested by many market participants, is that the main margin of adjustment is through quantities, rather than prices. The trading of large amounts, for example, has reportedly become more complex and time-consuming, as many dealers are reluctant to warehouse large positions. Another reason is conjunctural factors (see below) that affect current measures of market liquidity.

2. Market liquidity trends driven by more than one driver

Technology and competition are shaping adjustments in trading and business models. Bond markets remain in a state of transition, reflecting the impact of a variety of structural and conjunctural drivers. For one, technological progress and competition are shifting trading activities towards electronic platforms as well as to more automated execution and clearing of transactions. This, and regulatory changes that enhance market transparency, have helped reduce average trading costs and mitigate the impact of reduced liquidity provision by traditional market-makers. At the same time, these changes may imply that market prices react more strongly and quickly to order flow information, adding to the difficulties involved in trading large amounts and contributing to the decline in depth in some markets.

De-risking continues amid tighter regulation. The broader post-crisis response represents another key driver of current trends. Banks, in many jurisdictions, have continued to trim their trading-related exposures or have narrowed the scope of

their market-making activities. The evidence suggests that this development reflects a mix of both market-based and regulatory factors. In terms of market-based adjustments, diminished dealer risk tolerance and a more granular assessment of risk-adjusted returns for individual business lines have, in many cases, reduced dealers' willingness to make markets.

More stringent regulatory requirements to contain systemic risks in the financial system, in turn, have – by design – curbed dealers' risk-taking capacity. As a result, many dealers reportedly provide liquidity only when they can easily match client orders, but step back from quoting during more volatile market conditions, particularly in the absence of formal market-making arrangements.

Monetary policies: supporting liquidity, but at the risk of increased fragility? A key conjunctural factor is the impact of monetary policy on market liquidity. Unconventional monetary policies in major advanced economies, including central bank forward guidance and the low-yield environment more generally, have supported bond valuations and reduced volatility in many fixed income markets.

Overall, these measures are perceived to have supported market liquidity, although to different degrees across market segments (eg sovereign bond cash vs repo markets) and at different stages of an intervention (eg at the initial announcement of purchases vs after a prolonged period of large-scale purchases). At the same time, there are concerns over an increasing share of momentum trading activity and the risk of crowded trades based on policy expectations, raising the question of how liquidity conditions will adjust to monetary policy normalisation.

3. Transition to a new regime?

Strengthening the resilience of market-makers. Risk-taking by market-makers can add to market liquidity by providing depth. At the same time, it can erode market-makers' own resilience if it is not supported by adequate capital and robust risk management practices. Thus, resilience comes at a cost, and experience suggests that the pre-crisis price of immediacy did not reflect this cost. Under-priced liquidity services were predicated on expectations of an implicit public sector backstop for major financial institutions. In that setup, the key market-makers represented a source of illiquidity contagion.

Post-crisis regulatory reform aims at addressing these weaknesses by strengthening banks' resilience to market, counterparty and funding risks. When these risks materialise, they can be of first-order importance to market conditions, even if they may appear to have little bearing on market liquidity in calm periods.

Resilient market-makers and resilient liquidity – a trade-off? Improved resilience of market-makers, brought about by regulation, raises the cost of market intermediation. It may also create the false impression of a trade-off between more resilient intermediaries and more resilient market liquidity. In fact, the practice of benchmarking those costs on the pre-crisis price of liquidity is misleading because it ignores the ongoing transition in the functioning of the market. From a medium-term perspective, more resilient market intermediaries should be better able to absorb risks under stressed market conditions and reduce the risk of market disruptions.

Technological improvements and ongoing market adjustments, such as pooling liquidity on new platforms and improving order-matching efficiency, should also help mitigate the effects of higher costs of dealers' immediacy services.

Adapting policy to the new market environment. As market participants are adjusting to changes in market functioning and the redistribution of risks underway, one persistent challenge for policy is to monitor how these risks are being managed. In addition, changes to liquidity provision and its robustness may have a strong bearing on the transmission of monetary policy and the effectiveness of central banks' operational frameworks. This argues for a close monitoring of liquidity conditions as well as an ongoing assessment of how new liquidity providers and trading platforms are affecting the distribution of risks among market participants. Authorities may also need to further analyse the impact of algorithmic trading, which has gained importance due to the proliferation of electronic trading platforms in the most liquid market segments, and to assess the effectiveness of trading mechanisms to deal with episodes of market stress (eg the pros and cons of circuit breakers).

1. Introduction

Fixed income market liquidity plays a crucial role in the conduct of monetary policy and the stability of the financial system. Therefore, central banks have a vital interest in monitoring liquidity conditions as well as the drivers that affect their robustness during episodes of market stress.[1]

Background. In November 2014, the Committee on the Global Financial System (CGFS) published a report on the current trends and drivers of market-making and proprietary trading in fixed income markets (CGFS (2014)). The report pointed to signs of increased liquidity bifurcation and fragility, with market activity concentrating in the most liquid instruments and deteriorating in the less liquid ones. Several factors, including both structural and conjunctural ones, were found to be driving these developments.

The report concluded that, in future, the pricing of immediacy services could become more consistent with actual market-making capacity and costs. Yet, given that markets were in a state of transition, it remained difficult to provide a definitive overall assessment. Against this background and given recent market events,[2] the CGFS decided to reconvene the original Study Group under the chairmanship of Denis Beau (Bank of France) in order to update its initial assessment and to engage in follow-up analysis on trends in fixed income market liquidity.

A plethora of markets. The term "fixed income" spans a wide range of markets that differ along many dimensions. One such dimension is market liquidity, with the most liquid markets (eg those for major sovereign bond futures) trading almost exclusively on electronic platforms, often on central limit order books, and where liquidity is provided by a multitude of market participants. These include the "traditional market-makers" (eg banks and securities firms) and, to an increasing extent, other less-regulated entities (eg principal trading firms; "PTFs") that are challenging their peers' business models.

On the other end of the spectrum are markets with infrequent and thin trading, such as many corporate bond markets, where different features of the underlying securities hamper the matching of demand and supply.[3] These markets have broadly maintained a dealer-centric setup, where traditional market-makers provide immediacy services by warehousing assets, often over longer periods of time, to meet client orders (principal-based trading) or, acting as brokers, seek to match investors willing to buy and sell (agency-based trading).

Given these differences, the effects of structural changes (eg technological innovations, regulation) and conjunctural developments (eg monetary policy) are

[1] See, for example, CGFS (1999) for a more detailed discussion of the link between monetary policy and fixed income market liquidity.

[2] For two recent examples, see the case studies presented in this report (Box 2 and 3).

[3] Given the large number of corporate bonds, often with relatively small total outstanding amounts per issue and a variety of contractual features (eg call options), the probability of finding matches in investor supply and demand for any given bond is much more limited than for other asset classes (eg equities, sovereign bonds). Trading these bonds, therefore, typically relies on intermediation by market-makers. For related analysis, see eg Goldstein et al (2007) or Bao et al (2011), and CGFS (2014) for a discussion.

likely to differ significantly across markets and jurisdictions. In addition, a comprehensive assessment of these drivers would ideally take account of the multifaceted interlinkages between these markets (eg between the cash, derivatives and repo markets; or given the market-making activities of major banks in multiple markets at the same time). Such detailed data, however, are generally not available in a consistent form.

Focus on sovereign and corporate bonds. This report, therefore, provides a selective overview of key market trends and liquidity drivers, focusing primarily on (cash) sovereign bond markets. It also considers developments in corporate bond markets, although based on a much more limited number of metrics. To complement the data, the Study Group collected more qualitative information and market feedback, based on an informal survey (see Box 4) and a roundtable discussion with market participants.

The report is structured as follows: Section 2 provides an update on selected market-based liquidity metrics. In addition, this section discusses developments in the fragility of market conditions, based on an analysis of liquidity jumps in major sovereign bond markets. Section 3 reviews the main drivers of current trends, highlighting the linkages between both structural and conjunctural factors. Section 4 considers the market implications of the observed trends and drivers and concludes with a discussion of possible policy implications.

2. Update on fixed income market liquidity

This section starts by reviewing a number of market-based liquidity metrics that, taken together, provide an approximation of current liquidity conditions. In addition to measuring the ability to trade during normal times, market participants and authorities are also concerned about how liquidity conditions respond to significant adverse shocks. The second part of this section, therefore, discusses indicators that gauge the fragility of liquidity conditions. Two case studies complement the assessment by showing how market-makers and liquidity responded during recent episodes of market stress.

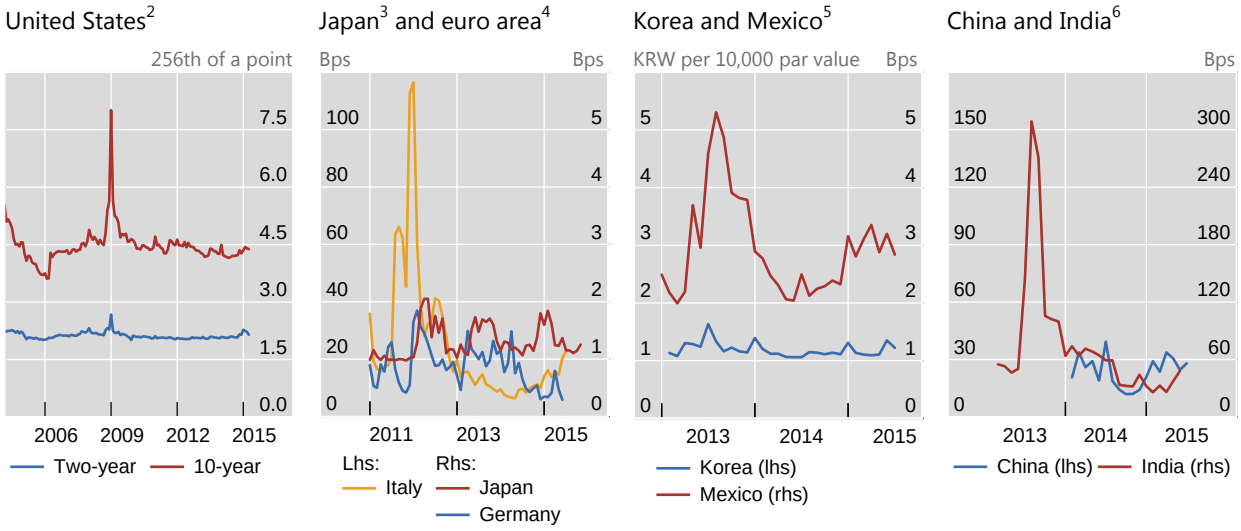
Revisiting trends in market liquidity. Market liquidity is a concept with multiple dimensions that cannot be sufficiently described by any single measure. For the purpose of this report, market liquidity can be broadly defined as the ability to rapidly execute large financial transactions at low cost with limited price impact.[4] Assessing liquidity conditions, therefore, requires measures of immediacy, tightness, depth and resilience as well as indicators of market breadth if comparing liquidity across similar instruments. Such measures are difficult to come by and are typically only available for markets where trading takes place on central limit order books and/or is subject to comprehensive data collection and disclosure requirements, ie those markets that are usually considered to be the most liquid.

Bid-ask spreads remain tight amid declining market depth. Price-based metrics, such as bid-ask spreads, suggest that liquidity conditions in sovereign bond markets

[4] For a discussion of the concept, see CGFS (1999); for a discussion of suitable measures see CGFS (2014), in particular Appendix 3.

are little changed since the CGFS's initial review.[5] Indeed, for many markets (Graph 1), they have remained at levels comparable to those observed before the global financial crisis. Episodes of bond market stress, such as the bouts in emerging market economy (EME) spreads during the "taper tantrum" in 2013, appear to have had only a short-lived impact on market conditions (Graph 1, right-hand panels).

Bid-ask spreads of benchmark sovereign bonds remain tight[1] Graph 1



[1] Monthly averages. [2] Spreads for US Treasury notes in the inter-dealer market; these spreads are reported in 256ths of a point, equivalent to about 0.39 cents per US$ 100 face value (par). [3] 10-year Japanese Government bonds. [4] Medium-term government bonds (BTPs) for Italy, 10-year government bonds for Germany. [5] Five-year Korean and Mexican government bonds. [6] Most liquid benchmark sovereign bonds.

Source: Study Group member contributions based on national data.

Quantity-based metrics, by comparison, point to somewhat diminished market depth and transaction sizes, although to different degrees across jurisdictions and market segments (Graph 2, left-hand panels).[6] Quoted depth for two-year US Treasury notes, for example, has declined by more than 65% since its peak in early 2013. Likewise, quoted depth in the Italian sovereign bond market has declined most recently. While both measures have remained well above the troughs observed during past episodes of stress, a combination of different factors rather than individual market events appears to be driving the recent decline (see Section 3).

Estimates of the potential price impact of large trades support the above findings. For both US and Italian sovereign bonds, price impact measures have increased recently, suggesting a greater sensitivity of market prices to the arrival of

[5] The cut-off date for the Group's initial assessment was approximately end-2013; see CGFS (2014).

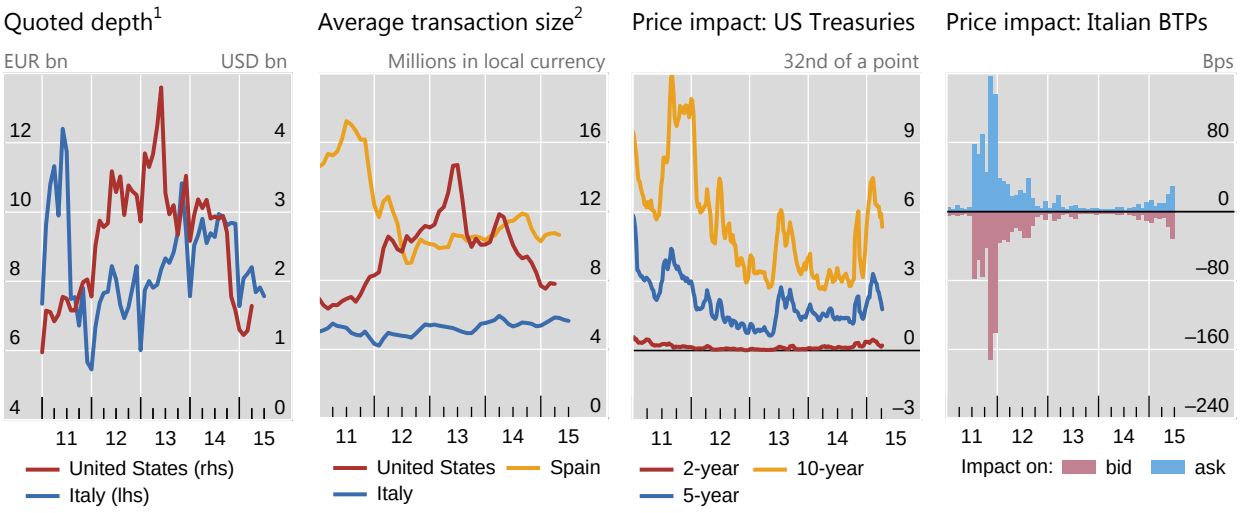
[6] Quoted depth serves as a proxy of market depth. It measures the quantity of securities that is bid (or offered) at the posted bid and ask prices.

large orders without any clear signs of more widespread market tensions (Graph 2, right-hand panels).[7]

Dealers continue reducing their inventories. Another determinant of liquidity conditions is the capacity and willingness of dealers to warehouse securities. This is particularly the case for markets that rely heavily on principal-based market-making services, such as those for corporate bonds. Based on this reasoning, sizeable and permanent reductions in dealer inventories may indicate a diminished capacity and/or willingness of market-makers to provide risk capital.

US primary dealers, for example, have continued to reduce their corporate bond inventories over the past years. Since the beginning of the year 2013, they have cut back their net positions in US Treasuries by nearly 80%. During the same time, dealers in India have also curtailed their corporate bond holdings, following the earlier decline observed for their government securities portfolios during 2013, which includes the "taper tantrum" episode. Australian banks, in turn, have been raising both sovereign and corporate bond net positions (Graph 3).[8]

Reduced depth suggests a stronger price impact of large trades — Graph 2



[1] Quoted depth at five levels for two-year US Treasury notes; quoted depth for the five best quotes exhibited in MTS Cash for medium- and long-term Italian government bonds (BTPs); monthly averages. [2] Average transaction size for two-year Treasury notes (United States); for a weighted average of all Italian sovereign bonds; and for Spanish public debt; three-month moving averages. [3] Price change per $1 billion net order flow; monthly averages. [4] Estimated impact of high-value orders (buy and sell orders of €50 million) on the quoted prices of benchmark 10-year BTPs from January 2010 to the end of June 2015.

Source: Study Group member contributions based on national data.

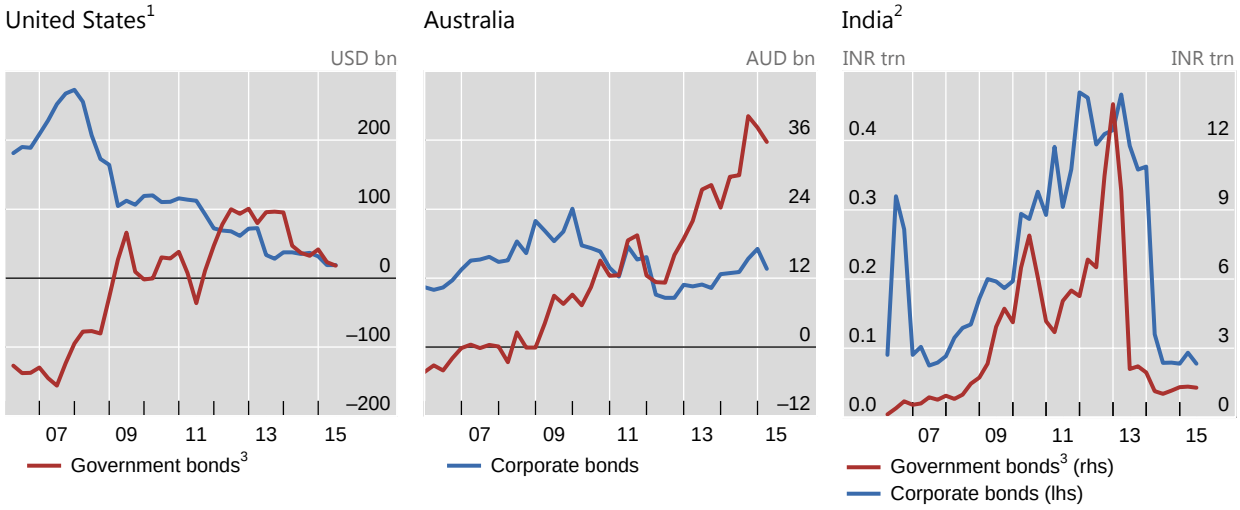
[7] Similar developments are also found by Kurosaki et al (2015) for JGB futures markets.

[8] For some markets, alternative measures of dealer positions are available that can complement the analysis (data not shown). If dealers can short bonds, their gross positions may be more reflective of their willingness to make markets than their net positions, since market-makers may be keeping net positions low to limit their exposure to changes in asset prices. This measure points to a less pronounced decline in dealer activity in US Treasury markets. By comparison, market-making in Korean debt markets – as gauged from the same metric – would appear to have declined in recent years, contrasting with the increase in dealer inventories. For India, in turn, this measure seems to convey the same trends as implied by developments in net dealer positions (Graph 3, right-hand panel).

Total bond holdings of financial institutions in Japan and the euro area also suggest a declining trend in corporate bond inventories. Such holdings have declined by more than 25% in both economies over the past five years (ie by the equivalent of US$ 40 billion in Japan and US$ 840 billion in the euro area, respectively). By comparison, government bond holdings (which include banking book positions for these series) have continued to rise, with financial institutions in Japan adding US$ 120 billion (+13%) and those in the euro area adding about US$ 240 billion (+17%) over the past five years, respectively.[9]

Net positions of dealers

Graph 3



[1] Includes all US primary dealers. [2] Sample of 10 primary dealers and banks. [3] Domestic central government bonds.

Source: Study Group member contributions based on national data.

Rising demand for immediacy. How do developments in the supply of immediacy services compare with trends in its demand? One broad gauge of demand is changes in the bond holdings of mutual funds and exchange-traded funds (ETFs). These funds typically allow investors to redeem their shares at short notice, which, in turn, suggests that fund managers rely on dealers' immediacy services in order to sell bonds in a timely manner.[10]

Since 2009, bond funds have attracted $3 trillion of investor inflows globally, accumulating total net assets of more than $7.4 trillion by the end of April 2015 (BIS (2015a)). At the same time, the magnitude of monthly flows has trended upwards, pointing to an increased demand by fund managers for immediacy services (Graph 4, left-hand panel). Trading volumes have also been rising in many countries,

[9] These data are based on the Japanese Flow of Funds and ECB statistics. For Japan, "financial institutions" refers to banks and securities companies, whereas it encompasses all monetary financial institutions (excluding the Eurosystem) in the euro area.

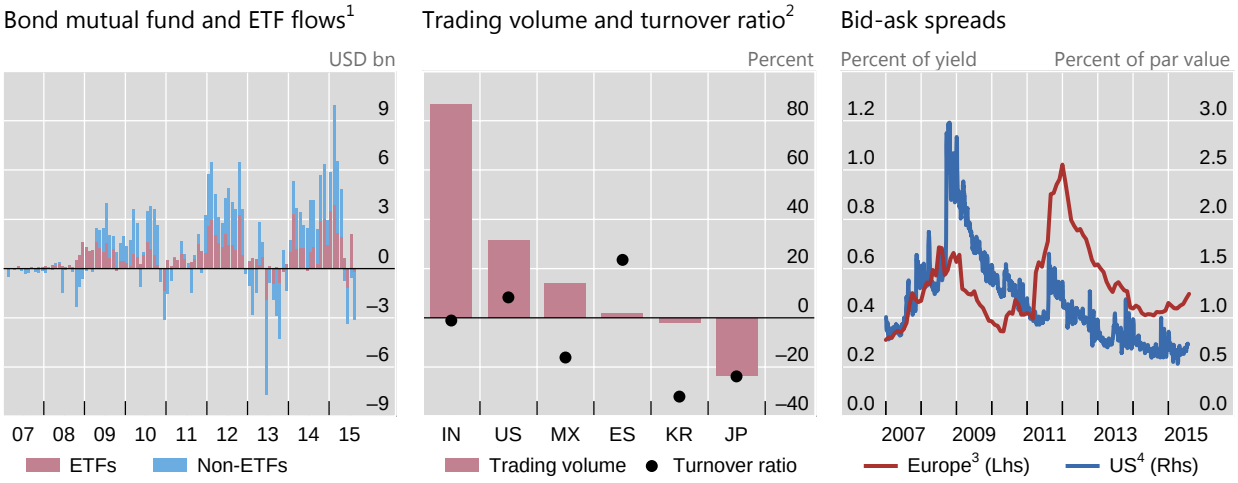
[10] Technically, ETFs redeem creation units only to authorised participants, such as dealers who make markets for ETF shares in the secondary market, and typically by payment in kind. Hence, ETF investors rely on the immediacy services provided by these dealers and may need to bear the risk that ETFs trade at a discount to the fund's net asset value. Ramaswamy (2011) provides a discussion of the risks associated with large investor withdrawals.

although often not keeping pace with the expansion of primary bond markets as suggested by reduced turnover ratios (ie trading volumes divided by outstanding amounts, Graph 4, centre panel).

Diverging trends in supply and demand suggest adjustments in trading are underway. The reduction in dealers' market-making capacity or willingness and, for some markets, limited scope for substituting their services in the short run, points to the risk of continued liquidity bifurcation – liquidity concentrating in the most liquid market segments (such as futures and cash markets for benchmark sovereign bonds) that require less dealer balance sheet capacity or rely less on dealer-intermediated trading more generally, while deteriorating in the less liquid ones (eg off-the-run sovereign bonds, corporate bonds).[11]

Diverging trends in market-making demand and supply also imply upward pressure on trading costs and, ultimately, higher costs of financing in primary markets. Yet, price-based metrics of these costs, such as bid-ask spreads (Graph 4, right-hand panel)[12] and liquidity premia in corporate bond markets, provide little evidence of any significant changes thus far. In fact, estimates suggest that liquidity premia are well below their long-term averages (Bank of England (2015)).

Rising demand for immediacy services – the case of corporate bonds — Graph 4



ES = Spain; IN = India; JP = Japan; KR = Korea; MX = Mexico; US = United States

[1] Monthly in- and outflows into corporate bond mutual funds and corporate bond ETFs globally; as reported to EPFR. [2] Change in the trading volume and turnover ratio (ie trading volume divided by outstanding amounts), comparing the average value over the last 12 months with the corresponding long-term averages over the period from 2006–15. For India, the long-term average of the turnover ratio includes data as of June 2010. [3] Average bid-ask spreads for euro-denominated non-financial corporate bonds (all ratings) with a maturity greater than one year from Belgium, France, Germany, Italy, Netherlands, and Spain. [4] Average bid-ask spreads for investment grade bonds; five-day moving averages.

Sources: Federal Reserve Bank of New York; FINRA; IMF GFSR; Bloomberg; EPFR; Study Group member contributions based on national data; BIS calculations.

[11] Dick-Nielson (2013), for example, argues that the reduction in US dealers' corporate bond inventories is likely to have raised transaction costs in particular for those bonds that dealers cannot turn over quickly, such as lower-rated issues that are not included in major bond indices.

[12] These spreads, which are based on transaction data, may overestimate the degree of market liquidity. Based on an alternative measure using changes in bond prices, Bao et al (2011) conclude that US corporate bonds, for example, are far less liquid than implied by their bid-ask spreads.

One reason, as indicated by many market participants, is that the main margin of adjustment is through quantities, rather than prices. Trading large amounts, for example, has reportedly become more complex and time-consuming, as many dealers are reluctant to warehouse large positions. Another reason is conjunctural factors that support current measures of market liquidity (see Section 3).

Liquidity during stressed conditions. In addition to measuring the ability to trade during normal times, market participants and authorities are also concerned about how liquidity conditions might respond to adverse shocks. While it is inherently difficult to anticipate tail events, indicators of fragility and case studies (Box 2 and 3) of liquidity conditions and market-makers' behaviour during recent bouts in volatility can support the assessment of market resilience (see Box 1 for a definition of market resilience and fragility).

Box 1

Market resilience and fragility – definitions and determinants

Market resilience can be characterised along several dimensions. One is based on a *dynamic* definition, suggesting that market resilience is the time it takes for prices to return to fundamental values in response to a shock (eg an order imbalance in response to new information). Another uses a *functional* definition, where market resilience is the ability of the market to continue functioning in situations of market stress. This is the case if market-makers and other market participants are able to absorb shocks without a major impact on the immediacy they provide to buyers and sellers.

A fragile market, by comparison, is one where prices tend to significantly diverge from fundamental values in response to shocks, with the adjustment often being subject to discontinuous pricing ("gapping"), bouts of volatility as well as an abrupt deterioration in liquidity conditions. A market is also considered to be fragile if it is often hit by disturbances – particularly in the absence of obvious fundamental drivers.

Factors supporting market resilience include (i) a large and diverse number of active market participants, (ii) sufficient capacity and willingness of market-makers to absorb short-term order imbalances, (iii) market transparency, supporting participants in evaluating fundamental asset values as well as assessing counterparty and other risks and (iv) effective supervision.

On a daily basis, indicators of fragility measure how far market liquidity deviates from its average over the day and, in particular, how often unusually illiquid conditions arise. At lower frequencies, these indicators assess how often highly unusual episodes of illiquidity arise, such as the low depth and high price impact observed in the US Treasury market on 15 October 2014 (Box 2).

Jumps as indicators of fragile liquidity. One approach to gauging the fragility of liquidity conditions is to measure the frequency of illiquidity spikes, defined as an abrupt deterioration ("jump") in the underlying liquidity metric. The identification of such jumps is ideally based on high-frequency data which reveal more about the fragility of liquidity conditions than metrics based on averaging over a longer time span. In addition, the analysis of complementary liquidity metrics (eg bid-ask spreads, quoted depth) is likely to provide a more complete picture of liquidity conditions. Such data are only available for a few highly liquid markets such as those for major benchmark sovereign bonds or related futures. Yet, any identified trends in the robustness of liquidity conditions for these markets are likely to have broader implications, given their role as reference markets for the pricing in other fixed income securities and related derivatives.

Box 2

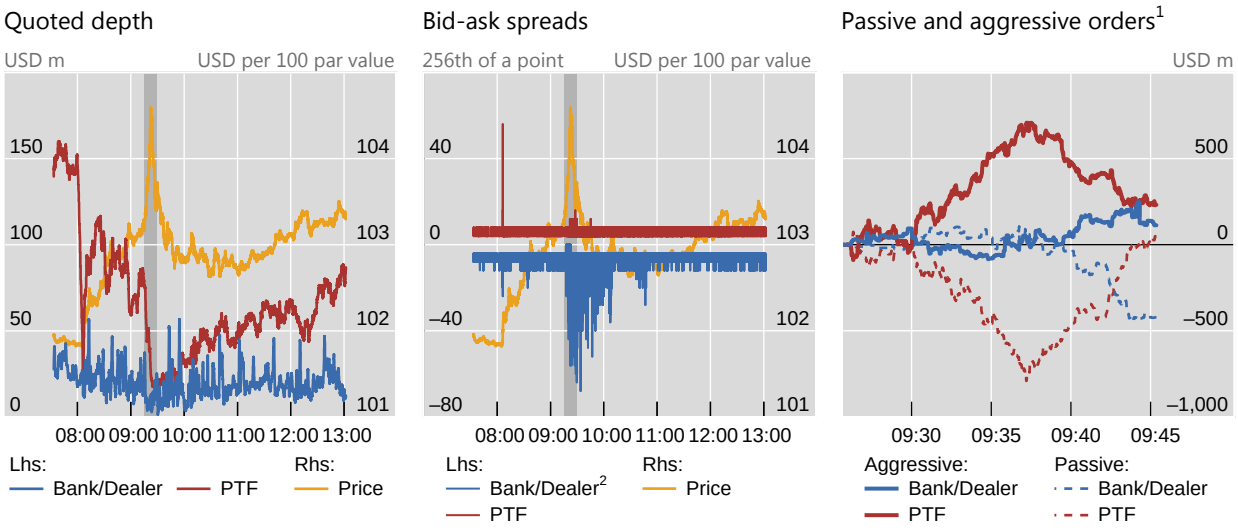
Case study: the "flash rally" in the US Treasury market

On 15 October 2014, the US Treasury securities market experienced an unusually high level of volatility, with the benchmark 10-year Treasury note trading in a 37 basis point range. During the "event window" (between 09:33 and 09:45 Eastern Time), without a clear cause, the 10-year yield declined 16 basis points and then rebounded. Such a large round-trip in prices in so short a time with no obvious catalyst is unprecedented in the recent history of the US Treasury market. This case study compares the liquidity provision by dealers and principal trading firms (PTFs) during the event window and the resulting impact on market liquidity.①

Trading activity surges and liquidity deteriorates. During the event window, trading was continuous. PTFs and bank-dealers, in that order, accounted for the largest shares of trading volume in both the cash and futures markets.② No trades on the interdealer cash or futures platforms were broken or adjusted, nor was there price "gapping", ie jumps from one price to another with no transactions in between. The high trading volume and continuity of pricing showed that the ability to transact remained in place even at the most volatile times of the day. Yet, market participants reported significant liquidity concerns and some participants temporarily disengaged their automated price-quoting systems, turning back to manual or voice trading to manage their risks.

Dealers' and PTFs' reaction functions differ

Graph A



The grey shaded area in the left-hand and centre panels indicates the event window.

[1] A passive order is defined as a standing order to buy or sell an instrument in the order book, while an aggressive order is that which is executed when matched against a standing "passive" order. [2] Inverted scale for the bid-ask spreads quoted by banks and dealers.

Sources: US authorities Joint Staff Report (2015).

PTFs reduce depth while dealers widen spreads. Both PTFs and bank-dealers took action to contain their risk exposure to volatility during the event window (Graph A). PTFs continued to provide the majority of order book depth and maintained a tight spread between bid and ask prices, but decisively cut back their limit order quantities. In contrast, bank-dealers widened their bid-ask spreads so that limit orders were only met at a substantial distance from the top of the book. Despite the surge in trading volume during the event window, there was no noticeable change in net positions of PTFs or bank-dealers. This is in contrast to the build-up in short positions in the futures markets (ie positions that gain in value if the price of the underlying asset declines) by hedge funds during the first half of the event window (when prices were rising).

Order imbalances. During the event window, an imbalance between the volume of buyer-initiated trades and seller-initiated trades was observed, with more buyer-initiated trades as prices rose, and more seller-initiated trades as prices fell. Bank-dealers and PTFs were the main net aggressive buyers of Treasury futures as prices rose, and net

aggressive sellers as prices fell. In the cash market, PTFs showed similar behaviour, whereas bank-dealers appeared to be neutral during the first part of the event, and shifted to seller-initiated trading during the second part as prices declined (Graph A, right-hand panel).

Liquidity provision. A similar breakdown of the net passive trade flow by participant type shows that PTFs were large net passive sellers during the first part of the event window and net passive buyers during the second part of the event, consistent with market-making activity and their contribution to the depth at the top of the order book. Notably, the PTF pattern of passive flows closely mirrors the pattern of PTF aggressive flows. Hence, as a group, their net position remained largely unchanged throughout the event window, suggesting that the PTFs were deploying many different types of trading strategy. In contrast, net passive bank-dealer flows were not indicative of significant market-making activity during the event window.

Self-trading increased. A notable aspect of trading on 15 October was the heightened level of self-trading, defined as a transaction in which the same entity takes both sides of the trade so that no change in beneficial ownership results. During the event window, the share of overall transactions resulting from self-trading was substantially higher than average. Another aspect of self-trading flows during the event window was its directional nature. Between 09:33 and 09:39, the cumulative net aggressive buyer- minus seller-initiated self-trade volume increased by around $160 million in the cash 10-year note, accounting for close to one fifth of the total imbalance between buyer- and seller-initiated trades observed over that time interval. The bulk of self-trading in cash and futures markets occurred among PTFs, perhaps because such firms can run multiple distinct trading algorithms simultaneously.

The analysis also revealed that changes to the Treasury market structure over recent years have been significant. These changes provide an important context for understanding the unusual volatility that day and for assessing the risk that such an event might recur.

① For a more detailed analysis, see *Joint Staff Report*, "The U.S. Treasury Market on October 15, 2014", 13 July 2015, on which this case study draws.

② This pattern is similar to that of other control days.

The first row of Graph 5 plots average bid-ask spreads for 10-year US Treasury notes, JGB futures and Italian Treasury bonds (Buoni del Tesoro Poliennali; "BTPs"), respectively. The dots indicate instances where spreads have shown day-to-day jumps (ie increases) of two standard deviations or more. The second row, for comparison, highlights jumps (ie abrupt declines) in quoted depth for the same financial instruments.

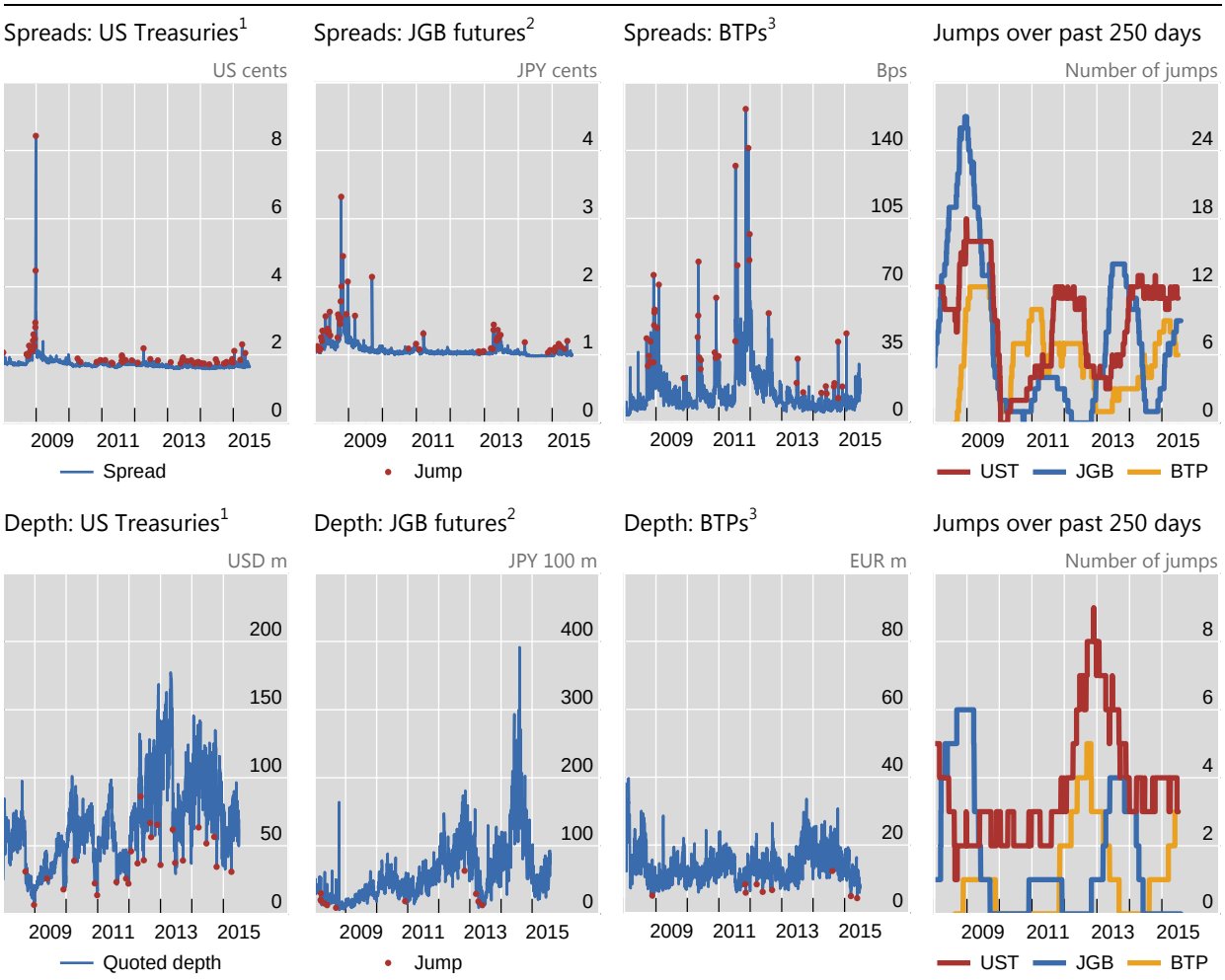
Signs of increasingly fragile liquidity conditions? Unsurprisingly, the jumps are concentrated during the global financial crisis, when liquidity conditions deteriorated significantly across a wide range of markets.[13] Other crisis periods, such as the euro area sovereign debt crisis, have resulted in more regionally concentrated jumps, typically inducing adverse changes in both spreads and depth at the same time. Some jumps can also be attributed to major monetary policy announcements. One example is the rising number of jumps around the introduction of quantitative and qualitative easing (QQE) by the Bank of Japan in April 2013. Notably, fluctuations in market depth appear to have increased since then, a development that may have been amplified by a reduced willingness of market participants to submit orders in an environment of increasing volatility (Kurosaki et al (2015)).

[13] As argued in, for example, Brunnermeier (2009), concerns about banks' as well as other major market-making institutions' default and liquidity risks may have propagated illiquidity risks during the global financial crisis.

More recently, there has been a modest clustering of jumps for some of the measures, without any clear evidence of major uncertainty or strains in the associated markets. One interpretation is that liquidity conditions may have become increasingly fragile, consistent with the recent deterioration in some of the quantity-based liquidity measures (Graph 2) and the underlying drivers (see Section 3).[14]

Jumps in bid-ask spreads and quoted depth: signs of fragile liquidity?

Graph 5



[1] 10-year US Treasury notes. [2] Japanese Government Bond (JGB) futures contract based on 10-year JGBs. [3] 10-year Italian government bonds (Buoni del Tesoro Poliennali; "BTPs"). [4] Total number of jumps recorded over the past 250 trading days. A jump is defined as a rise (decline) in spreads (the percentage change in quoted depth at the first tier) of at least twice its standard deviation.

Sources: Study Group member contributions based on national data.

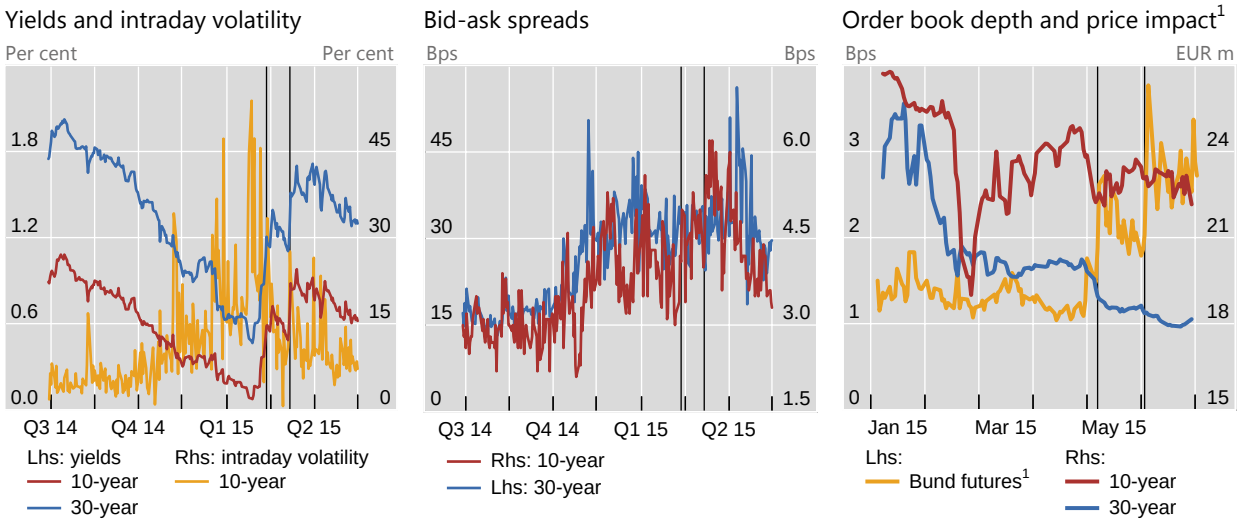
[14] Recent analysis of flash events in futures markets (ie instances where prices swing by unusually large amounts within a trading hour) – which are typically accompanied by strained liquidity conditions – suggests that such events may actually be a relatively common feature in markets that are highly liquid on normal trading days (Massad (2015)).

Case study: The sudden reversal in bund yields

Between January 2014 and April 2015, yields on German government bond ("bunds") declined markedly, before reversing sharply in mid-April and surging again in early June (Graph B, left-hand panel). The rise in yields was widespread and marked by bouts in volatility, resembling the bond market sell-off during mid-2013 ("taper tantrum") that followed a reassessment by market participants of the pace of monetary policy exit in the United States.

Bund market developments

Graph B



The first vertical line in each panel shows 7 May 2015; the second one shows 3 June 2015, the date of the ECB policy announcement.

[1] The price impact is based on the Eurex liquidity measures, which approximated the roundtrip costs of buying and, at the same time, selling futures with a notional amount of €50 million.

Sources: Eurex; MTS Euro Benchmark Markets; Thomson Reuters; BIS calculations.

Prices swing in absence of a trigger. On 7 May 2015, price swings within the day were particularly pronounced, with yields on long-term bunds rising by more than 20 basis points, before returning to their opening prices on the day. In contrast to the rise in yields in early June, which has been attributed to changes in inflation expectations following the release of the ECB's economic outlook (BIS (2015b)), there are no clear indications of any specific events triggering the market reaction on 7 May. In this regard, the event looks similar to the US market "flash rally" (Box 2).

Market uncertainty. In the absence of a specific trigger, market commentary suggests that a number of factors may have contributed to comparatively fragile market conditions in the run-up to the yield reversal. One factor is uncertainty regarding the implementation of the Eurosystem's Public Sector Purchase Programme (PSPP), including its impact on the availability of securities for trading that the ECB and national central banks were expected to purchase on a large scale. Such concerns may have been further fuelled by expectations of a reduction in net issuance of bunds. In addition, they may have contributed to the perceived decline in market liquidity ahead of the yield reversal, with bid-ask spreads for long-term bunds trending upwards amid declining depth (Graph B, centre and right-hand panels).

Stretched positioning. An unwinding of positions by leveraged directional investors in fixed income derivatives markets represents another candidate factor. Reportedly, positions based on expectations that the PSPP would induce a further decline in interest rates had become relatively crowded during April. This suggests that some participants' positions may have been vulnerable to even small increases in yields, particularly if faced with margin calls on their derivatives contracts. Adding to this are indications of less activity in German government bond futures markets in recent years, as gauged from some measures (eg trading volume relative to open interest). Furthermore, the price impact of large orders in bund futures contracts spiked in May (Graph B, right-hand panel), underscoring the close ties between liquidity conditions in cash and futures markets.

Rising risks. A third factor may have been rising market risks. At the currently high levels of duration, small increases in yields result in comparatively large mark-to-market losses on bond holdings and can trigger bouts of volatility (Graph B, left-hand panel). Increased market risk, in turn, weighs on the capacity of market-makers to warehouse securities. This is due to the immediate impact on key risk management metrics, such as value-at-risk, which dealers employ to set limits on their exposures. Hence, reduced market-making capacity or even procyclical selling of bonds by dealers may also have contributed to increasingly fragile liquidity conditions during the yield reversal.

3. Drivers

This section discusses structural and conjunctural factors that have a bearing on the trends presented in Section 2. The structural factors relate to changes in the market environment due to innovations in technology and to regulation. Their impact on the way fixed income markets function has been substantial. At the same time, trends in market liquidity are also driven by powerful conjunctural factors such as post-crisis deleveraging and the conduct of monetary policy in major currency areas. The discussion in this section is largely of a qualitative nature given the difficulties in quantifying the relative influence of these factors on the availability and pricing of liquidity services.

Technology and competition: shaping adjustments in trading and business models

Increasing share of electronic trading. Technological progress and competition are shifting trading activities towards electronic platforms, although to different degrees across financial instruments and jurisdictions.[15] This, and additional regulatory efforts to enhance market transparency, have helped to reduce average trading costs.[16] Some electronic trading platforms can also partially compensate for the reduced liquidity provision by traditional market-makers. This is because they enable other market participants to provide liquidity, as exemplified by the activity of PTFs in US Treasury markets (Box 2). In addition, some platforms are designed to support "buy-side-to-buy-side" trading in bonds, allowing investors to trade without the intermediation of dealers or other market-makers. Despite increasing use of electronic platforms, most bond markets remain quote-driven, ie with dealers quoting prices either continuously or in response to customer requests.

Price impact an obstacle for large trades? Greater use of electronic trading and enhanced transparency in fixed income markets typically comes at the cost of greater price impact from large trades. Individual trades in bond markets tend to be of larger value than in other markets (eg equities[17]), primarily because institutional investors hold the lion's share of bonds. Yet, similar to the negotiation of block

[15] See Markets Committee (2016) for a detailed analysis.

[16] See, for example, IMF (2015) or Bessembinder et al (2006).

[17] According to PWC (2015), the average transaction size on NYSE and Euronext was about US$ 10,000 and US$ 13,000 in the year 2015, respectively, By comparison, average trade sizes for US investment grade corporate bonds and European corporate bonds stood at about US$ 500,000 and US$ 600,000.

trades in equity markets, large trades seem less suitable for trading on electronic platforms because prices move quickly against participants who enter large orders due to the transparency of the market infrastructure.[18] This also discourages market-makers from accommodating large trades if they fear that they cannot unwind their positions without risking a sizeable impact on prices.

The ensuing adjustment in market transactions is consistent with the trends highlighted in Section 2. Investors increasingly split larger transactions into smaller amounts and rely on algorithms to optimise trading performance on electronic platforms, which tallies with declining order sizes (Graph 2). Market-makers, in turn, are cutting back on the quantities they quote and the size of their inventories, contributing to the observed reduction in depth in some markets (Graph 2).

Trading "less liquid" instruments. While electronic platforms can improve the matching of buyers with sellers in the largest market segments such as benchmark government bonds, they are less suitable for markets in very heterogeneous instruments. Corporate bonds are less standardised than sovereign bonds, with bespoke clauses and repayment features. This lowers the probability of matching orders at any given point in time. Therefore, liquidity in corporate bond markets is likely to remain more dependent on dealer intermediation than in other markets.

Bank deleveraging and regulation

The broader post-crisis response represents another key driver of current trends. Banks, in many jurisdictions, have continued to cut back their trading-related exposures and have raised their capital buffers (Graph 6, left-hand and centre panels). Some have reportedly also narrowed the scope of their market-making activities by focusing on a selection of fixed income instruments or by increased client tiering (ie offering certain immediacy services only to core clients). In addition, many market-makers are reportedly providing liquidity only when they can easily match client orders, but step back from quoting during more volatile market conditions, particularly in the absence of formal market-making arrangements.

Reassessing the risks. The available evidence suggests that this development reflects a mix of both market-based and regulatory factors. In terms of market-based adjustments, diminished dealer risk tolerance as well as a more granular assessment of risk-adjusted returns for individual business lines have, in many cases, contributed to reducing the dealers' *willingness* to make markets.[19] More stringent regulatory requirements to contain systemic risks in the financial system, in turn, have scaled down dealers' risk-taking *capacity*.

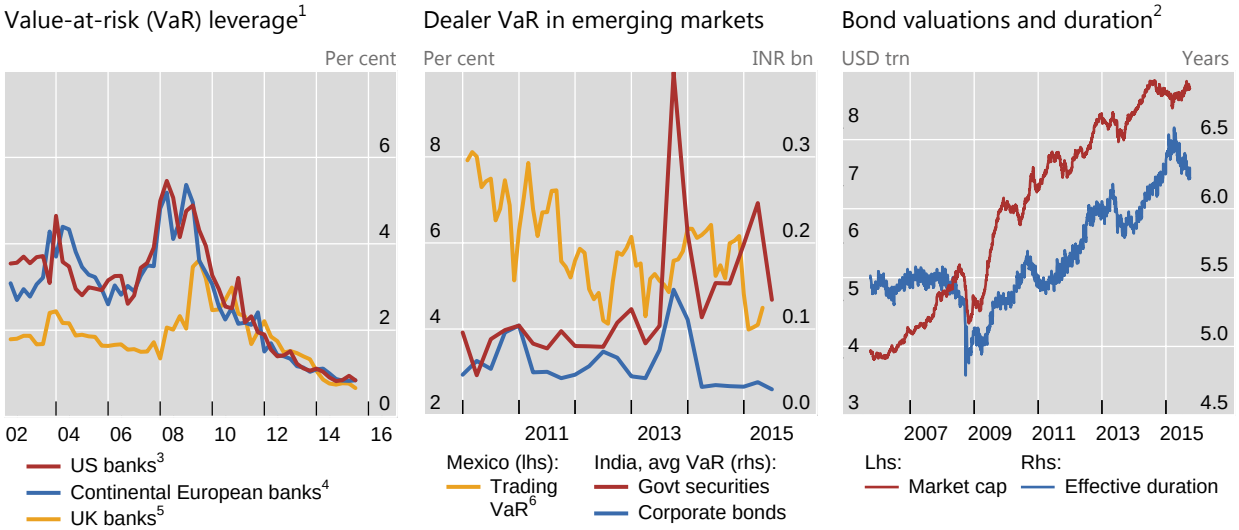
Structural shift or cyclical adjustment? It is hard to predict how far bank deleveraging reflects a structural trend or a conjunctural development. Research points to the fact that dealers adjust their leverage procyclically (Adrian and Shin (2010), (2014)), suggesting that cycles in liquidity conditions are a recurring feature of financial markets (CGFS (2001)). Likewise, dealers' shareholders appear to have

[18] Some electronic platform providers have developed specific protocols to facilitate the trading of large amounts, such as "workups" in US Treasury markets. See Fleming and Nguyen (2015) and Fleming et al (2015).

[19] See, for example Adrian et al (2013) and Adrian et al (2015).

curbed their tolerance for earnings volatility, which is typically higher for trading activities than for other bank business lines.[20] Such adjustments tend to be particularly pronounced in the aftermath of large losses (Barth et al (2002)).

Dealers are deleveraging amid rising risk of mark-to-market losses — Graph 6



[1] Annualised total trading VaR (99% confidence) divided by total equities, weighted by banks' total assets. [2] Based on the Merrill Lynch global corporate bond index. [3] Bank of America, Citigroup, Goldman Sachs, JPMorgan Chase, Lehman Brothers (to Q2 2008), Morgan Stanley. [4] BNP Paribas, Deutsche Bank, Société Générale, UBS. [5] Barclays, Royal Bank of Scotland, HSBC. [6] In percent of banks' net capital.

Sources: Bloomberg; Merrill Lynch; Study Group member contributions based on national data.

Assessing the impact of regulatory reform on market liquidity. Given the multiple drivers at play, it is difficult to quantify the impact of regulatory changes on market liquidity. In fact, much of the observed reduction in leverage (Graph 6, left-hand and centre panels) occurred ahead of the announcement of new regulations targeting specific activities, such as constraining banks' proprietary trading, or affecting the absolute and relative (ie differently across asset classes) costs of trading-related positions. Furthermore, given the other structural changes such as technology (see above) the dependence of market liquidity on dealer balance sheet capacity may have declined, at least for some markets.

Pricing examples help inform the assessment. Remaining mindful of these caveats and of the fact that the finalisation of some of the regulatory reform efforts was still pending (eg the final calibration of the Basel III leverage ratio), the Study Group conducted an informal survey among market-makers on the relative importance of regulatory changes for their P&L accounts from August to September 2015 (Box 4). Survey participants provided estimates of the relative importance of different cost drivers including regulatory capital requirements as well as trading and operational costs using two highly stylised portfolios: one of sovereign bonds and one of corporate bonds.

[20] See Roengpitya et al (2014).

The survey results suggest that the P&L impact of recent regulatory changes has been differentiated. For the sovereign bond example, both the Basel III leverage ratio and higher risk-weighted capital requirements were considered as having the largest impact on regulatory capital charges and, hence, dealers' profits. For the corporate bond example, by comparison, revisions to the Basel II market risk framework ("Basel 2.5") were seen to have had the largest impact on regulatory charges. Overall and given the calibration assumptions, the survey responses imply that, for these simple pricing examples, the gross revenue required to yield a return on capital of 8% under a fully phased-in Basel III framework would have resulted in returns above 20% given the requirements pertaining under Basel II.[21]

Overburdened by regulation? Market participants have raised concerns that regulatory reforms, by raising the costs of warehousing assets, have contributed to reducing market liquidity and could be keeping banks from acting as shock absorbers during periods of market stress. Yet, measuring the profitability of market-making is complicated by several factors.

One is the lack of comparable data, suggesting that assessments have to rely on individual studies or surveys.[22] While these studies often point to a decline in the profitability of banks' trading activities, the decline in banks' performance metrics (eg return on equity) after the global financial crisis appears to have been more widespread and not particularly pronounced for banks with significant trading activity (Roengpitya et al (2014)), possibly reflecting a return to more sustainable longer-term averages (McKinsey (2014)). Moreover, banks with comparatively high capital ratios in 2009, and those that increased their capital ratios subsequently, have been more likely to raise their trading exposures than their peers (Cohen (2013), Cohen and Scatigna (2014)).

Another factor is the importance of ancillary revenues from related customer business (eg prime brokerage). Generating these revenues typically requires banks to offer immediacy services to their customers.[23] This suggests that profitability assessments may need to be conducted at the bank level rather than at the level of individual business lines.

A third factor is the difficulty in separating market-making from other (proprietary) trading activities (Duffie (2012), CGFS (2014)). Regulatory reforms have aimed at containing banks' exposure to seemingly profitable trading activities (in non-risk adjusted terms), by raising the sensitivity of capital requirements to risk

[21] While the two, highly simplified, pricing examples (Box 4) do not attempt to assess the quantitative impact of new regulations on banks' existing portfolios, the survey results appear broadly in line with some industry studies. For one example, McKinsey (2011) estimates the return on equity will decline from 19% (flow rates) and 18% (flow credit) to 8% and 6% due to the impact of recent regulatory reforms (ie Basel 2.5, Basel III and the OTC derivatives reform). The return on equity for banks' proprietary trading, in turn, is expected to decline from 35% to 7%.

[22] For examples of central bank surveys that gather information on market liquidity, see the ECB's *Survey on credit terms and conditions in euro-denominated securities financing and OTC derivatives markets* (September 2015), and the Federal Reserve Bank of New York's *Federal Reserve senior credit officer opinion survey on dealer financing terms* (June 2015). These surveys suggest that market participants consider regulation to have had a strong negative impact on fixed income market liquidity.

[23] Primary dealer (PD) schemes are one possible example, with PDs supporting liquidity in sovereign bond markets in exchange for eg preferential access to primary market issuance.

exposures or by restricting certain activities outright. At the same time, bank shareholders and creditors have reportedly reassessed their risk-return trade-off, suggesting that bank risk-taking and profits have declined to levels more commensurate with the banks' risk-taking capacities.

Box 4

Market-makers' P&L – two stylised examples based on survey results

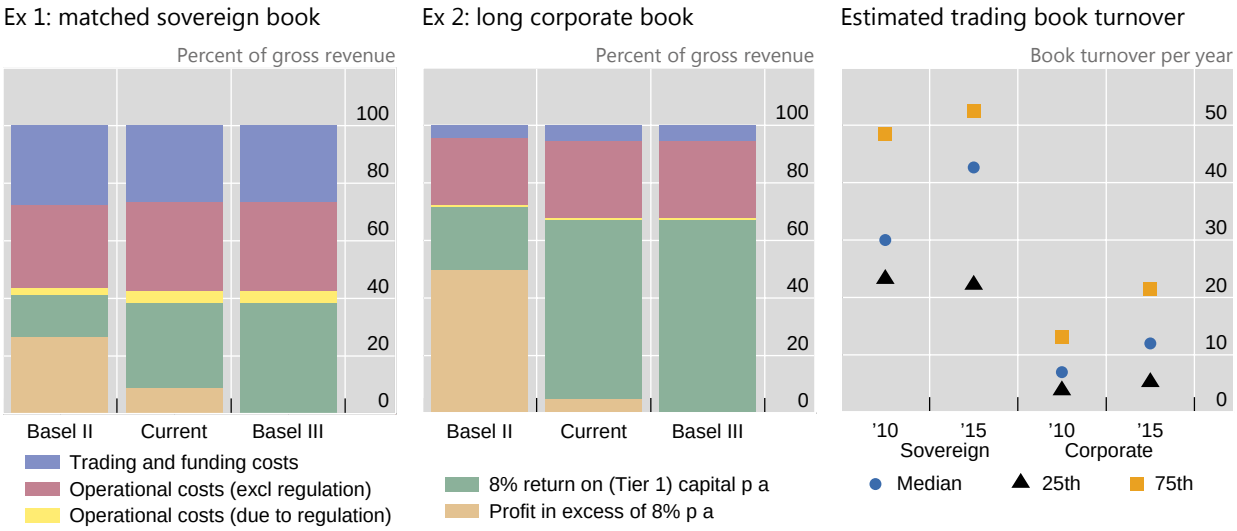
Informal survey. To inform the assessment of drivers affecting the supply of immediacy services, the Study Group conducted an informal survey among market-makers from August to September 2015, receiving responses from more than 40 firms from 11 jurisdictions.

Survey participants were asked to estimate the costs associated with holding two stylised trading books: (i) a repo-funded matched domestic sovereign bond book (ie with no directional exposure) and (ii) a net long corporate bond book, composed of long-term investment grade corporate bonds with interest rate risks being fully hedged. For both examples, respondents provided estimates of current regulatory capital requirements, those given under the former Basel II rules and for a fully phased-in Basel III framework. Participants also estimated operational and trading costs as well as the costs associated with regulatory compliance (eg expenses on reporting, staff).

Scope of the survey. The two examples are based on highly simplifying assumptions and asked respondents to make additional assumptions if needed for the estimation of specific cost factors, acknowledging differences in cost accounting across firms, pending finalisation of the Basel III calibration, and the limited time available to conduct the survey. Therefore, the results provide a broad gauge of the relative importance of these costs, rather than intending to quantify the specific impact of any individual regulation.

Asking the traders – two stylised pricing examples[1]

Graph C



[1] Average estimates based on 42 survey responses. Gross revenues are kept unchanged in all three scenarios and are determined by assuming a return on total capital of 8% (ie capital charge on required Tier 1 capital) under a fully phased-in Basel III framework. For the current and fully phased-in Basel III estimates (Basel II), all other costs (ie cost of trading, operational cost) are based on respondents' estimates for the year 2015 (2010).

Sources: Survey responses; Study Group member calculations.

Sovereign bonds. Keeping these caveats in mind, the survey responses suggest that, for the sovereign bond pricing example, the assessment of the main drivers of regulatory capital costs depends on the bank's current balance sheet position – some respondents considered the leverage ratio to have the largest impact, whereas others pointed

to the more stringent risk-weighted capital requirements. Overall, respondents expected a rise in capital charges of about 24% of gross revenue for this specific example, when moving from the initial Basel II to a fully phased-in Basel III framework. Keeping the amount of gross revenue constant, these estimates imply a decline in the return on (Tier 1) capital from about 22% to the assumed calibration level of 8%, if comparing the Basel II requirements and those expected to be pertaining under Basel III. Notably, the majority of respondents already accounted for upcoming Basel III requirements in their estimates of current regulatory costs, indicating that – to a large extent – adjustments in business models had already taken place (Graph C, left-hand panel).

Corporate bonds. For the corporate bond example, respondents indicated that, on average, revisions to the Basel II market risk framework ("Basel 2.5") had had the largest impact on regulatory charges. In line with this, respondents suggested, on average, that capital charges would have had increased significantly for this pricing example, when moving from Basel II to current requirements. The remaining phase-in of the Basel III requirements, in turn, was expected to have only a minor impact. Assuming constant revenues and a return on capital of 8% annually under the fully phased-in Basel III framework, survey responses suggest that for this example the return on capital would have amounted to about 26% annually under Basel II requirements (Graph C, centre panel).

Business model adjustments. The majority of respondents suggested that inventory turnover had increased from 2010 to 2015, particularly for sovereign bonds (Graph C, right-hand panel). This result tallies with the perceived changes in business models underway, suggesting that many market-makers have trimmed their inventory but are seeking to maintain their trading activities by raising inventory velocity.

Monetary policy

Monetary policy actions have an important bearing on fixed income markets. Government bonds are key securities in central bank operations and yield curve gyrations influence market conditions in both private and public debt securities. But the influence of monetary policy extends beyond the cyclical/conjunctural stance and relates to the overall framework and strategy in the conduct of policy. These issues are discussed below.

Supporting liquidity, but at the risk of increased fragility? Accommodative monetary policies in the past several years are an important conjunctural driver of fixed income market liquidity. Persistently low policy rates, coupled with unconventional monetary policies in major advanced economies, including central bank forward guidance, have supported bond valuations, reduced volatility and supported bond issuance in many fixed income markets. Overall, these consequences of monetary policy are perceived to have also supported market liquidity, although to different degrees across different market segments (eg sovereign bond cash vs repo markets) and at different stages of an intervention (eg at the initial announcement of purchases vs after a prolonged period of large-scale purchases). At the same time, there are concerns that the prolonged period of low rates has given rise to one-sided positioning of market participants and the risk that liquidity conditions may deteriorate as portfolios are adjusted simultaneously in response to the first signs of policy normalisation.

Multiple channels. Monetary policy can support market liquidity through a variety of channels. One is via confidence effects. This effect is facilitated during strained market conditions through the central bank's engagement, which can help revive trading by reducing market uncertainty and acting as a reliable buyer in the market (Christensen and Gillan (2015), De Pooter et al (2014)). Similar effects are associated with forward guidance on policy rates or central bank communications more broadly, which help to reduce uncertainty among market participants.

Yet another channel is through funding effects. Monetary policy easing directly supports the funding conditions of banks and thereby, more indirectly, also the funding conditions of other non-bank market-makers.[24] Improved funding liquidity, in turn, lowers the cost of providing liquidity services, supporting market liquidity.[25]

Portfolio rebalancing represents a fourth, though not independent, channel, operating through the central bank's influence on risk premia (Bekaert et al (2013), Morris and Shin (2014), or Hattori et al (2015)). By reducing the yields on sovereign bonds and other directly targeted assets, monetary policies can raise investor demand for less liquid instruments, supporting trading activity in these markets.

Challenges. Past and ongoing monetary policy accommodation is unprecedented in terms of both size and scope. This suggests a strong impact on trading, extending well beyond the assets purchased by central banks, and may be associated with a number of challenges. One such challenge is scarcity effects, given that large-scale asset purchases reduce the amount of securities available for trading. To mitigate scarcity concerns, central banks in many jurisdictions have established or expanded their securities lending facilities.[26]

A second challenge relates to the risk that asset valuations may have become predicated on unsustainable expectations of continued monetary policy accommodation. Related to this, some market participants have raised concerns about increasing "one-sidedness" of markets, pointing to the risk of crowded trades and illiquidity if expectations were to change. Increasingly similar trading strategies and rising concentration of bond holdings with institutional investors could amplify such risks.

In addition, the decline in yields over the past years has induced a significant expansion in primary bond markets, with issuers seeking to lock in favourable funding conditions by issuing more long-term bonds.[27] Hence, bond investors have increasingly exposed themselves to duration risk (Graph 6, right-hand panel), making their trading decisions more responsive to changes in interest rates. Notably, turning points in monetary policy, have been associated with sharp and widespread declines in bond prices during previous episodes, such as the bond market sell-off in 1994 (Borio (2004)). This raises the question of how liquidity conditions will adjust to monetary policy normalisation.

[24] Funding conditions are loosened both directly, given the reduction in policy rates, as well as more indirectly, given the increase in the value of collateral instruments.

[25] For a formalisation of this effect, see eg Gromb and Vayanos (2002) as well as Brunnermeier and Pedersen (2009). The analysis by, for example, Fontaine et al (2015) provides empirical support for this channel.

[26] According to the IMF (2015), the Federal Reserve's purchases of MBS initially supported market liquidity in these instruments, whereas liquidity decreased modestly during the later stages of the purchasing programme(s) due to scarcity effects.

[27] Another factor is increasing issuance by lower-rated companies and in smaller amounts, indicating that investors are holding an increasing amount of less liquid bonds. See IMF (2015).

4. A new regime for fixed income market liquidity? – Market and policy implications

What do current developments in market liquidity (Section 2) and the associated drivers (Section 3) imply for the resilience of financial markets? The answer to this question is likely to be different across jurisdictions and asset classes, depending on the relative strength of these drivers as well as the market participants' ability to find alternative ways of sourcing liquidity. This section discusses some of the main implications of these trends, focusing on risks for market liquidity and resilience under adverse market conditions.

Market implications

Drivers point to liquidity bifurcation. Some of the drivers discussed in Section 3 are also suggestive of continuing liquidity bifurcation, with liquidity concentrating in the more liquid instruments, and deteriorating in the less liquid ones. More widespread use of electronic platforms, for example, can allow for a greater number and variety of market participants to provide liquidity as well as improve the efficiency of matching orders, helping to mitigate any effect of reductions in traditional market-makers' services. Thus far, however, trading on these platforms appears to have a comparative advantage primarily for relatively standardised instruments and small trade sizes.

The effect of reductions in dealer's risk tolerance and changes in regulation, in turn, depends on the risks that trading in specific assets implies for market-makers' balance sheets, suggesting a greater impact on liquidity in the riskier, ie typically less liquid, instruments.[28] Some studies, for example, find evidence that diminished market-making capacity has raised the sensitivity of corporate bond prices to changes in asset manager demand. Such demand shocks are also shown to have a greater, albeit temporary, adverse impact on bond issuance than before the global financial crisis (Baranova et al (2015)).

Increasingly fragile liquidity? To the extent that rising costs and falling market shares have diminished the profitability of market-making, dealers may have fewer incentives to provide liquidity during periods of market stress.[29] While this is an intended consequence of both market-based factors (eg the repricing of risks given reduced risk tolerance) and regulatory reforms to enhance dealers' resilience, market liquidity may become more dependent than before on the willingness and ability of other market participants to take contrarian views.[30] Ongoing trends towards greater concentration and uniformity in the asset management industry cast some doubt on whether this is currently the case: see IMF (2015) and, for an overview, Papaioannou et al (2013).

[28] PWC (2015), for example, document a continued decline in the number of active market-makers in European corporate bonds, particularly for high-yield instruments.

[29] How far liquidity providers have acted as shock absorbers in the past is, however, an open question. Anand and Venkataraman (forthcoming), for example, suggest that liquidity providers without explicit market-making obligations pull back in unison if market conditions are unfavourable.

[30] This risk is not new, however, as suggested by the discussion in Barth et al (2002).

Markets where non-dealer market-makers – who are typically subject to less stringent regulatory requirements – play a major role seem to be at least as susceptible to abrupt bouts of liquidity deterioration as markets that rely on dealer intermediation. This is reflected in the discussion of recent episodes of market stress (Box 2 and 3). These alternative liquidity providers typically submit orders that result in tight bid-ask spreads but only for quantities of moderate size. In such an environment, narrow spreads could result from trading strategies primarily geared towards attracting information on the order flow (Madahavan (1995)). Hence, they could be a reflection of the ability of these firms to adjust their prices almost instantaneously to any market move, while carrying limited inventory risk, rather than an indication of ample liquidity conditions.

Self-reinforcing shifts in the supply of immediacy services. While dealers' decisions to supply liquidity are driven by their individual cost-benefit analysis, market liquidity conditions reflect their collective stance and can give rise to feedback loops that can amplify trends (Brunnermeier and Pedersen (2009)). For example, a market-maker may react to rising costs by reducing the intermediation services it offers, if costs cannot be passed on to customers and other market participants. This can imply a decline in market liquidity and will raise the risk (and the cost) of trade intermediation for other dealers who now have fewer alternative ways of unwinding positions. Higher costs, in turn, may further erode the supply of immediacy as dealers create a feedback loop where the overall decline in market liquidity is larger than the direct impact from the original trigger. Clearly, the process can also work in reverse: moderate increases by dealers can lead to large improvements in overall market liquidity, also through feedback effects.[31]

These dynamics help explain the rapid deterioration in market liquidity during periods of stress as well as the potentially strong impact of confidence effects from monetary policy (see below). This externality in the supply of liquidity services is hard to measure but can potentially be a very important determinant of public policy.[32] If it is significant, this suggests that interventions that promote or curtail the ability or willingness of dealers to intermediate can have a more than proportional impact on liquidity.

Strengthening market resilience

Strengthening the resilience of market-makers. Risk-taking by market-makers can bolster market liquidity by providing depth, but may erode their resilience if it is not supported by adequate capital and robust risk management practices. Thus, resilience comes at a cost, and experience suggests that the pre-crisis price of immediacy did not reflect this cost. Under-priced liquidity services had been predicated on expectations of an implicit public sector backstop for major financial

[31] Feedback loops in market liquidity may also arise across different assets, as suggested by the empirical work of Chordia et al (2005) or Goyenko and Ukhov (2009). To explain such effects, Cespa and Foucault (2014), for example, propose a model in which liquidity providers in one asset infer information by observing the prices of other securities. If market liquidity in the reference securities declines, the prices of these securities become less informative. Higher uncertainty, in turn, induces liquidity providers to cut-back their immediacy services in the market they are active in.

[32] Barclay and Henderschott (2004), for example, provide empirical evidence of liquidity externalities by comparing market conditions during and outside stock exchange trading hours.

institutions. In that setup, key market-makers represented a source of illiquidity contagion. This was clearly an unsatisfactory state of affairs from the standpoints of both public policy and economic efficiency.

Post-crisis regulatory reform aims at addressing these weaknesses by strengthening banks' resilience to market, counterparty and funding risks. When these risks materialise, they can be of first-order importance to market conditions, even if they may appear to have little bearing on market liquidity in calm periods (Borio (2000), CGFS (2001)).

Resilient market-makers and resilient liquidity – a trade-off? Improved resilience of market-makers, brought about by regulation, raises the cost of market intermediation. It may also create the false impression of a trade-off between more resilient intermediaries and more resilient market liquidity. In fact, the practice of benchmarking those costs on the pre-crisis price of liquidity is misleading because it ignores the ongoing transition in the functioning of the market. From a medium-term perspective, more resilient market intermediaries should be better able to absorb risks under stressed market conditions and reduce the risk of market disruptions. By contrast, artificially reducing the cost of risk-taking (by relaxing regulatory requirements) provides the wrong incentives and leads to a situation where weakened intermediaries are unable to bear losses and are forced to withdraw completely from market-making in stressful periods.

Adapting policy to the new market environment

Addressing the underlying economic risks comes first. A key determinant of market liquidity is the market participants' trust in the quality of the traded securities. If the quality of an asset comes into doubt, liquidity evaporates and trading seizes up, as suggested by the collapse of the securitisation markets during the global financial crisis.[33] Measures that support an asset's fundamental value (eg by reducing credit risk) and the ease with which it can be assessed (eg by improving disclosure), therefore, have a first-order impact on market liquidity, particularly during periods of market stress.

Furthermore, deteriorating liquidity conditions are typically a symptom rather than a source of market imbalances, notwithstanding their potential to amplify such imbalances by feeding back into asset valuations and increasing market uncertainty. Thus, it is important to note that policies to enhance liquidity (see below) cannot eliminate the underlying economic risks. Hence, they complement – rather than substitute for – efforts that support an asset's fundamental values or mitigate the risks of destabilising order imbalances.[34]

Supporting initiatives and backstops. In its initial assessment, the Study Group proposed a number of policy responses that, if pursued, would help make the pricing of immediacy services more consistent with actual market-making capacity and costs (CGFS (2014)). These responses included both supporting initiatives to

[33] See, for example, Brunnermeier (2009).

[34] This could include policies to ensure that new technologies help preserve a competitive market structure, while also incentivising participation by heterogeneous market participants (ie in terms of investment horizons, liquidity needs and risk assessments). See also Markets Committee (2016) for additional policy considerations that focus on electronic trading.

raise the probability of achieving more appropriately priced and robust liquidity conditions (eg by promoting transparency and monitoring, considering market-making arrangements) as well as possible backstops (eg central bank liquidity provision subject to the associated cost-benefit considerations) to address vulnerabilities that may arise under adverse scenarios.

Based on the follow-up analysis presented in this report, the following supplementary policy considerations appear warranted:

Managing liquidity risks. While market participants are adjusting to the redistribution of risks that is taking place (ie from dealers to bond investors), one persistent challenge for policy is to monitor how these risks are being managed. Indeed, increasingly fragile liquidity may amplify the risk of short-term dislocations of asset prices. This argues for a conservative approach in assessing the size of liquidity buffers and counterparty risks. At the same time, efforts to improve risk management should aim at internalising the impact of market participants' behaviour on liquidity risk, given the self-reinforcing dynamics of liquidity conditions during periods of market stress.[35]

A broad approach to monitoring. Changes to liquidity provision and its robustness may also have a strong bearing on monetary policy transmission and the effectiveness of central banks' operational frameworks. This argues for a close monitoring of liquidity conditions by central banks and other authorities as well as an ongoing assessment of how new liquidity providers and trading platforms are affecting the distribution of risks among market participants and their access to immediacy services. The manifold interlinkages across markets and asset classes (eg cash, funding and derivatives markets) underscore the need to take a broad approach to such monitoring activity.

Assessing the tools. Authorities may also need to further analyse the impact of algorithmic and other forms of short-term oriented trading, which have gained importance in some key fixed income markets. This could include assessing the effectiveness of existing mechanisms to deal with episodes of market stress (eg circuit breakers and other forms of changes in the auction mechanism), the scope and capacity of existing supervision, and any need for adjustments given the ongoing changes in the market environment.

[35] See, for example, recent proposals on best practices for market participants when promoting liquidity and market robustness (Treasury Market Practices Group (2015)). Another example is the US Securities and Exchange Commission's proposals to improve the liquidity risk management practices of open-ended funds and the permission for "swing pricing" under certain circumstances (SEC (2015)).

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The Group is also grateful to José María Vidal Pastor and Jhuvesh Sobrun (Bank for International Settlements) for able research assistance.