

Global financial markets liquidity study

August 2015

Contents

Important notice	5
Executive summary	8
1 Introduction	14
1.1 Purpose of this study	14
1.2 Rising liquidity concerns	14
1.3 Our approach	16
1.4 Structure of this report	16
2 What is liquidity?	17
2.1 Dimensions of liquidity	17
2.2 The benefits of financial markets liquidity	19
2.3 How is liquidity provided?	20
2.4 The role of market makers	21
2.5 Differences in liquidity across markets	23
2.6 When liquidity dries up	28
2.7 Excess money supply	29
2.8 Broader factors affecting market liquidity	29
3 Impact of current financial sector regulations on financial markets liquidity	35
3.1 Capital and liquidity requirements	36
3.2 Market infrastructure and transparency	40
3.3 Structural reforms	45
3.4 Recovery and resolution	48
3.5 Taxes and levies	50
3.6 Aggregate reform impact	50
4 Financial markets liquidity	51
4.1 Rates	51
4.2 Credit	60
4.3 Securitisation	75
4.4 Foreign exchange	77
4.5 Commodities	84
4.6 Equities	87
4.7 Emerging markets	96
4.8 Summary	102
4.9 Overall assessment	104
5 Drivers of future financial markets liquidity	105
5.1 Continued banking sector and capital markets regulation	105
5.2 Increase in the size of financial markets	109
5.3 Impact of electronic trading platforms	111
5.4 Impact of new and different market participants	113
6 Policy considerations	117
6.1 Introduction	117
6.2 Policy considerations	117
Appendices	121

Appendices

Appendix A:	Glossary	122
Appendix B:	Bibliography	124
Appendix C:	Review of regulations affecting liquidity	135
Appendix D:	Summary of impacts of regulations on liquidity	142
Appendix E:	Summary of other studies	144
Appendix F:	Methodology for assessing liquidity impacts in corporate bond markets	149

Important notice

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Synopsis

Market liquidity is critical to effective market functioning. Liquidity in financial markets facilitates the efficient allocation of economic resources through the productive allocation of capital and risk, the accurate generation and dissemination of issuer-specific information, and the effectiveness of monetary policy and financial stability. The current market evidence points to a measurable reduction in financial market liquidity. For instance, European corporate bond trading volumes have declined by up to 45% between 2010 and 2015. Evidence suggests that large trades are becoming more difficult to execute without affecting prices, with market participants breaking up larger trades into smaller tranches. There have been measurable reductions in banks' trading capacity: banks' holdings of trading assets have decreased by more than 40% between 2008 and 2015, and dealer inventories of corporate bonds in the US have declined by almost 60% over the same period. This has accompanied a decline in turnover ratios in corporate bond markets, where trading volumes have failed to keep pace with the increase in issuance.

The reduced liquidity observed is a product of multiple factors, including but not limited to banks de-risking in the wake of the crisis (selectively de-leveraging and unwinding large non-performing and capital-intensive credit books), following the introduction of new regulatory risk frameworks.

This report explains the important role and underlying economics of market-making. Post-crisis, banks have substantially strengthened their balance sheets (global banks' equity levels have increased by around 68% between 2006 and 2013); improved their ability to measure and price risk; and introduced business models that are more closely aligned to serving client investment needs. Unlike other market participants, bank dealers are uniquely designed to provide clients services that require principal risk taking. This function is a vital element of market resilience during volatile events. The report describes the positive transition that global markets are making in reaction to new market forces, including increased electronification and new entrants in providing core services to support the real economy. Such diversity is a necessary and welcome development, and complements the role banks and bank dealers will continue to play in effective market functioning.

In analysing the new market dynamics, including the effects that market-based and prudential regulations are having on market liquidity, this report provides an analysis of specific regulatory initiatives that are presenting challenges for banks' traditional role as market makers. These substantial challenges impact the ability of bank dealers to facilitate liquidity and the redistribution of risk in times of volatility, potentially introducing new and unforeseen risks to our markets and economy.

The report tries to weigh the costs and benefits of regulation, and identify those regulatory initiatives that in aggregate, could have greater adverse impacts on market liquidity than may have been envisaged when designed individually, especially when the interactions of market-based and prudential regulations on market participants are considered. Despite the reduction in dealer liquidity, markets have continued to trade. Corporate and sovereign bond issuance continues apace, particularly in the United States. Thus, the withdrawal of dealer liquidity to date has not caused measurable economic damage. This is due to two reasons. First, market participants have adjusted to this reality by trading less frequently and in smaller batches. Second, current market conditions (quantitative easing and extraordinary monetary policy) are reducing liquidity pressures.

A key question raised by this report is how sanguine market participants, policymakers and economists should be about this current state of affairs. Even if one assumes that markets would adjust to a world with limited dealer liquidity, and where new entrants and trading technology bring together borrowers and savers, the role of principal risk takers will continue to serve a unique and important role in financial markets. End-users have raised concerns about whether liquidity from other market sources will fully compensate for the loss of dealers' market-making capacity, and whether such an adjustment could have substantial costs for issuers and investors and economic growth and jobs more broadly.

Thus, the study concludes that current and future market liquidity is a subject of concern for market participants. It further finds that there are grounds for a review of the calibration of the reforms to date and the ongoing regulatory agenda, in order to properly understand and consider the effects of regulatory initiatives on market liquidity by asset class, and to consider whether upcoming regulatory initiatives could likely exacerbate the trends in liquidity.

Executive summary

Introduction

There have been numerous studies and reports to date that offer valuable insights into the topic of market liquidity. These reports, however, often focus on a particular market or a specific regulation and as such, the aggregate impacts of recent regulations on market liquidity are not well understood.

With increasing concerns being voiced on the far-reaching impacts of regulatory developments on market liquidity, including from their bank members, the Global Financial Markets Association (GFMA) and the Institute of International Finance (IIF) commissioned PwC to undertake a broad review of global financial markets liquidity.

This study summarises our findings. It does not necessarily represent the views of GFMA or IIF members, but rather, focuses on a review of financial markets liquidity using available data. We also spoke to financial market participants to interpret and validate the findings from the market data and gather views on future trends.

Importance of liquidity in financial markets

Liquidity is a multi-dimensional concept, generally referring to the ability to execute large transactions with limited price impact, and tends to be associated with low transaction costs and immediacy in execution. While some market practitioners question whether liquidity can be adequately defined, we consider there are various aspects of liquidity that can be measured and studied. In particular we focus on the four attributes of: (i) immediacy; (ii) market depth and resilience, (iii) market breadth and (iv) tightness.

We consider liquidity to be important for effective market functioning. Liquidity in financial markets facilitates the efficient allocation of economic resources through the efficient allocation of capital and risk, the effective generation and dissemination of issuer-specific information, and the effectiveness of monetary policy and financial stability. The financial crisis demonstrated the advantages of having a robust financial system which is able to absorb unpredictable shocks, while maintaining market-wide liquidity. We consider market liquidity to be invariably beneficial.

In some markets such as fixed income and bespoke derivative instruments where matching supply and demand for a given instrument becomes more challenging, market makers, such as banks and trading firms are essential in providing liquidity and facilitating transactions by stepping in as counterparties to such transactions. This involves buying or selling financial instruments without an immediate matching transaction and it requires market makers to bear risks relating to the movement in inventory values.

Liquidity conditions can differ significantly across different asset classes, even in normal times. Financial assets with lower levels of liquidity tend to have higher liquidity risk premia, and market participants also tend to face higher transaction costs and wider bid-ask spreads when trading in these instruments. Properly pricing liquidity risk premia is a positive result of post-crisis reforms, which helps to decrease the risks of rapid growth

“Liquidity appears to have become increasingly brittle... Although liquidity in these markets looks adequate during normal conditions, it seems to disappear abruptly during episodes of market stress”

Richard Berner, Director of the Office of Financial Research,
Speech at the Brookings Institution, 8 June 2015

“There is evidence that liquidity in some key markets has become more fragile”

Clara Furse, Bank of England
Speech titled “Liquidity matters”, 11 February 2015

“Market liquidity is structurally lower now than it was in the past...This will quickly become apparent in a down market.”

Guy Debelle, Assistant Governor of the Reserve Bank of Australia,
Speech at Citi’s 6th Annual Australian and New Zealand Investment
Conference, Sydney, 14 October 2014

“Market adjustments to date have occurred without significant stress. However the risk of a sharp and disorderly reversal remains given the compressed credit and liquidity risk premia.”

Mark Carney, Chairman of the Financial Stability Board (FSB)
“Carney says see risk of disorderly unwinding of portfolios”
Reuters, 26 March 2015

in instruments where there is little understanding of the underlying risks. However, a lack of liquidity for some asset classes has a very real cost to the end-users of financial markets and the report identifies where these costs may outweigh the benefits of new market developments.

We consider there are at least five broad trends driving global market liquidity conditions at the moment. These include: (i) stable and supportive global monetary conditions, which support overall liquidity throughout the economy; (ii) the increase in electronification and digitalisation in financial markets, which helps reduce the costs of trading and links up buyers and sellers; and (iii) the growing engagement of providers of alternative market-based financing in some aspects of market-making. Countering these three trends are: (iv) the overall increase in the size of financial markets and associated demand for liquidity; (v) the reduced supply of dealer market-making capacity, which is driven by regulatory reforms in the financial sector; and a diminished risk appetite across banks as they adjust to a post-crisis market environment.

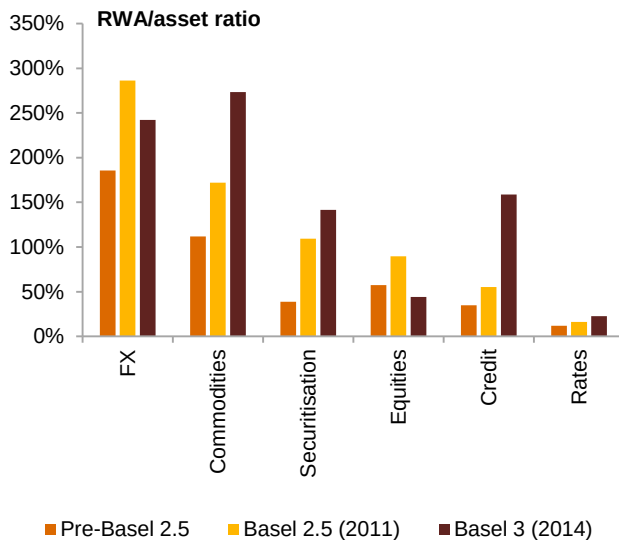
The findings from our study suggest an early-warning signal, in that Quantitative Easing (QE) programmes and the global economic and monetary environment have been generally favourable to market functioning. However, following the unwinding of QE or in a stressed environment, liquidity risks and market fragilities are likely to be revealed, potentially resulting in higher volatility in financial markets and increased pressure on corporates and investors to manage risks and adjust their portfolios. At this point, the role of alternative market based finance providers (algorithmic and high frequency traders, hedge funds) as resilient providers of liquidity will be tested. These providers are not likely, in the short- to medium term, to be sufficient to fully replace the current and potential additional loss of market-making capacity and trading activity from dealers.

Impact of regulatory reforms on financial markets

We have identified five broad ways in which regulatory reforms have impacted or will impact financial markets activity:

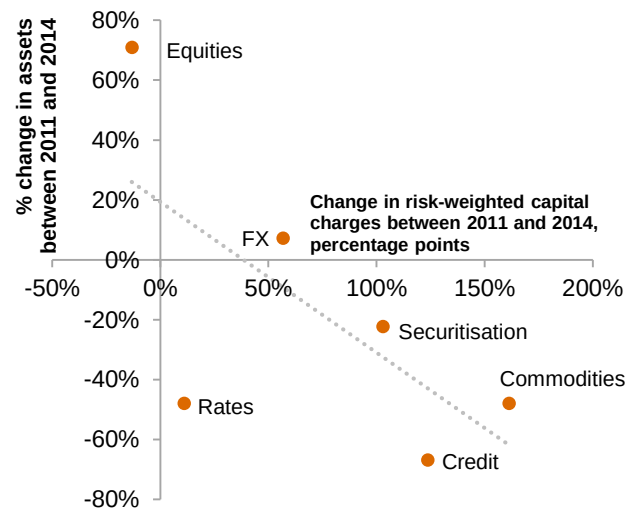
- **Bank deleveraging, refocusing and exits.** As banks respond to the new regulatory environment, they have sought to make more efficient use of capital and liquidity resources, by reducing the markets they serve and streamlining their operations.
- **Reduction in market-making activity.** Capital and funding intensive areas such as market making in fixed income, credit, derivatives and commodities have been particularly impacted. This can lead to a reduction in liquidity in those dealer-led markets where market making provides a key source of liquidity. Our analysis shows that changes in capital and liquidity regulation have greatly increased both capital charges across banks' business areas (see Figure 1) and the cost of financing those businesses. The increases are more pronounced in commodities, securitisation and credit. Our analysis of the evolution of global banks' balance sheets suggests that business lines that are either low-risk, but impacted by the non-risk-based leverage capital ratios (such as sovereign and investment-grade bonds); or business lines that have experienced a relative increase in capital intensity, were the ones more likely to experience higher levels of deleveraging (see Figure 2). This is consistent with our finding of a decline in the number of market makers active in European corporate bond markets.

Figure 1: Changes in risk-weighted capital charges due to changes in the Basel capital regime



Source: PwC analysis, Tricumen

Figure 2: Degree of deleveraging (reduction in assets) in relation to change in risk-weighted capital charges by area of capital markets activity (2011 prepared on a pre-Basel 2.5 basis)



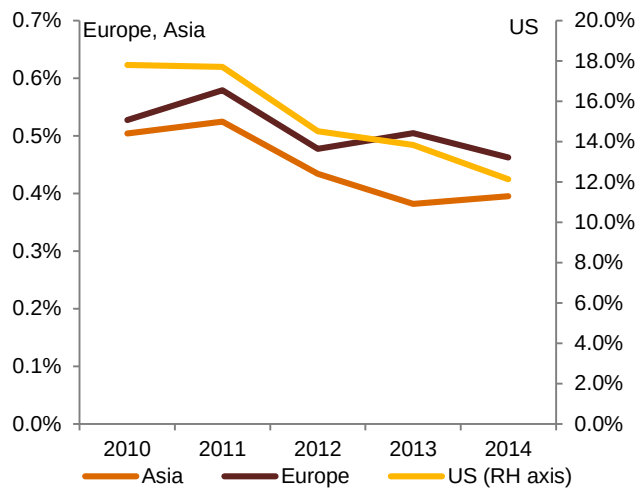
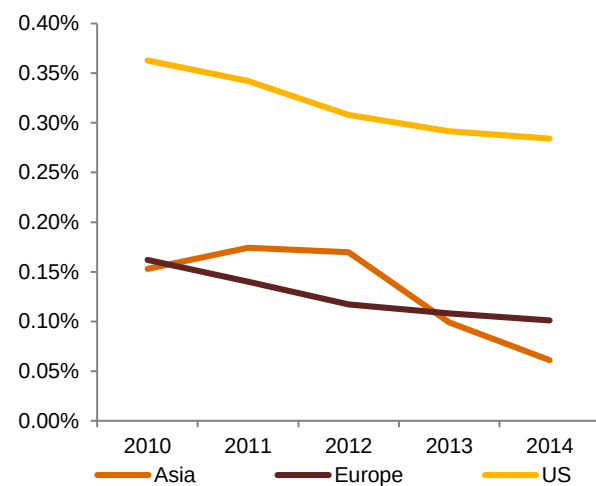
Source: PwC analysis, Tricumen

- **Shifts in trading patterns**, as characterised by the move towards central clearing and electronic trading platforms. While the shift in trading patterns as a consequence of new regulatory rules may improve liquidity for standardised, centrally cleared trades, it will reduce liquidity for those OTC instruments that are not suited to central clearing or trade reporting (e.g. corporate bonds, OTC derivatives such as infrastructure financing hedging, embedded floors in insurance policies etc.), but are used frequently by investors and corporations.
- **Liquidity contraction in repo markets**. With outstanding balances in repo and other bank funding markets falling, the contraction in repo markets has impacted liquidity provision by market makers across other capital markets.
- **Increased demand for and hoarding of liquid assets**. Liquidity rules and collateral requirements increase the need for banks to hold high quality liquid assets, which, reduces their availability to support other transactions, including repos. The lack of available high quality collateral can have a significant impact on liquidity in secured markets, especially during a stressed environment. Prudential rules have also materially increased the cost of holding less liquid assets, further increasing the demand for liquid assets.

Decline in market liquidity

Our study finds specific areas where market liquidity has declined, and warning signs that more significant declines may be masked by other factors. These include:

- **Difficulties in executing trades**: Market participants are still generally able to execute the trades they require, but the time taken and effort required to execute both with dealers and across multiple platforms has increased.
- **Reduction in market depth**: There are signs of declining depth and immediacy in capital markets as characterised by falling transaction sizes. Some price impact measures also show that smaller trading volumes are now moving market pricing by larger amounts. The ratios of trading to the size of markets (turnover ratios) for both corporate and sovereign bonds are on the decline (see Figures 3 and 4) as trading volumes have failed to keep pace with an increase in issuance.

Figure 3: Sovereign bond turnover ratios (average daily volumes/outstanding volumes)**Figure 4: Corporate bond turnover ratios (average daily volumes/outstanding volumes)**

Source: Asian Development Bank, Trax, SIFMA, PwC analysis

- **Increase in volatility:** There is evidence that episodes of market correction and volatility are now rising, after falling considerably since the global financial crisis. Volatility in bond markets in 2015 is around 40% higher than in 2014. Whereas current market volatility is not as high as the extreme levels of volatility witnessed during the global financial crisis, volatility is arguably above historical levels during benign economic conditions.
- **Bifurcation in liquidity:** There is market evidence to suggest that a “bifurcation” is taking place across some markets. Liquidity is increasingly concentrating in the more liquid instruments and falling in less liquid assets. Areas of financial markets which have seen particular declines include longer dated FX forward contracts, some aspects of the high yield debt market and the single name CDS market. Liquidity reduction is not solely confined to less liquid areas, as even traditionally liquid sovereign debt markets have experienced liquidity shortages.

Outlook for liquidity

There are countervailing developments affecting the outlook for market liquidity. On the one hand, there are pending or planned rules that are likely to reduce market liquidity still further: regulations yet to be implemented, such as the Fundamental Review of the Trading Book (FRTB), Markets in Financial Instruments Directive and Regulation (MiFID II and MiFIR), EU bank structural reform and the proposed financial transaction tax (FTT), if inappropriately calibrated, will have a significant impact on the viability of banks' market-making activities and increase transaction costs for capital markets participants. The recently adopted G-SIB surcharge in the United States, in which four of the five factors that determine the surcharge are driven exclusively by capital markets behaviour, is certain to reduce market liquidity further. Any incorporation of a G-SIB surcharge into the Federal Reserve's CCAR would exacerbate this effect.

On the other hand, there are three developments that could improve financial markets liquidity in a sub-set of asset classes. First, the growth of exchange-traded funds (ETFs) provides investors with a more tradeable instrument for investment, in the absence of directly investing in the underlying asset, which may not be as liquid. Second, more widespread adoption of electronic trading could further reduce transaction costs for market participants by providing additional platforms to match buyers and sellers. Such platforms will, in some cases, help reduce the time required to locate buyers and sellers and improve the process of price discovery. Although electronic trading platforms have seen growth in recent years, they do not fully replace liquidity provision by dealers, in particular the ability to bear proprietary risk and thereby provide immediacy. There may also be structural limits to their adoption, particularly in markets with a large number of different instruments traded, such as corporate credit and certain derivatives. Lastly, the partial retreat of banks from some financial markets has also been accompanied by the entrance or growth of other market participants taking on some principal risk-taking activities.

In summary, the entry and growth of other market participants increases the diversity of market participants, the range of trading strategies employed, and facilitates market functioning by providing additional trading activity and market linkage. However, the collective impact of these three developments and other behavioural adaptations is not likely, in the short- to medium term, to be sufficient to fully replace the current and potential additional loss of market-making capacity and trading activity from dealers. Also, it raises questions of whether new market entrants have the necessary risk frameworks to support the new services.

Policy considerations

In any study of this kind, the empirical data is of course capable of different interpretations particularly as to detailed cause and effect. But we think three things come out very clearly. First, market liquidity plays an absolutely crucial role in facilitating the efficient and stable functioning of markets and, by extension, economies. Second, the weight of empirical evidence does support a hypothesis that markets are less liquid. Third, for these reasons, the ongoing policy agenda should set the preservation or indeed restoration of market liquidity as a high priority.

Our study highlights the importance of the role played by market makers in providing liquidity, which has diminished since the global financial crisis as the balance sheet capacity of market makers has fallen. This has led to reduced market depth. The implementation of further reforms are also likely to have significant implications for future market liquidity.

We recognise that there are substantial benefits to the range of banking sector regulations which have now been implemented, in the form of a lower probability and impact of future banking crises.

We also note that regulation is not the only driver of reduced markets liquidity, as some of the reduction in financial markets liquidity can be attributed to other factors including a post-financial crisis change in risk appetite and market focus of some market participants. Lower profitability and the pressure to reduce costs have also contributed to further deleveraging and balance sheet reduction.

Within the overall package of reforms, there are some which make a strong contribution to financial stability with minimal impact on financial markets liquidity and other measures that have a less clear financial stability benefit with larger detrimental impact on financial markets liquidity. Our findings suggests there would be value in distinguishing the former from the latter.

With these thoughts in mind, we provide four considerations for how financial markets liquidity could be better incorporated as a consideration in the ongoing programme of banking sector and financial markets reform. We expand on these considerations in Chapter 6.

Consideration 1: Gather and analyse market data and insight for a better understanding of liquidity conditions and the link between regulation and market liquidity. This study has leveraged available data from public sources on current market liquidity conditions. It also laid out a framework for analysing the linkages between regulation and market liquidity. To further analyse these linkages, additional data analysis could be helpful, potentially using non-publicly available data and more adequate market indicators, such as aggregate trading volumes in OTC markets, price-impact indicators, and more granular time bucketed pre-trade and transactional data, particularly in corporate bond markets, and considering potential developments such as contractionary monetary policy.¹

We also suggest a more systematic approach to the assessment of the integrated impact of both market-based and prudential regulations on individual asset classes. This will make it easier to detect whether the integrated impact of individually appropriate reforms is unduly detrimental to an individual asset class. We believe that the most effective way to conduct such an analysis is by asset class or activity. Thus, for a given asset – say, an investment grade corporate bond, or an interest-rate swap – it would be beneficial for all stakeholders if there were an inventory of all the rules – capital, liquidity, clearing, margin – that affect the cost of holding and

¹ We note that the European Systemic Risk Board (ESRB) is planning to assess the potential financial stability effects from the current low interest rate environment and structural changes in the financial sector. Source: “Press release: ESRB General Board meeting in Frankfurt”, 25 June 2015.

financing that asset, and then examine whether the integrated regulatory requirements accurately reflect, overstate, or understate its risk.

Consideration 2: Assess existing and future regulatory decisions to strike the right balance between solidifying banking sector stability and maintaining financial markets liquidity. Key areas for assessment would include non-risk based rules, as well as rules that are at the earlier stages of policy development such as FRTB, trade reporting, G-SIB capital surcharges and EU bank structural reforms, in terms of their stability benefits and financial markets liquidity effects.²

Consideration 3: Review the global regulatory landscape, across different rule areas (market infrastructure, capital and liquidity requirements and structural reforms) to ensure coherence and to avoid detrimental financial markets liquidity effects. There are inherent tensions between different reforms which can stifle the effectiveness of individual reforms and add complexity and unintended consequences. Where there are cases of detrimental impacts on financial markets liquidity and rule revisions would not reduce stability benefits, then we consider there is a clear case for change. For example, the leverage ratio requirement does not allow for the netting of repo exposures in interbank/inter-dealer repo transactions unlike risk-based capital requirements, which imposes a higher capital requirement than risk-based requirements. Within the G-SIB framework, banks do not get reduced capital requirements following the implementation of the Net Stable Funding Ratio (NSFR), Liquidity Coverage Ratio (LCR) and total loss-absorbing capacity (TLAC) requirements, which contribute to lower bank risk. Such a layering of capital and liquidity requirements, each individually sensible, can be excessive in aggregate and detrimental to market liquidity. We provide further examples of areas that could benefit from greater regulatory coherence in Chapter 6.

Consideration 4: Review the regulatory landscape for consistency across international borders, to avoid unnecessary liquidity fragmentation. The growth in regulatory requirements that differ across territories and markets, and the uneven application of regulations on different market participants has contributed to a geographic fragmentation of liquidity. Regulations differ both by type and by method of implementation. Examples include the different approaches to structural reform across the US, UK and Europe and different pre and post-trade reporting requirements. This could result in established cross-border trading relationships becoming broken as smaller sources of regional liquidity emerge (ISDA, 2015). Such regulations increase the complexity of trade execution and reduce incentives for banks to provide liquidity across both territories and markets. Further work by key stakeholders, including market participants and policymakers, to review the coherence and any overlaps of current regulatory reforms, and identify areas of divergence, would be helpful.³

All of these considerations suggest increasing the emphasis on market liquidity in the next wave of banking and financial markets regulation. While it will continue to be important to focus on enhancing the resilience of banks through the regulatory process, it will be equally important to consider the regulatory effects on market liquidity, as more liquid, diverse, and effective financial markets will have long-term benefits on the global economy.

² The Bank of England will host an Open Forum to take stock of the reform agenda in financial markets following the Fair and Effective Markets Review. Source: Bank of England 2015) "Open Forum: Building Real Markets for the Good of the People".

³ We note that via the Financial Stability Board (FSB), the G20 countries adopted a cross-border approach to a comprehensive reform agenda for OTC derivatives markets to ensure policy coherence.

1 Introduction

1.1 Purpose of this study

Since the global financial crisis, regulatory initiatives have been proposed or implemented that seek to reduce both individual bank risk and systemic risks. Regulators have responded by increasing capital and liquidity requirements, planning for orderly recovery and resolution, and introducing various forms of structural reform. Market infrastructure reforms have also been introduced, such as EMIR and Title VII of the Dodd-Frank Act that aim to move derivatives to central clearing. MiFID II seeks to improve transparency in capital markets. The so called “Volcker Rule” in the Dodd-Frank Act (and parts of the EU proposals on bank structural reform – yet to be finalised) explicitly remove ‘proprietary’ trading from universal banks’ capital markets activity.

These regulations will have far-reaching impacts on banks and other market participants, both intended and – potentially – unintended. The intended impacts include containing the risk and leverage within the banking system; making failing banks more resolvable without recourse to taxpayers; making banking activity generally more transparent; and in some areas (notably proprietary trading) prohibiting them altogether for certain firms.

However, one of the possible unintended impacts could be a reduction in the liquidity of some financial markets, meaning, a reduction in market efficiency, including in times of stress. This, in turn, could increase the fragility of the financial system, as characterised by greater price volatility, more difficult price discovery and episodes of market disruption.

A reduction in liquidity also introduces frictions and costs to end users of those markets (such as companies seeking to raise capital to invest and manage their risk) thus impeding economic recovery and growth.

There have been numerous studies and reports to date that offer valuable insights into these issues, however, these reports often focus on a particular market or a specific regulation and as such, the

aggregate impacts of recent regulations on market liquidity are not well understood.

With increasing concerns being voiced on this matter, including from their bank members, GFMA and the IIF have commissioned PwC to undertake a broad review of global financial markets liquidity, highlighting the important linkages between financial services regulation and capital markets liquidity with a particular focus on their impact on end-users.

We focus on market liquidity as a broad topic and do not address conduct or governance issues in relation to trading activities. These issues have been investigated by policy makers, for example the Fair and Effective Markets Review led by the Bank of England, the Financial Conduct Authority (FCA) and HM Treasury.⁴

1.2 Rising liquidity concerns

Low interest rates, strong asset valuations and generally vibrant financial markets currently contribute to an impression of strong financial markets liquidity. However, there are emerging concerns of underlying structural market changes, which increase the vulnerability of financial markets to shocks. Changes in trading behaviour also risk impairing the efficient allocation of capital and the management of risk.

There are signs that volatility has increased, as characterised by several short-lived episodes of high volatility and impaired liquidity. By way of example, sovereign bond markets experienced a severe recent spike in volatility on 15th October 2014, when US Treasury yields plunged by 33 bps following the publication of unexpectedly weak US retail sales data and other factors.^{5,6}

Chris Salmon, Executive Director for Markets of the Bank of England notes that corporate debt and equity markets are now more volatile in response to price shocks in the post-crisis period, compared to the pre-crisis period.⁷

⁴ FEMR (2014) “How fair and effective are the fixed income, foreign exchange and commodities markets?” Consultation document.

⁵ This event was analysed by the US Department of Treasury, the Federal Reserve, SEC and CFTC in its “Joint Staff Report: The U.S. Treasury Market on October 15, 2014”.

⁶ 1 basis point or “bps” is equivalent to one hundredth of one percent.

⁷ Salmon, C. (2015), “Financial Market Volatility and Liquidity – a cautionary note”, 13 March 2015.

Foreign exchange (FX) markets have also not been immune to shocks. Concerns during the European sovereign debt crisis manifested themselves as increased volatility in euro currency markets between 2010 and 2011. Then on 15th January 2015, currency markets were particularly affected by the appreciation of the Swiss franc following the Swiss National Bank's decision to remove its cap to the Euro.⁸

These emerging concerns have triggered comments by central bankers and studies on financial markets liquidity. The Bank of England also recently set out its work plan to assess the causes of declining liquidity in markets and increasing fragility and the reliance of corporates on market-based finance within the UK and globally.⁹

“Resilient financial markets are vital to the functioning of the economy, providing essential services to borrowers and savers and to financial institutions that intermediate credit to households and companies, including real money investors and commercial banks.”

Financial Stability Report July 2015
Bank of England

“Liquidity appears to have become increasingly brittle... Although liquidity in these markets looks adequate during normal conditions, it seems to disappear abruptly during episodes of market stress”

Richard Berner, Director of the Office of Financial Research,
Speech at the Brookings Institution, 8 June 2015

“There is evidence that liquidity in some key markets has become more fragile”

Clara Furse, Bank of England
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“Market adjustments to date have occurred without significant stress. However the risk of a sharp and disorderly reversal remains given the

compressed credit and liquidity risk premia.”

Mark Carney, Chairman of the FSB
“Carney says see risk of disorderly unwinding of portfolios”
Reuters, 26 March 2015

“Fixed income markets of advanced economies witnessed some sharp intraday movements which raised concerns that price adjustments were being amplified by low levels of secondary market liquidity.”

Financial Stability Review May 2015
European Central Bank

Research by the Committee on the Global Financial System (CGFS, 2014) and Fender and Lewrick (2015) found liquidity has tightened in certain bond markets, with spreads widening in high yield and emerging market corporate debt. Their research also suggests that liquidity is increasingly concentrating in the most liquid instruments and falling in less liquid assets – a phenomenon termed “bifurcation”. Their interviews with market participants also suggest that the execution of block trades has declined in recent years. As other studies point out, the decline in secondary market liquidity is coinciding with a significant increase in primary debt issuance, especially high yield corporate debt issuance (28% increase between 2010 and 2014).¹⁰ These factors are increasing the demand for liquidity, even as market and regulatory forces are reducing dealers' ability to provide it. In markets where there is insufficient liquidity, volatility could increase and market participants could face higher transaction costs.

The current low interest rate environment also creates the risk of market disruption in the event of an increase in central bank policy rates and bond yields. This risk was clearly realised during the bond market sell-off in 2013 that followed from the Federal Reserve's announcement that it would begin to slow its programme of asset purchases. Capital losses on bonds are not the only risk – equity prices and exchange rates have been affected by Quantitative Easing (“QE”) – and the unwinding of QE could result in higher volatility and reveal structurally less liquid capital markets, which will have significant consequences for the ability of corporates and investors to manage risks and adjust their portfolios. This means the combination of

⁸ Between 2010 and 2011, movements in the euro exchange rate against the US dollar amounted to 3 standard deviations, 4 standard deviations against the pound and the yen, and 10 standard deviations against the Swiss franc. Source: ECB (2013).

⁹ Bank of England (2015) “Financial Stability Report July 2015”.

¹⁰ CGFS (2014) and Oliver Wyman and Morgan Stanley (2015).

emerging risks with more fragile financial markets may suggest uncertain times ahead.

1.3 *Our approach*

Our work was split into three phases: (i) information gathering; (ii) analysis; and (iii) formulating policy considerations. We have gathered information from previously published studies on financial markets liquidity; and market data on liquidity indicators across financial markets. We also spoke to financial market participants to interpret and validate the findings from the market data and gather views on future trends.

Our scope is purposely wide. We cover all the main financial markets including equities, fixed income, commodities and currencies, including their associated derivative markets. We review emerging markets separately across all financial markets.

We have used external, publicly available, third-party data sources to provide a data-rich granular assessment of capital markets liquidity.

In addition, we have commissioned bespoke data from Trax, MarketAxess and Tricumen – all leading providers of capital market data, trade matching and regulatory reporting services to the global securities market.

We have held discussions with GFMA and IIF and their members to support the gathering and interpretation of data.

1.4 *Structure of this report*

This report sets out our findings.

In **Chapter 2**, we define market liquidity and its benefits. We set out how liquidity is provided, the consequences of illiquidity and provide an overview of global financial liquidity.

In **Chapter 3**, we set out the banking and financial market regulations implemented since the global financial crisis and describe the ways in which these impact financial markets liquidity.

In **Chapter 4**, we review the current trends in liquidity across capital markets and highlight particular areas of concern.

In **Chapter 5**, we consider potential future drivers of liquidity, including future reforms, and developments in electronic trading, mutual funds and ETFs, market structure and new market participants.

In **Chapter 6**, we consider the policy implications of our study.

2 What is liquidity?

Key points

- Liquidity is a multi-dimensional concept, generally referring to the ability to execute large transactions with limited price impact, and tends to be associated with low transaction costs and immediacy in execution.
- We consider liquidity to be important for effective market functioning. Liquidity in financial markets facilitates the efficient allocation of economic resources through the efficient allocation of capital and risk, the effective generation and dissemination of issuer-specific information, and the effectiveness of monetary policy and financial stability.
- In some markets such as fixed income and bespoke derivative instruments where matching supply and demand for a given instrument becomes more challenging, market makers, such as banks and trading firms are essential in providing liquidity and facilitating transactions by stepping in as counterparties to such transactions. This involves buying or selling financial instruments without an immediate matching transaction and requires market makers to bear risks relating to the movement in inventory values.
- Liquidity conditions can differ significantly across different asset classes, even in normal times. Financial assets with lower levels of liquidity tend to have higher liquidity risk premia, and market participants also tend to face higher transaction costs and wider bid-ask spreads when trading in these instruments.
- The financial crisis demonstrated the advantages of having a robust financial system which is able to absorb unpredictable shocks, while maintaining market-wide liquidity. We consider market liquidity to be invariably beneficial.
- We consider there are at least five broad trends driving global market liquidity conditions at the moment. These include: (i) stable and supportive global monetary conditions, which support overall liquidity throughout the economy; (ii) the increase in electrification and digitalisation in financial markets, which helps reduce the costs of trading and links up buyers and sellers; and (iii) the growing engagement of providers of alternative market-based financing in some aspects of market making. Countering these three trends are: (iv) the overall increase in the size of financial markets and associated demand for liquidity; (v) the reduced supply of dealer market making capacity, which is driven by regulatory reforms in the financial sector; and a diminished risk appetite across banks as they adjust to a post-crisis market environment.
- The current global economic, monetary and financial market environment is generally favourable to liquidity, such that detecting risks and fragilities becomes more challenging.

We set out in this chapter what we mean by liquidity and how it is typically measured. Next, we set out the benefits of financial markets liquidity, and how liquidity is provided in different ways across financial markets. We then consider the consequences of illiquidity.

We also present recent trends in overall market liquidity, which provide a relevant backdrop before we consider liquidity conditions across individual financial markets in Chapter 4.

2.1 Dimensions of liquidity

General economic theory tells us that frictionless and well-functioning markets produce efficient outcomes for the ultimate benefit of consumers (Varian, 1992).¹¹ However, when these market conditions are not present, various impediments to trade can hinder the process of price discovery and can impair the ability of markets to function. They add costs and can reduce economic activity. This is why policy makers and competition authorities generally seek to reduce transaction costs to improve market outcomes.

The features that tend to be associated with liquid markets include low transaction costs, immediacy in

¹¹ Varian, H. (1992), "Microeconomic analysis", Third Edition.

execution, and the ability to execute large transactions with limited price impact. As a driver of trading costs, liquidity therefore affects the ability of dealers, funds, corporates and other market participants to engage in market making, hedging and investment activity.

In Europe, the introduction of MiFID II will bring significant changes to the way liquidity is defined for the purpose of trading and transparency requirements, which will have a significant impact on financial market liquidity. Article 2 of the Markets in Financial Instruments Regulation (MiFIR) contains a definition for a “liquid market”, that is a “market for a financial instrument or a class of financial instruments where there are ready and willing buyers and sellers on a continuous basis”.¹² The purpose of the liquidity definition is to identify liquid instruments for the purposes of MiFID and its transparency requirements. Instruments deemed liquid under MiFID II are subject to pre- and post-trade transparency. We note that the proposed liquidity definition in the context of assets eligible for liquid portfolios within MiFID II and MiFIR take into account the availability of ready and willing buyers and sellers (using the average frequency and size of transactions, the number and type of market participants and average spread). However, many assets that have the potential to be sold quickly with little market movement do not trade for a variety of reasons.

Alternatively, CGFS (2014) proposes that market liquidity is the “ability to rapidly execute large financial transactions with a limited price impact”, meaning that in deep and liquid markets, the most recent transaction should not have an effect on overall market price¹³. Neither should it have an effect on the supply of buying and selling orders (breadth and depth), nor the transaction cost (tightness of spread). It also should not inhibit the ability of new buyers to transact in the instrument (market resilience).

Liquidity is therefore multi-dimensional and can be captured in different ways. These different dimensions are described in Table 2.1.

Some measures are more suited to capturing liquidity in certain capital markets segments. For example, Gabrielsen, Marzo and Zagaglia (2011) and Fleming (2003) show that the bid-ask spread has traditionally provided a better measure of differences

in liquidity across instruments for quote-driven markets, such as corporate and sovereign bonds.

In the current market environment, however, we think that the changes in market structure and behaviour of market participants needs to be considered when interpreting liquidity measures over time, such as bid-ask spreads.

Bid-ask spreads are driven by the costs of market making, including the costs of funding their inventories, the cost of capital required to hold inventories and operating costs. As banks have reduced the amount of capital they employ (thereby reducing the amount of the risk they take on their balance sheet). Therefore, the bid-ask spread for a given trade may not need to compensate for the risk of movements in inventory values.

In addition, there are a wide range of bid-ask prices as transaction sizes tend to vary significantly even for the same instrument (e.g. due to the infrequency of trading and significant variation in trade sizes). This, combined with the fact that continuous two-way pricing is largely absent in credit markets, indicates that the current bid-ask spreads are more likely an indicator of how trades are being executed (i.e. smaller trades over a longer horizon when possible), rather than an indicator of liquidity itself. The bid-ask spread from successfully traded instruments may not capture the impact of not being able to trade bonds and hence may be an unreliable indicator of liquidity when market structures and behaviours are changing. Lastly, trading volumes are also dominated by secondary market trading shortly after a bond has been issued and hence may not fully represent liquidity conditions across the bond universe.

These reservations are supported by the Joint Staff Report into the US Treasury market on October 15 2014:

“Average bid-ask spreads and market depth, though often indicative of general market conditions, may need to be complemented by other measures in light of these [structural] changes to obtain a more meaningful picture of the state of market liquidity.”¹⁴

Given that there is no single definition for liquidity, and the difficulty of interpreting individual measures, our study considers liquidity across

¹² Regulation (EU) No 600/2014 of the European Parliament and of the Council, on markets in financial instruments and amending Regulation (EU) No 648/2012.

¹³ The overall price in a liquid market will be determined by the interaction of buyers and sellers, but individual transactions should have a limited price impact.

¹⁴ Joint staff report (2015) “The U.S. Treasury Market On October 15, 2014”.

different capital markets using all these different dimensions. Our study does not apply a uniform definition of liquidity across markets, but rather, we consider various measures and approaches of analysing market liquidity, which are set out in more

detail in Chapter 4. We place particular importance on careful interpretation of liquidity measures during a period of regulatory and market structure change.

Table 2.1: Dimensions of liquidity

Dimensions of liquidity	Description	Measures
Immediacy	Immediacy typically refers to the time it takes to complete a transaction. Market makers are a constant source of immediacy. Under an agency trading system, finding a trading match/partner depends on frequency of transactions and constant depth of trading interest in the security by investor.	• Number of market makers • Number of market participants • Availability of quotes • Average frequency of transactions and transaction sizes • Number of ‘zero-trading days’
Depth and resilience	A market is deep when there is a large flow of trading orders on both the buy and sell side on a frequent basis and there needs to be a constant interest and willingness to trade. With large orders in both directions, trading volumes should be high and the price impact of larger trades should be lower, creating lower volatility and resiliency. Depth measures can also distinguish between aggregate trading volumes, and turnover based measures, which capture the volume traded per security.	• Trading volumes • Dealer inventory holdings • Price impact of volume measures • Turnover ratios • Intra-day volatility
Breadth	Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.	• Segmentation of liquidity e.g. share of volumes accounted for by the most liquid securities • On/off the run spreads
Tightness	Tightness typically refers to the financial cost of completing a transaction.	• Bid-ask spreads
Multi-dimensional	Multi-dimensional measures incorporate a number of features of the above. They are typically grouped into price based and market impact based measures. Price based measures: inter-period volatility measures Market impact measures: residual liquidity risk premia, which reflects investors’ perception of conditions in secondary markets and the probability of having to take a large price discount at the point of sale.	• Liquidity risk premia • Liquidity score, which uses various metrics and indicators to create an overall liquidity score across fixed income asset classes. These scores are created by financial information providers (e.g. Bloomberg) and banks (e.g. UBS Delta)

Source: Various

2.2 The benefits of financial markets liquidity

Financial markets are a key source for financing business growth and government spending. They also provide important access for investors to invest and earn returns.

In most regions, such as in Europe, Latin America and Asia where businesses have been historically reliant on bank financing, capital markets are less

developed compared to markets such as the US. However, policymakers are increasingly recognising the importance of developing capital markets as an alternative to bank finance: the recent proposal for the EU Capital Markets Union seeks to develop deep and liquid capital markets across borders that complement banks as a source of financing. Policy developments which have encouraged further financial integration are also underway in Asia and

in other regions to promote growth in capital markets.¹⁵

Financial markets liquidity facilitates the efficient allocation of economic resources through a number of channels:

- Efficient capital markets facilitate the global flow of capital between investors, or savers, and borrowers. This generates benefits to the economy: studies show that liquidity in stock markets has a statistically significant relationship with present and future rates of economic growth, capital accumulation and an increase in productivity growth.¹⁶ A low liquidity premium also lowers issuance costs for corporates (Damodaran, 2005). Butler, Grullon and Weston (2002) find that, after controlling for other factors, investment banks charge lower fees to firms with more liquid stocks since they need to manage less risk. Well-functioning capital markets also provide diversified sources of funding, in addition to traditional bank lending.
- Liquid capital markets also facilitate the distribution of financial risks to market participants most able and willing to bear them, and enable investors to manage and hedge against risks, as well as adjust their portfolios effectively.
- Liquidity is necessary for the effective generation and dissemination of issuer-specific information. In the context of equity markets, movements in the share price are likely to reveal important information about changes in the firm's value in liquid markets, and can also reflect liquidity risks. Chordia *et al.* (2001) and Acharya and Pedersen (2005) show that there is a positive and statistically significant relationship between liquidity in equity markets and asset returns. Friction in the system, as characterised by high transaction costs, can therefore hinder the price discovery process.
- The effectiveness of monetary policy also depends on liquidity conditions in financial markets. Abbassi and Linzert (2012) analyse the effectiveness of monetary policy in steering money market rates in the euro area, and find that money market rates after the crisis became less responsive to the expected path of the European Central Bank's (ECB) policy rate, compared to before August 2007. The

loss of monetary policy effectiveness is partly attributed to money market rates being driven by higher liquidity premia. Therefore, financial markets liquidity is a key factor in ensuring the effectiveness of monetary policy.

- Deep and liquid financial markets are important to financial stability. Market participants require liquid markets in order to effectively manage risks and their own funding needs. There is a significant body of literature that suggests that financial derivatives reduce risk.¹⁷ A resilient and effective financial system enables corporates to manage business risks, such as currency, interest rates or commodity price risks. Market liquidity is also critical in maintaining the resiliency of financial markets during times of stress. Benos and Zikes (2014) find that frictions in inter-dealer markets inhibited dealers' ability to share risk and manage their inventories, which translated into a higher cost of trading above and beyond what can be explained by funding costs and aggregate uncertainty.

Policymakers recognise the importance of liquid capital markets to businesses and the economy. For example, the European Commission's Green Paper on Building a Capital Markets Union states that:

*"Improving the effectiveness of markets would enable the EU to achieve the benefits of greater market size and depth. These include more competition, greater choice and lower costs for investors as well as a more efficient distribution of risk and better risk-sharing... Well-functioning capital markets will improve the allocation of capital in the economy, facilitating entrepreneurial, risk-taking activities and investment in infrastructure and new technologies."*¹⁸

2.3 How is liquidity provided?

The way in which liquidity is provided across different asset classes is dependent on the characteristics of the underlying assets and the market structure. Market trading models can be typically categorised into the following:

- **Order-driven markets:** In order-driven markets, buyers and sellers display the prices at which they are willing to buy or sell financial instruments, and the amount they are willing to buy and sell at those prices. The presence of multilateral trading venues, such

¹⁵ See speech by Jacqueline Loh "Integrating Asia's Capital Markets", ASIFMA Annual Conference 2014, 5 November 2014.

¹⁶ Beck and Levine (2003) and Caporale, Howells and Soliman (2004).

¹⁷ See among others: Guay (1999), Jin and Jorion (2006), and Bartram, Brown and Conrad (2008).

¹⁸ European Commission (2015) Green Paper: Building a Capital Markets Union", 18 February 2015.

as exchanges ease the process of matching supply and demand for instruments that are sufficiently numerous and standardised. Markets such as equities, futures and options on short-term interest rates and commodities are typically order-driven markets. Trading on multilateral venues enable participants to trade standardised contracts, which tend to be linked to clearing facilities via central counterparties (CCPs). Liquidity in these markets is therefore provided by high levels of supply and demand from individuals, institutions and brokers on their behalf, which generates continuous two-way trading interest. This typically generates large volumes of outstanding orders in these markets.¹⁹

- **Quote-driven markets:** In quote-driven markets such as fixed income, FX, some commodities and derivatives markets, transactions are concluded on the basis of quotes that are provided by market makers to market participants. Quotes are typically made available on a continuous basis to participants that are valid for a point in time and continuously adjusted. Providers of quotes on a continuous basis have to bear risk in relation to any price movements in between buying and selling assets and therefore commit capital to support the provision of liquidity in these markets. In this way dealers improve markets with poor underlying market transaction activity with enhanced liquidity in terms of both immediacy and depth.
- **Request for quote (RFQ) markets:** In RFQ markets (on and off venue), quotes are provided to buyers and sellers on request either electronically or by voice negotiation, such as in fixed income and non-exchange traded derivatives. In RFQ markets, market makers provide liquidity and price quotes that are valid for a point in time where there is not sufficient continuous buying and selling interest to support an order-driven model with acceptable rates of matching. MiFID I also introduced the systematic internaliser (SI) regime for equities, where market makers execute client orders on their own account. In MiFID I, this regime is focussed on trading shares but MiFID II aims to extend the regime to capture a much wider set of assets.

In a RFQ market, a client may request quotes from a number of dealers and determine the place of

execution based on their best execution policy. The market maker facing the client will then commit its capital when executing the trade and take on the risk. The client may also request an indicative price or stream as part of the price discovery process.²⁰

2.4 The role of market makers

The relatively standardised nature of certain instruments, for example, equities, tend to be order-driven, and trading is facilitated by stock exchanges and other venues that can match large numbers of buyers and sellers for each order.

However, markets such as fixed income and derivatives are characterised by a significantly large number of instruments with different characteristics (tenor, payment terms, coupon rates etc.), which makes matching supply and demand for a given instrument more challenging. By way of example, the number of European fixed income instruments covered by Trax alone amounts to 310,000. This compares to around 19,000 publicly-listed equities across Europe. Fixed income instruments are also by their nature purchased for income rather than capital appreciation, and some investors are less likely to trade these instruments after the initial purchase. In the absence of a continuous two-way market for buyers and sellers in these markets, market makers such as banks and broker-dealers facilitate transactions by stepping in as counterparties to such transactions by buying or selling financial instruments without an immediate matching transaction. These are therefore traded over-the-counter (OTC) rather than on exchanges.

Derivatives markets have also been largely OTC-traded as end-users have historically traded bespoke products specific to their requirements or economic needs. Such trades tend to be less frequent as trade matches are again harder to find. Market-making activities require banks to buy and hold inventories of financial assets and therefore commit their balance sheets to enable investors to exit or enter their positions quickly. Market makers provide liquidity in these markets by absorbing temporary supply-demand imbalances, which help dampen the impact on market volatility and improve price discovery.

There are limits to the role of market makers. Market making does not prevent long-term demand and supply factors from influencing the price of assets,

¹⁹ There are examples where exchange-traded instruments could also experience lower levels of liquidity, e.g. smaller listed companies tend to experience smaller trading volumes than larger companies.

²⁰ TABB Group (2012) "MiFID II and Fixed-Income Price Transparency: Panacea or Problem?".

rather market making – through enabling trading – helps markets to find their clearing level efficiently.

Market makers are compensated for the risks and costs incurred via the following revenue streams:

1. **Facilitation revenues:** principally derived from the spread between the purchase price of the asset and the sale price of the asset; and
2. **Inventory revenues:** which include any income derived from the asset during ownership (e.g. coupon or dividend payments) and the change in value of the underlying asset.

We specifically categorise market makers as intermediaries that facilitate trade in variable price securities and provide immediacy through their balance sheet i.e. principal trading. That is, we focus on dealers who are ready to immediately trade fixed amounts of securities at stated bid and ask prices. Market makers help provide immediacy and certainty around the price and size of trades, by committing balance sheets and warehousing inventory risk. This is in contrast to agency traders, who match buyers and sellers, but do not provide immediacy themselves on their own account, and cannot guarantee immediacy. In their case, the compensation for this brokerage is a commission.

Bid-ask spreads can be impacted by the costs to market makers of funding their inventories, the cost of capital required to support holding inventories, any expected gains or losses on holding inventories and the operating costs of running market making activities, including risk management or hedging costs.

This means that, all else being equal, an asset which a bank or broker-dealer expects to be able to sell quickly with little price movement will command a smaller bid-ask spread than an asset which the bank or broker-dealer anticipates may be difficult to offload.

Primary and secondary markets are also closely interlinked, with market makers typically underwriting bond issues and subsequently actively trading those bonds in secondary markets. Market makers and issuer clients therefore benefit from good secondary market liquidity of their issues as this reduces the liquidity premium demanded by

investors in primary issues as well as mitigating the risks of underwriting.²¹

In Box 2.1 we explore the economics of market making, setting out the fundamental trade-offs market makers face, and the behaviour these trade-offs create. We find that, over the period studied, market makers have often maintained (but typically not increased) trading presence and inventory levels during periods of heightened market volatility. We also find that more recently, there is a possible shift in market maker behaviour, where market makers are less able to maintain inventory levels during periods of heightened market volatility.

Market makers are distinct from other market participants, for example corporate hedgers who seek to hedge specific business risks or proprietary traders who seek to maximise profits on all trades. Financial firms that undertake proprietary trading (trading for the firm's own profit without the link to client servicing), add to market trading volumes, as these firms are also a source of supply and demand for financial assets. However such activity is different to liquidity provided through market-making activities. Whereas proprietary trading activity is largely concerned with trading profit, market-making has a different, customer-driven business model, which means liquidity – here the provision of both buy and sell quotes – can be provided on a more continuous basis. Market makers earn a commercial return by providing market making activities, in which they may not profit in every transaction, but over time and across the whole business.

For example, the importance of the customer franchise is one factor that explains the more consistent provision of market-making services by banks during times of elevated market volatility or stress. The ECB notes the following in its opinion on the European structural reform proposal:

“The ECB considers it important to sufficiently preserve the market-making activities of banks in order to maintain or increase asset and market liquidity, moderate price volatility and increase security markets’ resilience to shocks. This is essential for financial stability, the implementation and smooth transmission of monetary policy, and the financing of the economy. Therefore, any regulatory treatment should avoid negative consequences for market-making activities that are not justified by significant risks.”²²

²¹ CGFS (2014).

²² Opinion of the European Central Bank of 19 November 2014 on a proposal for a regulation of the European Parliament and of the

Council on structural measures improving the resilience of EU credit institutions

Analysis by the Bank of England of market maker behaviour during periods of high and low volatility shows that market makers register large losses during periods of high volatility by trading against price trends to help dampen volatility.²³ Anand and Venkataraman (2012) also show that market makers on the Toronto Stock Exchange tend to stabilise prices and lower execution uncertainty.

Dealers' that compete for client business and gain market share also tend to have greater ability to cross-sell different investment banking services.²⁴

2.5 Differences in liquidity across markets

Liquidity conditions can differ significantly across the asset classes, even in normal times.

Some markets, such as equity and FX markets tend to be more liquid than fixed income markets such as the corporate bond market. Even within asset classes there can be significant differences in liquidity conditions. These differences tend to be driven by factors such as issuer-specific characteristics (financial performance, creditworthiness, macroeconomic factors, issuance frequency, volume of outstanding traded instruments and existence of benchmark debt), instrument-specific characteristics (e.g. issue size, maturity, coupon rates etc.), and market structure (proportion of exchange vs bilateral trading, and the importance of market makers to match supply and demand imbalances). For example, sovereign bonds tend to be more frequently traded than corporate bonds as they tend to be relatively more homogenous (although sovereign bonds are far more heterogeneous than equity

markets), and comprised of fewer, large issuances. Emerging market sovereign bond issues tend to be less liquid than bonds issued by sovereigns in advanced economies. Similarly, equity of smaller capitalisation companies is typically traded far less frequently than large corporate equities. The way in which trades are executed can also have an impact: trading in odd lots or in large blocks, particularly in fixed income markets can have a larger price impact than round lots or smaller blocks.²⁵

Research from AFME found that there is substantial heterogeneity in bond markets from a liquidity perspective, which demonstrates the need for a market maker model as a result of the large size but low frequency of trades. The analysis also found that low trading activity in fixed income markets tends to be associated with a high variation in trade size.²⁶

The implications are that financial assets with lower levels of liquidity tend to have higher liquidity risk premia, and market participants therefore tend to face higher transaction costs and wider bid-ask spreads when trading in these instruments.

For the purpose of our study, which is to review current liquidity conditions across financial markets and its expected evolution, we focus on changes over time. We therefore distinguish between asset classes (or sub-sections of asset classes) where liquidity has always been weak and contrast this to asset classes which have seen recent declines in liquidity. While there is still a policy rationale for improving liquidity across all market areas, our study is focussed on areas of more recent change.

²³ Benos, E. and Wetherilt, A. (2012) "The role of designated market makers in the new trading landscape".

²⁴ Bank of England (2011), CGFS (2014).

²⁵ Odd lots refer to trade sizes that are less than the "normal" unit of trading, whereas round lots are regular trade sizes which can differ across assets. It is the smallest order that can be placed through an exchange.

²⁶ AFME's work provides details of actual trading activity for various asset classes in Europe. See AFME (2012) "An analysis of fixed income trading activity in the context of MiFID II" and AFME response to ESMA's consultation paper on MiFID II/MiFIR.

Box 2.1: The economics of market making

We can explore pricing behaviour and market entry/exit decisions for market makers using models from the capital markets microstructure literature²⁷. In this box, we begin by reviewing which factors determine a market maker's decision to trade, or not trade, a particular security; we then review factors which determine pricing behaviour.

Market entry and exit

The decision of a market maker as to whether they should trade a particular security depends on a number of factors.

Table 2.2 captures the most prominent of these factors.

- Rate of transactions
- Price elasticity of demand
- Variability in inventory value
- Risk aversion

For each of the factors listed above, we provide an illustrative relationship between the factor and the decision of the market maker to either 'trade' or 'exit'. Overall, the decision of the market maker depends on the trade-off between expected income and the risk that is warehoused by holding positions in the security. In practice there may also be additional benefits to providing market making services to clients where those clients provide revenue to other areas of the business. Therefore the economics of market making must also consider the spill overs of costs and benefits across different business units.

Furthermore, there are interactions between each of the factors set out below which link together when assessing costs and benefits. For example, a higher rate of transactions may lead to lower variability in price for a particular security. Therefore the higher transactions fees may also be associated with lower price risks.

Therefore markets with higher transaction flows, few alternatives (lower elasticity of demand), little variability in inventory value and associated with lower risk tend to be associated with higher levels of market making activity. Investment grade corporate bonds, which have reasonably high trading volumes,

reasonably steady values and lower risk tend to be associated with greater levels of market making activity. Conversely, high-yield bonds which have less transaction flow and higher levels of risk tend to be associated with lower market making capacity and number of market makers.

Pricing behaviour

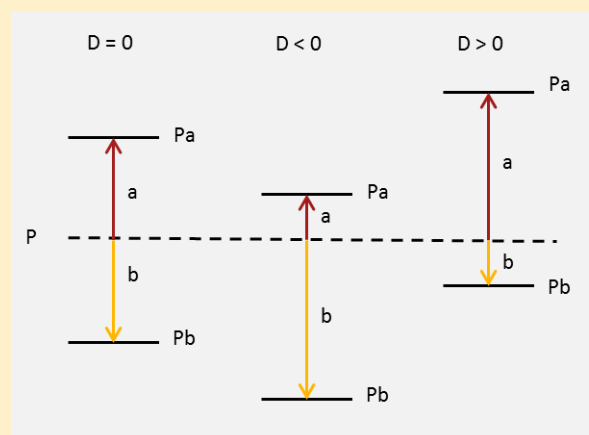
Market makers earn fee income through the bid-ask spread they maintain around their opinion of a security's 'true value'. This income compensates the market maker for the risk they warehouse and provides a return on capital for their investors.²⁸

The size of this spread depends on several factors. Dealer specific factors such as risk aversion; transaction specific factors such as the size of transaction, and security specific factors such as variability in value. In addition, the higher the RWA charges for certain products, the wider the spread as the costs of holding the inventory is higher.

Price responses to changing levels of inventory are not typically channelled through changes in spread, but instead, through the distribution of bid and ask prices relative to the 'true value' of the security. We label this change in distribution, the degree of price adjustment.

Figure 2.1 demonstrates this price adjustment.

Figure 2.1: Price adjustment with constant spread (where $d = a - b$)



Source: PwC analysis

²⁷ In particular we use the analytical framework presented in the seminal paper Ho and Stoll (1981), which establishes optimal dealer pricing under transaction and return uncertainty.

²⁸ The warehousing of risky securities increases risk weighted assets (RWAs). However, equity resources constraints may limit RWA growth, and hence also limit inventory size.

The figure shows that the bid and ask prices can adjust such that the spread remains constant, but the gap between ask price and true price (denoted 'a') and the gap between bid price and true price (denoted 'b') change. The left-hand distribution in the figure would be associated with an inventory level which was close to desired levels. However, if

inventory was accumulated above desired levels, we may observe a distribution such as the one shown in the centre distribution. In this configuration, customers would be incentivised to buy at the lowered ask prices, but not to sell as the lower bid price – facilitating inventory reduction. The reverse is true for the right-hand distribution.

Table 2.2: Prominent factors which determine market maker exit and entry for a given security

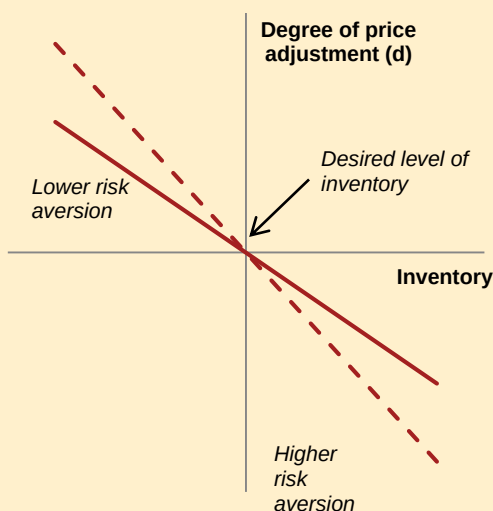
Factor	Rationale	Illustrative relationship
Rate of transactions	The benefits and costs to market making are dependent on the rate of transactions. Fewer transactions (in a fixed unit of time) result in low fee income and mean that surplus inventory may have to be held for longer on balance sheet – exposing the market maker to changes in the underlying value of the security.	Net benefit to market-making Trade Exit Rate of transaction arrivals
Price elasticity of demand	A lower price elasticity of demand means that the quantities of customer transactions are less sensitive to prices set by market maker. High price elasticities of demand may make market making unprofitable, for example, caused by competing sources of immediacy.	Net benefit to market-making Trade Exit Price elasticity of demand
Variability of inventory value	The variability of inventory value, is simply a function of the variability in the value of the underlying securities, and impacts the net benefit to market making. All else equal, the higher the variability in the price of the security, the more risk the market maker absorbs. A high level of variability may mean that risk outweighs the returns that can be earned through fees.	Net benefit to market-making Trade Exit Variance of inventory value
Risk aversion	The level of market maker risk aversion impacts the tolerance towards absorption of risky inventory. For a given risk level of a security, higher risk aversion will make it more likely that a market maker will not trade that particular security.	Net benefit to market-making Trade Exit Coefficient of relative risk aversion

Source: PwC analysis

The degree to which prices adjust, i.e. how quickly prices move from the left-hand distribution ($d=0$), to either the centre or right-hand distribution, as inventory is accumulated or dissipated respectively, depends on security and dealer characteristics. Two characteristics which are of importance are dealer risk aversion and the variance in the value of the security in question.

Figure 2.2 shows how the degree of price adjustment varies across different levels of inventory for a lower risk aversion case and a higher risk aversion case. Prices are adjusted to a larger extent for any deviation from desired inventory levels in the higher risk aversion case.

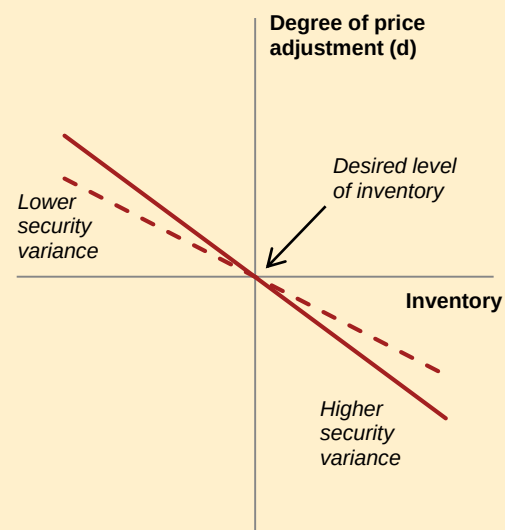
Figure 2.2: Degree of price adjustment and risk aversion



Source: PwC analysis

Figure 2.3 shows a similar relationship between inventory levels and the variance in the value of the security (or basket of securities) for which a market is being made. Interpretation is the same as the figure discussed above, where a higher security variance causes the degree of price adjustment to increase faster as inventory deviates from desired levels.

Figure 2.3: Degree of price adjustment and security value variability



Source: PwC analysis

These two relationships imply that both higher levels of risk aversion, and higher levels of volatility in underlying security values, could lead to faster price reactions from market makers to changes in inventory levels. This is particularly relevant in the case of one-sided transaction flows.

This review of pricing behaviour and drivers suggests market makers will provide liquidity into markets up to a point. When the risk gets too high in a one-way direction, then market makers, as other market participants will reduce trading activity. This also means that banks have commercial incentives to become more active with moderately increased volatility, especially when accompanied by increased transaction volumes, but that all market makers and market participants can leave the market in extreme events, when all liquidity does “dry up”.

Empirical evidence of market maker inventories

In this section we review market data to assess market maker behaviour over the past 10 years.

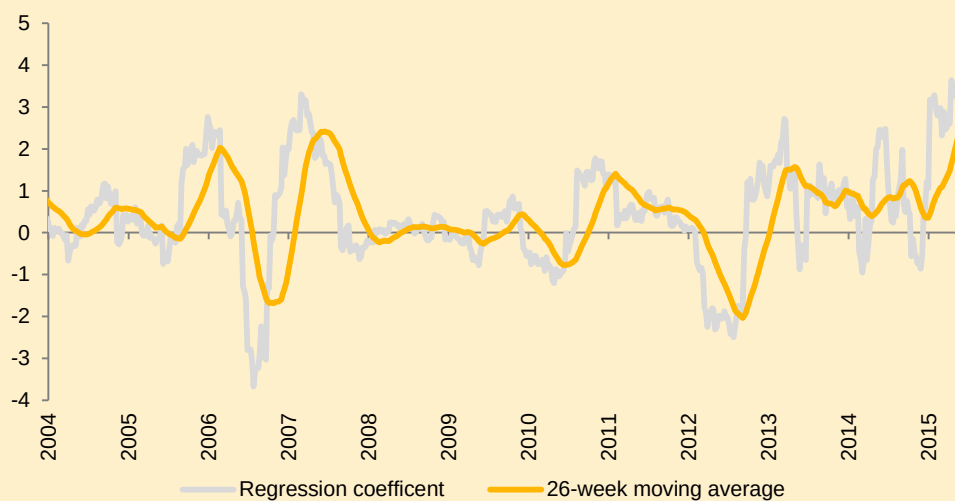
Market makers who provide immediacy should use their inventory to act as a counterweight to market demand. For example, as demand for bonds rises, and net order flows become positive, market maker inventories would be expected to decline, absorbing the market imbalance caused by temporary excess demand. Over short periods of time we would therefore expect to observe that inventories had a negative relationship with the market price of bonds.

We investigate this relationship empirically in Figure 2.4 below for the US market – the chart plots rolling coefficients for 26-week regressions of inventory changes in relation to bond price changes. In Figure 2.4, when the chart is above the line, this suggests a positive relationship between inventories and bond prices. When the chart is below the line, this shows a negative relationship between inventories and bond prices.

Figure 2.4 suggests that more often there is a broadly flat relationship between inventories which hold

steady in relation to bond prices. However, the relationship has become consistently positive since the beginning of 2013, and has not demonstrated the same reversion to a flat relationship as in past periods. This indicates there may be a change in the way market makers are functioning, indicating that market makers are less likely, or are less able, to absorb temporary supply and demand imbalances by stepping in as buyers (or sellers) against trades sought by other market participants.

Figure 2.4: US inventory response to US bond price changes



Source: Federal Reserve Bank of New York, Thomson Reuters, PwC analysis

2.6 When liquidity dries up

In this section, we review the linkages between individual asset classes and broader markets when liquidity falls.

As noted by the Bank of England's Financial Stability Report (July 2015), individual asset classes can experience shocks to liquidity, as characterised by short-lived episodes of volatility, such as the 15th October US Treasury "flash crash", which caused a temporary plunge and subsequent recovery in US Treasury yields.

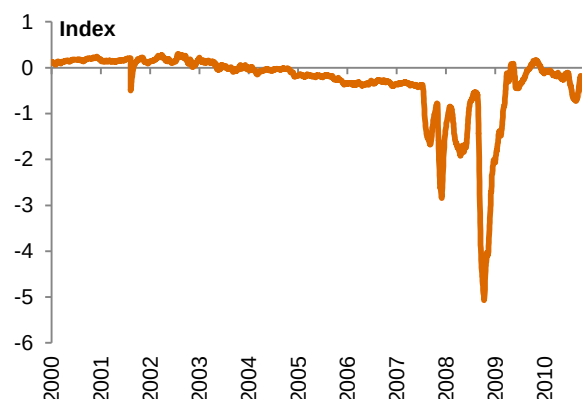
But financial markets are also increasingly interlinked across borders and asset classes, and as a result, the ease of financing tends to be correlated across geographies and asset classes. "Carry trades" provide a useful example: investors borrow in national currencies with low interest rates and invest in higher yielding currencies, and as a result, changes in liquidity conditions in one country can directly affect liquidity conditions elsewhere.

These linkages across markets increase investors' and corporates' access to capital markets and their ability to invest and obtain funding by encouraging cross-border lending and foreign currency-denominated loans. However, they also mean that a liquidity problem in one corner of financial markets can cause liquidity to decline in other markets, in turn leading to a contraction in aggregate supply of credit and a decline in economic activity.²⁹ This risk can materialise when markets are unable to absorb sudden changes in demand or supply of assets, and order imbalances. Such market illiquidity often causes increased volatility and higher execution costs for investors.

Commonalities in liquidity risk across markets, for example across bonds and equity markets (Chordia *et al.*, 2005), suggest that illiquidity in certain markets can therefore quickly transmit risk to other markets if any repricing of risk overshoots. This is particularly relevant for fixed income instruments, such as bonds whose maturities create a need for refinancing in the primary market.

This was observed during the height of the global financial crisis, when losses in the US subprime mortgage sector rapidly spread contagion to other markets, severely impairing liquidity in other markets that were not directly related to the mortgage sector. Short-term bank funding markets across the globe were severely disrupted, as money market funds and other buyers of short-term debt (including asset-backed commercial paper) withdrew from these markets (as shown in the sharp deterioration in liquidity in Figure 2.5). The impairment of bank funding caused banks to sell assets at distressed levels in order to meet their obligations, which only served to increase volatility in asset prices. Trading frictions (such as widening spreads) amplified this volatility, and further exacerbated market liquidity conditions. This in turn worsened liquidity conditions, leading to a downward liquidity spiral in markets due to mutually reinforcing reductions in market and funding liquidity (Brunnermeier and Pedersen, 2005 and 2007).

Figure 2.5: Money markets liquidity indicator³⁰



Source: ECB

This financial crisis therefore has demonstrated the benefit of having a robust financial system which is able to absorb inevitable shocks, while maintaining market-wide liquidity. Market illiquidity during the global financial crisis also contributed to yields on corporate bonds increasing and spreads widening (Federal Reserve, 2008), resulting in the difficulties faced by non-financial corporates in obtaining capital. Illiquidity in short-term credit markets

euro bond markets and; (6) the equity options market. The last two components which measure the liquidity premium are gauged by: (7) spreads on euro area high-yield corporate bonds which are adjusted to take account of the credit risk implied in these spreads by expected default frequencies (EDFs) and; (8) euro area spreads between interbank deposit and repo interest rates. The composite indicator is a simple average of all the liquidity measures normalised on the period 1999-2006".

²⁹ See Allen and Gale (2000), Diamond and Rajan (2005) and Shleifer and Vishny (2010).

³⁰ As discussed in ECB (2007) (Box 9), "the financial market liquidity indicator combines eight individual liquidity measures. Three of them cover bid-ask spreads: (1) on the EUR/USD, EUR/JPY and EUR/GBP exchange rates; (2) on the 50 individual stocks which form the Dow Jones EURO STOXX 50 index and; (3) on EONIA one month and 3 month swap rates. Three others are return-to-turnover ratios calculated for: (4) the 50 individual stocks which make up the Dow Jones EURO STOXX 50 index; (5)

during the financial crisis had the effect of squeezing supply of non-bank consumer credit, with significant impacts for employment.^{31,32}

This means that policymakers and regulators should therefore review liquidity conditions across asset classes, both during benign market conditions (where not all assets are equally liquid) and in times of market stress. We investigate both in our study. While it may be difficult to observe conditions across a range of stress scenarios, the use of case studies and changes in the behaviour of market participants can point to likely outcomes in times of stress.

2.7 Excess money supply

Market observers can characterise buoyant market conditions as being “awash with liquidity” and often suggest this is a pre-cursor or contributory factor to periods of market stress.

It is therefore important to distinguish between market liquidity and what is meant by “excess money supply”. Although they are interlinked, they are not the same. Market liquidity refers to the ease with which assets and financial instruments are traded, which is the focus of this study. Excess money supply, simply put, refers to excess money created beyond what is required for the economy.³³ Strong money supply growth can give the impression of strong market liquidity. However, some economists consider excess money supply, sometimes termed ‘macro liquidity’ can contribute to inflation and asset price bubbles, which may then pose risks to financial stability.³⁴

An environment of excess money supply can be particularly damaging in markets with underlying structural deficiencies. A good example is the US subprime residential mortgage backed securitisations market prior to the financial crisis, where weak lending standards combined with strong liquidity to create dysfunctional markets during the crisis. In this case, we suggest it was the poor market design (e.g. incentives of market participants) combined with excessive money supply and leverage which was at fault, rather than the market liquidity per se. By way of comparison, better designed markets with simpler products (e.g. US treasuries) still react to supply and demand conditions, but do not suffer the same consequences from excess money supply. The appropriate remedy for excess money

supply or macro liquidity is to moderate the money supply using existing monetary policy and prudential regulation tools, and the appropriate remedy for poor functioning markets is market reform. In neither case is a reduction in market liquidity desirable – even though this may result in additional friction and appear to alleviate the transmission of detrimental effects around the economy.

So we do not consider market liquidity in and of itself to be detrimental. Rather we consider market liquidity to be beneficial in both normal times and times of stress. For this study we therefore work on the premise that market liquidity is invariably beneficial.

2.8 Broader factors affecting market liquidity

In this section we consider the four factors driving global market liquidity conditions:

- Stable global monetary conditions
- Increase in electronification and digitalisation in financial markets
- Growth in the size of financial markets
- Performance in the banking sector

Stable global monetary conditions

There is no single comprehensive measure of global market liquidity. However, liquidity trends in the US government bond market provide a useful starting point for the following reasons. First, the US government bond market is crucial to the functioning of US dollar repo markets and the global financial system.³⁵ These securities enjoy the full backing of the US government and are considered to be effectively free of default risk. The market therefore serves as a benchmark for risk-free interest rates, which are used to forecast economic developments and to analyse securities in other markets that contain default risk. Second, the liquidity of US Treasury securities means that they are also well-placed to provide reliable reference rates for pricing and analysing other securities. Treasury securities are typically used by market participants to hedge positions in other fixed income securities, as well as in other markets more generally. Changes in liquidity in the US government bond market can therefore have wide-ranging implications on liquidity in other markets.

³¹ See Ramcharan, Van den Heuvel and Verani (2013) and Benmelech, Meisenzahl and Ramcharan (2014).

³² See Chodorow-Reich (2014).

³³ This is more formally captured as the Marshallian K, which is the difference between growth in money supply and nominal GDP. Source: Marshall, A. (1923) “Money, credit and commerce”.

³⁴ See Roubini (2015) for the distinction between macro liquidity and market illiquidity.

³⁵ However, as we discuss in Section 3, there are signs that depth in US Treasury markets have declined, particularly in the reduction in primary dealer inventories of US treasuries.

Figure 2.6 shows the spread between the off-the-run and on-the-run ten-year Treasury bills. The spread indicates the extra compensation investors require to hold less frequently traded “off-the-run” Treasuries. “Off-the-run” securities are those that have been previously issued while the most recently issued securities are referred to as “on-the-run” Treasuries. The spread increased dramatically during the height of the financial crisis but has since declined to below pre-crisis levels. It also remains low by historical standards. This indicator helps to show the overall buoyant nature of current markets.

As noted by the Bank of England (2015), volatility was observed to be relatively low across other financial markets during the summer of 2014, which was partly the product of a stable macroeconomic outlook.³⁶ Unconventional monetary policy (i.e. large scale asset purchases or QE in the US, UK and more recently, the Eurozone, also had the effect of dampening volatility in financial markets.

Figure 2.6: Off-the-run/on-the-run ten-year Treasury spread



Source: Federal Reserve

QE involves the purchases of financial assets financed by central bank increases in broad money holdings. It has a number of transmission mechanisms, of which portfolio (re)balancing is the main one: asset purchases not only increase the price of the assets purchased, but also the prices of other assets. Unless money is a perfect substitute for the assets sold to the central bank, sellers may rebalance their portfolios by buying other assets, including corporate bonds and equities. Higher asset prices result in lower yields and borrowing costs for firms

and households, and increased wealth for investors, which stimulate spending. QE also has the effect of improving market functioning by increasing liquidity (albeit government provided) via increased trading activity, as portfolios rebalance.

The US QE programme was initiated by the Federal Reserve in November 2008 and in less than six months it had more than doubled its holdings of bank debt, US agency MBS and Treasury notes. QE2 and QE3 followed in November 2010 and September 2012, where the Federal Reserve implemented policies to purchase US\$600 billion of Treasury securities and an open-ended US\$40 billion per month programme to purchase agency MBS respectively. In November 2014 US QE came to an end, by which time US\$4.5 trillion worth of assets had been purchased over a six year period.³⁷

In the UK, the Bank of England initiated its £175 billion asset purchasing programme in March 2009. This increased to £200 billion in November 2009, and £275 billion in October 2011. The final asset purchases in February and July 2012 saw the total Bank of England purchases reach £375 billion. In response to deflationary risks in the Eurozone, the ECB initiated its own asset purchasing scheme in March 2015, where it committed to purchasing €850 billion of government bonds before September 2016.

There is evidence that QE has improved market liquidity: Christensen and Gillan (2015)³⁸ found that liquidity improved in the markets which were targeted by US QE2.

However, the implementation of QE in the US and UK coincided with significant structural changes in the financial sector, where regulatory and performance pressures have driven a decline in banks' risk tolerance, which have resulted in some degree of pulling back from market making activities.

Low yields have resulted in unprecedented levels of corporate bond issuance. Total issuance by European corporates reached €118 billion during the first quarter of 2015 – a 20% increase from 2010.³⁹ The increase is even more pronounced for the high yield market, where bond issuance has increased 52% year-on-year.⁴⁰

The risk is that as a result of QE, the liquidity risk premia may have been compressed to artificially low

³⁶ Speech by Chris Salmon, “Financial Market Volatility and Liquidity – a cautionary note”, 13 March 2015.

³⁷ Note that the Federal Reserve continues to reinvest paydowns on its Agency MBS portfolio.

³⁸ Christensen, J. H. E. and Gillan, J. M. (2015) “Does Quantitative Easing Affect Market Liquidity”.

³⁹ “Fitch: QE Pushes European Corporate Bond Issuance Ahead of Loans”, press release, 31 March 2015.

⁴⁰ “European High Yield Bond Issuance Surges As Borrowing Costs Fall”, Forbes, 4 March 2015.

levels in financial markets, which masks the impact of reduced market-making capacity. The effect of QE on portfolio rebalancing and the liquidity risk premia are likely to reverse following the withdrawal of QE, which could expose the structural reduction in liquidity in capital markets.

The Bank of England's July 2015 Financial Stability Report notes that the compensation investors receive for bearing liquidity risks is similar to before the crisis in corporate bond markets, which could reflect

investors' search for yield in the current low interest rate environment.

Monetary policy normalisation and the reversal of QE in the US or UK could therefore result in persistently higher levels of liquidity risk premia as the market adjusts to an environment of higher interest rates, which could be accompanied by periods of heightened illiquidity and market volatility.

Box 2.2: Impact of unconventional monetary policy on market liquidity

In response to the impact of the financial crisis in 2008, the Bank of England (as well as other central banks) embarked on a loosening of monetary policy, using both conventional and unconventional monetary policy measures, such as "quantitative easing", or QE.

The Bank of England sets out five key channels through which QE can affect the economy:⁴¹

- Policy signalling effects: QE acts as a signal to market participants of the central bank's commitment to meet inflation targets, which lead market participants to expect policy rates to remain low for longer than otherwise. By anchoring expectations, asset purchases can support increased spending.
- Portfolio rebalancing effects: central bank asset purchases raise the price of assets bought and other assets, leading to investors rebalancing their portfolios to include higher yielding assets. The increase in asset prices helps to depress yields, which lowers borrowing costs for firms. This helps to support increased investment and spending.
- Liquidity premia effects: Asset purchases can improve market liquidity by actively encouraging trading. The effects of this channel only persist while asset purchases are ongoing.
- Confidence effects: Asset purchases may help to boost confidence, leading to an increase in investment and consumer spending.
- Bank lending effects: The higher level of reserves held by banks and liquid assets encourages banks to increase lending to corporates and consumers.

The Bank of England considers the portfolio balance channel to be the most important element of its approach, which is why purchases have been targeted towards long-term assets held by non-bank financial institutions such as insurers and pension funds. This is to encourage a shift towards riskier investments such as corporate bonds and equities. The impact of the bank lending channel may be dampened by the pressures on banks to reduce the size of their balance sheets and to rebuild their capital reserves.

Unconventional monetary policy instruments have had a mixed impact on improving market liquidity, as we explore below.

On the beneficial side, central bank asset purchases can improve market functioning by increasing demand and therefore liquidity through actively encouraging trading. Asset prices may therefore increase to account for the reduced liquidity risk premia. Christensen and Gillan (2014) show that quantitative easing by the Federal Reserve has resulted in lower liquidity risk premia of around 12 to 14 bps in US Treasury inflation-protected securities and the related market for inflation swap contracts, which represents a 50% reduction in the liquidity risk.

⁴¹ Joyce, Tong and Woods (2011). Although this study was set out in the context of UK QE, the channels through which QE impacts the economy are common across QE programmes. However, we

also note that research by Christensen and Rudebusch (2012) suggests that certain channels play a bigger role in affecting bond yields depending on the specific policy approach taken.

Joyce, Tong and Woods (2011) analyse the impact of UK QE announcements on gilt yields. They show that the term premia on gilts fell by around 25 bps at medium to longer maturities. QE has also put downward pressure on investment-grade sterling corporate bond yields, which fell by 70 bps. The effect is more marked for non-investment grade corporate bond, where yields fell by 150 bps, and spreads narrowed by 75 bps. Abbassi and Linzert (2012) find similar results for the ECB's non-standard monetary policy measures in October 2008, which lowered Euribor rates by more than 80 bps. Weale and Wieladek (2014) find that an asset-purchase shock of 1% of nominal GDP leads to a rise in real GDP of about 0.36% in the US and 0.18% in the UK. However, Martin and Milas (2012) fails to find a significant boost to output and employment in the UK and the US.

There is limited evidence of QE programmes impacting liquidity in equity markets, however it has had a demonstrable effect on equity prices. As ultra-low rates reduce investors' discount rates, they increase the present value of future cash flows, which puts upward pressure on equity prices (Bridges and Thomas, 2012, McKinsey, 2014).

Emerging markets have benefited from increased capital flows as a result of quantitative easing in developed economies. There are some studies that show episodes of US QE coinciding with modest portfolio rebalancing across emerging markets and the US (Fratzscher, Lo Duca and Straub, 2013).

However, other studies have shown less benign effects of quantitative easing. Kandrac (2014) provides evidence that the Federal Reserve's mortgage-backed security (MBS) purchases have 'tied up' large parts of these specific assets and therefore negatively affected trading volumes, trade size and implied financing rates in dollar roll transactions. The adverse liquidity effects were also shown to be most evident at the start of new purchase programmes, however, the programmes did not impair price discovery in the MBS market. Mishra *et al.* (2014) found that even emerging markets with stronger fundamentals, deeper financial markets and a tighter stance towards capital flows and macroprudential policies were also vulnerable to currency depreciations and increases in bond yields following the Federal Reserve's taper announcement, although these impacts were smaller. These effects suggest that emerging markets remain vulnerable to sudden shifts in monetary policy in advanced economies.

Increase in electronic and digitalisation in financial markets

The increasing electronic and digitalisation of financial markets have played a role in fundamentally changing the structure of markets and the way in which securities and derivatives are traded. This trend is characterised by the growth in electronic trading platforms (ETPs) and algorithmic (or automated) trading, which have evolved in response to the growing sophistication of technology in financial markets as well as regulatory developments.

The growth of electronic trading platforms (ETPs) have helped to pool liquidity more effectively than before by enabling the multilateral and cross-border interaction between buyers and sellers of financial assets. This growth is driven by: (i) regulatory changes that seek to shift trading in traditionally OTC products onto transparent exchanges and centrally cleared platforms; and (ii) the need for banks and dealers to service clients

using cost-effective business models, and to benefit from the scale economies offered by ETPs. These factors combined led to an increase in electronic flow across asset classes. For example, the share of electronic trading in European government bonds has increased from 43% in 2008 to 57% in 2014. Nearly three-quarters of FX trading volumes in 2013 were executed via ETPs, compared to 71% the year before.⁴²

The development of ETPs has contributed to lower transaction costs for market participants and improved transparency. The trend of increasing electronic trading in financial markets is also consistent with increasing digitalisation across other sectors, which are also facing technological disruption to their existing business models.

Algorithmic (or automated) trading that use computers to automatically execute trades once certain criteria are met, have also revolutionised trading strategies. The development of technologies

⁴² Greenwich Associates (2015) "European fixed income: E-trading growth continues" and Greenwich Associates (2014) "FX Electronic Trading 2014".

such as high-frequency trading (HFT) that reduce the delay, or latency, in execution have increased the speed at which market participants can access markets. The decimalisation of pricing also provided further growth opportunities for algorithmic trading and HFT.

The electrification of trading, whether via the increasing use of electronic platforms or automated trading strategies, reduces transactions costs (bid-ask spreads) for market participants and enhances immediacy in trade execution.

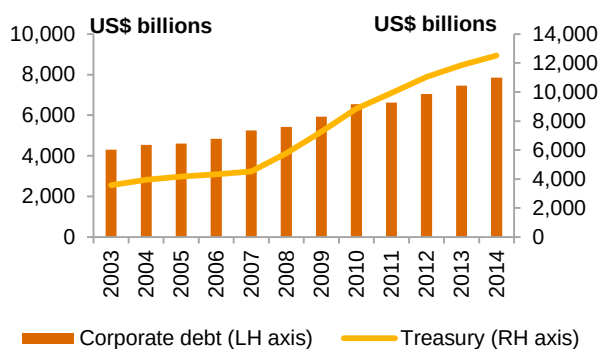
However, as we discuss in more detail in Chapter 5, there are several reasons why ETPs and automated trading strategies are likely to have a limited impact on market liquidity in certain asset classes in the short- to medium-term. There is also scepticism over the ability of the trading activity to be maintained in stress situations.

Growth in the size of financial markets

The size of financial markets has seen significant growth.

For example, debt issuance globally has increased as governments have funded fiscal deficits and corporates have taken advantage of the current low interest rate environment. US corporate bond issuance has risen by 35% between 2010 and 2014 to US\$1.5 trillion while outstanding amounts of US Treasuries increased by 41% to US\$12.5 trillion over the same period.

Figure 2.7: Outstanding amounts of US corporate debt and Treasuries

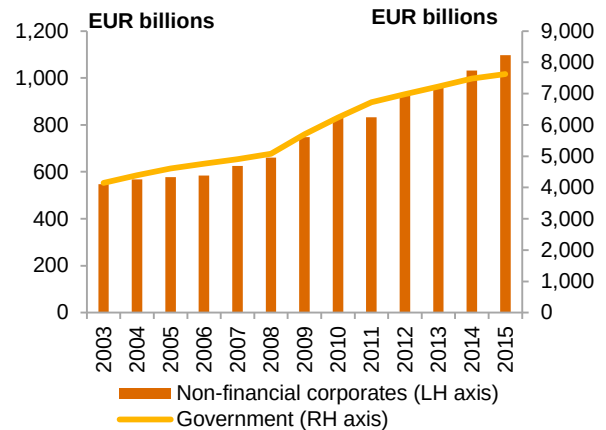


Source: SIFMA

Similarly in Europe, the amount of outstanding corporate bonds increased from €0.8 trillion in

2010 to €1.1 trillion in 2015, while sovereign bonds have increased from €6.2 trillion to €7.6 trillion over the same period.

Figure 2.8: Outstanding amounts of European corporate and sovereign debt



Source: ECB

As debt issuance has increased, these instruments are increasingly being held by investors such as pension and insurance funds, sovereign wealth funds, as well as money market funds. The Joint Staff report included data on the evolution of ownership of US Treasury debt and showed an increase in ownership share by the Federal Reserve and mutual funds.⁴³ While these trends are also evident internationally, an IMF working paper found significant cross-country variation in the investor base for government bonds.⁴⁴

The rise in the volume of investable assets has enabled significant growth in the fund management industry. Global conventional assets under management have increased from around US\$59 trillion in 2008 to around US\$64 trillion in 2012.⁴⁵

The growth in assets under management has also been accompanied by the rapid growth of exchange-traded funds (ETFs), in particular by institutional investors. Research by PwC shows that ETFs now hold over US\$2.6 trillion in assets globally, and is expected to rise to US\$5 trillion by 2020.⁴⁶ ETFs offer investors the ability to achieve exposures to specific asset classes and geographies, as well as liquidity. ETFs also offer a lower cost alternative to both active and passive mutual funds and UCITS. Alternative investments, such as

⁴³ Joint Staff Report (2015) "The U.S. Treasury Market on October 15, 2014", Figure 4.5.

⁴⁴ IMF (2012) "Government Bonds and Their Investors: What Are the Facts and Do They Matter?" by Jochen R. Andritzky WP/12/158.

⁴⁵ PwC (2014) "Asset Management 2020: A brave new world".

⁴⁶ PwC (2014) "Asset Management 2020: A brave new world".

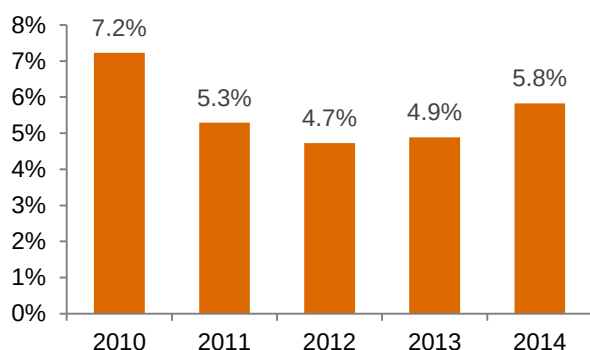
alternative UCITS in Europe and alternative mutual funds in the US are set to grow in institutional and retail portfolios. The rapid growth in assets under management has contributed to liquidity by increasing financial markets activity. However, the growth in the size of financial markets (including assets under management and ETFs), is likely to put further pressure on market liquidity. Although buy-to-hold strategies are less susceptible to changes in liquidity conditions, secondary market liquidity remains critical for the ability of investors to liquidate assets.

So while central banks do not currently require secondary market liquidity to unwind their QE programmes, other investors do and this demand for liquidity will be further exacerbated if and when central banks start to unwind QE.

Performance in the banking sector

The banking sector continues to face weak growth and profitability. As Figure 2.9 shows, the return on equity for global banks declined from 7.2% in 2010 to around 5.8% in 2014, due in part to regulatory pressures.

Figure 2.9: Return on equity for a sample of 32 global banks



Source: Capital IQ

Despite the broad economic recovery (which should aid bank performance), banks face significant headwinds: ongoing regulatory pressure is likely to lead to diminishing returns on capital from market making, and returns will remain well below banks' cost of capital. PwC estimates that the long-run cost of equity for banks will be around 8-10%.⁴⁷ Increasing electrification will also impact the margin and profitability of banks' trading activities. These factors are likely to lead to further restructuring, deleveraging and pressure to lower

market making capacity, either due to the reduction in trading balance sheets or bank exits. A PwC study suggests that banks have exited from businesses where they have low scale, particularly in equities and commodities trading, and are exiting from regions and jurisdictions in order to concentrate on areas of key strength and utility.⁴⁸

The impact on markets to date has been cushioned by banks' restructuring and changes in their operating and business models. However, increasing shareholder pressure for banks to restore returns to or above banks' cost of capital, will soon expose the limits of continued restructuring. As a result, banks are increasingly likely to begin to reflect more of the true economic cost of regulation in the pricing of their products, or further exit business lines for banks to restore returns to an appropriately sustainable level.

The increase in regulatory costs could also increase the barriers to entry for new participants, which limit their ability to achieve the scale required to replace the market making activities of existing banks. These will have a negative impact on market liquidity.

In summary, the current global economic, monetary and financial market environment is generally favourable to liquidity, such that detecting risks and fragilities becomes more challenging. In addition, the changes in liquidity are taking place amid the backdrop of significant changes to market structure and technology, growth in investable assets and continued weak financial performance in the banking sector. In general these trends are increasing the demand for market liquidity, while reducing banks' market making activities to support the provision of market liquidity.

In the next chapter we provide a more detailed review of the impact of regulations on financial markets liquidity, in particular setting out the transmission of regulations into market liquidity impacts.

⁴⁷ PwC (2012) "Banking industry reform: A new equilibrium"

⁴⁸ PwC Study: "Impact of bank structural reforms, Supplementary Report 2: Inventory of bank responses".

3 *Impact of current financial sector regulations on financial markets liquidity*

Key points

- Since the financial crisis, policymakers have introduced new regulations designed to: improve banks' capital and liquidity positions, improve market infrastructure and capital market transparency, restrict certain activities that may be undertaken by financial institutions, and ensure the resolvability of financial institutions.
- The suite of regulatory reforms across banking and capital markets has undoubtedly led to a more resilient banking industry. However, these reforms do not necessarily improve financial markets liquidity. For certain financial market activities, this may have been intended, but broader, presumably unanticipated, reductions in financial markets liquidity may have been deeper than intended.
- Financial markets liquidity has been affected by a combination of bank deleveraging and shrinkage in capital-intensive businesses, reduction in market making activity and complete exits of other market activities, shifts in trading patterns, liquidity contraction in repo markets, and the demand for and hoarding of liquid assets.
- The impact on financial markets liquidity is compounded across regulatory reforms. In addition, the lack of regulatory equivalence across jurisdictions is increasing the complexity and the costs of complying with regulations. So while reform assessments are usually undertaken at the individual reform level, market participants are making commercial responses across all reforms. This means the aggregate impact can be far greater than apparent from individual reforms.

Since the financial crisis, policymakers and regulators have recognised the need to introduce reforms that will further improve bank resilience and financial stability, with the aim of avoiding a repeat of the severe consequences of the global financial crisis. The governments and the central banks of the G20 agreed on a set of principles to “build a stronger and more resilient financial system which underpins growth in the global economy.”⁴⁹ Having set out the derivatives and capital principles of reforms in 2009-2010, the G20 is committed to finalising the remaining core regulatory elements in 2015. Other critical reforms will be completed soon, including rules to resolve “too-big-to-fail” institutions and a proposed common international standard on total-loss-absorbing-capacity for global systemically important banks (G-SIBs).⁵⁰

As set out in the previous chapter, regulation is one of a number of drivers of financial market liquidity. This chapter focuses on the range of regulatory requirements affecting liquidity that are already in place or are near finalisation. In Chapter 5, we review

potential future reforms still being considered. We group the major global, regional and national regulations into five main “thematic” areas:

- Capital and liquidity requirements to improve the resilience of banking institutions;
- Rules to improve market infrastructure and capital market transparency;
- Structural reforms that place restrictions on activities that may be undertaken by financial institutions;
- Reforms to ensure the resolvability of financial institutions in the event of an institutional, or broader crisis, in order to prevent the need for taxpayer support and wider contagion; and
- Taxes and other financial sector levies.

For each of these thematic areas we summarise the regulations and then assess the transmission mechanisms for how they impact financial markets liquidity. We do not cover all aspects of these regulations; rather we focus on those which have liquidity effects. More detailed information on each

⁴⁹ Communiqué Meeting of G20 Finance Ministers and Central Bank Governors, 20-21 September 2014, Cairns.

⁵⁰ Communiqué G20 Finance Ministers and Central Bank Governors Meeting, 9-10 February 2015, Istanbul

of these regulations are set out in Appendix C. Appendix D also itemises the impact on market liquidity by major regulation.

3.1 Capital and liquidity requirements

Key reforms

New and revised capital and liquidity regulations have a particular impact on banks' financial markets activities.

Before the introduction of the Basel 2.5 changes, the market risk framework was based on an assumption that trading book risk positions were all liquid, i.e. banks could exit or hedge these positions over a 10-day horizon. The global financial crisis proved this assumption to be false. As liquidity conditions declined during the crisis, banks were forced to hold risk positions for much longer than expected and incurred large losses from changes in value. Trading book capital reforms, starting with Basel 2.5 and continuing with the Fundamental Review of the Trading Book (FRTB), aim to address capital allocation, transparency and supervisory oversight of trading activities on a desk-by-desk basis. The Basel

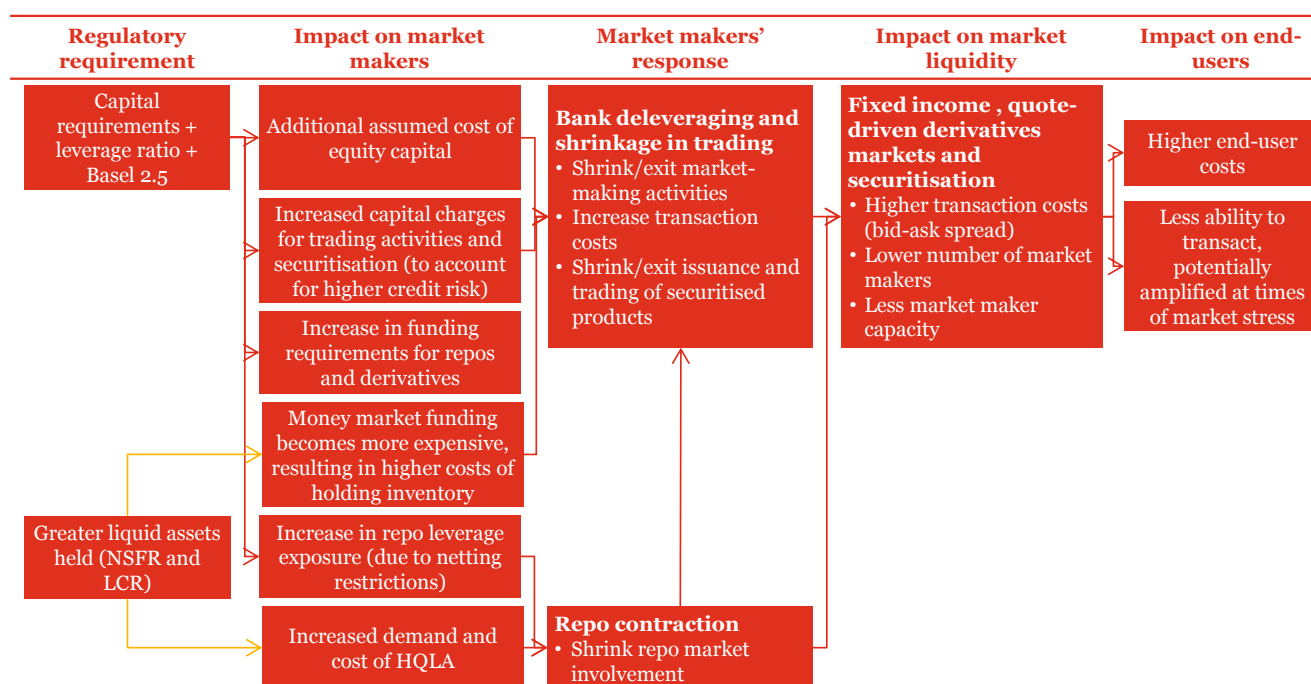
2.5 package of reforms included a series of rules that regulate capital charges on banking institutions in order to properly account for the market risk of their trading books.

Basel III aims to improve the banking sector's resilience to shocks, improve risk management and governance, and strengthen banks' transparency and disclosures.⁵¹ The new rules increase the amount and quality of capital that banks have to hold, and introduces a minimum leverage ratio requirement which aims to restrict the build-up of excessive leverage in the banking sector. It also introduces short- and long-term liquidity requirements. These rules are implemented in the EU through the Capital Requirement Regulation and Directive (CRD IV). The US Basel III Final Rule also implements the major aspects of the Basel III regime and incorporates changes as required through the Dodd-Frank Act.⁵²

Transmission mechanism

Figure 3.1 shows the transmission mechanism for capital and liquidity requirements, and how these requirements impact market makers, market liquidity and end-users of financial services.

Figure 3.1: Transmission mechanism of capital and liquidity requirements



Source: PwC analysis

⁵¹ BIS International regulatory framework for banks (Basel III).

⁵² US Senate Committee on Banking, Housing and Urban Affairs (2010) "Brief summary of the Dodd-Frank Wall Street Reform and Consumer Protection Act".

Banking sector deleveraging and shrinkage in trading activities

Banks' trading activities, including exposures to securitised products, now face higher capital charges on account of higher risk weights, higher minimum capital requirements and tougher deductions to equity capital. The impact of higher trading book capital requirements will impact the viability of banks' market-making and trading activities, particularly in capital intensive businesses, such as in credit markets.

We pick out a few features of the new capital and liquidity regime to demonstrate liquidity transmission effects and specific areas of shrinkage.

First, capital requirements have increased significantly for securities financing transactions (SFTs), which are an important source of liquidity and short-term funding in financial markets. However, there are significant differences between how the risk-weighted capital requirements and leverage ratio requirements are applied. For instance the risk-weighted capital requirements take into account the mitigation provided by the equity collateral and the riskiness of a mutual fund as counterparty. However, the leverage requirements do not take into account the collateral received (whether equities or bonds) or the creditworthiness of the counterparty. It also penalises under-collateralisation of the banks' exposure. PwC (2014) analysis of such a scenario where the bank is a principal in borrowing securities shows that the leverage ratio effectively increases the amount of capital required by 4.6x.

The proposed haircuts to be applied to SFT exposures may also overstate the credit risk of agency-indemnified SFT and therefore the "maximum possible loss" that a bank incurs. This is likely to affect the ability of banks to provide access to investment asset pools held by institutional investor clients. These are used to provide liquidity and support centralised clearing for OTC derivatives.⁵³

Within FRTB, the introduction of the liquidity horizon for banks' exposures to certain instruments are overly conservative.⁵⁴ The change in liquidity horizons creates a cliff effect on the capital charge (e.g. a sovereign migrating from investment grade to high yield would attract about 2.4 times higher

capital). As a result, banks may be less willing to underwrite new issues or may reduce market making activity.

Second, the CVA charge incurred by banks when entering into an OTC trade will disproportionately impact long-dated derivatives, uncollateralised exposures, low credit-rated counterparties and counterparties with no liquid CDS market.⁵⁵ The lack of available credit hedges and an illiquid CDS market for small- and medium-sized corporates will mean that exposures to these corporates are likely to attract significant CVA charges. This is likely to further impact banks' appetite to make markets in corporate bonds for smaller and medium-sized firms. Third, the leverage ratio will also have an impact on the client clearing business model. The business model is based on the fact that the clearing broker has access to the client's initial margin in case of default, and therefore the counterparty credit risk towards the clearing client is small. As the leverage ratio does not take into account the received initial margin, client transactions decrease the leverage ratio to an amount that is not in line with the actual risk being taken by the clearing broker. The resulting cost of capital will also not be covered by common clearing fees. A clearing broker has the choice to either increase the clearing fees materially, or give up client clearing as a viable business.

Under the new standardised counterparty credit approach, although clearing houses will be able to offset the initial margin fully against future exposure, this is only a partial offset, which would mean capital is also an issue for clearing members. Liquidity requirements are also expected to have an impact on trading activities. Research commissioned by GFMA and IIF shows that the RSF calibrations within NSFR for equity trading activities also has a significant impact on the cost of stock borrowing and reverse repo agreements, including shorting activities related to risk management. Equity positions held as hedges against equity swaps will also attract RSF factors of 50% or 85%, with no recognition of the funding provided by the equity swap. These are likely to lead to further reductions in banks' equity trading activities.⁵⁶

In order to meet the new capital requirements, global banks have taken significant steps to strengthen their balance sheets by raising or retaining equity and by reducing the level of assets, particularly those which

⁵³ State Street (2015) Response to "Consultative Document – Revisions to the Standardized Approach for Credit Risk".

⁵⁴ Defined as the time required to exit or hedge a risk position in a stressed market environment without materially affecting market prices.

⁵⁵ Source: Blackrock (2012).

⁵⁶ Source: GFMA and IIF (2014) "Comment on the Net Stable Funding Ratio consultative document: Additional Information on the Treatment of Equities".

attract higher risk-weighted capital charges. A BIS study in 2013 found that the majority of the adjustment to higher capital ratios had been achieved by global banks retaining earnings; with some support from other forms of equity raising (e.g. rights issues), and changes to total assets and asset mix (risk weights).⁵⁷ There was regional variation with greater deleveraging in Europe compared to emerging markets.

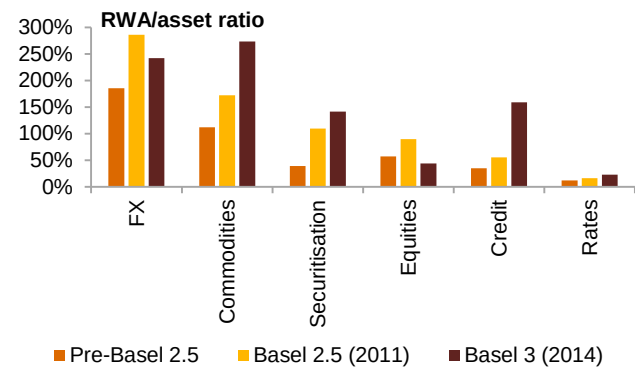
But increased capital requirements have also forced banks to focus on their core product lines and core customers, resulting in shrinkage in trading activities. A study by PwC in 2014 found that “Banks have exited from countries and regions with low market share in order to focus on regions and jurisdictions of key strength and utility”.⁵⁸

Using data from Tricumen, we analysed the evolution of global banks’ balance sheets as regulatory capital changes have taken effect. We compared changes in the ratio of RWAs to assets by business area between 2011 and 2014.

Our analysis shows that changes in the Basel capital regime have greatly increased risk-weighted capital charges across banks’ business areas (see Figure 3.2).⁵⁹ Our analysis also suggests that business lines that have experienced a relative increase in capital intensity have also experienced higher levels of deleveraging (see Figure 3.3), with credit being the most impacted.⁶⁰ This is consistent with our finding of a decline in the number of market makers active in European corporate bond markets.

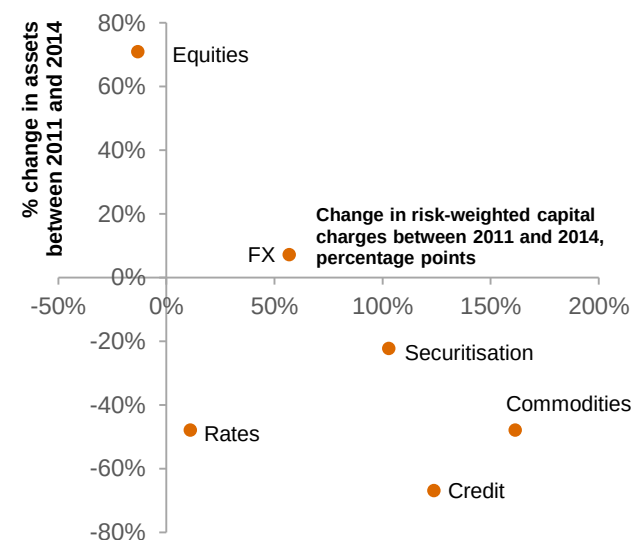
These shifts in risk-weighted capital could be exacerbated by the increasing emergence of the leverage ratio as the binding constrain in banks’ capital management. As a non-risk-sensitive measure, adherence to the leverage ratio provides for further significant capital increases for the least risky transactions.

Figure 3.2: Changes in risk-weighted capital charges due to changes in the Basel capital regime



Source: PwC analysis, Tricumen

Figure 3.3: Degree of deleveraging (reduction in assets) in relation to change in risk-weighted capital charges by area of capital markets activity (2011 prepared on a pre-Basel 2.5 basis)



Source: PwC analysis, Tricumen

Banks’ strategic responses have varied, depending on their core strengths. Some have focussed on equity capital markets, some on debt capital markets. Most banks have shrunk their international coverage, and are more selective in offering their balance sheet capacity to clients. Collectively this means that there are fewer banking participants in capital markets

⁵⁷ BIS (2013), “How have banks adjusted to higher capital requirements?”.

⁵⁸ PwC Study: “Impact of bank structural reforms, Supplementary Report 2: Inventory of bank responses”.

⁵⁹ By 2011, most banks have also moved from the Basel 1 to Basel 2.5 regime, which had a particularly pronounced impact on the risk weights for rates and securitisation.

⁶⁰ The data shown in Figure 3.2 and Figure 3.3 takes into account both the impact of regulatory capital changes and banks’ actions in adapting to higher capital requirements, e.g. by restructuring their business to improve capital efficiency or focusing on less capital-intensive areas.

activities and end users have access to a less diversified capital markets offering.

Repo contraction

The new rules are also likely to affect liquidity in repo markets. Among other functions, banks use repo markets to finance trading and market making activities. Therefore a decrease in liquidity in repo markets is likely to lead to a reduction in liquidity across other capital markets as they are more expensive or difficult to fund. Repos were traditionally assigned low risk weights, because they are normally fully collateralized with high quality collateral, so banks only needed to allocate limited capital to repo positions. However, banks now face higher capital charges to account for counterparty credit risk from repo exposures.

The situation is exacerbated because the new leverage ratio requirements mean banks can no longer net their repo exposures (i.e. reducing the number of repos that currently offset each other). Repo transactions must now be separately collateralised or haircut on a trade-by-trade basis.

In an interbank/inter-dealer repo transaction, although the risk-weighted capital requirements take into account the mitigation provided by collateral and the creditworthiness of the broker-dealer as a counterparty, the leverage requirement does not take these factors into account.

Table 3.1 shows PwC's (2014) analysis of the impact of the leverage ratio on risk-weighted capital requirements for various repo transaction scenarios. As a result of these differences, the leverage ratio imposes a higher capital requirement than is required by the risk-weighted capital requirements. The impact is even more significant where no netting is allowed for cash payables and receivables. However, the January 2014 proposal reinstates cash payable and receivable netting with the same counterparty in relation to SFTs subject to certain conditions.⁶¹

Banks' demand for high quality liquid assets (HQLA) such as sovereign debt will increase as a result of the LCR. By all accounts, in a market stress, banks can be expected to hoard HQLA, for fear of regulatory or market sanction if they are perceived as losing liquidity. Bank demand for these assets will also compete with money market funds, which typically hold Treasuries and sovereign debt to satisfy

statutory requirements to maintain minimum levels of overnight and weekly liquidity. The four biggest US banks have more than doubled their holdings of Treasuries to US\$251.8 billion despite low prevailing yields.⁶²

Table 3.1: PwC analysis of the impact of leverage ratio on risk-weighted capital requirement for various repo transaction scenarios

	Impact on risk-weighted capital requirement
Interbank / broker-dealer repo	13.5x
Interbank / broker-dealer repo (subject to Qualifying Master Netting Agreement, QMNA)	2.5x
Interbank / broker-dealer repo subject to QMNA but no netting allowed for cash payables and cash receivables	45x

Source: PwC (2014), based on the assumption that the bank targets a 12% Tier 1 capital ratio and a 3% Tier 1 leverage ratio.

The effect of banks increasingly hoarding HQLAs is likely to further depress activity in repo markets and markets for collateralised instruments as sovereign debt is commonly used as collateral in such transactions. A study by Anderson and Joeveer (2014) suggests that although there is no shortage of potential collateral, the unwillingness of banks to make assets available for re-use, or contractual and regulatory restrictions on re-use, could form bottlenecks within the system where available collateral is immobilised and unattainable by creditworthy borrowers.

Overall, this has led to a reduction in the size of the global repo markets. Federal Reserve data shows that aggregate repo volumes in the US have contracted from US\$3.9 trillion in 2008 to US\$2.4 trillion in 2014. Repo balances of large US banks have declined by 28% over the past four years. Similarly, ICMA data for Europe suggests that outstanding repo and reverse repo volumes in Europe have declined by around 18% since the pre-crisis peak.⁶³

The NSFR also requires a 50% required stable funding (RSF) factor to be applied to all loans (including reverse repos) to non-financial institutions, regardless of the maturity of the transaction and the underlying asset (although certain reverse repo to financial institutions with

⁶¹ BCBS (2014) "Basel III leverage ratio framework and disclosure requirements".

⁶² "U.S. Banks Hoard \$2 Trillion of Ultra-Safe Bonds", Bloomberg, 23 February 2015.

⁶³ ICMA European repo market survey Number 28, conducted December 2014.

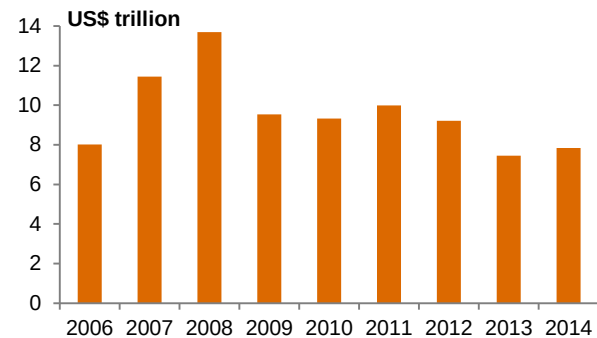
sovereign debt collateral have a lower RSF factor). This means that all reverse-repos with non-financial institutions under one-year maturity will require stable funding of 50% of the value of the reverse-repo, even if this is matched by another repo transaction. These changes, and the fact that no distinction is made for securities borrowed to support secondary market-making, is likely to further reduce bank activity in repo markets. Barclays anticipates this trend to continue with further falls of around 20% on account of regulatory changes.⁶⁴ In addition, a 20% gross payable RSF also applies to derivatives before the netting of posted collateral (before deducting variation margin posted). This in effect means derivatives receive two separate charges if banks cannot net their exposure, which could increase the cost of, and therefore further discourage, market making activities.

Impact on capital markets liquidity

The combined regulatory impacts are likely to result in re-pricing of, shrinkage of or withdrawal of market makers from capital- and funding-heavy areas of the business, such as trading in fixed income markets due to the higher risk weights for trading activities.

The overall result has been a reduction in banks' trading activities, particularly the inventories of financial instruments held to support market making activities. Major banks' gross and net trading securities holdings declined significantly during the global financial crisis in both the US and Europe (see Figure 3.4). Overall, this shows that banks' holdings of trading assets have decreased by more than 40% since 2008. This breaks down into a post-crisis shrinkage of around 30% and a further more gradual reduction of 10% over the past few years. Some research estimate there will be a further shrinkage in banks' credit balance sheets of the order of 5-15%.⁶⁵

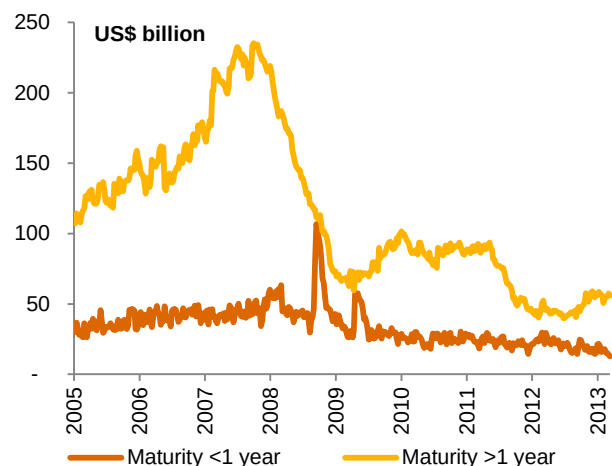
Figure 3.4: Bank holdings of trading assets for a sample of 32 global banks



Source: Capital IQ

In the US there has been a particular decline in overall dealer inventories of corporate bonds (see Figure 3.5). The withdrawal of some market participants means that trading activity is being facilitated by fewer banks, indicating the industry's increasing unwillingness to take on risk.⁶⁶

Figure 3.5: Dealer inventory holdings – US corporate bonds



Source: Federal Reserve

3.2 Market infrastructure and transparency

Key reforms

Our second regulatory area of focus includes market infrastructure, transparency, and customer protection reforms:

- In the US, Congress passed the Dodd-Frank Wall Street Reform and Consumer Protection Act in 2010 (Dodd-Frank).

⁶⁴ Barclays (2015) "The decline in financial market liquidity".

⁶⁵ Oliver Wyman and Morgan Stanley (2015).

⁶⁶ We note that the dealer inventory data may overstate pre-crisis inventories because it includes non-agency MBS, and therefore overstates the drop in corporate bond inventories.

- In Europe, two major sets of regulations have been or will be implemented: the recast Markets in Financial Instruments Directive (MiFID II) and Regulation (MiFIR) and EMIR.⁶⁷

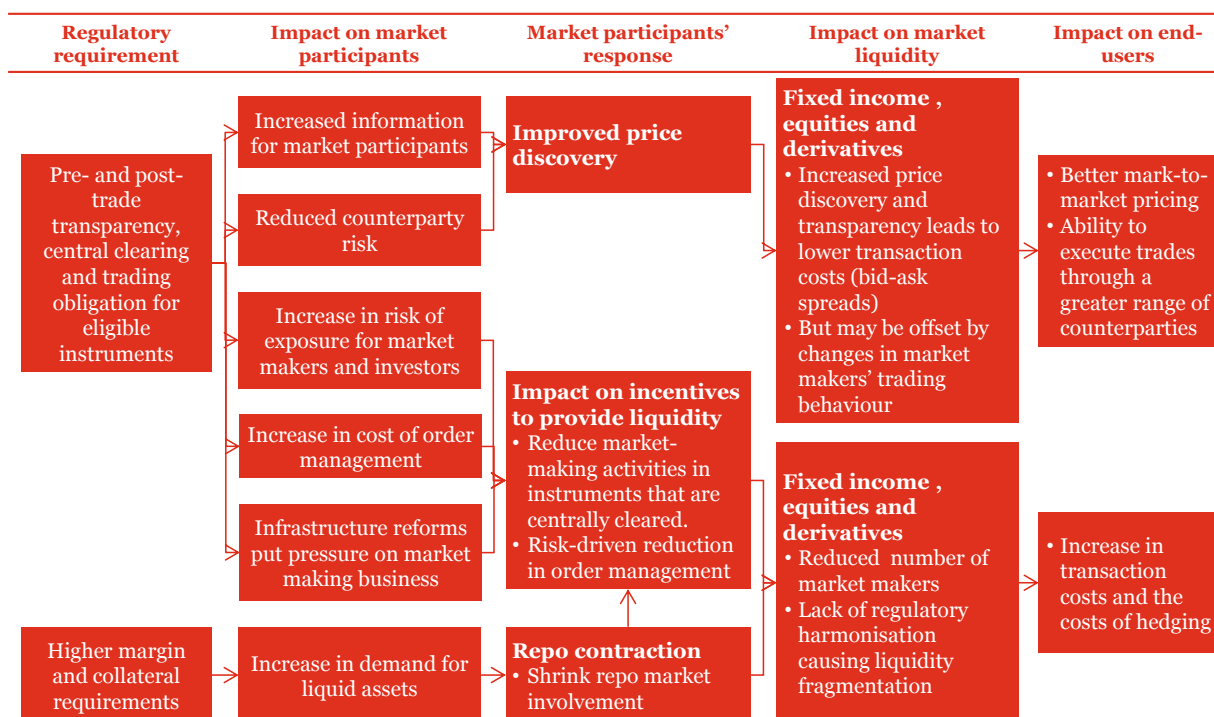
A key element of these regulations is the requirement for market participants to centrally clear OTC derivatives. The move to central clearing marks a shift from multiple and bilateral counterparty interactions into a “hub and spoke” model where the central counterparty (CCP) acts as a buyer and seller to mitigate counterparty credit risk. The effect of this change is to concentrate risk among CCP member firms rather than distribute it more widely across many bilateral interactions.⁶⁸ That said, the move to central clearing does have benefits as it offers greater transparency in order to improve regulatory oversight for financial stability, encouraging increased standardisation of derivative transactions, the mutualisation of losses among CCP member firms, by sharing counterparty credit risk and a more rigorous approach to risk management. Furthermore, in the event of a member firm default, the CCP acts as a “fire break” to mitigate the risk of contagion.

The recast and updated MiFID II rules seek to make financial markets more efficient, resilient and transparent by introducing pre- and post-trade transparency and trading obligations for shares and derivatives. It also extends the range of financial instruments and investment services regulated in Europe. A significant change will occur in the trading of non-equities asset classes, particularly bonds and derivatives. The new rules seek to move more OTC derivative trading onto trading venues and establish a new type of trading venue for non-equities instruments, i.e. Organised Trading Facilities (OTFs). MiFID II also expands the pre- and post-trade transparency regime to equity-like instruments (e.g. depository receipts, ETFs and certificates). These rules are expected to have significant impacts on fixed income and derivatives trading.

Transmission mechanism

Figure 3.6 shows the transmission mechanism of market infrastructure, transparency and investor protection requirements, and how these requirements translate into impacts on market makers, market liquidity and end-users.

Figure 3.6: Transmission mechanism of market infrastructure and transparency requirements



Source: PwC analysis

⁶⁷ Directive on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU, 2014/65/EU and Regulation on markets in financial instruments and amending Regulation No 648/2012, EU No 600/2014.

⁶⁸ See IMF (2010) “Chapter 3 of the Global Financial Stability Report: Making OTC Derivatives Safer: The Role of Central Counterparties”.

Price discovery

The increase in transparency requirements provides more information to market participants to aid price discovery and increases competition, which could result in lower transaction costs. The move towards central clearing also helps to minimise counterparty risks as CCPs mutualise (i.e. share between their members) the counterparty credit risks in the markets in which they operate.

Impact on incentives to provide liquidity

Although the introduction of the pre- and post-trade reporting regime is intended to improve transparency and to level the playing field between trading venues, it could increase the risk of exposure for market makers and investors. An ICMA (2014) study suggests that market makers are concerned that the increase in transparency would prevent market makers and investors from transacting without alerting the market to their positions, or revealing their positions to competitors.⁶⁹

The impact of the transparency regime for a given asset class will depend on how liquid instruments are defined by the regulation. We note that the proposed liquidity definition in the context of assets eligible for liquid portfolios within MiFID II and MiFIR take into account the availability of ready and willing buyers and sellers (using the average frequency and size of transactions, the number and type of market participants and average spread). Given the multi-dimensional nature of liquidity as outlined in Chapter 2, there is the risk that a “one-size-fits-all” definition does not capture other aspects of liquidity and nuances in liquidity across different asset classes. For example, many assets do not trade for a variety of reasons and therefore may actually be illiquid, despite the ability of market participants to sell these assets with minimal price impact.

Under the transparency regime, market makers have a limited period of time to hedge their risk before the mandatory publication of trade volumes under post-trade transparency requirements. However, if they fail to do so, other market participants could take up counter positions following publication (“winner’s curse”). Managing this risk becomes more difficult as trade sizes increase or the liquidity of the instrument decreases. If not properly calibrated, and illiquid

markets are classified as liquid and are therefore subject to transparency regimes, there is the risk that market makers could be discouraged from committing capital to facilitate trades, especially for wholesale trades, reducing liquidity and increasing spread. ESMA's proposals for liquidity calibration will result in the incorrect classification of many illiquid instruments as liquid either because the COFIA approach is not appropriate for the asset class (e.g. bonds) or the proposed COFIA classifications require further work (this is the case with many of the derivatives classes). A study by AFME shows that the December 2014 liquidity thresholds proposed by ESMA to classify sovereign and corporate bonds as liquid results in a high proportion of “false positives”.⁷⁰

It also introduces a cap on the amount of trading taking place for some financial instruments under the reference price pre-trade transparency waiver and negotiated trade waiver within a venue and across the EU, including off order books. The caps on equity trading under the reference price waiver are likely to have the largest impacts on mid- to small-cap stocks, for which trading off order books provide much-needed liquidity.⁷¹ If traders’ intentions to trade are exposed as a result of regulatory requirements, it may affect their incentives to continue providing liquidity in mid- to small-cap stocks.

There are exemptions to the transparency regime: derivative transactions of non-financial counterparties entered into for hedging purposes that take place over trading venues will be exempt from pre-trade transparency. Pre-trade transparency may also be waived for large-in-scale (LIS) orders taking place over trading venues and financial instruments for which there is no liquid market. These exemptions may limit the exposure of liquidity providers to undue risk. However, given the complexities of assessing liquidity conditions in fixed income markets, and in particular, the dynamic nature of fixed income liquidity, the concept of inherent liquidity characteristics for fixed income may not be meaningful, and could lead to the inaccurate classification of illiquid instruments as liquid.

stronger for small-cap equities than for medium- or large-cap equities. A one standard deviation increase in dark pool activity is associated with a 0.793 standard deviation decrease in quoted spreads. For large caps this is 0.077. A one standard deviation increase in dark pool activity is associated with a 0.843 and 0.215 standard deviation reduction in volatility for small- and large-caps respectively.

⁶⁹ ICMA (2014) “The current state and future evolution of the European investment grade corporate bond secondary market: perspectives from the market”.

⁷⁰ The AFME study using Trax data indicated that 83% of senior financial corporate bonds had 83% false positives and 3% false negatives. For EU sovereign bonds these were 17% and 29% respectively.

⁷¹ Research by Buti, Rindi and Werner (2011) shows that the positive effect of dark pool activity on liquidity is generally

In the US, one of the key concerns raised by market participants in corporate bond markets is the impact of post-trade reporting requirements, particularly for large transactions, to FINRA's Trade Reporting and Compliance Engine (TRACE).⁷² FINRA also consulted with market participants over the impact of transparency requirements on liquidity conditions in fixed income markets in July 2015.⁷³

MiFIR introduces an obligation for shares to be traded on a trading venue or through a systematic internaliser.

Impact on trading business models

The infrastructure reforms will affect the business models of firms that distribute instruments to investors via trading venues or on a bilateral basis, which puts pressure on profitability. The rules require that share trading takes place only on regulated trading venues. A firm can only execute a trade elsewhere if the trade is non-systematic or infrequent, or carried out between eligible or professional counterparties and does not contribute to the price discovery process.

The ability of these firms to provide OTC services will be increasingly eroded as trading activity moves to venues, unless they are trading as an SI. This will put pressure on execution-related revenues and transaction costs across all instruments that fall within the scope of MiFID II, particularly for those instruments which are not suited to central clearing.

Investment firms are also not permitted to operate both an OTF and an SI within the same legal entity, which is likely to be a hindrance to firms that provide a variety of execution services in the same entity. Derivatives that are clearing eligible and sufficiently liquid will have to be traded via OTFs, MTFs and regulated exchanges, but MTFs are not permitted to execute orders against proprietary capital and OTFs also face limits on the use of proprietary capital.

As a result, banks may shift trading in certain products to other entities (e.g. third party OTF) and pursue internal organisational and structural changes (e.g. create an OTF with a separate legal entity).

The combination of the capital requirements discussed above and the central clearing requirements demanded by EMIR and Dodd-Frank

mean that it is now expensive but critical for brokers to provide clearing services.

However, further ambiguities in the new rules and the high costs create disincentives for clearing members to extend clearing service through to clients of their clients (or indirect clearing services), which in turn has implications for the cost of doing business in OTC derivative markets.

Fragmentation in liquidity

Although the introduction of central clearing is intended to improve liquidity and mitigate counterparty credit risk, the lack of global convergence and recognition is causing fragmentation of market liquidity.

For example, the lack of harmonisation of CCP regulation in the US and Europe is causing fragmentation. Research by ISDA shows that global derivatives markets have fragmented along geographic lines since the introduction of the US swap execution facility (SEF) regime in October 2013.⁷⁴ Under SEF rules, electronic trading platforms that provide access to US investors were required to register with the US Commodity Futures Trading Commission (CFTC). This restricts the access of US market participants to European trading platforms that are unwilling or unable to qualify for relief from CFTC rules. European market participants may not wish to be subject to mandatory SEF execution and clearing requirements. This has caused liquidity fragmentation: European dealers have opted to trade Euro interest rate swaps with other European dealers rather than be subject to US rules. By December last year, 85% of Euro IRS transactions were traded between European entities, up from 71% in September 2013, before the SEF rules came into force.

Market fragmentation is also manifested in the polarisation of central counterparties and clearing houses and the way these firms offer services to market participants. Although EMIR allows appropriately regulated third-country CCPs to operate in the EU, the US applies a different approach to authorising foreign clearers to operate in the US by requiring a full assessment by the CFTC.

There are clear signs of liquidity fragmentation across the US and Europe. As an example, in May 2015, the difference in price for the same USD Swap cleared at London Clearing House (LCH) and

⁷² FINRA currently requires corporate bond transactions to be reported within 15 minutes.

⁷³ FT (2015) "Finra summons banks and asset managers over market fears", 14 June 2015.

⁷⁴ ISDA (2015), "Cross-Border Fragmentation of Global Derivatives: End-Year 2014 Update", April 2015.

Chicago Mercantile Exchange (CME) widened significantly – up to 2 bps – which is much larger than the typical bid-ask spread of 0.25 bps. The need for dealers to engage with other market participants with diverse trading strategies at another CCP gives rise to an interest rate risk and margin required at both CME and LCH. This increases the cost to fund this margin and the capital costs, hence causing the price differential. The uneven implementation of the CPMI-IOSCO Principles for Financial Market Infrastructures (PFMI) by various CCPs in different jurisdictions, with regard to margin requirements and default management, leads to a concentration of trades by type among clearing or central counterparties, leading to liquidity fragmentation across different clearing regimes and borders.

As a consequence, continued market fragmentation across borders and clearing houses will disrupt market liquidity for swaps and derivatives, which will further increase the cost of hedging for investors and corporates.

Impact on operational and transaction costs

Market makers may also face an increase in the cost of order management. MiFID II allows trading venues to impose a higher fee for placing an order that is subsequently cancelled than an order which is executed, to reflect the additional burden on system capacity without necessarily benefitting other market participants. This risks penalising legitimate order management that may not be high frequency in nature. This also risks distorting regular trading and reducing liquidity by increasing costs of providing passive liquidity, especially in exchange-traded derivatives.⁷⁵

There are also concerns that the existing leverage ratio framework does not recognise the exposure-reducing effects of the segregated initial margin in cleared derivatives exposures.⁷⁶ This has the effect of overstating the exposures of clearing houses with respect to its guarantees, and as a result, imposes high capital requirements on banks. This will also increase the amount of capital that needs to be allocated to banks' derivatives clearing business. As a result, end-users may face higher clearing fees when engaging in cleared derivatives transactions.

The new rules also require certain derivatives contracts – those that are both cleared through a central counterparty (CCP) and deemed sufficiently

liquid – to trade on a trading venue. The extra-territorial effect of the trading obligation could increase the costs of hedging for firms where trades are subject to overlapping EU and non-EU regulatory regimes.

The introduction of position limits for commodity derivatives will also have an impact on market participants in general and, specifically on MiFID II institutions. Although there are some exemptions for hedging activity for non-financial corporates, there are no exemptions for MiFID-licensed financial institutions and it does not recognise financial institutions to be eligible for the hedging exemption, although commodity derivatives are used in the normal course of business in order for banks to hedge their own risks. This will have an impact on the ability of financial institutions who have traditionally provided liquidity to the commodities market, which will increase the costs of hedging for end-users.

In addition, financial institutions and market participants are faced with higher operational costs to comply with the requirements on trade and transaction reporting, best execution and position management of commodities derivatives, which will require a revision to their data management capabilities. There will be an additional burden on Fixed Income, Currency and Commodity (FICC) businesses, equity-like products, structured deposits and OTC derivatives.

For derivatives in particular, the impact of margins for non-cleared OTC derivatives could be significant, in terms of cost and regulatory complexity, due to the need for some market participants to post collateral. Some studies suggest that the additional collateral needed to back outstanding trades could amount to US\$3.1 trillion without netting.⁷⁷ The demand for collateral is also likely to be procyclical, increasing significantly during times of market stress. This could have the effect of worsening liquidity in eligible collateral when it is most needed.

If apparent contradictions in the regulatory regime are not addressed, these will impair the ability of corporates and end users of financial markets to manage risks effectively.

⁷⁵ European Principal Traders Association (2013).

⁷⁶ The margin is the collateral posted by end-users to clearing houses when entering into a cleared derivatives contract, and the segregated initial margin refers to the portion of the margin that the clearing house collects from the end-user at the time the end-user enters into the derivative contract. Source: SIFMA.

⁷⁷ Morgan Stanley and Oliver Wyman 2012, "2012 Wholesale & Investment Banking Outlook: Decision Time for Wholesale Banks."

Repo contraction

Although the Basel III provisions over central clearing allow firms to apply lower risk weights to derivative transactions cleared through a central counterparty to reflect its lower default risk, investors now need to set aside more cash than previously to fund margin calls, “amounting to about \$700 per \$1 million hedged.”⁷⁸ This puts upward pressure on banks to hold liquid assets, including cash, to fund these calls and squeezes the availability of high quality collateral. The cost of collateral will rise as the market transitions to a world where eligible collateral is less available. The demand for additional collateral could result in banks reducing their presence in repo markets where high quality collateral tends to be used in repo transactions.

Impact on capital markets liquidity

For trading in certain instruments and with certain counterparties, the increase in transparency and improved price discovery from reforms could result in lower bid-ask spreads and greater ability for market participants to execute trades through a greater range of counterparties, and more efficient markets. It also provides more accurate mark-to-market pricing. The move to central clearing will also help mitigate counterparty credit risk.

However, the pressure on the viability of current business models of market makers who operate in OTC derivatives markets may result in exits or further shrinkage. The increase in the operational and financial costs to market makers as a result of these reforms could lead to a reduction in market making capacity and an increase in transaction costs via widening spreads, which results in adverse liquidity impacts for non-cleared derivatives.

3.3 Structural reforms

Key reforms

Our third area of regulatory focus in this report is direct restrictions on banks’ activities. At both the supra-national and national levels, policymakers have actively considered proposals to reform the existing structure of banks. These proposals generally seek to distance certain trading activities from retail banking activities, such as deposit-taking and loans to households and businesses.

The most significant reform active to date in this area is the Volcker Rule in the US, which prohibits proprietary trading for banks and their affiliates.

This restriction has significant consequences for various markets and in particular, those for corporate bonds, ABS, and OTC derivatives.

In Europe, policymakers have proposed the mandatory separation of trading activities from core banking activities, as well as introduced a ban on proprietary trading by banks, which are similar in spirit to the Volcker Rule. This is further explored in Chapter 5.

Structural reform has also been implemented nationally in other jurisdictions. In the UK, banks’ deposit-taking activities are planned to be “ring-fenced” or face economic separation from other parts of the bank by 2019. Although hedging for clients and securitisation are permitted within the ring-fenced entity, it is not allowed to conduct underwriting or market-making activity, which must take place outside the ring-fence. Structural reforms have been proposed at the national level, notably in France, Germany and Belgium that differ in the scope of activities subject to separation.

In Europe, the Short Selling Regulation (SSR) was introduced from 1 November 2012.⁷⁹ The regulation limits the trading of certain instruments (e.g., government bonds and CDS) and is aimed at increasing the transparency of short positions held by investors in EU sovereign debt and equities that are primarily traded in the EU. The regulation also seeks to reduce settlement and other risks, and in particular, risks to the stability of sovereign debt markets (as a result of uncovered sovereign debt and sovereign CDS positions).

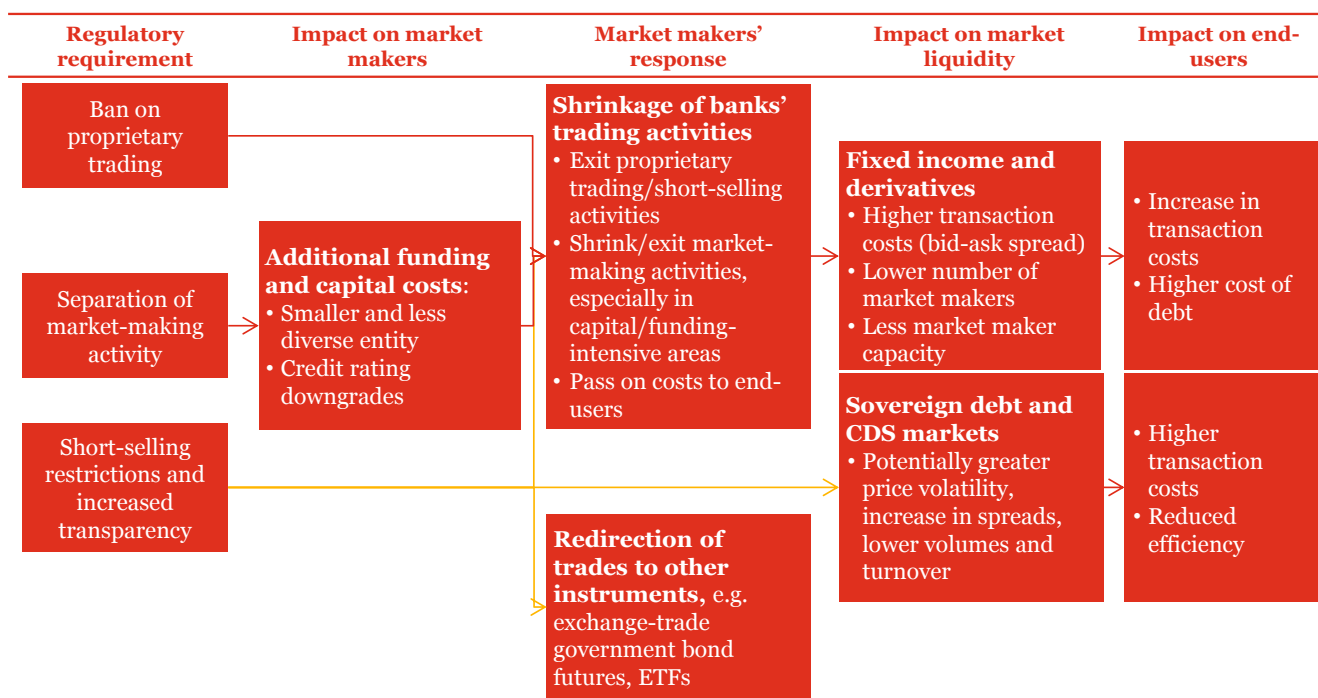
In addition, the Central Securities Depositories Regulation (CSDR) introduces a mandatory buy-in provision where the financial instruments are not delivered within four business days of the intended settlement date. This buy-in provision means that the failed-to purchaser (i.e. the disappointed counterparty) has the right to purchase the securities from another counterparty (or the buy-in agent) for guaranteed delivery to replace the original failed purchase.

Transmission mechanism

Figure 3.7 shows the transmission mechanism of structural reforms, and how these requirements translate into impacts on market makers, market liquidity, and end-users.

⁷⁸ Institutional Investor (2014) “Four years later: Dodd-Frank and Derivatives”.

⁷⁹ Regulation (EU) No 236/2012 on short selling and certain aspects of credit default swaps.

Figure 3.7: Transmission mechanism of structural reforms

Source: PwC analysis

Shrinkage of banks' trading activities

Banks are likely to scale down their trading activities in response to the ban on proprietary trading, bank separation reforms and short-selling restrictions.

Banks have already largely exited proprietary trading activities: A PwC study in 2014 showed that 90% of universal banks had either stopped or substantially reduced proprietary trading.⁸⁰ While this should reduce the risk of banks incurring substantial losses, it does remove one source of capital markets liquidity.⁸¹ An additional difficulty in implementing the Volcker Rule is distinguishing prohibited proprietary trading from legitimate market making. Both activities require banks to take on principal risk, and the degree of risk taken often varies across markets and asset classes, with principal risk taking becoming more pronounced during periods of market stress. A narrow interpretation of market making, may limit legitimate market making even more than currently envisioned and force a further reduction in trading activities.

Separating market making activities from core banking activities (as required by the European proposals) will result in a smaller and less diverse

trading entity. As a consequence, funding and capital costs will be higher, particularly for the trading entity, which is likely to receive a lower credit rating compared to the group where the market making activities used to occur. These changes could impair the long-term viability of universal banks' separated trading operations, particularly in fixed income.

Financial institutions also face higher operational costs in the form of processes and controls in place to ensure compliance with the new rules. For instance, banks that previously had no activities covered by the Volcker Rule must ensure that they have controls in place to prevent them from conducting proprietary trading going forward. At a minimum, banks will incur significant costs to ensure compliance programs meet reporting and documentation requirements. Short selling regulations have imposed more disclosure and reporting burden on institutions. The scope and coverage of such programs vary based on the size of the entity and complexity of the banking activities involved. The costs of enhanced compliance programmes also need to be amortised on a robust and profitable business franchise, leading to pressure

⁸⁰ PwC Study: "Impact of bank structural reforms, Supplementary Report 2: Inventory of bank responses".

⁸¹ A study by the GAO (2011) found that although proprietary trading required banks to take greater risks than trading activities

on average, it found that the revenues and losses from stand-alone proprietary trading were not particularly uncorrelated to overall revenues or losses over the 2006-2010 period reviewed, which effectively acts as a hedge to losses in banks' main businesses.

on smaller market participants to exit these activities.

Banks' fixed income and derivatives trading activities are likely to be most heavily impacted. Because transactions in these markets are typically OTC and rely on the support of banks' balance sheets, the reduction in banks' market making capacity and ability to hold inventory risk will have negative impact on market liquidity for corporate bonds, and to a lesser extent, sovereign bonds. A study by Oliver Wyman suggests that the potential impact on market liquidity as a result of the proposed Volcker Rule would be most felt in corporate bonds, private ABS, and OTC derivatives (interest rates, FX, credit and equity).⁸² Banks are also likely to scale back on trading activities as a result of short-selling restrictions or settlement requirements, particularly in sovereign debt and derivatives markets.

Shrinkage of sovereign debt trading activity and redirection of trading activity

The SSR requirement to have located and made arrangements to secure a security before a short sale has had an impact on trading activity in sovereign debt and CDS markets. The new short selling regulations mean that market participants can only buy protection through EU sovereign CDS when they have either a long position in the sovereign debt or to an exposure to a correlated asset in the same country, which is classified as a covered position. Investors also cannot short sell an EU sovereign bond unless they have a reasonable expectation that the settlement can be made when due.

Portfolio managers are less able to rely on sovereign CDS hedges, which reduces their appetite for taking out long positions in sovereign and corporate bonds to begin with. The rules have reduced sovereign CDS liquidity, and diminished interest in EU sovereign bond markets: net exposures to European sovereigns declined from US\$150 billion in August 2011 to US\$120 billion in October 2012.⁸³

Research by ISDA found that the liquidity of the iTraxx SovX Western Europe index, the main hedging vehicle for European sovereign risk, substantially diminished when the ban came into force.⁸⁴

The European short selling rules have also resulted in the redirection of trades to alternative markets. For instance, there has already been a sharp uptick in the number of investors using exchange traded futures as these instruments provide economically similar products to CDS or short positions. In fact according to IFR, a Thomson Reuters publication, which was released on the eve of the short selling rules coming into force, the flows into future transactions had increased dramatically.⁸⁵ Although this is an alternative to sovereign CDS, it is not a perfect substitute for hedging purposes and could come with its own set of risks (discussed further in Chapter 5).

The mandatory buy-in provision provides an additional level of risk to market makers as they provide liquidity in securities that they may not necessarily hold in inventory. This exposes them to a potentially significant cost. A study by the European Central Securities Depositories Association (ECSDA) suggests that a mandatory buy-in regime will result in 1.8 million buy-ins being executed per annum (based on current markets), with a total transaction value of €2.5 trillion.⁸⁶ ICMA (2015) also shows that the provision will result in an increase in bid-ask spreads, even for the most liquid sovereign bonds, and repo markets will see an increase in spreads in currently liquid securities, and a potential withdrawal of liquidity for less liquid securities.⁸⁷

Impact on capital markets liquidity

Although the impact of structural reforms on capital markets liquidity will not be immediate, it is likely to be considerable. The removal of proprietary trading removes one portion of market trading activity. The regulatory risk of some inventories being requalified, together with strong governance requirements, will also drive down trading inventories. The separation of retail and trading activities will put commercial pressure on the funding and capital costs for the separated trading entities, further constraining market making activities.

The evidence on the impact of short-selling bans or restrictions has also been mixed. Marsh and Neimer (2008) did not find evidence of significant detrimental impacts. However, Clifton and Snape (2008) analysed the impact on liquidity on the London Stock Exchange following the FSA's short

⁸² The Volcker Rule Restrictions on Proprietary Trading, Oliver Wyman, February 2012.

⁸³ Source: Credit Suisse (2012) "The Regulation on Short Selling and Certain Aspects of CDS", 17 October 2012.

⁸⁴ ISDA (2014) "Adverse liquidity effects of the EU uncovered sovereign CDS ban".

⁸⁵ "Europe's naked short selling ban leaves investors with skin in the game", Reuters blog, 4 December 2012.

⁸⁶ ECSDA (2015) "ECSDA Comments on the upcoming CSDR technical standards and technical advice on settlement discipline", 19 February 2015.

⁸⁷ ICMA (2015) "ICMA impact study for CSDR mandatory buy-ins", February 2015.

selling ban on financial and insurance stocks, and found that liquidity declined (increase in spreads and reductions in depth) following the ban. A study by ESMA (2013) found that although the regulation has led to a clear reduction in bid-offer spreads and a small decrease in volatility in EU stocks compared to US stocks, it has had no clear impact on trade volumes or the price impact of trades. The same study also found that it also reduced the speed of price discovery. Other studies have also found that the market efficiency is reduced when short-selling regulations are introduced.⁸⁸

3.4 Recovery and resolution

Key reforms

During the financial crisis, when markets failed to provide financial stability, governments were compelled to bail-out banks (among others), at a short-term cost to the taxpayer. Addressing bank recovery and resolution thus became a major area of financial reforms.

As part of these regulations, financial institutions are required to have appropriate plans and resources (living wills) in place to either recover from stressed conditions with little or no reliance on public resources, or, in the case of a bank failure, to resolve the business in an orderly manner. For instance, in the US, the Dodd-Frank Act requires large US financial institutions to prepare and submit written plans to US regulators for orderly resolution under the bankruptcy code without government financial assistance. The Bank Recovery and Resolution Directive (BRRD) in Europe establishes a framework

for the recovery and resolution of banks and investment firms across the EU.

A key element of these reforms is the requirement for firms to hold a minimum amount of loss absorbing capacity.⁸⁹ The minimum threshold will be determined based on each firm's risk profile, complexity, size, interconnectedness and other factors. Further criteria could be specified by the European Commission following a review by the EBA, to ensure that similar firms are subject to the same standards.⁹⁰ US regulators are currently mooting proposals to require systemically important banks to issue convertible long-term debt that will enable insolvent banks to recapitalise themselves in resolution, or a "gone concern" buffer.⁹¹ The Financial Stability Board is also currently developing policy proposals to enhance the total loss absorbing capacity (TLAC) of G-SIBs which consist of instruments that can be legally, feasibly and effectively written down or converted into equity in case of resolution. The minimum amount of TLAC is within a range of around 16-20% of banks' RWAs. This requirement effectively doubles the leverage ratio requirement under Basel III.⁹² The TLAC requirement also goes further to exclude capital buffers (unlike minimum requirement for own funds and eligible liabilities or MREL).

Transmission mechanism

Figure 3.8 shows the transmission mechanism of recovery and resolution reforms, and how these requirements translate into impacts on market makers, market liquidity and end-users.

⁸⁸ ESMA (2013) "Final report: ESMA's technical advice on the evaluation of the Regulation (EU) 236/2012 of the European Parliament and of the Council on short selling and certain aspects of credit default swaps", 3 June 2013.

⁸⁹ The bail-in tool may exclude secured liabilities, guaranteed deposits, client money, and liabilities with an original maturity of less than one month, claims of employees, tax and social liabilities. Resolution authorities may also exclude derivative liabilities if it is necessary to do so in order to further a resolution objective.

⁹⁰ Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery

and resolution of credit institutions and investment firms and amending Council Directive 82/891/EEC, and Directives 2001/24/EC, 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU, 2012/30/EU and 2013/36/EU, and Regulations (EU) No 1093/2010 and (EU) No 648/2012, of the European Parliament and of the Council.

⁹¹ Speech by Stanley Fisher (2015) "The Great Recession: Moving Ahead", Stockholm, 11 August 2014.

⁹² FSB (2014) "Adequacy of loss-absorbing capacity of global systemically important banks in resolution", Consultative document, 10 November 2014.

Figure 3.8: Transmission mechanism of recovery and resolution

Source: PwC analysis

As a result of the minimum requirement to hold loss absorbing capacity, overall bank funding costs are likely to rise, as banks adjust their liability structure to include more costly debt. For banks that fall short of loss absorbing capacity requirements, this requires them to increase their unsecured liabilities, as secured ones cannot be bailed-in. The effect of TLAC combined with NSFR will further incentivise long-term as opposed to short-term funding, which is less suited to trading activities. The proposed leverage ratio measure under MREL is likely to require deposit-funded banks (e.g. UK banks under the ring-fencing regime), to hold loss absorbing capacity that exceeds the underlying risks.

Lenders to banks are also likely to demand higher yields on contingent capital to reflect the increased likelihood of their claims being written down or converted into equity compared to other types of debt. Existing research shows that the cost of raising additional contingent capital instruments, which act in a similar way to bail-in instruments, could cost on average 500 bps more than raising senior debt by the same issuer.^{93,94} Various market estimates place the increase in yields of senior unsecured debt to be around 100 to 300 bps under bail-in powers.⁹⁵

The additional cost of funding unsecured debt could be offset by lowering the cost of funding secured debt which now offers lower risk and returns to investors. However, investor appetite for unsecured debt remains highly uncertain which could limit the offsetting effect on financing costs: JP Morgan reports that 34% of European bank debt investors

would reduce their investment in senior unsecured debt if it became a bail-in instrument.⁹⁶ A key determinant of investor willingness to purchase bail-in debt will depend on whether issuers are able to maintain standalone investment grade status: the JP Morgan report shows that the percentage of EU banks classed as non-investment grade is expected to increase from 2% to 33%.⁹⁷

In addition, banks are required to deduct inventory held for market-making from TLAC and there is no explicit allowance of underwriting TLAC instruments, unlike the explicit exemption provided in Basel III. This provides a disincentive for dealers to underwrite or make markets in TLAC instruments, such as capital instruments and long term unsecured debt, which would decrease the liquidity of TLAC instruments in secondary markets. This could also increase the cost of issuing such debt.

Impact on capital markets liquidity

Taken together, lower ratings and lack of investor appetite for convertible debt will increase banks' cost of funding. The regulations push banks towards longer-term funding structures that is less suited to trading activities. In addition, the interaction of the MREL requirements with other reforms, such as capital and leverage requirements may add more pressure on banks' market making activities. These effects are likely to cause banks to shrink their balance sheets, particularly in low margin areas which are funding intensive. This will have a larger impact on liquidity in fixed income markets.

⁹³ Strictly speaking, bail-in powers and contingent capital instruments are not the same although they behave similarly. Contingent capital instruments are new bank capital instruments that are converted to equity or written off when a contractually-set "trigger event" occurs, e.g. a decline in the CET ratio to some pre-defined level that could be above the regulatory minimum. In contrast, bail-in powers allow authorities to impose a haircut on unsecured bondholders or uninsured depositors and to convert

their debt into equity when a bank is deemed not viable. See IMF (2013).

⁹⁴ In normal market conditions, it will cost 160 bps more for banks to issue bail-in debt compared to senior unsecured debt of similar maturities. Source: Le Lesle (2012).

⁹⁵ IMF (2013).

⁹⁶ Henriques, Bowe and Finsterbusch (2013).

⁹⁷ Henriques, Bowe and Finsterbusch (2013).

3.5 Taxes and levies

A number of countries have increased taxation receipts from the financial sector by implementing bank levies, which is a tax on specific elements of the balance sheets of financial institutions. For example, the UK bank levy specifically targets larger banks, and aims to raise around £3.9 billion per year following the March 2015 budget. Several EU countries have also implemented or proposed various forms of taxes on financial activities.⁹⁸

The impact of banking sector taxation and other levies adds to the performance challenge facing banks. With returns across the sector still below a commercial cost of capital, the sector will need to continue to re-price, shrink or cut costs. The impact of bank levies are likely to be diffused. However, those that target banks' balance sheets (as a taxation base) are likely to put further pressure on bank activities that are more capital- and funding intensive.

3.6 Aggregate reform impact

The suite of regulatory reforms across banking and financial markets should lead to a more resilient banking industry. However, the reforms, in most cases, point towards a reduction in financial markets liquidity. For certain financial markets activities, this may be intended, but broader, presumably unanticipated, reductions in financial markets liquidity is likely to be detrimental.

The impact on financial markets liquidity is also compounded across the many layers of regulatory reforms. So while reform assessments are usually undertaken at the individual reform level, banks are making commercial responses across all reforms. This means the aggregate impact on financial markets liquidity can be far greater than apparent from individual reforms.

In summary, we have identified five broad ways in which regulatory reforms have impacted financial markets activity to date:

- **Bank deleveraging, refocusing and exits.** As banks respond to the new regulatory

environment, they have sought to make more efficient use of capital and liquidity resources, by reducing the markets they serve and streamlining their operations.

- **Reduction in market-making activity.** Capital and funding intensive areas such as market making in fixed income, credit, derivatives and commodities have been particularly impacted. This can lead to a reduction in liquidity in those dealer-led markets where market making provides a key source of liquidity.
- **Shifts in trading patterns,** as characterised by the move towards central clearing and electronic trading platforms. While the shift in trading patterns may improve liquidity for standardised, centrally cleared trades, it will reduce liquidity for those OTC instruments that are not suited to central clearing or trade reporting (e.g. corporate bonds, OTC derivatives such as infrastructure financing hedging, embedded floors in insurance policies etc.), but are used frequently by investors and corporations.
- **Liquidity contraction in repo markets.** With outstanding balances in repo and other bank funding markets falling, the contraction in repo markets has impacted liquidity provision by market makers across other capital markets.
- **Increased demand for and hoarding of liquid assets.** Liquidity rules and collateral requirements increase the need for banks to hold high quality liquid assets, which, reduces their availability to support other transactions, including repos. The lack of available high quality collateral can have a significant impact on liquidity in secured markets, especially during a stressed environment. Prudential rules have also materially increased the cost of holding less liquid assets.

In Chapter 4 we review trends in liquidity conditions across financial market asset classes. This is to review the extent of the impact of regulatory changes on financial markets liquidity.

⁹⁸ PwC (2014) "Proposed" bank levies – update".

4 Financial markets liquidity

Key points

- We have identified four broad areas of decline in financial markets liquidity. These are: (i) difficulties in executing trades; (ii) reduction in financial market depth; (iii) increase in volatility; and (iv) decline in liquidity in the assets which have traditionally been less liquid (“liquidity bifurcation”). These effects are most pronounced in dealer-driven markets for OTC-traded financial instruments.
- Market participants are still generally able to execute the trades they require, but the time taken and effort required to execute with dealers and across multiple platforms has increased.
- The fragmentation of liquidity in derivatives as a result of regulatory changes and the growth of new trading venues and platforms are creating an increasingly challenging environment for executing trades in relation to hedging activity, such as longer-term forward FX contracts and interest rate swaps.
- There are signs of declining depth and immediacy in fixed-income markets as characterised by falling transaction sizes. Some price impact measures also show that smaller trading volumes are now moving market pricing by larger amounts. The ratios of trading volumes to the size of markets (turnover ratios) for both corporate and sovereign bonds are on the decline as trading volumes have failed to keep pace with an increase in issuance.
- There is evidence that episodes of market correction and volatility are now rising, after falling considerably since the global financial crisis. Volatility in bond markets in 2015 is around 40% higher than in 2014. Whereas current volatility is not as high as the extreme levels of volatility witnessed during the global financial crisis, volatility is arguably above historical levels during benign economic conditions.
- There is market evidence to suggest that in some markets a “bifurcation” across financial markets is taking place. Liquidity is increasingly concentrating in the most liquid instruments and falling in less liquid assets. Areas of financial markets which have seen particular declines include longer dated FX forward contracts, some aspects of the high yield debt market and the single name CDS market. Liquidity reduction is not solely confined to less liquid areas, as even traditionally liquid sovereign debt markets have experienced liquidity shortages.

This chapter reviews each of the assets classes in turn. We summarise our review of liquidity indicators at the beginning of each market section below and then provide a market overview and description of how liquidity is provided in each market. We then review trends in market liquidity, as informed from market data.

4.1 Rates

Liquidity assessment:

Sovereign bond markets, which have been affected by short-term periods of volatility, show declines in depth and immediacy. Breadth in interest rate derivatives has declined, as indicated by bifurcation across currencies and across cleared and non-cleared derivatives.

In this section we discuss the interest rate and interest rates derivative markets.

4.1.1 Rates

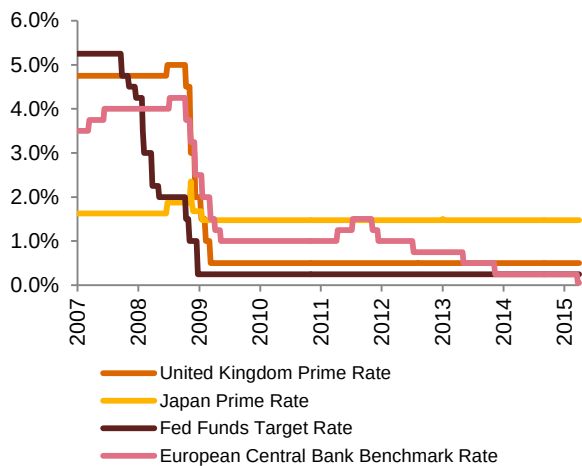
We provide a brief overview of key interest rates, such as central bank policy rates, interbank rates and government bond yields (collectively referred to here as ‘rates’). These rates form the basis for a vast array of financial contracts acting as key benchmarks for use in commercial contracts, loan agreements and in asset pricing.

Market overview

Policy rates of central banks anchor the broader universe of market rates. By adjusting the policy rate, central banks control the cost to banks of obtaining funding. The central bank effectively adjusts the supply of base money to meet market demand for liquidity at the official rate. The policy rates targeted by central banks are often a short-term repo rate. For example, the target rate of the Bank of England is a two weeks repo rate, based on high quality

collateral⁹⁹. Figure 4.1 presents the evolution of major central banks' policy rates from 2007 to March 2015. From the chart it is clear that there has been very little movement in these core global rates over the past several years, as an era of exceptionally loose monetary policy has persisted.

Figure 4.1: Major central banks policy rates



Source: Capital IQ

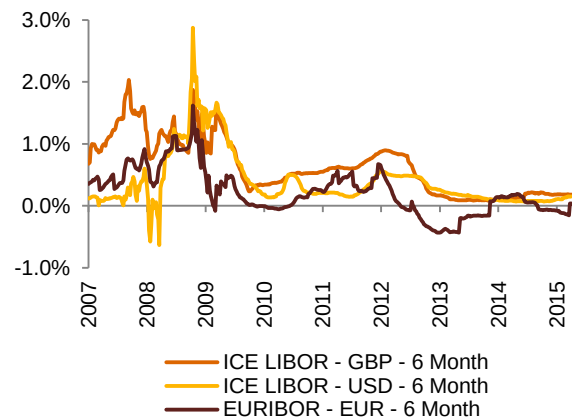
Additionally, banks can obtain funding through the interbank money market, with cash being transferred from banks with excess reserves, to those with a deficit in reserves (reserves can also be obtained through repo transactions). These interbank loans are unsecured interbank cash loans. The key rates in this market are the interbank offered rates, for example, the London Interbank Offered Rate (LIBOR) and the Euro Interbank Offered Rate (EURIBOR).

Because interbank loans bear more credit risk than collateralised repos or banks deposits with central banks, LIBOR tends to have a positive spread over corresponding central bank rates. However, the spread tends to be small (see Figure 4.2 for the spread of LIBOR over central bank rates in three currencies). This is because both interbank loans and repo agreements are short-term in nature and close substitutes (albeit imperfect). This means that the official central bank rate influences how expensive it is to accumulate reserves, and conversely, the return that can be earned on excess reserves.

During the financial crisis, interbank markets were disrupted, and spreads between LIBOR and central

bank policy rates jumped significantly. The rise in spreads during the crisis is captured in Figure 4.2, but this has since declined, as market conditions have normalised.¹⁰⁰

Figure 4.2: Spread of 6-month LIBOR and EURIBOR over central bank policy rates



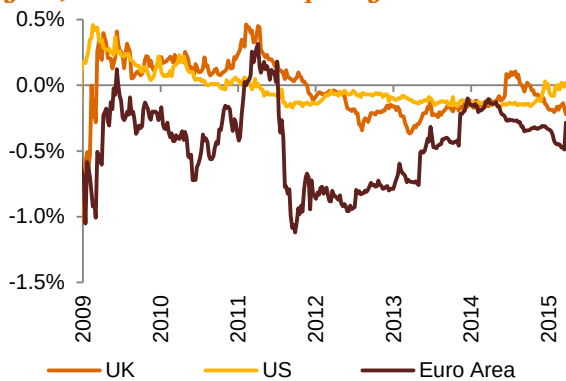
Source: Capital IQ

Another key market rate that is a close substitute for short-term repo rates is the short-term government bond yield. These yields are also influenced by the central bank policy rate. Figure 4.3 shows that in the UK and US, in particular, the one-year government bond yield has traded at a rate very close to that of the central bank policy rate, but the Euro Area has been more varied. Both short-term government bond yields and short-term repo rates are considered close to the 'true risk-free rate'.¹⁰¹ Long-term government bond yields, on the other hand, are influenced by future expectations of short-term policy rates, amongst other factors. Figure 4.4 plots trends in the yields of 10-year sovereign bonds for various established markets, which shows a broad decline in yields since 2007.

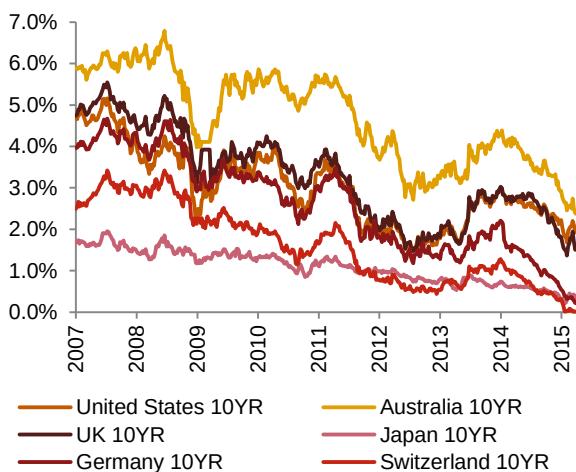
⁹⁹ For short-term repo the Bank of England only accepts 'Level A' collateral – for example highly liquid and high-quality sovereign debt.

¹⁰⁰ Abbassi and Linzert (2012) find similar results for the ECB's non-standard monetary policy measures in October 2008, which lowered EURIBOR rates by more than 80 bps.

¹⁰¹ Bank of England (2000), 'Inferring market interest rate expectations from money market rates', Bank of England Quarterly Bulletin, November 2000.

Figure 4.3: Spread of short-term sovereign bonds (1 year) over central bank policy rate

Source: Capital IQ, Bank of England, ECB

Figure 4.4: Yields on 10-year sovereign bonds, 22-day moving average

Source: Capital IQ

More recently in Europe, long-term government bond yields have been more directly impacted by unconventional monetary policy, i.e. QE. One of the main goals of QE is to lower the long-end of the yield curve, through outright purchases of longer-dated government securities. Daines, Joyce, and Tong (2012) show that the UK QE programme has had an impact by lowering the yields on UK gilts. Bernanke *et al.* (2004) found that QE in Japan lowered yields by around 50 bps. Longer-term government bond yields are not just dependent on monetary policy decisions, but also fiscal policy decisions through likely impacts on inflation, and in extreme cases, concerns of sovereign default. QE may also improve market functioning and reduce the liquidity risk premia by making it easier for investors to sell assets when required. There is some evidence that QE has

had an impact on liquidity in sovereign bond markets.

As set out above, there is a high-degree of interconnectedness between different key rates. However, there can be divergences in liquidity within an asset class. We investigate these trends below.

Provision of liquidity in the rates market

The diversity of government bond issues and large transaction sizes mean that market makers play an important role in providing liquidity in sovereign bond markets. For sovereign bond issues, access to primary market government debt is limited to primary dealers.¹⁰² Primary dealers, which are mainly comprised of large banking groups, are authorised to buy, promote and distribute sovereign debt. In return, primary dealers are required to meet quantitative thresholds for auction participation and market making obligations in secondary markets. Government bonds, particularly for advanced economies, tend to be traded more frequently than corporate bonds.

Government debt management offices (DMOs) have a clear interest in maintaining and monitoring secondary markets liquidity for government bond issues: higher levels of liquidity lowers investors' liquidity risks following issuance, which helps to lower the cost of issuance for sovereigns.

A number of DMOs have signalled their concerns about market liquidity, for instance, the chief executive of the UK DMO, Robert Stheeman, has expressed that the lack of liquidity is currently the biggest challenge facing the UK DMO.

However, in the current period of expansion in sovereign bond markets, the primary issuance of sovereign debt in developed markets have performed well. DMOs have not experienced any significant adverse impact on their activities from changes in liquidity conditions to date. Mr. Stheeman also said that "a single uncovered auction would not unduly concern me".¹⁰³

Repo markets are highly linked to sovereign bond markets, as collateral reduces exposure to credit risk. Repo markets are primarily used by banks and broker-dealers to finance long positions via general collateral repos, borrow specific securities, or borrow cash from cash-rich entities including central banks, retail banks, money market funds, securities lenders and increasingly non-financial corporations. These transactions take place on a bilateral basis. Liquidity

¹⁰² CGFS (2014).

¹⁰³ Reuters (2015) "Expect shocks as liquidity shrinks, says head of UK DMO", 20 July 2015.

in this market and the size of the haircut applied to the transaction is underpinned by liquidity conditions of the underlying collateral. For instance, the collateral required for the Bank of England's short-term repo transactions is instruments that are "liquid in all but the most extreme circumstances".¹⁰⁴

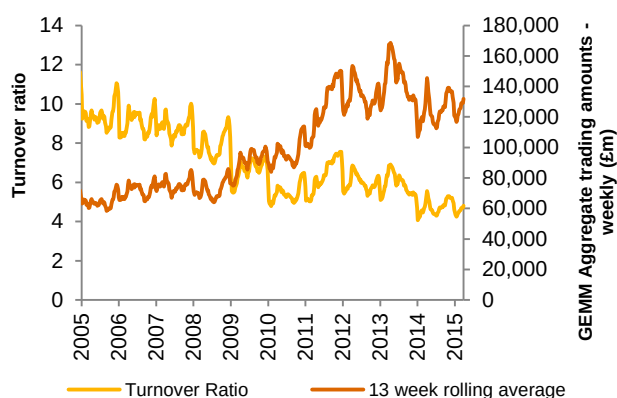
Trends in liquidity

Immediacy¹⁰⁵

Following the financial crisis, many governments adopted expansionary fiscal policies to counteract recessionary pressure. This led to large amounts of government bond issuance, increasing the stock of government bonds outstanding.

In the UK, the expansion in the stock of outstanding debt means that although volumes of GILTs traded has grown over the period 2008-2012, their turnover ratio has been falling. Therefore, there is less Gilt trading activity per pound of outstanding debt. This is captured in Figure 4.5 where volume is measured using aggregate weekly trading volumes in Gilts as reported to the UK Debt Management Office (DMO) by Gilt-edged Market Makers (GEMMs). After peaking in early 2013, aggregate weekly trading volume has stabilised at approximately £125 billion per week, but turnover is at its lowest point since 2005.

Figure 4.5: Aggregate weekly trading amounts of UK gilts and turnover ratios (GEMMs)

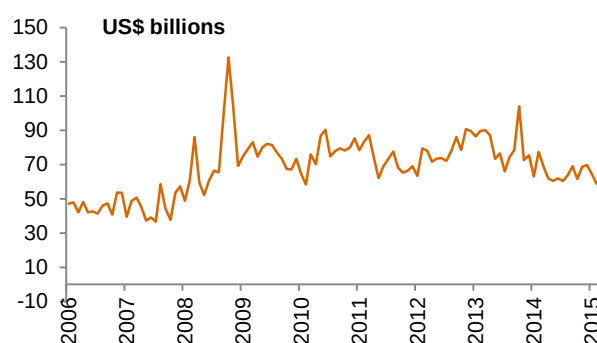


Source: Debt Management Office, Thomson Reuters

In the US, trading volume of treasury securities has remained relatively flat over the past five years according to SIFMA data (see Figure 4.6). Average daily trading volume fluctuated around the \$70 billion mark for Treasury Bills (including coupon securities). However, despite the consistent level of

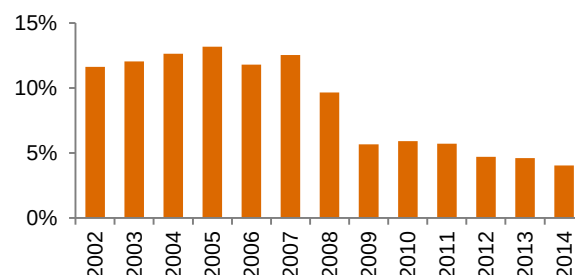
trading volumes, the number of times the outstanding volume of assets has changed hands has fallen since 2010, and this lower turnover ratio indicates reduced liquidity in the market (see Figure 4.7). In addition, since 2010, the average trade size for US treasuries has fallen from \$3.7 million to \$1.7 million (see Figure 4.8).

Figure 4.6: Average daily trading volumes in US Treasuries



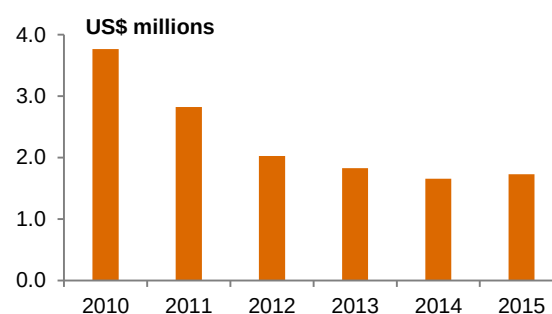
Source: SIFMA

Figure 4.7: US Treasury turnover – Average daily volumes to amount outstanding



Source: SIFMA

Figure 4.8: Average trade size in US Treasuries



Source: Trax

transactions and depth of trading interest in the security by investor.

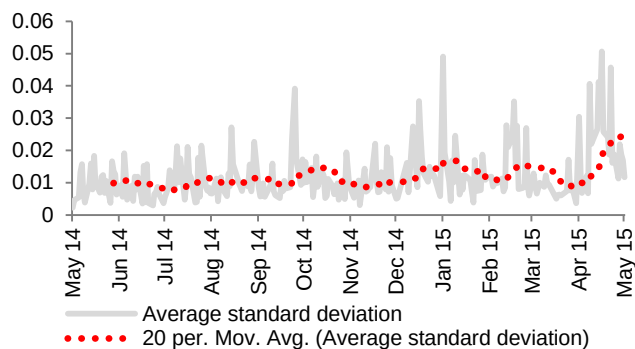
¹⁰⁴ Bank of England Sterling Monetary Framework.

¹⁰⁵ Immediacy typically refers to the time it takes to complete a transaction. An alternative measure is the frequency of

Depth and resilience¹⁰⁶

There is some evidence that volatility has increased, even for markets that are considered to be more liquid. As Figure 4.9 shows, the average intra-day volatility for German sovereign bonds have remained relatively stable over 2014. However, the yield rose by around 20 basis points over a number of hours (compared to normal movements of no more than a few basis points), despite the lack of significant change in economic fundamentals.

Figure 4.9: Average intra-day standard deviation in prices of German sovereign bonds



Source: Trax, PwC analysis

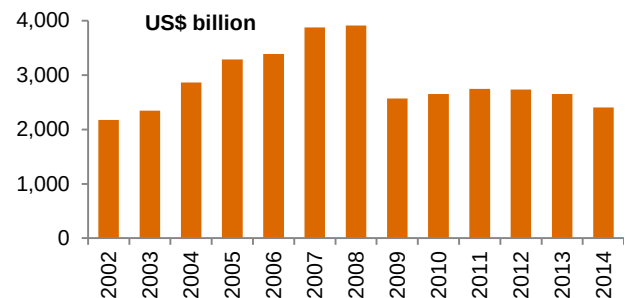
There is some evidence that the price impact of trading in sovereign bonds have increased. A number of studies have investigated the change in price impact measures, including:

- The Federal Reserve of New York reviewed the flash crash event and found the price impact US treasuries rose from one half of one 32nd of one basis point per billion dollars of net order flow to one and a half. However, it noted that this was not outside of historical levels.¹⁰⁷
- JPMorgan estimated one investor could have traded 100 contracts of 30-year Bund futures in early 2014 without moving the market significantly. In May 2015 that number had fallen to 20 contracts.

Volumes of repo financing by US Government Securities Primary Dealers declined substantially during the crisis. According to SIFMA data (shown in Figure 4.10) dollar denominated repo financing fell by a third from around US\$3.9 trillion in 2008 to

US\$2.6 trillion in 2009. More recently, there has been a gentler decline in traded repo volumes. Average daily amounts outstanding in 2012 were US\$2.7 trillion, declining to \$2.65 trillion in 2013, and down to US\$2.4 trillion in 2014.

Figure 4.10: US Total Repo Financing, average daily amount outstanding



Source: SIFMA

A survey of the European repo market conducted by ICMA shows somewhat a similar decline in repo activity compared to peak levels.¹⁰⁸ In 2006 and 2007, total repo outstanding was approximately €6.4 trillion; most recently, in December 2014, total repo business measured €5.5 trillion.

The global decline in repo can be attributed to both shrinking intermediary balance sheets and new regulations that are attempting to discourage short-term wholesale funding (see chapter 3).

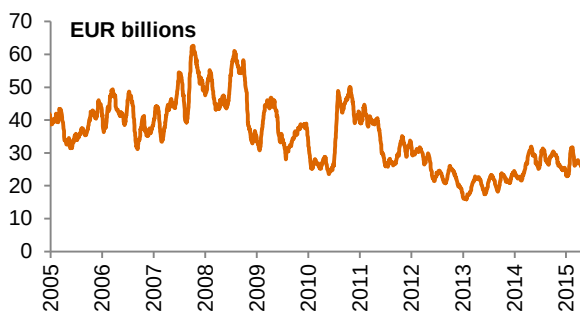
With regard to volumes of interbank trading, Figure 4.11 presents aggregate daily Euro Overnight Index Average (EONIA) trading volume from 1999 through to March 2015.¹⁰⁹ The disruption at the time of the global financial crisis in 2008 is clear. Total EONIA daily trading volumes fell by around 50% from approximately €60 billion in the summer of 2008, reaching around €31 billion by November 2008. There has been continued volatility since 2008, and further steep declines in EONIA volumes associated with concerns over the solvency of Euro area sovereign credit. Overall, EONIA volumes have been on a relatively strong downward trend since early 2008, and despite recent increases, remain at subdued levels compared to the period 1999 to 2008.

¹⁰⁶ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

¹⁰⁷ New York Federal Reserve, 16 October 2013, "Dealer Balance Sheet Capacity and Market Liquidity during the 2013 Selloff in Fixed Income Markets".

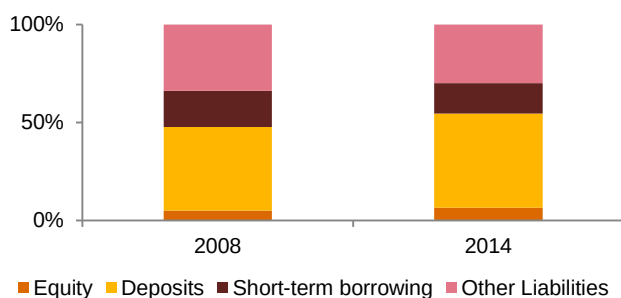
¹⁰⁸ International Capital Market Association (2015), 'European repo market survey', no.28.

¹⁰⁹ EONIA is the volume weighted average of overnight interbank lending which is denominated in Euros.

Figure 4.11: Aggregate EONIA trading volume

Source: ECB

One reason that overnight lending volumes in Europe may have remained subdued is because of reduced usage of short-term debt markets by banks. As shown in Figure 4.12 short-term borrowing comprises a smaller proportion of bank liabilities.

Figure 4.12: Liability structure for a sample of 27 global banks

Source: Capital IQ

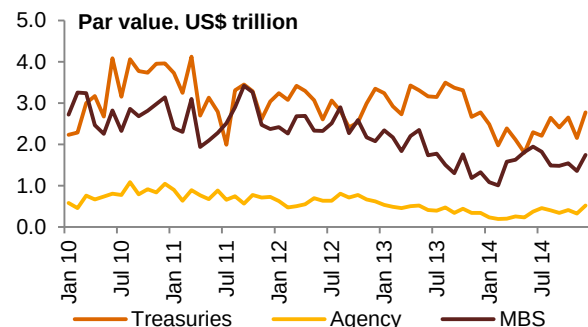
Furthermore, overall balance sheet size for most banks has also shrunk over the period 2008-2014.

Breadth¹¹⁰

Figure 4.13 disaggregates repo trends into sub-categories of General Collateral Financing repos (GFC repo)¹¹¹, allowing for a more granular inspection of trends. The figure shows the total nominal value of GFC repos submitted for clearing to FICC. Since 2010, there has been a downward trend in Mortgage-backed Securities (MBS) repo, where the collateral is 30-year MBS issued by Fannie Mae or Freddie Mac. Over the same period, the amount of treasury-backed repo has been volatile, but is on a downward trend. Agency-backed repo, which comprises a much smaller proportion of overall repo outstanding, also declined consistently from late

¹¹⁰ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

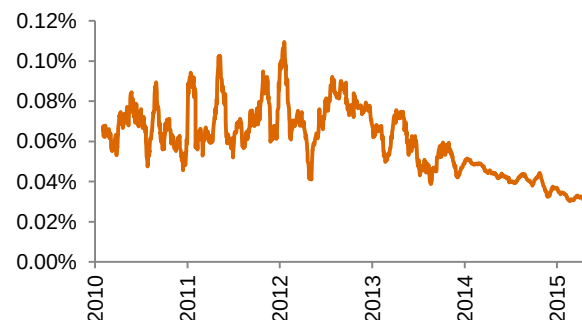
2010, through to early 2014, although the declining trend has slowed somewhat lately.

Figure 4.13: DTCC GCF Repo submitted for clearing

Source: SIFMA, DTCC

Tightness¹¹²

The injection of liquidity from unconventional monetary policy may have contributed to the benign liquidity environment in sovereign bond markets, as shown by the downward bid-ask spreads for UK Gilts. Figure 4.14 plots the bid-ask spreads on all 'short' and 'medium' term conventional Gilts outstanding up to April 2015, as categorised by the DMO. The median bid-ask spread as a percentage of mid-price was typically over 5 bps for the year 2010 to 2012, but has since declined to below 5 bps.

Figure 4.14: UK Gilt bid-ask spreads

Source: Debt Management Office, Thomson Reuters

Trading in US Treasury bills also offer another measure of liquidity. The spread between 'off-the-run' bills and the most recently issued 'on-the-run' bills reflects a measure of the liquidity risk premia (see Figure 4.15). The data currently suggests that there are no obvious liquidity challenges in relation to this indicator, as the liquidity risk premium has fallen to very low levels since the peak of the crisis,

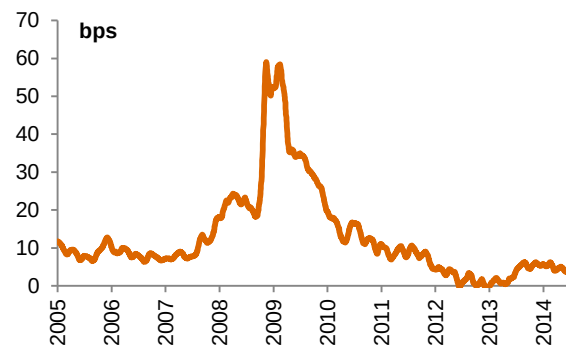
¹¹¹ The GFC repos are executed without specifying the specific collateral securities until near the end of the trading day.

¹¹² Tightness typically refers to the financial cost of completing a transaction.

and since 2012 has been lower than pre-crisis levels. This trend has been supported by QE, and the bond purchases made across the yield curve. Christensen and Gillan (2014) show that QE by the Federal Reserve has resulted in lower liquidity risk premia of around 12 to 14 bps in Treasury Inflation-Protected Securities (TIPS) and the related market for inflation swap contracts, which represents a 50% reduction in the cost of bearing liquidity risk.¹¹³

Trends in bid-ask spreads on sovereign bond transactions in Asian countries show no discernible trend. A survey of market makers by the Asian Development Bank (ADB) shows that between 2009 and 2013, bid-ask spreads have risen in Hong Kong, but fallen in Singapore.

Figure 4.15: Off-the-run/on-the-run 10yr US Treasury spread



Source: Bank of England

Box 4.1: 2013 Taper Tantrum

Between 1st May 2013 and 5th July 2013, US sovereign bond yields rose rapidly from 1.64% to 2.71%. The cause of the rise in yield of more than 1 percentage point in a relatively short period of time was attributed to Ben Bernanke's testimony before the Joint Economic Committee on May 22nd – during which he alluded to the possibility of a slowing in the pace of asset purchases given that there is continued economic improvement.

This degree of market shift has been experienced historically, for example, when lower interest rate expectations following the crisis led to a significant reduction in sovereign bond yields. However, the degree of change observed during the taper tantrum episode in response to a seemingly small announcement, has led to many commentators to suggest that this is an indication of how markets might perform in the future.

The decline in fixed income market liquidity, as characterised by the increasing inability of dealers to hold inventory, was claimed to have exacerbated the velocity and magnitude of the rise in sovereign bond yields. Adrian et al. (2013)¹¹⁴, investigated the role and cause of this reduction in market liquidity in what has been referred to as the 'taper tantrum'. Their study estimated that price impact coefficients at the time were not exceptional from a historical perspective. However, they found that the gross positions of dealers in Treasuries had indeed declined over the period in question and the reduction in dealer exposures was due to lower risk appetites and capacity to provide market liquidity.

Box 4.2: 2014 US Treasuries Flash Crash

On October 15th 2014, there was a steep drop of 37 basis points in 10-year US Treasury yields, after which yields rebounded to normal levels.

The 'flash crash' followed the release of a series of bad news regarding the US Economy, causing a rush into the safety of US Treasury assets. A combination of reduced market maker ability (or willingness) to absorb temporary market imbalances and the lower supply of short-term safe assets may have exacerbated the short-term price spike; however, automated trading may have also played a significant role. Identifying a dominant cause of this market shock has proved challenging to date. However, the Joint Staff report by the US Department of Treasury, the Federal Reserve, SEC and CFTC also notes that the growth of high-speed trading contributed to the growth of principal trading firms, which accounted for a significant share of liquidity-removing trades during the flash crash event.¹¹⁵

An ongoing concern is that this event will not be one-off, and indeed this was reflected in recent remarks by the Executive Vice President of the New York Federal Reserve.¹¹⁶ The reduction in market maker inventories, and short-supply of traditional safe sort-term assets, may have left the financial system more sensitive to unexpected events such as this.

¹¹³ The authors argue that QE programs to affect yields by reducing priced frictions to trading as reflected in liquidity premiums through a liquidity channel.

¹¹⁴ Adrian et al (2013) "Dealer Balance Sheet Capacity and Market Liquidity during the 2013 Selloff in Fixed Income Markets", FRB: FEDS Notes.

¹¹⁵ US Department of Treasury, the Federal Reserve, SEC and CFTC (2015) "Joint Staff Report: The U.S. Treasury Market on October 15, 2014".

¹¹⁶ Ibid.

4.1.2 Rates derivatives

In this section we summarise the market for rates derivatives. We review liquidity trends in this market, which plays a fundamental role in allowing corporates and financial intermediaries to manage their balance sheet risk exposures.

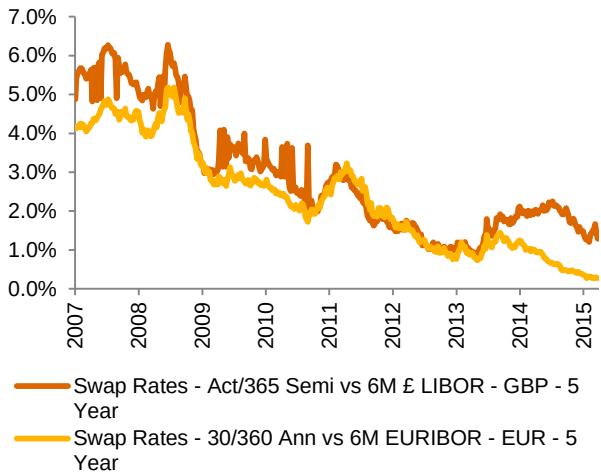
Market overview

The most prominent form of interest rate derivative is an interest rate swap (IRS). A vanilla IRS involves exchange of cash flows, one at a pre-agreed fixed rate with another at a floating rate, often based on major reference rates, such as six month LIBOR.

Historically IRS have been traded OTC. Interest rate swaps allow corporates to reduce the uncertainty of future cash flows and future liabilities.¹¹⁷

Figure 4.16 shows the trend for the rate of the five year fixed-floating IRS. The prices for swaps denominated in GBP and EUR have fallen significantly since 2008. However, compared to GBP-denominated swaps, the EUR IRS rate has continued to decline through 2014, as expectations of prolonged expansionary monetary policy in the Euro area have grown.

Figure 4.16: GBP and EUR 6M Libor - 5YR interest rate swap



Source: Capital IQ

Another common interest rate derivative is a short-term interest rate future (STIR). These relatively simple futures have a rate equal to 100 minus the chosen interest rate, and mature at a fixed point in time. These can be used to hedge, or take proprietary

¹¹⁷ Research by ISDA suggests that 63% of single-currency fixed-to-floating swaps trade less than once a day, while other products are less liquid. 68% of multi-currency fixed-to-floating swaps traded less than once a month. Source: ISDA (2014) "MiFID II and MiFIR consultation paper".

trading positions on the future interest rate movements.

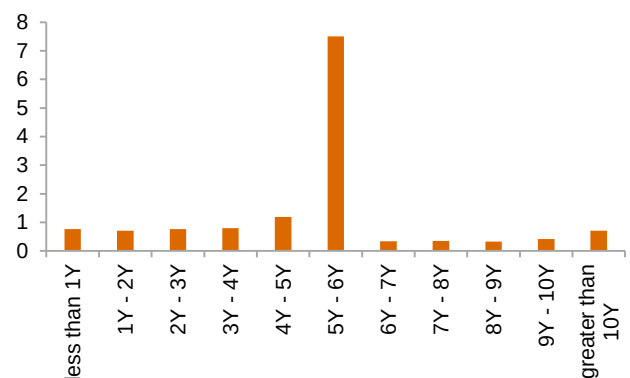
Provision of liquidity in the rates derivatives market

Interest rate derivatives are generally traded OTC. Commonly traded derivatives such as vanilla swaps tend to be more liquid than bespoke instruments. For example, floating rate reference indices in interest rate derivatives tend to be highly standardised.

However, generally speaking, the interest rate derivatives market is characterised by heterogeneity in contract terms, low frequency of trading and a high degree of trade dispersion. Liquidity is provided by banks who step in as market makers. In an interest rate swap for example, the counterparty on the other side of the trade tends to be investors (e.g. non-bank financial institutions) and corporates who want to exchange one stream of interest payments for another.

Trading activity in sovereign single name CDS tends to be concentrated in instruments with tenors between 5 and 6 years, with trading activity significantly falling off for tenors beyond 6 years.

Figure 4.17: Sovereign single name CDS, average number of trades per day by tenor



Source: ISDA

Trends in liquidity

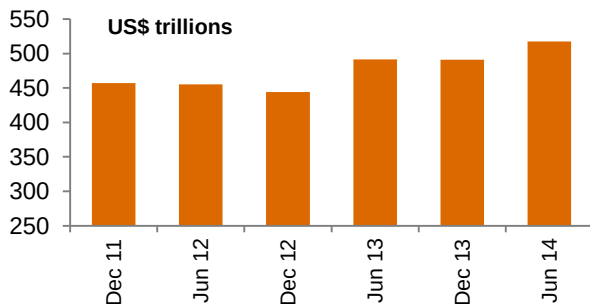
Depth and resilience¹¹⁸

Figure 4.18 shows the notional outstanding amounts for interest rate derivatives. ISDA estimates that

¹¹⁸ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

outstanding amounts have increased 13% between December 2011 and June 2014.

Figure 4.18: Interest rate derivatives contracts, notional amounts outstanding

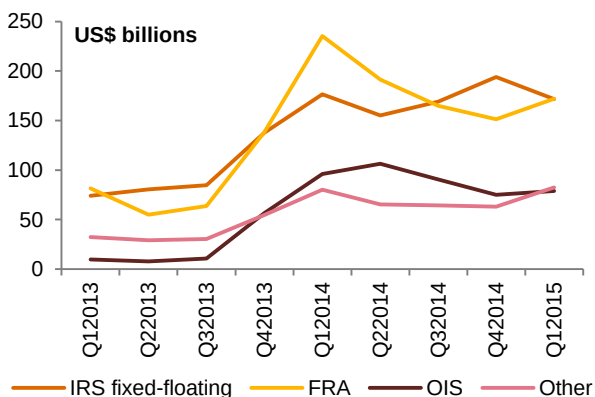


Source: ISDA

Note: This data has been adjusted by ISDA based on BIS data to take into account the impact of clearing and compression in order to provide a more accurate picture of gross notional outstanding volume.

However, trading volumes have failed to keep pace with the growth in outstanding notional amounts. Figure 4.19 shows that average trading volumes in interest rate derivatives increased between 2013 and 2014. Nevertheless, this trend has since reversed, and in particular, for Forward Rate Agreements (FRAs), where trading volumes declined by 26.9% in the first quarter of 2015 compared to a year ago.

Figure 4.19: Average daily trading volumes, notional amounts



Source: ISDA

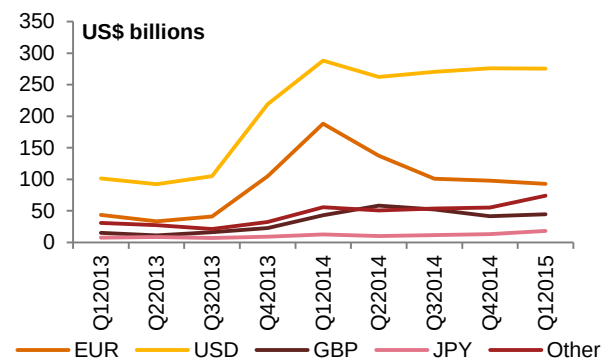
Breadth¹¹⁹

Figure 4.20 shows the average daily trading volumes for interest rate derivatives by currency. The chart

¹¹⁹ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the

shows that while average volumes for USD-denominated interest rate derivatives have remained stable, trading volumes, for the most part, have declined across other currencies, notably for EUR- and GBP-denominated derivatives. More importantly, there is a trend of liquidity bifurcation across different currencies, as illustrated by the widening gap in trading volumes between interest rate derivatives that are denominated in USD and other currencies.

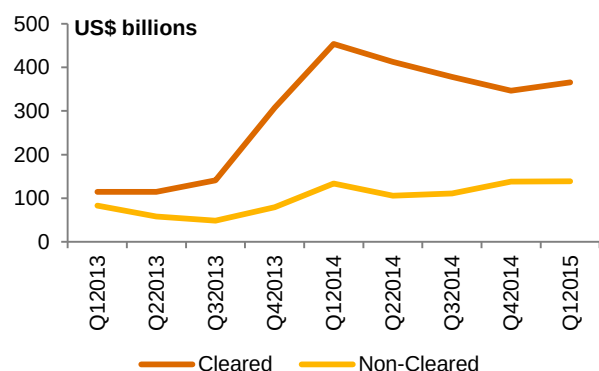
Figure 4.20: Average daily trading volumes for interest rate derivatives by currency



Source: ISDA

Figure 4.21 shows average daily trading volumes for cleared and non-cleared interest rate derivatives. Although the trading volumes for both cleared and non-cleared derivatives have increased since 2013, the growth in trading volumes for cleared derivatives has outstripped growth in non-cleared derivatives.

Figure 4.21: Average daily trading volumes for cleared and non-cleared interest rate derivatives



Source: ISDA

number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

4.2 Credit

Liquidity assessment:

The increase in issuance volumes in corporate credit markets have not been matched by a corresponding increase in trading volumes, which indicates a decline in depth and immediacy.

Similarly, in credit derivatives, average transaction sizes for some CDS products have fallen, which suggests depth and immediacy have both declined.

4.2.1 Investment grade and high yield

Market overview

Corporate credit markets provide financial and non-financial corporates (NFCs) with access to short- and long-term financing.

Short-term credit market include instrument such as certificates of deposit (CDs) issued by banks, and commercial paper issued by both banks and NFCs with relatively high credit ratings. Long-term bonds provide long-term financing to financial institutions and NFCs. Table 4.2.1 below sets out the financing sources which are available to both financial intermediaries and NFCs.

Table 4.2.1: Financing sources for financial intermediaries and non-financial corporates

	Secured or Unsecured	Short-term funding	Long-term funding
Financial Intermediaries	Unsecured	Interbank deposits, Commercial paper, Certificates of Deposit	Senior unsecured bonds, Subordinated debt
	Secured	Repo, Asset-backed commercial paper	Covered bonds, Asset-backed securities, Mortgage-backed securities
Non-Financial Corporates	Unsecured	Commercial paper (with a high credit rating), Revolving credit facility	Senior unsecured bonds, Subordinated debt
	Secured	Bank loans	Secured bonds, Bank loans

Source: PwC analysis

Shorter-term funding markets are more closely aligned to rates markets. In this section we focus more on bonds, and in particular corporate bonds.

There are a number of key features for bonds, which make them a distinct asset class and clearly different from other asset classes or sources of financing such as equities. These are:

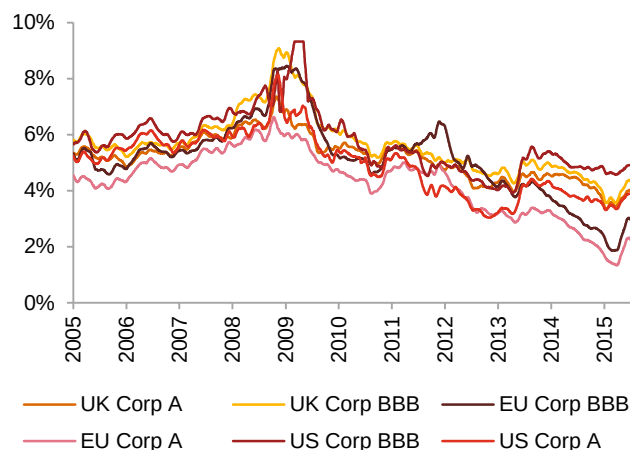
- Bonds have a fixed maturity date (with the exception of irredeemable, callable and puttable bonds whose redemption date can vary). As such, both issuers and investors are particularly concerned about liquidity risk around the time of redemption.
- Bonds have a known coupon payment. This attracts investors who seek a regular income.
- Bond issues can be quite diverse. For instance, while corporates may only issue one or two types of equity, they can issue a range of debt instruments with varying characteristics, e.g.

currency, seniority, and optionality (e.g. convertibility into equity). Each bond is unique.¹²⁰

- Bonds are exposed to credit risk depending on the credit quality of the issuer. This means that the pricing of bonds (corporate and sovereign) will vary as investors' views of the issuers' credit risk change.
- Corporate bond yields are also dependent on yields on sovereign bonds (with an additional yield spread). This means that interest rates and liquidity conditions in sovereign markets can impact corporate bond markets. Figure 4.22 shows the evolution in corporate bond yields. It shows that yields have trended downwards over time in line with sovereign bond yields, which have partly been driven by unconventional monetary policy.

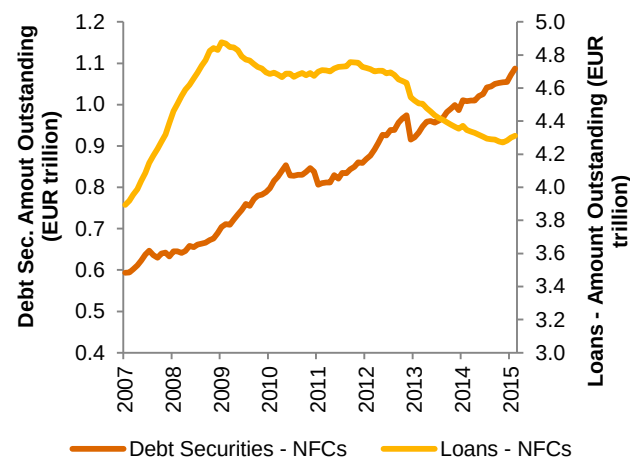
¹²⁰ For example, Severn Trent plc (which is listed on the London Stock Exchange) offers one class of shares, with a market capitalisation of \$8 billion, whereas it has 24 issues of corporate debt amounting to almost \$5 billion, which vary in maturity, size

of issue, coupon rates and currencies. Bayerische Landesbank currently has one equity security but has approximately 645 different corporate bonds outstanding. Source: AFME (2012)

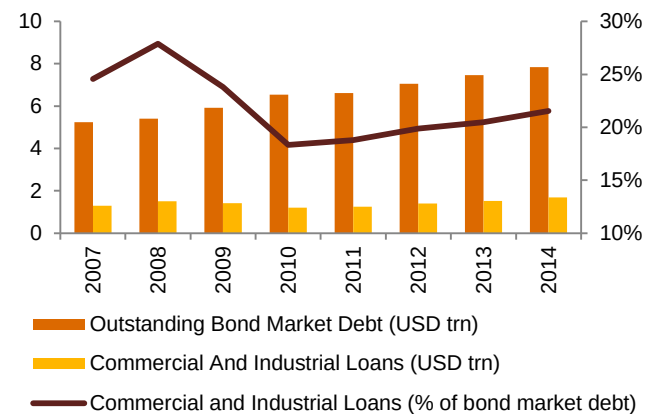
Figure 4.22: Yields on 10-year corporate bonds, 22-day moving average

Source: Thomson Reuters

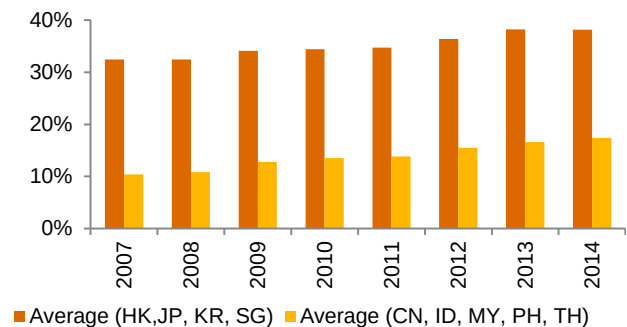
Since the global financial crisis in 2008, corporate bond issuance has grown significantly. Figure 4.23 to Figure 4.25 show that corporate bond markets have been growing strongly across Europe, the US and Asia. However, trading volumes have not risen as quickly. We discuss the implications of these trends on bond turnover ratios and market liquidity in the next section.

Figure 4.23: Outstanding amount of corporate bond and bank loans in Europe

Source: ECB

Figure 4.24: Outstanding amount of corporate bonds and bank loans in the US

Source: FRED, SIFMA

Figure 4.25: Size of local currency corporate bond market as a percentage of GDP in Asia

Source: Asian Development Bank

Provision of liquidity in corporate credit markets

Corporate issuers use investment banks for Initial Public Offerings (IPO) of equity, as well as for the issuance of bonds and subsequent sales to investors through the primary market. Calibrating the yield on these issues draws heavily from existing comparable traded bonds. This means that the trading conditions in corporate bond markets have a direct bearing on the cost of credit to corporate borrowers.

The analysis of trading activity shows that although credit instruments can turn over large monthly volumes given the size of the overall amounts issued, individual issues are generally traded infrequently. This can be explained by the fact that most investors have relatively longer investment horizons and corporate credit instruments are generally low

volatility products that offer attractive returns over the long term.¹²¹

Generally speaking, corporate bond markets are less liquid than advanced economies' sovereign bond markets. Analysis by AFME (2012) shows that the average transaction size in government bonds is around 20 times larger than for corporate bonds, which is partly driven by fewer and larger issuance sizes.¹²² For example, the UK only has 33 conventional Gilts outstanding with maturities classed as, short, medium or long.¹²³ Typically these Gilts trade with bid-ask spreads that are approximately 0.05% of the bonds' mid-value.¹²⁴

Even within corporate bonds, trading frequency can differ significantly from one issue to another. This results in a large variation in trading frequency within the asset class. A study by AFME suggests that 63.8% of the corporate bonds sampled traded less than 20 times per month, 10.1% traded 50 to 100 times and 0.6% traded 200-400 times in a month.¹²⁵

The diverse characteristics listed above, and the fact that investors tend to employ a buy-to-hold strategy when investing in corporate bonds, mean that corporate bonds are not well suited to exchange trading, as it can become difficult for buyers and sellers to find a match for their trades for any specific bond.

The diversity in bond issues and fragmentation of liquidity arising from relatively small issues and bespoke financial instruments mean that secondary credit markets have traditionally operated OTC, where market makers step in as the counterparty for their clients' trade. Market makers therefore play a crucial role in providing liquidity and supporting price discovery in these markets. In order to absorb temporary imbalances in supply and demand, market makers' balance sheets must hold the necessary capacity to warehouse inventory risk.¹²⁶

Because corporate bonds can trade large monthly volumes but individual securities trade relatively infrequently, market makers can take on large risk positions when facilitating liquidity in secondary markets. This enables them to facilitate their clients' needs by offering a price on any asset based on the

risks and costs of the specific immediate transaction. The market maker will then seek to hedge their risk or unwind their position in the secondary markets, if and when possible.

Primary market participants also tend to provide liquidity to the secondary market through market making after bonds are issued. Investment banks and primary market dealers provide secondary market liquidity required by their clients, and distribute issues to long-term bondholders, which helps to reduce liquidity premiums at issuance (or new issue premium) and reduces the cost of funding for their clients.¹²⁷

This market making activity, where corporate bond risks are warehoused on intermediary balance sheets, is of substantial importance to corporate bond liquidity. As mentioned in Chapter 3, one of the impacts of the banking sector regulation has been a marked reduction in the amount of trading assets held by banks to support their market making activities.

Trends in liquidity

In this section we review the range of liquidity indicators across corporate credit markets.

Immediacy¹²⁸

There is some evidence that average transaction sizes have declined, which means immediacy in credit markets have declined.

Figure 4.26 shows the average trade size for US investment grade bonds over the period 2010 and 2014.

¹²¹ AFME (2012) "An analysis of fixed income trading activity in the context of MiFID II"

¹²² AFME (2012) "An analysis of fixed income trading activity in the context of MiFID II".

¹²³ Conventional gilts in issue classified as short, medium or long, as at 21st April 2015, source: Debt Management Office.

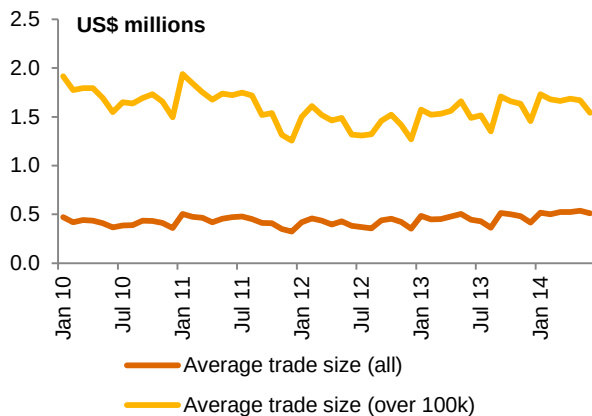
¹²⁴ Based upon average bid-ask spreads for short and medium term conventional UK gilts over the period 2010-2015.

¹²⁵ Conventional gilts in issue classified as short, medium or long, as at 21st April 2015, source: Debt Management Office.

¹²⁶ This means fixed income capital markets are both funding and capital intensive.

¹²⁷ Furse (2015), 'Liquidity matters', speech given by Dame Clara Furse, External Member of the Financial Policy Committee.

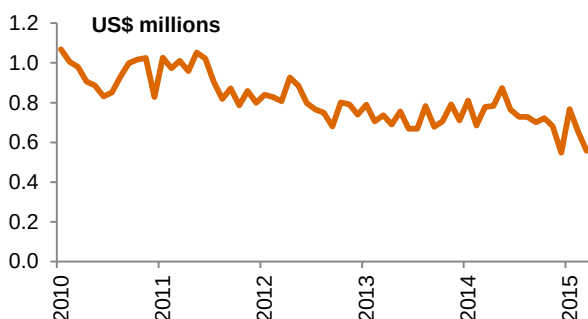
¹²⁸ Immediacy typically refers to the time it takes to complete a transaction. An alternative measure is the frequency of transactions and depth of trading interest in the security by investor.

Figure 4.26: Average trade size, US investment grade corporate bonds

Source: MarketAxess

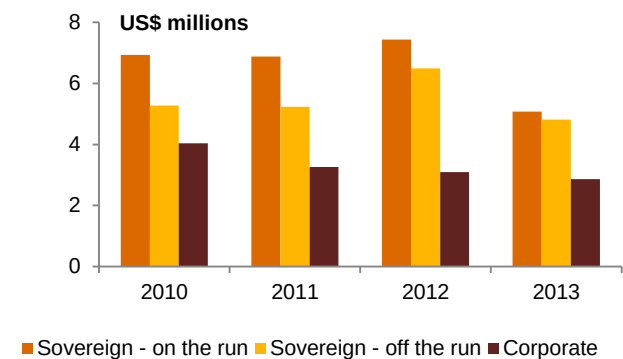
Note: The average of all trades includes smaller, retail trades. Excluding this long tail of small trades increases the average trade size.

While the overall average trade size in Figure 4.26 across all trades has not trended significantly upwards or downwards over the period, larger trades (over US\$1 million) have experienced a reduction in average trade size. Since 2010-11, no single month saw average trade sizes in excess of \$1.75 million. The trend is more pronounced in Europe, as shown in Figure 4.27. This suggests institutional investors are experiencing difficulty in executing large trades without affecting markets. This reduction in immediacy, and hence liquidity, has an impact on trading behaviour as market participants now need to break up larger trades into smaller tranches in order to execute these trades (without suffering detrimental price impact).

Figure 4.27: European corporate bonds, average trade size

Source: Trax

Furthermore, in Asia, there are signs of declining average transaction size, both for sovereign and corporate bonds. Figure 4.28 shows typical transaction sizes for corporate bonds have been declining each year since 2010 – based on a simple average across China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand. This also suggests that immediacy, and liquidity, in on the decline in Asian corporate credit markets.

Figure 4.28: Transaction size for local currency sovereign (on and off-the-run) and corporate bonds - sample of Asian countries

Source: Asian Development Bank

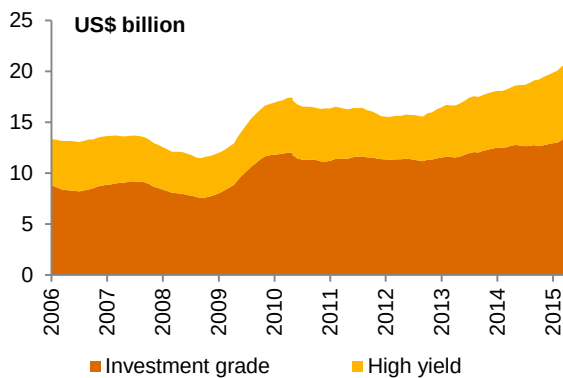
Depth and resilience¹²⁹

One aspect of the depth of corporate credit markets is trading volumes. The larger the trading volumes, the higher the likelihood of brokerage trading matches being found, or in the case of market-making, the quicker the inventory is used. Figure 4.29 shows that US corporate bond trading volumes have been rising over the past 5 years. This is true for both investment grade bonds as well as high yield bonds. Average daily volumes through 2014 and the beginning of 2015 have frequently been over \$20 billion. However, as we discuss in more detail below, trading volumes have not kept pace with the rate of issuance in recent years, meaning that the turnover ratio has declined.

¹²⁹ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of

transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

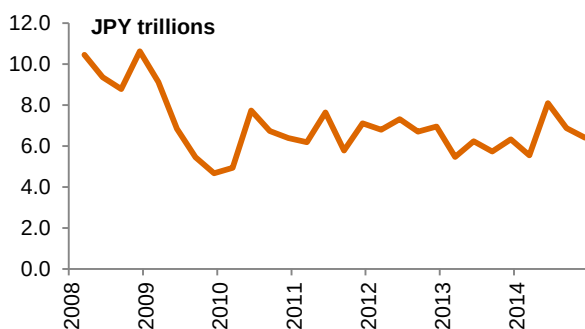
Figure 4.29: US corporate bond average daily trading volume (publicly traded), 12-month rolling average



Source: SIFMA

In Japan, as Figure 4.30 shows, the volumes for locally denominated bonds have been declining. Corporate bond trading volumes for the most recent quarter were under half their peak value at the end of 2008.

Figure 4.30: Local currency corporate bond trading volume in Japan



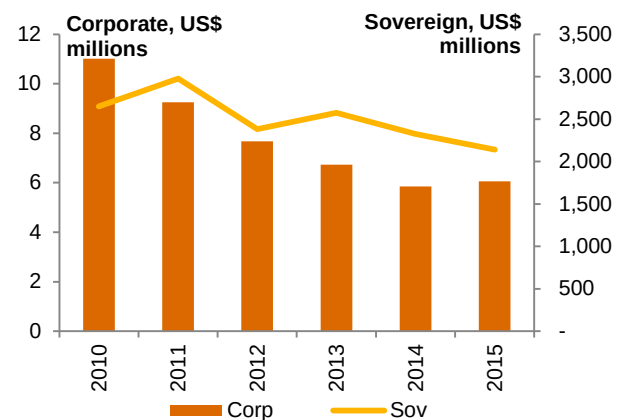
Source: Asian Development Bank

Similarly in Europe, bond trading volumes have reduced significantly, particularly for corporate bonds which are almost half of their 2010 volume (see Figure 4.31). This has been accompanied by a decline in average trade sizes as well (see Figure 4.27).

Analysis of detailed transaction-level data on European fixed income markets by Trax suggests that trade counts have declined by 5% during the year to 2015 Q2. Average daily volumes have also declined by 21% over the same period.¹³⁰

¹³⁰ The Trax data covers pricing and volume information for around 53,000 individual bonds, approximately 65% of all fixed income transactions in Europe. Fixed income instruments include corporate and sovereign bonds, covered bonds, agency debt,

Figure 4.31: European corporate and sovereign bonds, average monthly trading volumes



Source: Trax

Note: Using data provided by Trax, we analysed a representative sample of bonds issued before 2008 over the period between 2010 and 2015. Following a cohort of bonds enables us to avoid the potentially distortive liquidity effects of new issues, which tend to trade more frequently than off-the-run issues. Liquidity trends may be driven by the bond lifecycle, i.e. bonds trade relatively frequently after they are first issued but then tend to stabilise a year after the bonds are issued. We seek to mitigate the risk of lifecycle effects by considering the liquidity trends for our sample of bonds at least a year after they are issued. We consider this to be a better approach to analyse long-term liquidity trends, compared to an approach which takes a consistent lifecycle cohort of bonds but with different underlying characteristics.

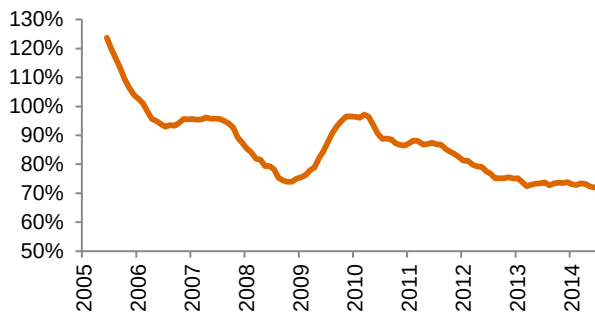
Volume measures suggest that liquidity may have risen in some regions, yet fallen in others. However, such a measure alone should be treated with caution. If growth in trading volumes fails to keep up with rapid growth in bond issuance, then this may imply a net overall decline in liquidity. In this case, a more suitable measure for liquidity is turnover ratios. A turnover ratio represents trading volumes as a percentage of the total value of bonds outstanding for a particular time period. This measure captures more accurately bond trading volumes relative to outstanding bond issuance.

Figure 4.32 shows the turnover ratio for US investment grade bonds. Despite the rise in trading volumes, as shown Figure 4.29 the turnover ratio has been declining the US as the stock of outstanding bonds has increased. The turnover level is now at a lower level than at the height of the crisis in late

emerging market debt and asset-backed securities. Source: Trax. The data excludes intra-entity trades and trades of instruments prior to its issue date are excluded.

2008. The ratio has been on a persistent downward trend since the beginning of 2010.

Figure 4.32: US investment grade corporate bonds turnover ratio



Source: TRACE, MarketAxess

The decline in the depth of liquidity in credit markets could also be linked to the decline in repo markets activity (see Figure 4.10). Because repo markets offer an efficient source of money market funding for banks, a decline in repo market activity could have negative effects on the ability of banks to fund market making activities, particularly in credit markets.

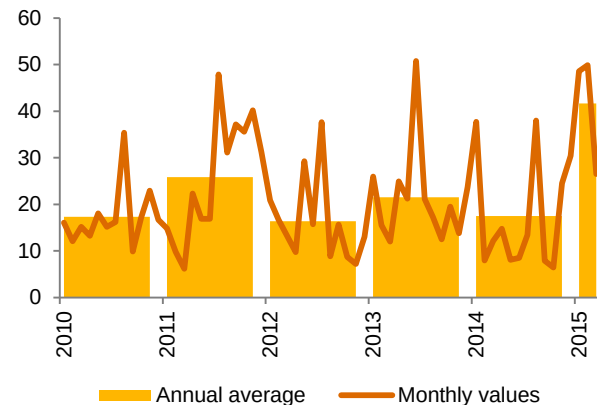
In some developed Asian markets, there has not been such a movement in turnover ratios. For example, data from the Asian Development Bank suggests that corporate bond turnover has been rising in Japan between 2010 and 2014 from 7.0% to 8.5%.

Lastly, price impact measures show that smaller trading volumes are now moving market pricing by large amounts. Whereas very deep markets (e.g. US Treasuries market) can accommodate large trading volumes with minimal price effect, less deep markets exhibit larger price movements. The increase in price impact measures has been identified across asset classes from government bonds through to corporate bonds and equities.

Based on a sample of monthly price and volume data for European corporate bonds supplied by Trax, Figure 4.33 plots the median price impact – the Amihud measure of liquidity – from 2010 to 2015.¹³¹ The Amihud measure of liquidity is a price impact measure that captures the price response in basis points associated with a specified amount of trading volume. It shows that there have been spikes in price responsiveness during periods of heightened

volatility e.g. the peaks of Eurozone sovereign debt concerns and around the announcement of US QE tapering by the Federal Reserve. Of note is the recent increase in the Amihud measure at the beginning of 2015.

Figure 4.33: Median Amihud measure for European corporate bonds

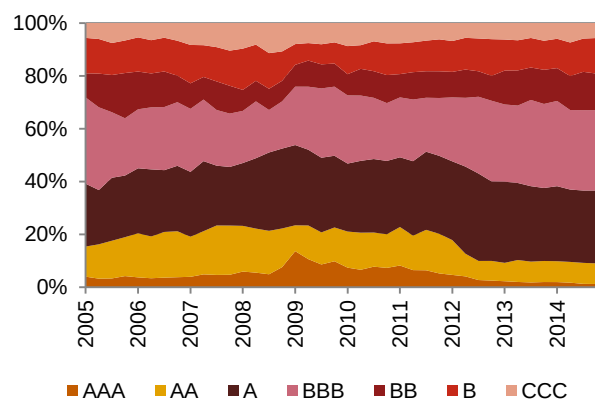


Source: PwC analysis

Breadth¹³²

Figure 4.34 shows trading volumes for US corporate bonds by credit rating. It shows that the share of trading volumes for investment grade (BBB or higher) and high yield bonds have remained stable. Within investment grade bonds, it shows that the share of BBB-rated bonds have increased relative to A or higher-rated bonds.

Figure 4.34: US corporate bond trading volumes by credit rating



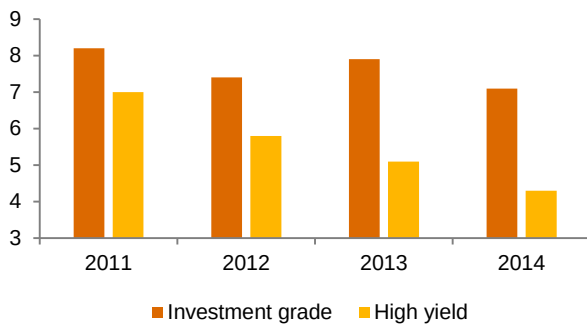
Source: SIFMA

¹³¹ As corporate bond prices are not as likely as sovereign bond prices to move on a daily basis, we specifically estimate Amihud measures with respect to weekly or monthly price responses to \$1million of trading volume.

¹³² Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

Lower quality issues, though, are likely to be associated with a lower number of market makers. As Figure 4.35 shows, although the average number of market makers for both European investment grade and high yield corporate bonds have decreased, the decline in the number of market makers is steeper for high yield bonds.

Figure 4.35: Average number of active market makers - European corporate bonds



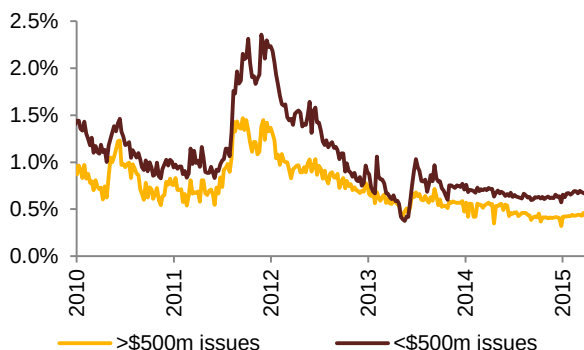
Source: Trax, PwC analysis

Tightness¹³³

Bid-ask spreads are a measure of tightness in fixed-income credit markets. The spread imposes a transaction cost which investors face when entering and closing positions.

Corporate bonds are far more broad and diverse than government bonds. As shown in Figure 4.36, corporate bond bid-ask spreads for a sample of EU corporate and financial firms' bonds trade with bid-ask spreads far larger (around 1%) than those for sovereign bonds (0.05%).

Figure 4.36: Bid-ask spreads on sample of European corporate bonds, by issuance size



Source: Thomson Reuters, Trax

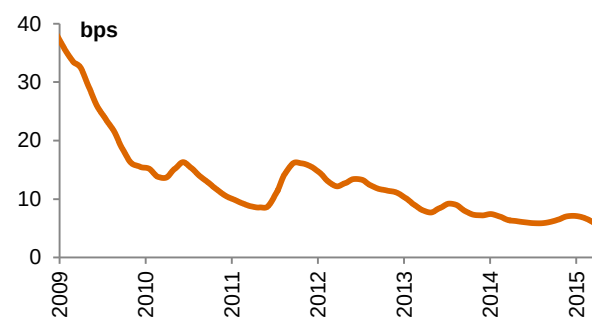
¹³³ Tightness typically refers to the financial cost of completing a transaction.

Since the 2008 financial crisis, bid-ask spreads for EU corporates have broadly trended downwards. The average bid-ask spread for both larger (over \$500m at issuance) and smaller issuances fell steeply following the peak of the Eurozone crisis, and has continued on a downward trajectory since mid-2013. There has, however, been some divergence between bid-ask spreads on larger issuances (\$500 million or over) compared to smaller issuances (under \$500 million), which suggests possible bifurcation of liquidity within corporate bond markets.

Globally, we found that there has been a downward trend in bid-ask spreads, consistent with the European experience. For example, analysis by BlackRock shows that bid-ask spreads for US corporate investment grade bonds have tightened to 2007 levels.¹³⁴ Joyce, Tong and Woods (2011) show that UK QE has put downward pressure on investment-grade sterling corporate bond yields, which fell by 70 bps. The effect is more marked for non-investment grade or high yield (HY) corporate bonds, where yields fell by 150 bps, and spreads narrowed by 75 bps.

Spreads in the US have also narrowed. Figure 4.37 shows the bid-ask spread of the index containing 1,000 of the most actively traded US issues. Bid-ask spreads based on this measure appear to have reached their lowest point in 2014 and remained at the same level since.

Figure 4.37: US investment grade bid-ask spread index



Source: MarketAxess

As discussed in Chapter 2, we need to carefully interpret the implications of current low bid-ask spreads, as they do not necessarily reflect the changing trading behaviour of the market participants.

¹³⁴ Source: BlackRock (2014) "The liquidity challenge: Exploring and exploiting (il)liquidity".

Unlike equity markets, there is seldom a continuous two-way market of buyers and sellers for bond markets. As a result, although some broker-dealers provide two-way pricing on larger, more actively-traded bonds, they are far less likely to provide two-way pricing for less actively traded bonds. Bid-ask spreads are therefore usually one-way and relevant for a specific size of trade at a specific point in time, and spread measures may not always reflect widening spreads for less liquid issues.

A study by ICMA (2014) notes that intermediaries, chiefly banks and broker-dealers have responded to

stricter capital requirements and currently benign liquidity conditions by changing their business models: there has been a shift towards holding smaller quantities of bonds in inventory but providing volumes through active trading on an agency basis, which may explain why spreads have not widened.¹³⁵

In addition, there is the risk that the currently low bid-ask spreads are masking structural illiquidity, which could unwind in the event of QE policy normalisation. This is discussed in more detail in Section 2 and in Box 2.2.

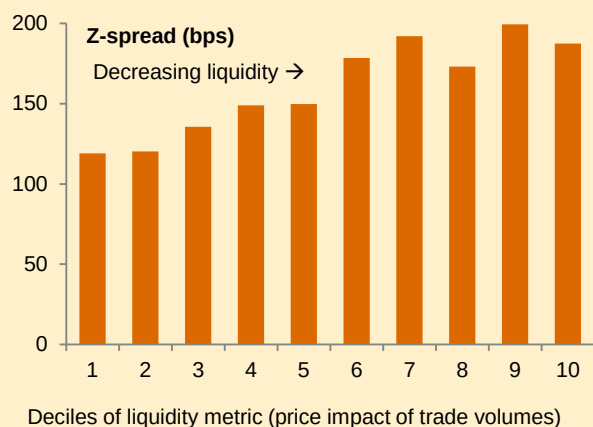
¹³⁵ International Capital Markets Association (2014), “The current state and future evolution of the European investment grade

corporate bond secondary market: perspectives from the market”, November 2014.

Box 4.3: Impacts on cost of credit from changes in market liquidity

An increase in transaction costs and other frictions in trading as a result of rising illiquidity will increase corporates' cost of financing. For corporate bonds, which are OTC traded, empirical evidence suggests that such frictions are an important driver of the liquidity risk premia. This is a premium that investors demand when financial instruments cannot be easily liquidated.¹³⁶ Other research has found a relationship between secondary market liquidity and the firm's financing decision in primary capital markets, which implies that the liquidity risk associated with secondary market trading influences firm's financing decisions through funding costs.¹³⁷ As set out in Appendix F, there is a clear relationship between liquidity and the spread of corporate bonds over benchmark government bond yields. This shows that as bonds become less liquid, bond spreads will rise resulting in a higher cost of debt financing. The impact of reduced market liquidity is likely to be concentrated in smaller users of debt capital markets, where liquidity conditions are currently poor.

Figure 4.38: Relationship between corporate borrowing spread and liquidity



Source: Trax and PwC analysis

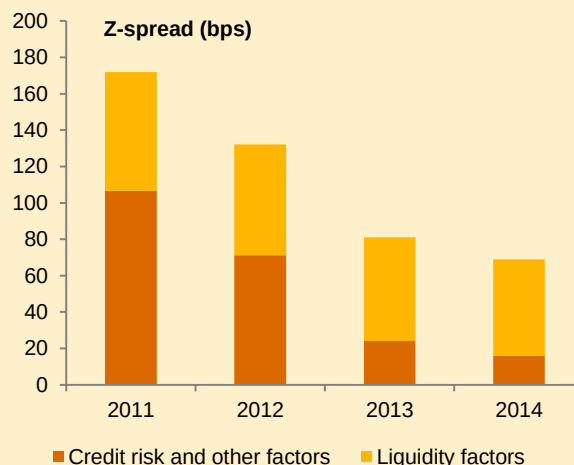
We analyse the impact of a decline in liquidity by using an econometric approach to analyse the relationship between the liquidity risk premia and a number of market liquidity indicators and bond-specific characteristics. Using bond trading data from Trax, for a sample of approximately 750 European corporate bonds over the period 2011 to 2014, we decompose corporate bond spreads into the

credit risk premia and liquidity risk premia, while controlling for bond-specific factors such as maturity.

Our econometric results (discussed in detail in Appendix F) show that market liquidity indicators, such as the number of market makers, bid-ask spreads, the Amihud measure of liquidity, and other liquidity scores play an important role in explaining corporate bond spreads.

Our analysis of z-spreads¹³⁸ for corporate bonds shows that z-spreads have declined over the period 2011 to 2014 (see Figure 4.39). A major cause of this decline has been the stabilisation of markets relative to the crisis period for the Eurozone in 2011. We find the premium for bearing credit risk has fallen dramatically over this period, but the contribution of liquidity factors to the spread has remained broadly stable over the four year period. Therefore, we do not find evidence that investors currently require higher premiums for illiquidity in 2014 compared to previous years.¹³⁹ This finding somewhat contradicts some of the findings in our review of capital markets with considerable changes to market structure, behaviour and reduced liquidity, as principally measured by market depth.

Figure 4.39: Composition of z-spread for European corporate bonds



Source: Trax, Thomson Reuters, Capital IQ and PwC analysis

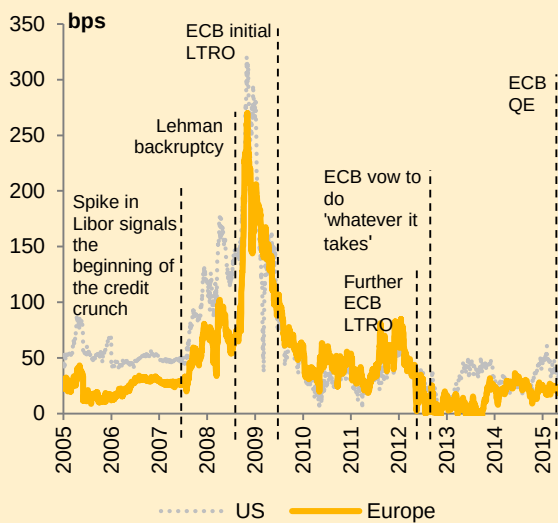
¹³⁶ Amihud *et al.* (2006) also discuss a series of asset pricing models in which frictional costs lead to higher expected returns, compensating investors for investing in illiquid assets. See also Edwards *et al.* (2007) and Bao *et al.* (2011).

¹³⁷ Arseneau, Rappoport and Vardoulakis (2015).

¹³⁸ The spread that would be captured by the investor over the entire Treasury spot-rate yield curve if the bond is held to maturity.

¹³⁹ The Bank of England noted in their December 2014 Financial Stability Report that an increase in the liquidity risk premium might have been expected given changes to market characteristics, but is yet to be exhibited in market data.

Figure 4.40: CDS-based liquidity risk premium estimate for US and Europe



Source: Trax, Thomson Reuters, Capital IQ and PwC analysis

Our analysis broadly corresponds with our estimates of the CDS-based estimation of corporate bond

liquidity risk premia. As Figure 4.40 shows, the liquidity risk premia has declined over time for both the US and Europe.¹⁴⁰ We also note that these declines have typically coincided with monetary policy announcements in Europe.

This suggests that the current environment where there is strong demand for corporate credit, supported by QE could be masking a potential structural rise in liquidity risk premia. This is likely to be revealed as QE is tapered or withdrawn.

In summary, liquidity matters to corporate bond markets. Although there has been no significant structural increase in the liquidity risk premia, a reduction in liquidity of corporate bonds as a result of a reduction in market depth, number of market makers or an increase in the price impact of trades, should result in an increase in the liquidity risk premia, which will then lead to an increase in corporates' cost of financing. At this stage, it is difficult to quantify this possible effect.

¹⁴⁰ This is consistent with the Bank of England's measure of the liquidity risk premia, as reported in the December 2014 Financial Stability Report.

4.2.2 Credit derivatives

Market overview

Credit derivatives provide companies and financial intermediaries a mechanism through which they can either protect themselves against or take a view on credit risk of an underlying or a basket of underlying instruments.

The credit derivatives market also plays a role in providing price transparency. It is used to inform both primary issuance of corporate bonds and secondary trading.

There are a diverse range of credit derivatives. The most common credit derivatives are Credit Default Swaps (CDS). The CDS market can be broadly categorised into the following products:

- **Single name CDS and CDS indices:** A single name CDS is where protection is bought or sold for a single entity, whereas CDS indices are equivalent to buying or selling protection on a basket of entities. Prior to the creation of CDS, financial intermediaries and investors had little choice but to wait for assets and their associated credit risk to mature. However, with CDS, credit risk can be more actively managed.¹⁴¹ A CDS index on the other hand consists of a basket of single-name CDS that have a shared characteristics, e.g. all companies that have issued US high yield corporate bonds.
- **On-the-run and off-the-run CDS indices:** Every six months, a new series of a CDS index is introduced to the market, updating the set of constituents within the index. The most up to date series is known as the on-the-run index, all older series of the index are considered off-the-run.

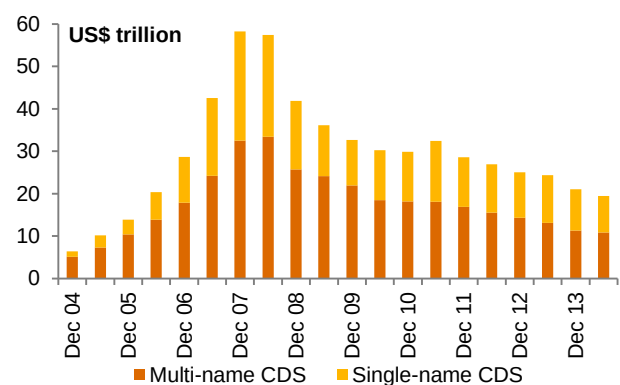
According to Markit, a major market data provider, the benefits of using CDS indices are as follows:¹⁴²

- **Tradability:** Credit indices can be traded and priced more easily than a basket of cash bond indices or single name CDS.
- **Liquidity:** Significant liquidity is available in indices.
- **Operational efficiency:** This is supported by standardized terms, legal documentation and electronic straight-through processing. This supports low transaction costs.

- **Industry support:** Credit indices are supported by all major dealer banks, buy-side investment firms, and third parties.
- **Transparency:** Rules, constituents, fixed coupon and daily prices are all available publicly. Credit indices produced by Markit including iTraxx and CDX roll every six months, meaning a new index is created with updated constituents.

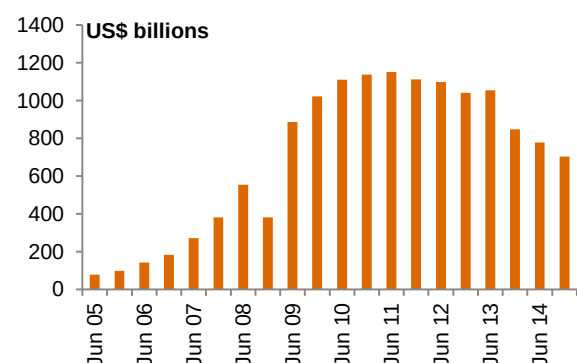
The CDS market grew extremely rapidly prior to 2008. This is shown in Figure 4.41 by the growth in notional principal amounts outstanding on CDS contracts globally. Between the end of 2004, and the end of 2007, the CDS market had grown from \$6.4 trillion to \$58.2 trillion - a nine-fold increase in just three years. In the aftermath of the global financial crisis, credit derivative markets shrunk considerably. One reason for this is the demand for insurance against credit defaults has waned, and partly due to stricter regulations around trading credit derivatives.¹⁴³

Figure 4.41: Global notional total CDS outstanding



Source: BIS

Figure 4.42: Notional CDS outstanding - Japan



Source: Bank of Japan

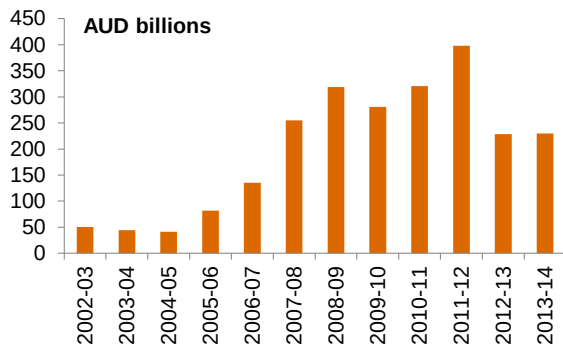
¹⁴¹ Hull J C (2005), Fundamentals of Futures and Options Markets, 5th Edition.

¹⁴² Markit (2012), 'Market Credit Indices: A Primer'.

¹⁴³ Deutsche Bank annual default study report.

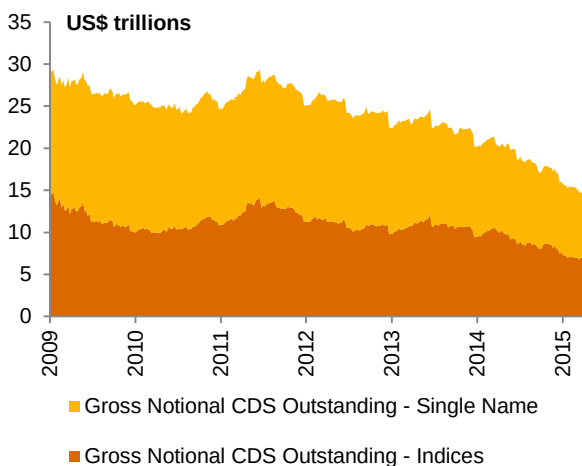
Market growth (or retrenchment), however, has not been consistent across the globe. In Japan for instance, the growth of the credit derivatives market was very rapid pre-2008. The market continued to grow until 2011 (Figure 4.42) before falling back. Similarly, the Australian market did not experience such an immediate downturn as in the US (see Figure 4.43 and Figure 4.44). Nevertheless, as the US is the largest CDS market globally, its trajectory has a large weighting in overall global market size.

Figure 4.43: Notional CDS outstanding - Australia



Source: AFMR

Figure 4.44: Gross notional US single name CDS and CDS indices outstanding



Source: IADS

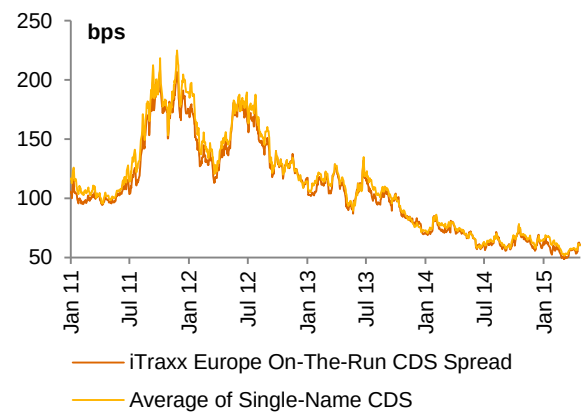
Figure 4.45 shows the five-year CDS spread available on iTraxx, a European credit index comprised of 125 single names. The spread plotted corresponds to the on-the-run series, i.e. the newest and most liquid index. The figure also plots the average CDS spread of all the single company CDS comprising the index.

The difference between these two lines is typically a small number of basis points, as large gaps will be disappeared through arbitrage.

At the end of March 2015, the average spread on this 5-year basket of European CDS was approximately 60 bps. This means that a buyer of credit protection against a European corporate would pay an annual coupon of 60 bps against the notional principle of the CDS contract to the seller of the protection and in return would receive a pay-out if a credit event is realised during the life of the contract.¹⁴⁴

As captured in Figure 4.45, CDS spreads have fallen substantially since 2012, signalling that the market has assigned a lower probability of default for the average European corporate.

Figure 4.45: CDS spread on iTraxx Europe and average of single name CDS



Source: Capital IQ

Provision of liquidity in corporate credit markets

Like other derivatives, CDS have historically been traded OTC. The low and variable trading frequency and size of CDS instruments highlights the importance of market makers facilitating liquidity in this market. Research by the Federal Reserve Bank of New York suggests that dealers tend to hold on to the risk taken on in customer trades for some time before hedging.¹⁴⁵ For single-name CDS, bid-ask prices are either quoted on a 'spread' basis or a 'price' basis, depending on the product type.

CDS indices tend to be more liquid due to their standardised features, compared to single-name CDS. Research by ISDA shows that 63.1% of credit derivatives index trade less than once per day and

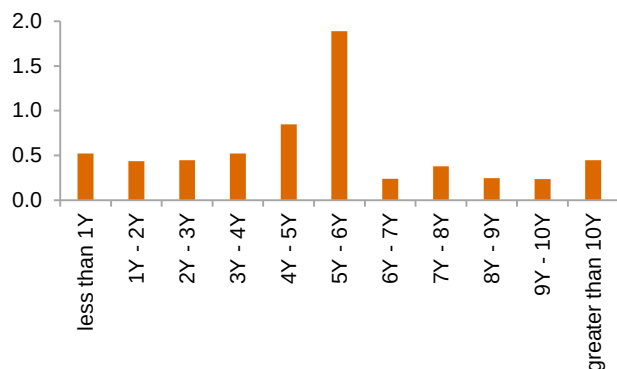
¹⁴⁴ Settlement in the event of default involves either physical delivery of the bonds or a cash payment.

¹⁴⁵ Federal Reserve Bank of New York (2011) "An analysis of CDS transactions: implications for public reporting", Staff Report no. 517, September 2011.

77.2% of single-name contracts traded less than once a day. Liquidity is also concentrated in on-the-run indices: research by the Federal Reserve Bank of New York show that trading activity was more active and consistently centred on on-the-run indices, specifically the North American Investment Grade CDX and the iTraxx Europe.¹⁴⁶ Trading activity on CDS indices amounted to 1,150 trades a day on average with a trading volumes of US\$53 billion between May and July 2010, whereas only 300 trades a day for a value of US\$21 billion were observed in off-the-run indices.

Similar to sovereign single name CDS, trading activity in sovereign single name CDS tends to be concentrated in instruments with tenors between 5 and 6 years. Trading activity is significantly lower for other tenors, particularly for those over 6 years.

Figure 4.46: Corporate single name CDS, average number of trades per day by tenor



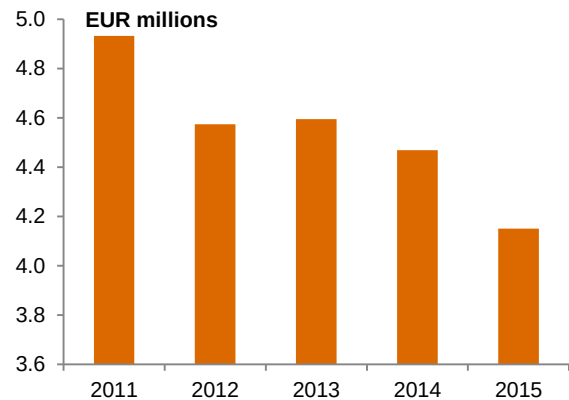
Source: ISDA

Trends in liquidity Immediacy¹⁴⁷

As discussed above, single-name CDS volumes fell by approximately 50% between 2011 and 2015, yet the average daily number of transactions fell approximately 38%. The difference between these two numbers is explained by a reduction in the average size of each CDS transaction between the years. Figure 4.47 shows the annual average transaction size of single-name European CDS cleared through ICE, which has declined from approximately €5 million in 2011 to approximately €4.2 million in the first three months of 2015. Likewise, Figure 4.48 shows that the cleared average trade size for CDS has fallen from \$40 million per

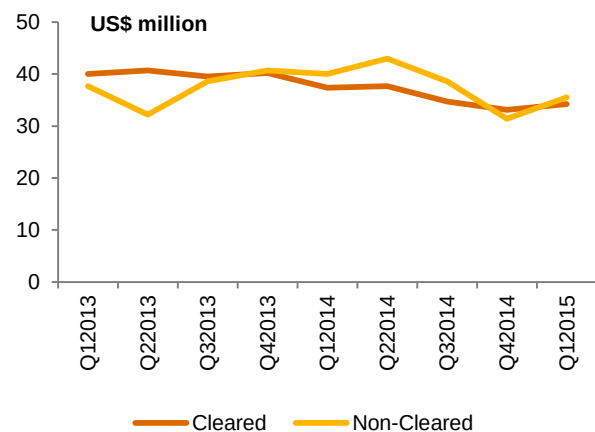
trade in Q1 2013 to \$34 million in the first quarter of 2015. The average transaction size of non-cleared transactions has also recently declined between 2014 Q2 and 2015 Q1.

Figure 4.47: Average CDS transactions size - European single name



Source: ICE

Figure 4.48: CDS Index average trade size



Source: ISDA

Although the average size of transactions has declined, the proportion of days on which a single-name CDS does not trade has deviated very little over the past few years. The proportion of 'zero-trade' days as a percentage of days for which clearing records exist has remained around 70% over the entire period of analysis.

transactions and depth of trading interest in the security by investor.

¹⁴⁶ Federal Reserve Bank of New York (2011) "An analysis of CDS transactions: implications for public reporting", Staff Report no. 517, September 2011.

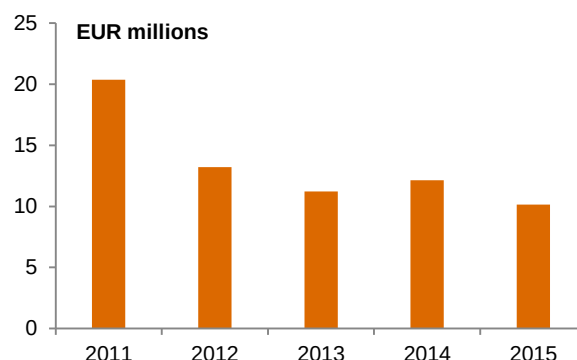
¹⁴⁷ Immediacy typically refers to the time it takes to complete a transaction. An alternative measure is the frequency of

Depth and resilience¹⁴⁸

Data shows that the volumes of single-name CDS traded in Europe have been slowing. As shown in Figure 4.49, the series of annual average daily volumes of European single-name CDS, cleared through the Intercontinental Exchange (ICE), have fallen by approximately 50% between 2011 and 2015. This trend is also captured in the average size of transactions in European single-name CDS (see Figure 4.47). These have fallen from an average of four transactions per day in the average cleared single-name CDS in 2011, down to just 2.5 transactions per day in 2015.

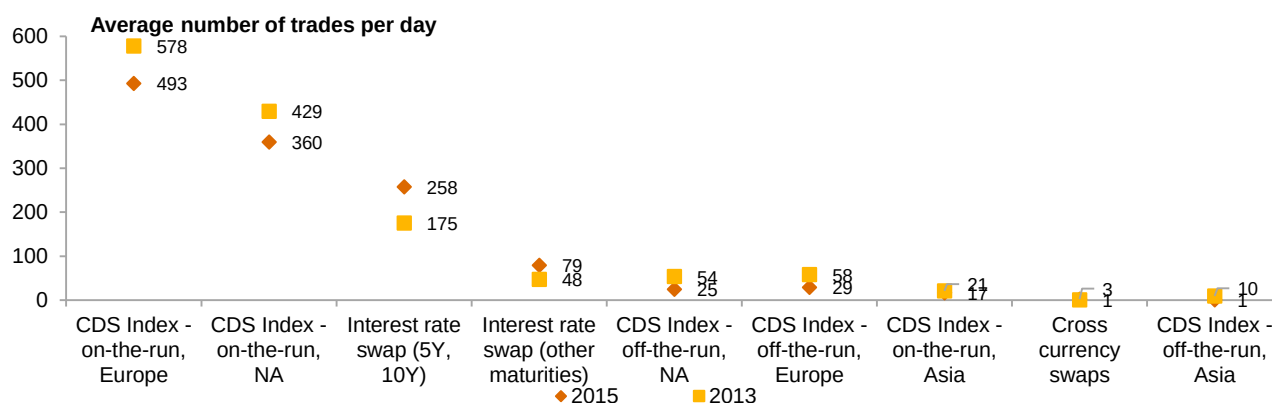
The daily trade counts across the range of a CDS indices have also declined between 2013 and 2015, as Figure 4.50 shows. This suggests that the costs of hedging for end-users have increased.

Figure 4.49: Average daily volumes of European single name CDS cleared through ICE



Source: ICE

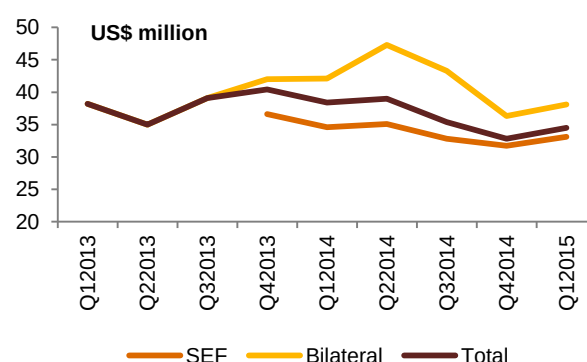
Figure 4.50: Average number of trades per day across CDS indices



Source: ISDA

There are some signs that the CFTC's requirement for full compliance with SEF rules from October 2014 has had an impact on the volume of CDS indices transactions. Figure 4.51 shows that the average trade size for CDS indices have declined, particularly for bilateral trades.

Figure 4.51: Average trade size for CDS Indices



Source: ISDA

¹⁴⁸ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include

turnover, which captures volumes traded relative to the size of the underlying market.

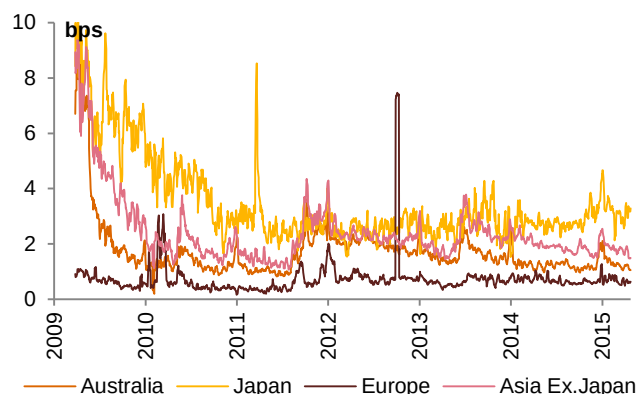
Breadth¹⁴⁹

Alongside the drop in trading volumes as evidenced by data, there has been a general drop in the number of market participants offering CDS, particularly single-name CDS, with a number of large banks dropping their coverage of single-name CDS. This points to a reduction in the breadth of liquidity.

Tightness¹⁵⁰

One measure of liquidity in the CDS market is bid-ask spreads. As shown in Figure 4.52, bid-ask spreads were elevated in most global regions after 2009, based on iTraxx indices for each region. Tightness in the market has subsided somewhat since 2009 in most markets, although Japan and other Asian markets seem to exhibit structurally higher spreads. Bid-ask spreads on the European iTraxx have been lower by an order of 1-3 bps over the 2009 to 2015 period. This likely reflects the greater levels of activity in the European index relative to the others – making it easier for market makers to manage exposures.

Figure 4.52: Bid-ask spread iTraxx on-the-run series



Source: Thomson Reuters

CDS indices tend to be more liquid due to their standardised features, compared to single-name CDS, where quotes are often provided on request rather than on a continuous basis. As a result, bid-ask spreads on single-name CDS tend to be wider. Figure 4.53 plots the average bid-ask spread over the past 5-years on the average constituent of the on-the-run iTraxx Europe series. Whereas bid-ask spreads on the index has typically fluctuated around 1 bp, bid-ask spreads on the underlying CDS have traded in the range 4 bps to 14 bps. The trend in European single-name CDS appears relatively flat over the 2014-15 period.

Figure 4.53: Average bid-ask spread of iTraxx Europe single name CDS



Source: Capital IQ

As mentioned earlier, the bid-ask spread may not reflect lower levels of liquidity for vanilla corporate credit instruments due to changes in banks' business models and market trading behaviour. This means that bid-ask spreads do not need to compensate as much for the risk of movements in inventory values. However, as we discuss in the depth and resilience section, lower liquidity levels in CDS markets are manifesting as lower trading volumes.

¹⁴⁹ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the

number and diversity of market participants, and by segregation of assets into different liquidity strata.

¹⁵⁰ Tightness typically refers to the financial cost of completing a transaction.

4.3 Securitisation

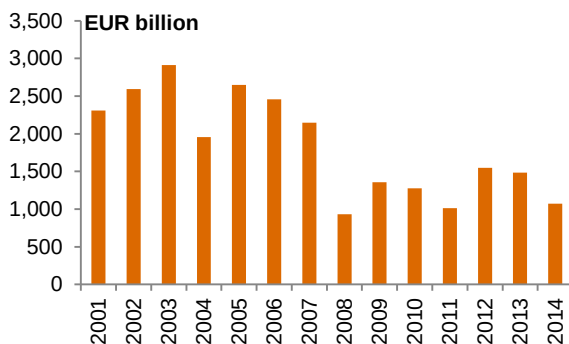
Securitisation is the pooling together of cash-generating assets, such as mortgages, auto loans and SME loans, created by banks and initially funded on their balance sheets, and funding these assets instead by (typically) transferring them to Special Purpose Vehicles (SPVs) which then issue bonds in the capital markets.

The process of pooling together cash-generating assets can transform relatively illiquid assets into more liquid tradable securities.

Market overview

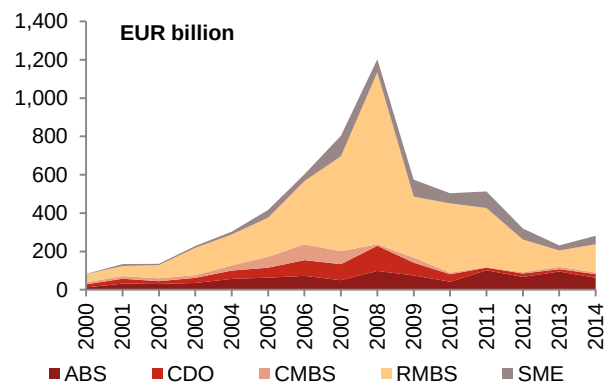
The securitisation market was buoyant until 2008, with most issuance volume generated in the US. There was a significant and growing market in Europe. However, from 2008 onwards, following the US sub-prime residential mortgage crisis, which was exacerbated by the repackaging of poorly performing RMBS into Collateralised Debt Obligations (CDOs) and Structured Investment Vehicles (SIVs), new securitisation issues (even those of high quality collateral) have steeply declined in volume, as investors became wary about this asset class and as regulatory changes such as increased capital and risk retention requirements have changed the economics of engaging in securitisation. Figure 4.54 and Figure 4.55 show levels of securitisation issuance for the US and Europe respectively. Growth in US securitisations in the build-up to 2008 was relatively flat compared to the European market, as the US capital markets were more mature.

Figure 4.54: US securitisation issuance



Source: AFME, SIFMA

Figure 4.55: European Securitisation Issuance

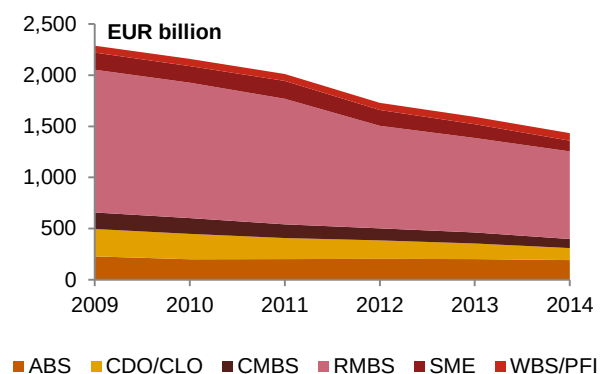


Source: AFME

The regulatory response to the financial crisis has been to increase requirements for issuers and investors with regard to capital, liquidity, disclosure and risk retention. This is despite the robust credit performance of most asset classes other than US sub-prime mortgages through and since the crisis. For example, as of mid-2014, cumulative defaults on European prime RMBS amounted to just 14 basis points over seven years.¹⁵¹

The US securitisation markets are now showing signs of recovery in some sectors. However, recovery in Europe has been much slower with placed issuance not exceeding EUR 100 million for several years. Outstanding amounts of European securitised products continued to decline, as shown in Figure 4.56. This decline may have been exacerbated by the regulatory treatment of securitisations and the availability of funding facilitated by central bank policy.

Figure 4.56: European securitised products outstanding by collateral type



Source: AFME

¹⁵¹ Source: Standard & Poor's.

However, the regulatory outlook may be changing. Specifically, the European Commission (along with the ECB, Bank of England and European Banking authority) has acknowledged the benefits of “simple transparent and standardised” securitisation and the part it can play in Capital Markets Union. At the global level, the Basel / IOSCO Task Force on Securitisation Markets is analysing “simple transparent and comparable” securitisation. Both initiatives seek to define this category of securitisation, and will then go on to consider a different regulatory treatment including potentially less onerous capital requirements under the Basel framework.

Provision of liquidity in the securitisation market

Liquidity in the secondary market for securitisations is provided in a manner similar to that of corporate bonds. Securitisations are mostly traded OTC through market makers, who use their balance sheets to enable trades without matched buyers.

Trends in liquidity

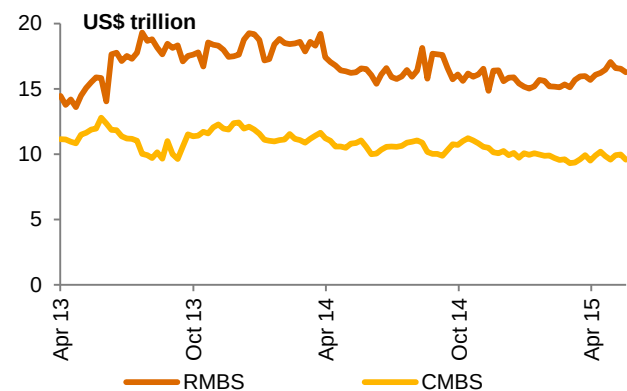
The primary market for securitisations globally remains subdued, despite strong default performance across most securitisation classes, with some variation can be seen across asset classes.

Secondary market trading volumes, an indicator of depth, have either exhibited decreases or no change in recent years. In the US, data from SIFMA on daily trading volumes of agency Mortgage Backed Securities (MBS) shows that average daily volume has decreased from US\$321 billion in 2010 to US\$178 billion in 2014. Meanwhile, trading volumes for non-agency MBS and asset backed securities (ABS) have been largely flat over the same period. ABS daily trading volumes for example, have averaged approximately US\$1.5 billion per day from 2011 up until April 2014, while the equivalent figure for non-agency MBS has been US\$4 billion. However, it should be noted that these trends may be distorted by the action of government sponsored

enterprises (GSEs) in liquidating legacy non-agency MBS, particularly in anticipation of an increase in interest rates.

Another indicator of secondary market liquidity for securitised assets is dealer inventory holdings. These are shown in Figure 4.57. Similar to the trends in trading volumes, the level of primary dealer inventory holdings of CMBS and RMBS has been relatively flat over the past 25 month period, which suggests that liquidity conditions have not significantly changed in recent months. The proportion of total dealer inventory of which they comprise has remained at approximately 50% over the period.

Figure 4.57: US primary dealer inventory of CMBS and RMBS



Source: Federal Reserve

Liquidity trends may improve with the changing regulatory outlook, with greater alignment around the need for high quality securitisations, prospects for the asset class look distinctly brighter. Proposals outlined by the US Federal Housing Finance Agency to develop a common platform for mortgage securitisation for GSEs such as Fannie Mae and Freddie Mac which can ultimately be used by the rest of the industry, as well as the move towards a single issuance for both institutions will drive greater liquidity in the securitisation market.

4.4 Foreign exchange

Liquidity assessment:

FX markets are experiencing declining breadth in forward markets, with liquidity declining in longer-dated forward markets compared to shorter-dated forwards.

Currencies are traded in FX markets around the globe. These markets operate 24 hours, 5.5 days a week, and with around \$5.3 trillion of trading each day it is by far the world's most traded asset class. In an increasingly globalised economy, the role of FX markets in facilitating international trade and investment by enabling currency conversion should not be underestimated. Without the ability to trade in different currencies, businesses would be unable to gain access to resources, and to create demand for its goods and services in other markets. Investors engage with FX markets to trade currencies in order to buy and sell foreign assets and securities, and to diversify their portfolios.

Financial centres around the world function as trading venues for multiple types of buyers and sellers – the largest of which are London (where 40% of transactions take place), New York (19%) and Singapore (6%).¹⁵² The share of electronic trading in FX markets has increased, and now accounts for around 90% of spot FX dealing¹⁵³ which is typically conducted in quote driven markets.

In this section we provide an overview of FX markets, firstly the spot market, followed by forward and derivative markets. Drawing upon market data, we then set out areas for concern around liquidity across these markets.

4.4.1 Spot

Market overview

The main intermediaries in these markets are FX dealers, which are generally (but not always) banks, who primarily deal as principal. Around 95% of transactions are conducted OTC, particularly for the spot markets. In spot markets, the traded currencies are exchanged on the settlement date which can vary depending on the currency. The standard settlement day for most currencies is two business days after the trade date (T+2).¹⁵⁴ Prices are quoted on a number of

different trading platforms, though the potential for arbitrage ensures that pricing discrepancies are short-lived.

Provision of liquidity in FX spot markets

FX spot markets are supported by banks' market making operations. The spreads of these market making activities is generally low where there is good price transparency and high demand, particularly in the major currency pairs.

One of the most important drivers of market structure in the FX markets has been the development of the Continuous Linked Settlement (CLS) system used by many major market participants. The CLS group, which is owned by its member banks, now accounts for the settlement of 46% of daily FX volumes across all products. One of the main benefits of CLS has been the reduction of settlement risk caused by FX transactions occurring in different time zones.

Further developments in FX markets have helped to make the market more efficient. The increase in liquidity aggregation that links liquidity pools via algorithms (e.g. by directing orders to venues with the lowest trading costs) have helped to increase price transparency and competition, thereby lowering transaction costs.¹⁵⁵ Algorithmic trading and order execution strategies allow risks to be shared faster and among more market participants.

Non-dealer financial institutions are also increasingly engaged in FX markets, including specialist providers, non-bank providers and algorithmic traders. Multi-dealer platforms and single-dealer platforms have gained an increasing share of FX trading volumes, while voice execution has declined to less than half of overall client volumes.¹⁵⁶

Trends in liquidity

Immediacy¹⁵⁷

Some market participants face an increase in the costs of executing certain trades, e.g. large transactions. Prime brokerage is the key route to market for many market participants, which help them trade in FX markets at competitive prices. Smaller hedge funds and algorithmic traders have been deterred by rising charges imposed by prime

¹⁵² BIS Triennial Central Bank Survey of foreign exchange and derivatives market activity.

¹⁵³ Financial Stability Board (2014) "Foreign exchange benchmarks: Consultative document", 15 July 2014.

¹⁵⁴ The exceptions to this convention are US and Canadian dollars, which have a settlement time of T+1 because they operate within the same time zone.

¹⁵⁵ Search costs refer to the costs associated with searching for the best quotes and counterparties, particularly in non-consolidated markets.

¹⁵⁶ Oliver Wyman (2015) "AFME liquidity conference: FX market structure", 25 February 2015.

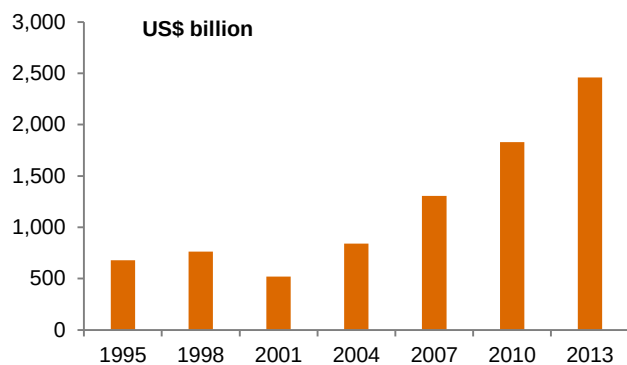
¹⁵⁷ Immediacy typically refers to the time it takes to complete a transaction. An alternative measure is the frequency of transactions and depth of trading interest in the security by investor.

brokers, which will have an impact on liquidity in FX markets. Regulators have also raised margin requirements in response to shock events, which have knock-on impacts on transaction costs: the National Futures Association raised the margin requirements for transactions involving several major currencies, including the Swiss franc, Japanese Yen and Australian dollar, following the Swiss franc event on 15th January 2015.¹⁵⁸

Depth and resilience¹⁵⁹

Based on the latest BIS triennial central bank survey, trading volumes in FX markets (spot and derivatives) have increased from \$3.3 trillion in April 2007 to \$5.3 trillion a day in April 2013 (see Figure 4.58).

Figure 4.58: Average daily volumes of FX spot transactions



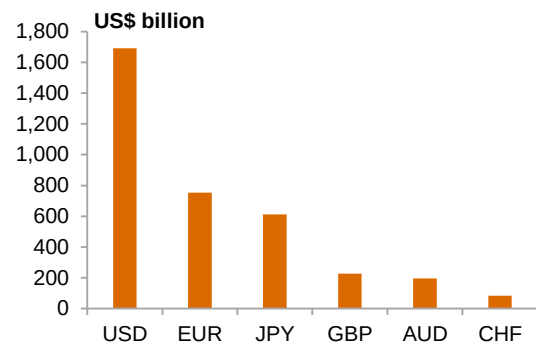
Source: BIS Triennial Survey 2013

Average daily turnover in spot transactions increased from \$518 billion in 2001 to \$2.5 trillion in 2013. More recently, the increase in overall FX volumes over the past three years was driven by several factors: First, the shift in monetary policy by the Bank of Japan in April 2013 triggered high trading volumes across asset classes, including FX. Second, research by BIS also suggests that the increase was driven by an increase in investors' search for yield and desire to diversify their asset portfolios; for example, by going into equities and emerging market bonds. This generated additional FX trading as a by-product. BIS research shows that FX turnover increased most for countries that saw significant growth in equity prices. Trading volumes also

increased in currencies where local bond markets offered attractive returns.

The US Dollar is the dominant currency in terms of FX transaction volume. US\$1.7 trillion worth of US Dollar daily spot transactions were made on average in 2013¹⁶⁰, the next largest was the euro with \$0.8 trillion (see Figure 4.59).

Figure 4.59: Average daily spot transactions by currency, 2013



Source: BIS Triennial Survey 2013

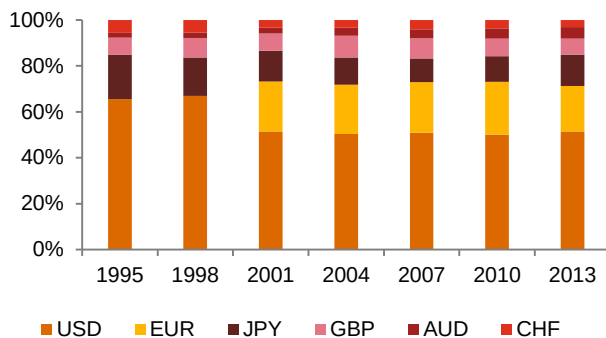
Figure 4.60 shows that the US Dollar's dominant position has been relatively constant since 1995. In comparison, the euro's share of volume has declined 6 percentage points from 2010. As of 2013 it comprised of 17% of FX transactions in 2013. The European sovereign debt crisis was a major contributor to the decline in euro trading volumes. As a result of the financial crisis, doubts were raised as to the creditworthiness of Eurozone countries, and the potential effect of financial contagion. This was reflected in the downgrade of some European sovereign bonds by credit rating agencies.

¹⁵⁸ Other currencies subject to the increased margin requirements include the Swedish krona, Norwegian krone, Russian rouble, Brazilian real and Mexican peso. Source: National Futures Association (2015) "Notice I-15-07: Immediate attention required – Financial Requirements Section 12 – Additional increases in required minimum security deposit for forex transactions", 23 January 2015.

¹⁵⁹ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume

flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

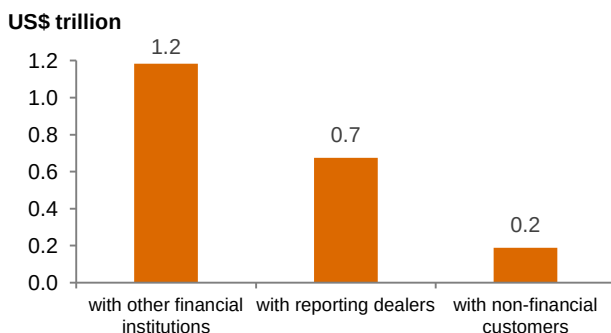
¹⁶⁰ BIS Triennial Central Bank Survey of foreign exchange and derivatives market activity.

Figure 4.60: Share of trading volumes by currency, 1995-2013

Source: BIS Triennial Survey 2013

Breadth¹⁶¹

Figure 4.61 shows average daily FX spot trading volumes by counterparty. It shows that trades between reporting dealers and other financial institutions (a category that includes non-dealer/non-reporting banks, institutional investors, and hedge funds), account for the largest share of turnover, at US\$1.2 trillion in 2013. This is followed by inter-dealer transactions and trades between dealers and non-financial customers.

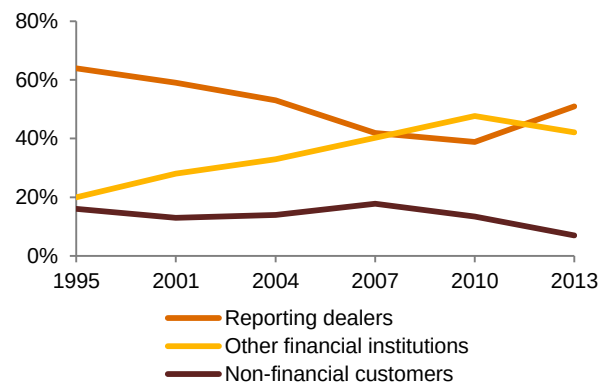
Figure 4.61: Average daily trading volumes in FX spot markets by counterparty, 2013

Source: BIS Triennial Survey 2013

Note: The data from BIS covers all transactions taking place where one of the large FX reporting dealers was on at least one side of the trade. Transactions that did not involve at least one of the large reporting dealers to the BIS Triennial Survey are excluded.

Figure 4.62 shows that the share of trades taking place between dealers and other financial institutions' has increased over time whereas the

share of inter-dealer trades has declined. This shift is primarily driven by two factors: (i) the opening up of FX trading platforms to hedge funds and other customers through prime brokerage agreements; and (ii) the greater internalisation of trades as FX flows are increasingly concentrated in a handful of major banks, which allow banks to match more customer trades directly on their own books, and reduces the need to go to inter-dealer markets as a way of managing inventory.¹⁶² The increase in the diversity of market participants also increases the scope for trading (Banerjee and Kremer, 2010).

Figure 4.62: Share of FX transaction volumes by counterparty, 1995-2013

Source: BIS Triennial Survey 2013

Figure 4.63 shows the standard deviation of exchange rates for major currencies. Data from Thomson Reuters suggests that exchange rate volatility, as measured by the standard deviation in exchange rates, is currently lower than compared to the crisis, and indeed pre-crisis levels (with the exception of the Australian dollar and Swiss franc). However, there have been some signs of an increase in intraday volatility. When Federal Reserve Chair Yellen announced the US would not be 'impatient' when deliberating increasing interest rates - this led to a huge unwinding of traders' short-euro positions, and created a feedback loop that drove the euro even higher. At one point during the day, the EUR/USD exchange rate moved 200 pips¹⁶³ up within 3 minutes.¹⁶⁴ However, FX markets were quick to return to equilibrium following shock events.

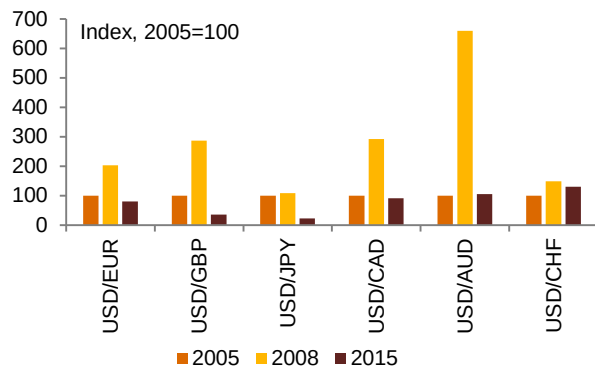
¹⁶¹ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

¹⁶² In the spot market, the market share of the ten firms reporting the highest volumes in the US market increased from 91% in 2010

to 98% in 2013. Source: Federal Reserve Board. See also Rime, D. and Schrimpf, A. (2013) "The anatomy of the global FX market through the lens of the 2013 Triennial Survey".

¹⁶³ Price interest point. Most major currencies are priced to 4 decimal points, so 1 pip is equal to 1/100th of one cent.

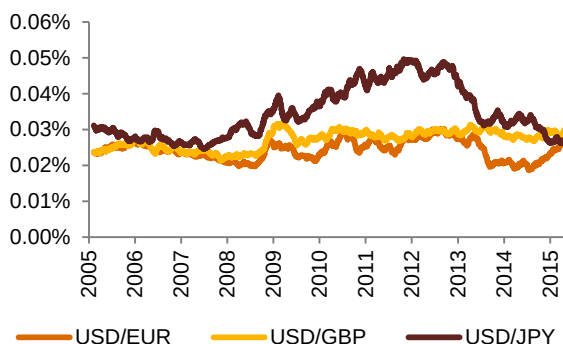
¹⁶⁴ MarketWatch (2015) "Why liquidity is drying up in the currency market", 25 March 2015.

Figure 4.63: Standard deviation in exchange rates for major currencies

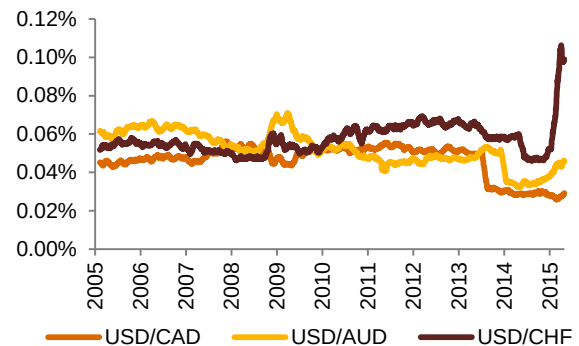
Source: Thomson Reuters

Tightness¹⁶⁵

Liquidity trends in currencies tend to move together. FX liquidity can be driven by shocks affecting FX markets as a whole, or as a result of idiosyncratic shocks to individual currencies that can cause ripple effects in the market. FX market participants often look to hedge their positions using correlated currencies to reduce the effect of exchange rate fluctuations between the base and hedged currency. Figure 4.64 and Figure 4.65 show the bid-ask spread for major currency pairs (EUR-USD, USD-JPY, GBP-USD, USD-AUD, USD-CHF and USD-CAD). Bid-ask spreads in FX markets are historically narrow, with spreads typically in the order of 2-6 bps.

Figure 4.64: Bid-asks spread for spot USD/EUR, USD/JPY, USD/GBP

Source: Thomson Reuters

Figure 4.65: Bid-asks spread for spot USD/CAD, USD/AUD, USD/CHF

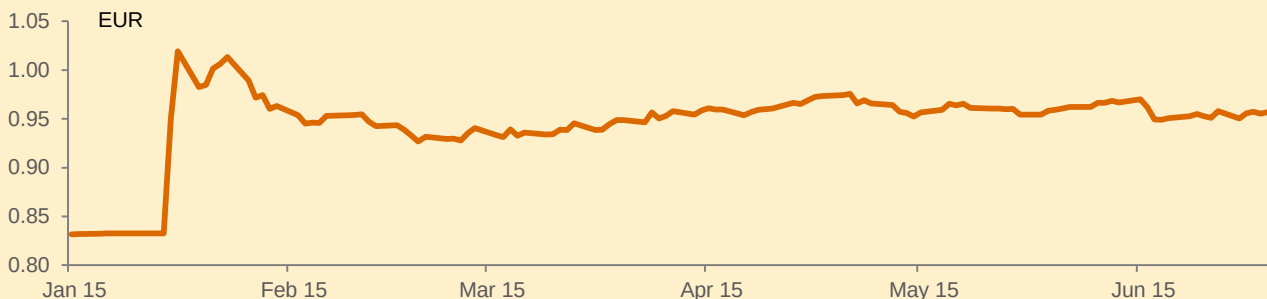
Source: Thomson Reuters

All currencies experienced a significant decline in liquidity during the financial crisis. Data from Thomson Reuters suggests that spreads for major currency pairs (EUR-USD, USD-JPY, GBP-USD, USD-AUD and USD-CHF) increased by around 30% between August 2008 and January 2009, as shown in Figure 4.64 and Figure 4.65 (although spreads for USD-CAD actually declined during the crisis). Since the crisis, spreads have remained fairly stable for the sterling and euro. However, the euro faced several bouts of widening spreads due to concerns over the European sovereign debt crisis, and more recently, risks over a possible Greek sovereign default. Spreads in the Australian and Canadian Dollar have largely declined since the crisis. However, spreads for the yen have widened steadily until 2012, before declining to pre-crisis levels. This is largely attributed to unconventional monetary policies implemented by the Bank of Japan. Spreads for the Swiss Franc however, have remained elevated following the crisis, and spiked significantly following the sudden appreciation of the Swiss franc in January 2015.

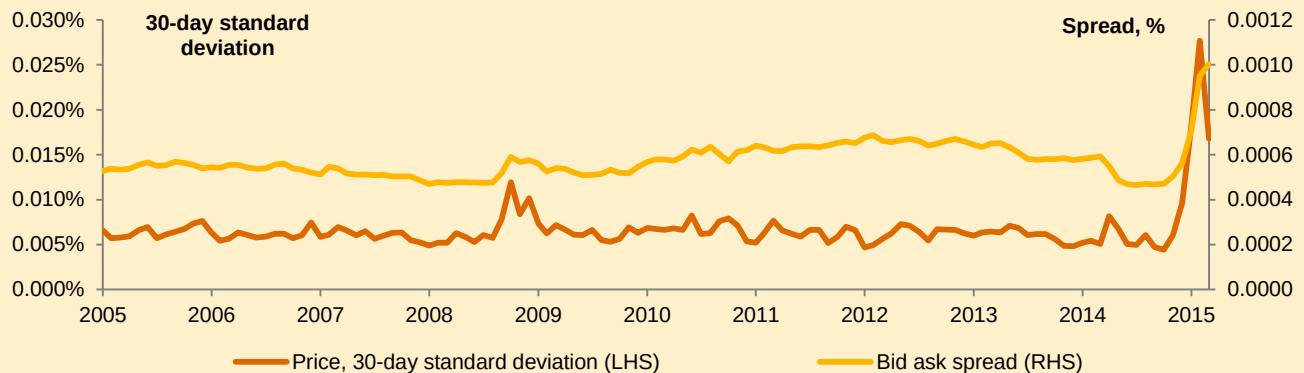
¹⁶⁵ Tightness typically refers to the financial cost of completing a transaction.

Box 4.4: Anatomy of the SNB Swiss franc move

On 15th January 2015, the Swiss National Bank (SNB) unexpectedly announced it would remove the floor of 1.20 francs per Euro, which sent the value of the Swiss franc soaring by almost 30% against the euro in the same day (see Figure 4.66). This was one of the largest currency shocks since the collapse of the Bretton Woods system in 1971. The episode caused bid-ask spreads and volatility to spike precipitously (see Figure 4.67).

Figure 4.66: EUR/CHF exchange rate

Source: Thomson Reuters

Figure 4.67: Bid-ask spread and standard deviation in USD/CHF exchange rate

Source: Thomson Reuters

Although trading volumes were reasonably high, the ability of market participants to trade without affecting prices, or to trade at all, was clearly impaired. Some trading platforms simply stopped providing quotes for Swiss francs for periods of time. Banks experienced volatile trading performance whilst providing liquidity. Although FX markets have a large and varied pool of participants, large bank players are still needed to be able to internalise those losses and to continue making markets during a temporary shock to FX markets.

Although one might expect some volatility during events of market correction, the subsequent response of market participants and the resulting exchange rate volatility may have been an overreaction. Although volatility receded fairly quickly as the market unwound itself, there are some signs of overshooting – the exchange rate plunged by 30% during the day, before recovering around half the fall in March 2015. The exchange rate eventually settled at its current level of €0.95.¹⁶⁶ In comparison to the impact of the UK exit from the European exchange rate mechanism, the value of the pound depreciated by 25% to the US dollar, and quickly settled at a new equilibrium around the US\$1.25 mark.

The extent of the overshooting and high level of volatility during the Swiss franc event was partly due to uncertainty over the global economic outlook and monetary policy, but as market makers respond to higher capital requirements and lower risk appetites, this suggests lower market liquidity could also be a factor. Electronic platforms may have helped to pool liquidity in normal times, but could also exacerbate discontinuous pricing during stress periods.

¹⁶⁶ Average of exchange rate data between 1st April 2015 and 30th June 2015.

4.4.2 FX derivatives

Market overview

FX derivatives (as defined by BIS) include FX forwards (which include deliverable FX forwards and non-deliverable FX forwards or NDFs), FX swaps and FX options. For businesses and investors, FX derivatives are crucial for managing risks.

Derivatives provide businesses who deal in foreign currencies the ability to hedge FX risks. For example, corporates and financial firms can use currency forwards to hedge against currency fluctuations by agreeing in advance the price at which a currency can be sold or bought at a future date. Businesses may also use FX swaps in order to limit or manage exposure to currency fluctuations. A key characteristic of this market is its wide diversity in the trading product structures used which, by their very nature, are not liquid.

Provision of liquidity in FX derivatives

The significant heterogeneity present in FX derivatives markets means that banks perform a critical role in supporting these markets.

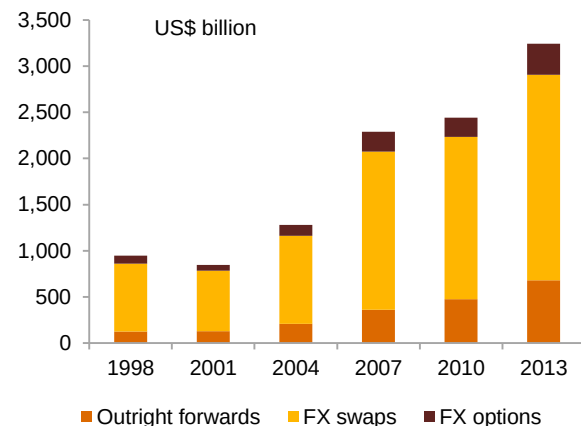
There is significant variation in liquidity across FX derivatives. Liquidity in FX derivatives markets are for some instruments, linked to liquidity in spot markets. For example, short-term FX forwards are relatively more liquid compared to NDFs and longer FX forwards.

Trends in liquidity

Depth and resilience¹⁶⁷

Figure 4.68 shows trading volumes in FX derivatives over time. Trading volumes increased from US\$949 billion in 1995 to \$3.2 trillion in 2013. FX swaps account for around 42% of total FX transaction volumes (in notional amounts) in 2013, followed by spot transactions. FX forwards is the next largest category, accounting for 13% of total FX transaction volumes. A survey conducted by the US Federal Reserve on trading volumes in OTC FX markets suggests that trading volumes in NDF contracts account for around 15% of total volume of FX forwards in the US in 2013.¹⁶⁸

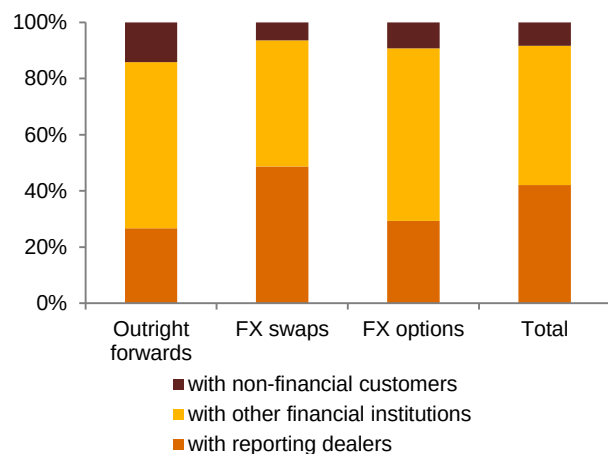
Figure 4.68: OTC FX derivatives trading volumes by instrument



Source: BIS Triennial Survey 2013

Figure 4.69 shows FX derivative volumes by counterparties. Inter-dealer trading and trading between reporting dealers and other financial institutions comprise 90% of the overall FX derivatives market. Inter-dealer trading accounts for a greater market share in the swap markets, whereas other financial institutions have a larger share in forwards and options.

Figure 4.69: Share of trading volumes in FX derivatives, by counterparty, 2013¹⁶⁹



Source: BIS Triennial Survey 2013

Of all FX derivative transactions turnover, inter-dealer trading, trading between dealers and other financial institutions, and trading between dealers

¹⁶⁷ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

¹⁶⁸ Federal Reserve Bank of New York "The FX and interest rate derivatives markets: turnover in the United States", April 2013.

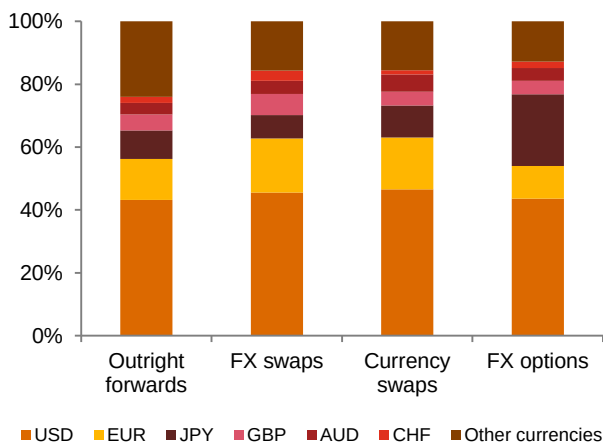
¹⁶⁹ Note: An FX swap refers to a transaction one party borrows one currency from, and simultaneously lends another to, the second party. Each party uses the repayment obligation to its counterparty as collateral and the amount of repayment is fixed at the FX forward rate as of the start of the contract.

and non-financial customers account for around 50%, 40% and 10% of the total transactions respectively. The presence of non-financial customers is most significant in FX forwards and cross-currency interest rate swaps. One driver of non-reporting banks' (a subset of other financial institutions) high volumes could be related to their funding needs. Banks often use the FX swap market to obtain short-term funding. The Bank of England's review of the FX derivatives market also suggests that part of the increase in non-reporting banks' activity in FX markets is due to the reduction in the average maturity of smaller European banks' wholesale funding. This is turn has increased the frequency of refinancing.¹⁷⁰

Breadth¹⁷¹

Figure 4.70 shows the share of volumes for six major global currencies in FX derivative markets. US Dollars hold by far the greatest share of the market at 45% across FX derivative instruments in 2013. This is followed by Euro, Japanese Yen, Pound Sterling, Australian Dollar and the Swiss Franc.

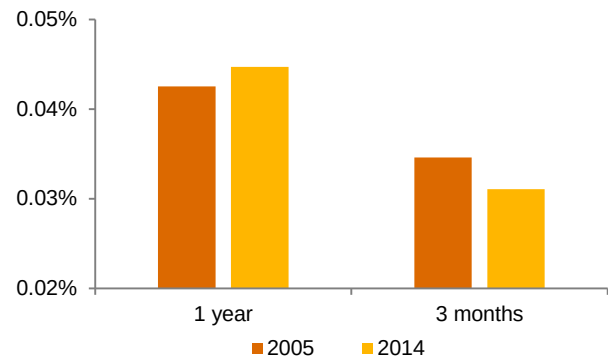
Figure 4.70: Share of trading volumes in FX derivatives by currency, 2013



Source: BIS Triennial Survey 2013

Figure 4.71 shows bid-ask spreads for EUR-USD 3-month vs 1-year forwards. It is clear that longer-term forwards tend to trade at wider spreads than short-term forwards. However, the data shows that the spread for 3-month forwards narrowed in 2014 while the spread for 1-year forwards widened compared to historical levels. These contracts attract higher regulatory capital charges, which is having an impact on liquidity in this part of the market.

Figure 4.71: Bid-ask spreads for EUR-USD forwards, 3-month vs 1 year

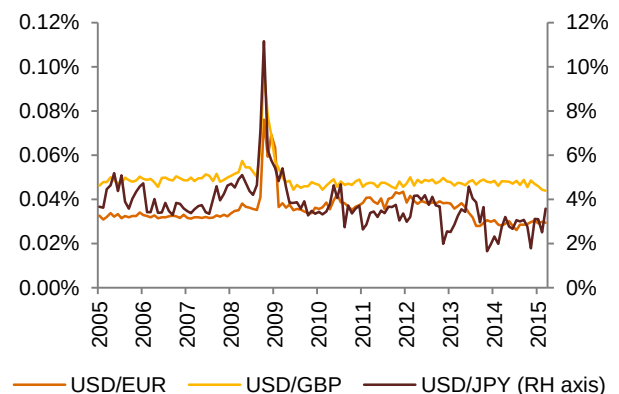


Source: Thomson Reuters

Tightness¹⁷²

Figure 4.72 shows bid-ask spreads for EUR-USD, GBP-USD and USD-JPY 1-month forwards. Data from WM/ Reuters suggests that spreads have declined slightly overall and remain below pre-crisis levels for FX forwards. The spreads for EUR-USD, GBP-USD and USD-JPY 1-month forwards have fallen by around 8%, 10% and 20% respectively between 2007 and 2015.

Figure 4.72: Bid-ask spreads for 1-month forwards



Source: Thomson Reuters

¹⁷⁰ Bank of England (2013) "The foreign exchange and OTC interest rate derivatives market in the UK", 2013 Q4 Quarterly Bulletin.

¹⁷¹ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity

characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

¹⁷² Tightness typically refers to the financial cost of completing a transaction.

4.5 Commodities

Liquidity assessment:

There are signs of reduced liquidity in commodity markets as indicated by wider bid-ask spreads. There is also some decline in breadth due to the fall in diversity of market participants as some banks have exited from physical trading.

Market overview

The commodities market is global in nature and includes different types of markets, products and players.

Commodities derivatives typically fall into two broad categories, depending on the type of settlement:

1. **Physical delivery:** These contracts require an actual and physical delivery of the commodity on the trade maturity,
2. **Cash settlement:** These transactions do not result in an actual exchange of physical commodity and are in the form of cash settlement. Such transactions include, forwards, futures, options, and swaps. These contracts are essential to support risk management in physical and financial markets.

The markets for physical delivery and cash settlement are highly interconnected and price movements are always underpinned by the interaction of supply and demand in physical markets.

Products that are typically traded on commodity markets are wide-ranging and differ in their physical characteristics, e.g. perishability, seasonality, storability and modes of transportation. Typically-traded commodities include:

- Agricultural products, e.g. corn, wheat and coffee
- Energy e.g. oil and gas
- Metals, including precious metals (e.g. gold) and industrial base metals (e.g. iron and copper)

In contrast to other more homogenous asset classes, commodities have varying characteristics. This

means liquidity does also vary depending on the type of commodity (e.g. oil is more liquid than coal), the characteristics of the product (e.g. perishability, seasonality, storability) and the maturity of the derivatives contract (e.g. short dated futures are more liquid than long dated futures). So within individual commodity groups, there can be significant variation, for example winter wheat vs spring wheat.

Similar to other derivatives markets, participants in commodities market include hedgers, proprietary traders, and market makers.

Over the last 5-10 years, the overall size of the commodity (cash settled) market has varied considerably. Commodity-based assets under management peaked in August 2011 to \$446 billion. By January 2015, this had fallen to \$267 billion – a 40% drop¹⁷³. The pre-2011 growth was supported by a commodity price super-cycle and increasing role of commodities in asset allocation.

Provision of liquidity in commodities markets

Liquidity in commodity markets is provided by the interaction among the various commodity participants in the market.

Corporate hedgers may be both buyers and sellers of commodity derivatives, depending on their view of expected price movements and impact on their business.

On the other hand, traders and market makers do not have a “natural” market position, and so can pool risks from different commodity market participants, for example, through cash-settled derivatives. Financial institutions, therefore, play a central role in connecting disparate buyers and sellers through combined physical and financial market activities, as well as needing to hedge their own commodity risk exposure.

Traders and financial institutions are important liquidity providers particularly in less liquid commodity markets because they take client flow from both buyers and sellers over a sufficient time period so as to intermediate and manage risks efficiently. When acting as market makers, these entities also help to improve price convergence and promote efficient markets.

Market makers are compensated through the bid-ask spread on trades and hence less liquid commodity trades typically require a higher bid-ask spread.

¹⁷³ Research by Barclays Capital.

However, many of the investment banks have scaled back or exited from commodities trading in recent years.

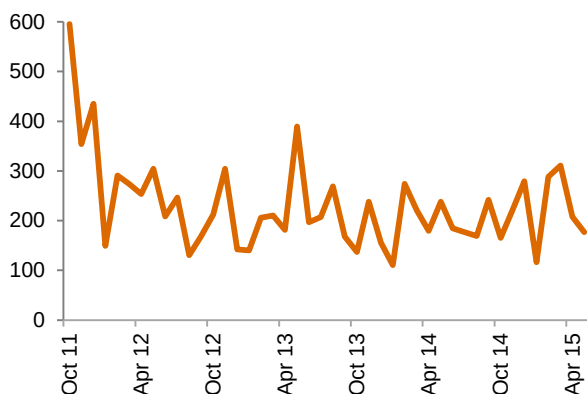
Trends in liquidity

Liquidity in commodity markets is primarily driven by economic drivers, seasonal factors, and trade flows. In this section we focus on liquidity trends across commodity derivatives markets, often by reviewing specific commodities to provide an indication of broader market conditions.

Depth and resilience¹⁷⁴

There is some variation in depth across different commodities. Figure 4.73 shows traded volumes of copper have broadly trended downwards since October 2011. Figure 4.74 shows traded volumes for oil futures (cleared through ICE), which have broadly trended up over the past 10 years.

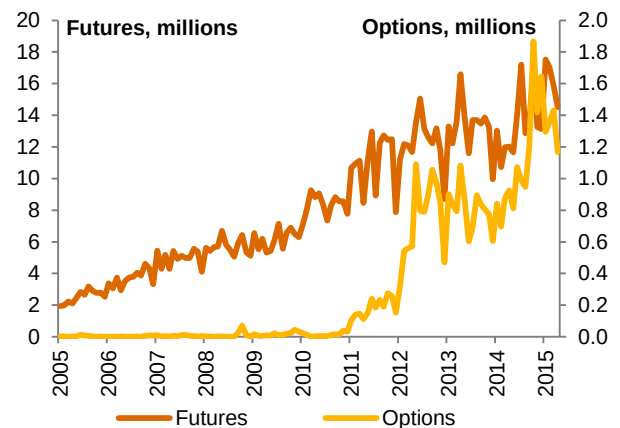
Figure 4.73: Copper listed derivatives trading volumes, number of contracts traded



Source: LME

¹⁷⁴ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

Figure 4.74: Number of contracts traded for Brent crude



Source: LME

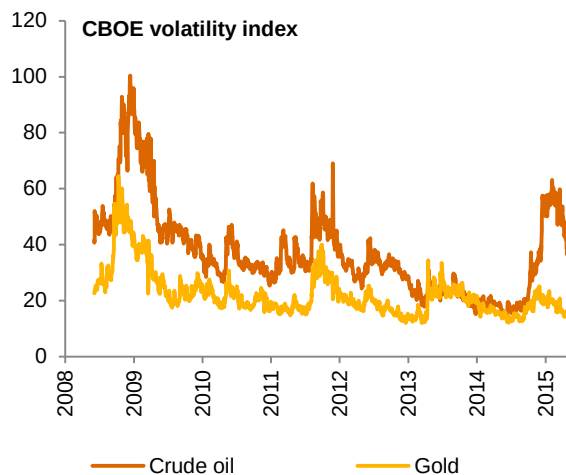
Barclays estimates that total commodity assets under management have fallen from US\$518 billion at the end of 2012 to \$286 billion in October 2014.¹⁷⁵ While the amount of commodities assets under management has declined, the velocity or turnover of trades in this market has not declined in the same way as fixed income markets.

Breadth¹⁷⁶

Figure 4.75 shows the trends in volatility in the price of two major commodities. Although the increase in volatility is not marked (in relation to historical ranges), recent trends and events -such as the late 2014-2015 oil price crash- suggest that weaker liquidity could contribute to a period of higher volatility. The spike in oil volatility associated with this price crash is shown in Figure 4.75. The overall long term volatility for both crude oil and gold, however, has been on the decline since the crisis. There is little evidence of structurally higher levels of volatility.

¹⁷⁵ FT (2014) "Investors flee from commodities as markets slide", 12 November 2014.

¹⁷⁶ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

Figure 4.75: Volatility in commodity prices

Source: Thomson Reuters

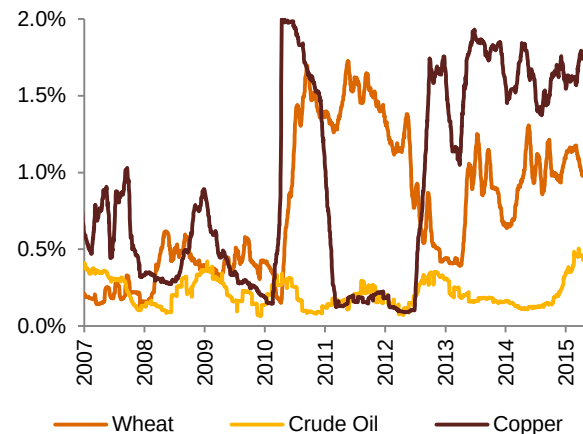
Trends in volatility across commodities have tended to track each other. However, there seems to be a divergence in trends in volatility for gold and oil recently. Volatility in oil prices spiked following the plunge in oil prices during the summer of 2014 while price volatility in gold has remained relatively low. This is consistent with the findings of Bicchetti and Maystre (2014), who show that the increasing correlations for a number of major commodities from 2008 have begun to reverse. The authors postulate that this is caused by the withdrawal of banks from commodities.

There is also some evidence of a decline in the diversity of market participants. In the last few years, there has been a decline in physical commodities trading activity by banks, as set out in our study of how banks have responded to enacted and anticipated regulatory reforms.¹⁷⁷ This was also noted by the Bank of England, FCA, and HMT joint consultation on the Fair and Effective Market Review (FEMR): “A recent trend across many commodity markets has been a transfer of market share in trading from the major investment banks to vertically-integrated commodity firms, combining both a physical business and a trading arm”.¹⁷⁸

Tightness¹⁷⁹

Figure 4.76 shows that spreads on wheat futures have become much more volatile and have trended upwards since 2010. This suggests that the cost of trading commodity derivatives has become more

expensive, and more unpredictable; ranging from below 20 bps to over 150 bps in a single year (2013).

Figure 4.76: Bid-ask spreads in Wheat futures, Crude oil and Copper listed derivatives

Source: Thomson Reuters

Similarly, Figure 4.76 indicates that copper spreads have become much more volatile and are generally trending upwards, albeit more erratically.

Figure 4.76 also shows that oil spreads are substantially lower than other commodities (as a consequence of market size), but have risen to levels not seen in a decade.

Box 4.5: The 2014 oil price collapse

Q3 2014 saw a collapse in the price of oil across the globe, driven by a wide range of geopolitical events and broader demand and supply factors. Figure 4.76 and Figure 4.74 show volumes and spreads have remained volatile since Q4 2014, despite the oil price stabilising towards the end of 2014.

Even in a very liquid asset such as oil, this increased volatility suggests that liquidity is far from consistent during periods of uncertainty, potentially reflecting the reduced number of market makers who are prepared to trade against the market.

¹⁷⁷ PwC (2014) “Structural reform study: Supplementary report 2 Inventory of bank responses to regulatory change”.

¹⁷⁸ FEMR (2014) “How fair and effective are the fixed income, foreign exchange and commodities markets?”, Consultation document.

¹⁷⁹ Tightness typically refers to the financial cost of completing a transaction.

4.6 Equities

Liquidity assessment:

Trading volumes and transaction sizes have declined, indicating declining depth and immediacy. Liquidity conditions have generally worsened for mid-cap equities. Trading in equity derivatives are increasingly concentrating in frequently-traded equity indices and on large-cap equities.

Market overview

Equities are securities which confer an ownership interest in a corporation. Equity markets, similar to the bond market, can be divided into primary and secondary markets: the primary market is used to offer new equity issues in a market, e.g. via an initial public offering (IPO). The subsequent buying and selling of issued shares occurs in the secondary market.

Along with debt markets, equity markets are important avenues for corporates to raise capital for expansion and investment. They also provide investors with opportunities to generate returns from their investments. An investor hopes to reap a dividend or sell his shares for a profit, while the corporation benefits from the capital injection which is the values of its shares.

By facilitating the efficient flow of capital, equity markets make a positive contribution to economic growth. Academic research suggests that stock market development boosts economic growth.¹⁸⁰ Developed equity markets also help to allocate risks. Obstfeld (1994) showed that international risk sharing through internationally integrated stock markets improves resource allocation and can accelerate the rate of growth. It is therefore vital that equity markets are liquid and allow the efficient flow of capital into productive ventures.

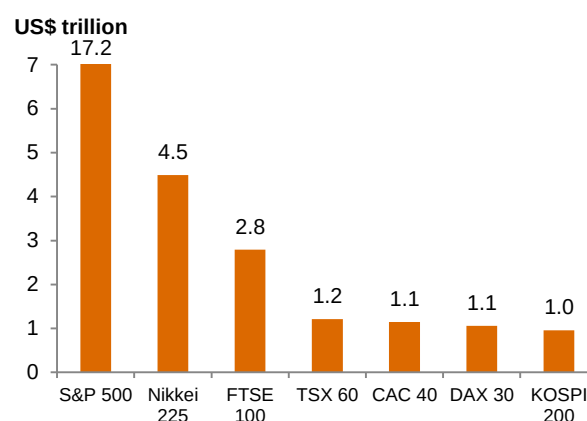
In this section we provide a brief overview of equity markets, split by large capitalisation, mid-capitalisation and then equity derivatives.

4.6.1 Large cap equities

Secondary markets for equity range from highly liquid stocks for large companies, through to illiquid private placements of equity in unlisted companies. In 2014, companies on the S&P 500 (companies with the largest market capitalisation in the US) saw trading volumes of around US\$29 trillion. In the same year, the FTSE 100 saw over US\$1.7 trillion in value of trading. Equity market instruments tend to be fairly standardised, as most companies issue a limited number of class of shares¹⁸¹, while debt instruments can be quite diverse.

At the height of the crisis, the outstanding market capitalisation fell significantly – in most cases falling below 2004 levels. This has since recovered, and most markets have exceeded their pre-crisis peak. Figure 4.77 shows market capitalisation for major stock indices as of 2014.

Figure 4.77: Total market capitalisation of major global stock market indices, 2014



Source: Thomson Reuters

The market for ETFs has also grown significantly. ETFs are attractive to investors for a number of reasons, including intraday tradability, transparency, tax efficiency¹⁸², and access to specific markets or asset classes. Net assets of equity ETFs in the US increased by 5 times from the beginning of 2006 to \$850 billion in 2015, with large-cap equities experiencing the largest increase. Daily creation and redemptions are a greater proportion of total trading for bond ETFs (19%) than for equity ETFs (9%).

¹⁸⁰ For example, Greenwood and Smith (1997) show that large stock markets decrease the cost of mobilising savings, thus facilitating investment in productive technologies. Levine and Zervos (1993, 1998), Rousseau and Wachtel (2000), Beck and Levine (2003) and Demirguc-Kunt (1994) show that stock market development is strongly correlated with growth rates of real GDP per capita.

¹⁸¹ Companies issue different types and classes of shares, including preference shares and dual class shares.

¹⁸² In the UK, ETFs are exempt from stamp duty so investors do not have to pay this tax when they buy the fund through their broker or fund platform.

Provision of liquidity in equities

This standardisation in equities lends these instruments to exchange trading. These exchanges generally have large numbers of buyers and sellers and orders can be matched quickly which facilitates immediacy in trade execution. Exchanges are subject to the regulatory requirement of pre-trade transparency so bid-ask prices are displayed and exchanges are also subject to corporate governance and disclosure requirements on a public basis.

Liquidity in exchanges is provided by a combination of designated market makers (DMMs) and a “public limit order book”, in which any investor can provide liquidity. DMMs contribute directly to liquidity and price efficiency. They also contribute to stability in financial markets, as they are required to list bid and ask prices and cannot leave markets like other market participants in instances of illiquidity and price instability.¹⁸³

DMMs and market makers facilitate transactions in the absence of a buyer-seller match, by either finding a match for the previously unpaired buyer or seller, or by committing their own balance sheet capacity to execute the trade. Their primary function is to enable buyers and sellers to execute large orders efficiently, either in respect of time to execution or minimisation of price impact. Even within liquid markets, DMMs can play a useful role, because markets that are usually liquid can also experience episodes of acute order imbalances and price dislocations. DMMs contribute to price efficiency through their price continuity obligation.

The majority of equity instruments are traded over exchanges: 62% of European equities are traded on exchanges such as the London Stock Exchange (LSE), while 16% are traded OTC.¹⁸⁴ Small cap equities tend to be less liquid than large caps and are often traded OTC.

One of the most significant changes in this market has been the creation of Multilateral Trading Facilities (MTF), for which new EU regulation implemented through MiFID in 2007, created the necessary regulatory structure for these trading platforms to develop. MTFs represent regulated trading venues which bring together multilateral buying and selling interest similarly to that of an

exchange but with some ability to have differing levels of pre-trade price transparency.

MTFs also developed dark pool MTFs to allow block equity trading, which benefits from the MiFID pre-trade transparency waiver for large-in-scale orders. A study by TABB Group (a financial markets research firm) shows that in the first quarter of 2014 dark volume and dark pools accounted for 43.6% and 17.2% of US equity volumes.¹⁸⁵

The remaining part of trading, conducted outside MiFID-regulated venues (RMs, MTFs and SIs), includes multilateral trades conducted on organised venues which do not come under present MiFID definitions (such as Broker Crossing Systems (BCSs) and some dealer platforms), and bilateral exchanges by phone, email or on single dealer platforms. The latter trading method is mostly used for large equity blocks or products which offer limited liquidity, such as customised derivative products.

A feature of liquid equity markets is the presence of algorithmic or high frequency traders. High frequency traders at times function as liquidity providers, where they can be aggressive through capitalising on their market linkages to provide and/or take liquidity away from the market or they can be passive by placing limit orders onto electronic order books. In principle, such traders actively trade throughout the day and take positions in securities that in their perspective are mispriced – however, they usually close their positions by the end of the day such that they have no or little overnight exposure.

Trends in liquidity

In the sections below, we show the trends in equity market's liquidity for each of the different dimensions of liquidity.

Immediacy¹⁸⁶

Figure 4.78 shows that the average transaction size for stocks listed on Euronext and NYSE have declined by 55% and 14% respectively since 2004. Due to decreasing liquidity, the potential impact of block orders has increased, and so there is a growing trend of voice-broking where large trades are involved, in order to avoid causing significant market movements. Transaction sizes for equities listed on

¹⁸³ Benos, E. and Wetherilt, A. (2012) “The role of designated market makers in the new trading landscape”, Bank of England.

¹⁸⁴ AFME (2011) “Market Analysis, the Nature and Scale of OTC Equity Trading in Europe.”

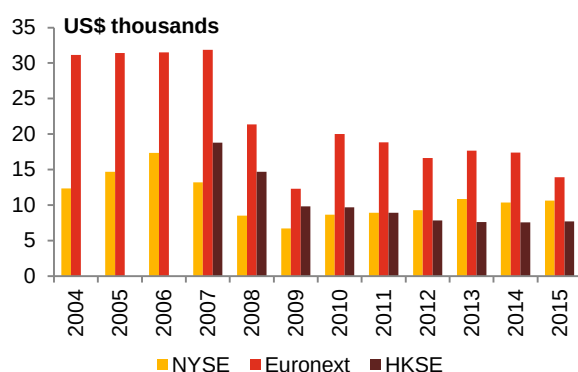
¹⁸⁵ TABB Group (2014) “US Equity Market Structure: Q1-2014 TABB Equity Digest”.

¹⁸⁶ Immediacy typically refers to the time it takes to complete a transaction. An alternative measure is the frequency of transactions and depth of trading interest in the security by investor.

the Hong Kong Stock Exchange has also declined by almost 60% since 2007.

In the early 2000s, block trades accounted for a quarter of US equity trading volumes. However, by 2012, less than 5% of shares traded on US equities markets were in blocks of 10,000 or more.

Figure 4.78: Average transaction size for major stock exchanges

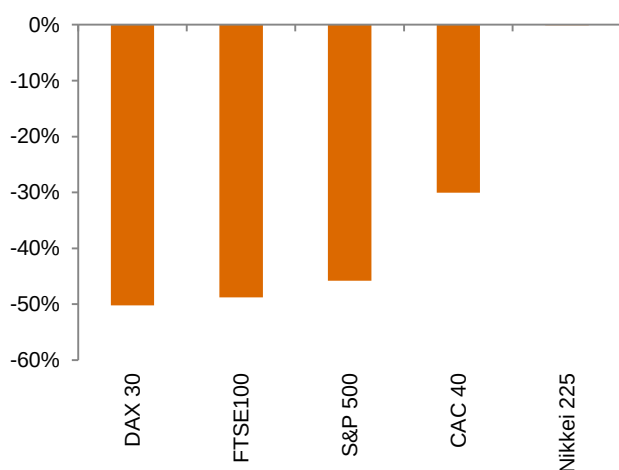


Source: WFE

Depth and resilience¹⁸⁷

Market participants are finding it harder to execute block trades, as characterised by the decline in trading volumes in key markets (as shown in Figure 4.79). Similarly average transaction volumes have also declined.

Figure 4.79: Change in trading volumes for major equity indices (2008 to 2015)

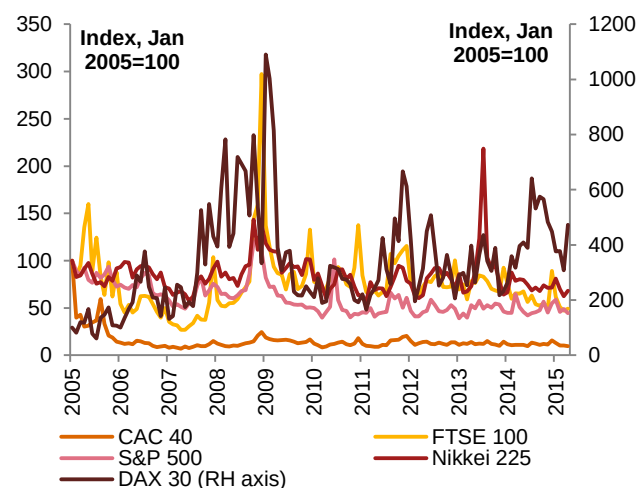


Source: Thomson Reuters

¹⁸⁷ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

We use the Amihud (2002) measure of illiquidity, which is the daily ratio of absolute stock return to its trading volumes, averaged over each month. Amihud measures the daily price impact of the order flow, which is exactly the concept of illiquidity, since it quantifies the price/return response to a given size of trade.¹⁸⁸ The higher the measure, the larger the price impact and therefore the more illiquid the market. Figure 4.80 shows that Amihud illiquidity has generally declined since the crisis across all major stock indices. However, the DAX 30 saw elevated levels of illiquidity in early 2015. There is some evidence that the growth of HFT trading strategies have contributed to this trend: Benos and Sagade (2013) find that aggressive HFT activity in the U.K. equity markets generates both significantly greater permanent price impact and significantly greater noise than non-HFTs.

Figure 4.80: Amihud measure of illiquidity

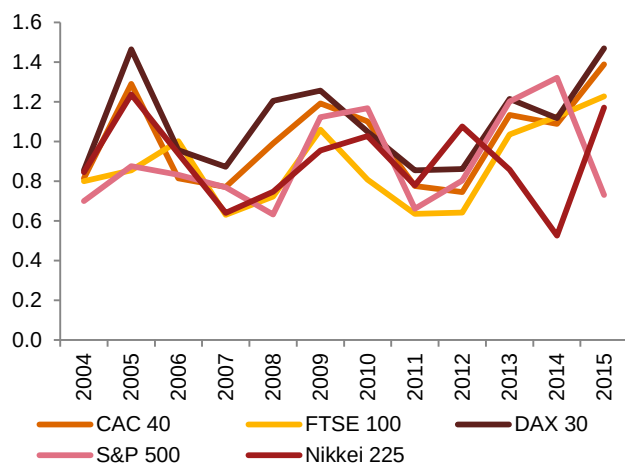


Source: Thomson Reuters

We use the Gabrielsen, Marzo and Zagaglia (2011)¹⁸⁹ market efficiency coefficient to quantify the resilience of liquidity. A more liquid market implies a smaller variance of transaction prices around the equilibrium price. The difference between actual and equilibrium prices in liquid markets is smaller than what should be observed in illiquid markets, and this is what the market efficiency coefficient seeks to capture. It is measured as the ratio of the variance of long-term stock returns to the variance of short-term stock returns. The higher the MEC, the more illiquid the market.

¹⁸⁸ Amihud, Y., Mendelson, H. and Pedersen, L. "Liquidity and asset prices". Foundations and Trends in Finance: Vol. 1: No. 4, pp 269-364.

¹⁸⁹ Gabrielsen, A., Massimiliano, M. and Zagaglia, P. "Measuring market liquidity: An introductory survey".

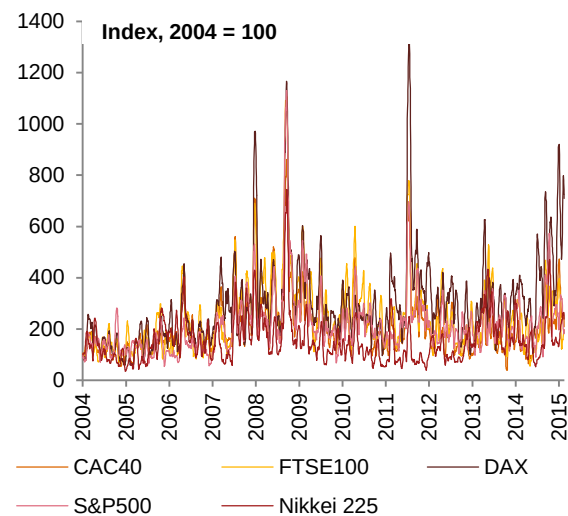
Figure 4.81: Market efficiency coefficient

Source: Thomson Reuters

Figure 4.81 shows the DAX 30 and FTSE 100 indices experienced large spikes in early and late 2008, when illiquidity peaked. The responsiveness of price to execution costs have declined over time. However, more recent periods have been marked by an increase in price responsiveness, which is consistent with the conclusions we draw from reviewing the Amihud measure of illiquidity.

Recent data on dark pool trading activity also indicate that off-exchange equity trading volumes have declined. Data from TABB Group suggests that average daily shares fell from \$897 million in April 2014 to \$761 million in April 2015.¹⁹⁰

Figure 4.82 shows price volatility through the standard deviation of prices, which provides an overall indication of resilience in equity markets. Before and during the financial crisis until mid-2009, all five markets followed a similar trend. Price volatility peaked in late 2008 with Germany, France and UK reaching the highest points. Although markets recovered from the crisis, fears over the effect of the European sovereign debt crisis, and concerns over France's AAA sovereign rating caused increased volatility in August 2011.

Figure 4.82: Volatility in equity prices

Source: Thomson Reuters

Since 2012 volatility has generally settled at pre-crisis levels. However, volatility has increased notably towards the end of 2014 and the beginning of 2015.

Mamaysky (2014) found that in the US and UK, the majority of the declines in equity volatility that have occurred tended to take place around central bank QE announcements, which suggests that QE has improved liquidity in equity markets.

Breadth¹⁹¹

Figure 4.79 shows the change in trading volumes for major equity indices since 2008, and it is clear that trading volumes have declined – and in some cases, halved – since the crisis. This trend is consistent with widening spreads in Germany and the US. Japanese spreads did not shift greatly in this period and so market volume remained constant. However the UK and France saw a decline in spreads, yet market volume has dropped dramatically. During this period France saw the introduction of the financial transaction tax, which contributed to decreased trading volumes as a result.¹⁹²

Falling FTSE 100 volumes are largely the result of political and economic uncertainty over growth prospects in Europe. Low trading volumes could also result in trading activity having a disproportionate impact on the market, which further depresses trading volume.

¹⁹⁰ TABB Group (2015) "Equities Liquidity Matrix April 2015".

¹⁹¹ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the

number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

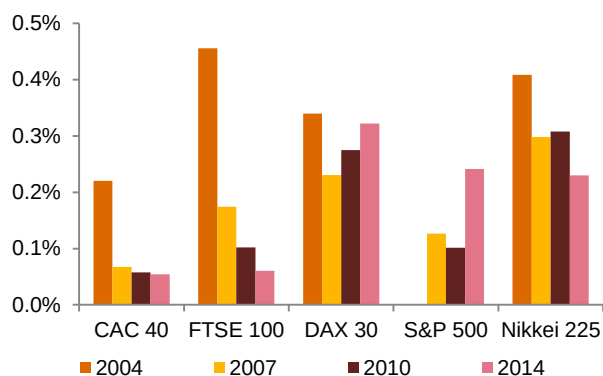
¹⁹² Capelle-Blanchard and Havrylych (2014).

Tightness¹⁹³

We use bid-ask spreads in equity markets as a measure of tightness.

Figure 4.83 shows bid-ask spreads for several major stock indices since 2004. Spreads were at their highest levels in major markets, except for the US and Japan, in 2004. Spreads have decreased over time in France, UK and Japan. Germany and the US are exceptions in that 2014 saw spreads near or surpass the 2004 peaks, while France, UK and Japan near record lows.

Figure 4.83: Bid-ask spreads for major stock market indices



Source: Thomson Reuters, S&P500 2004 data unavailable

4.6.2 Mid-cap equities

Market overview

Secondary markets for small to mid-cap equities are typically less liquid than large cap equities, for example: in 2014 the S&P MidCap 400 turned over 125 billion shares, while the FTSE250 turned over \$264 billion.

Liquidity in these markets tend to be exclusively facilitated by DMMs, which means that the role played by DMMs is far more important in the trading of small and mid-cap companies (Bank of England, 2012). DMM's trade continuity obligation helps to address asynchronous trading needs, especially for small-cap stocks where some may not trade for extended periods of time. Menkveld and Wang (2012) show that DMMs improve liquidity levels and liquidity risk for small cap stocks.

¹⁹³ Tightness typically refers to the financial cost of completing a transaction.

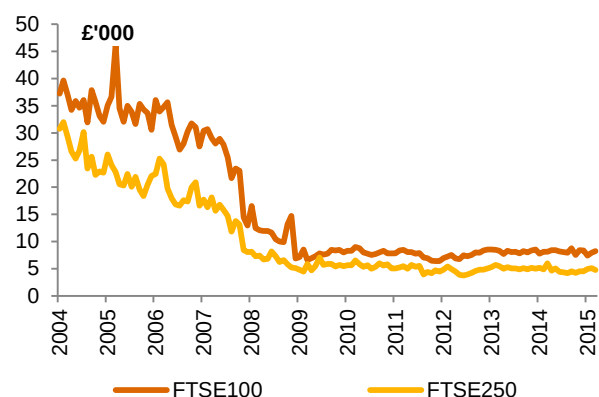
¹⁹⁴ Immediacy typically refers to the time it takes to complete a transaction. An alternative measure is the frequency of transactions and depth of trading interest in the security by investor.

Trends in liquidity

Immediacy¹⁹⁴

An important measure of liquidity for smaller capitalised equities is the average number of transactions. Unlike large caps, small and mid-cap equities tend to be traded less frequently. Figure 4.84 compares the average transaction value for FTSE100 and FTSE250 equities. The average size of transactions has generally declined for both FTSE100 and FTSE250 equities, with a steeper decline observed in the former.

Figure 4.84: Average transaction size, FTSE100 and FTSE250

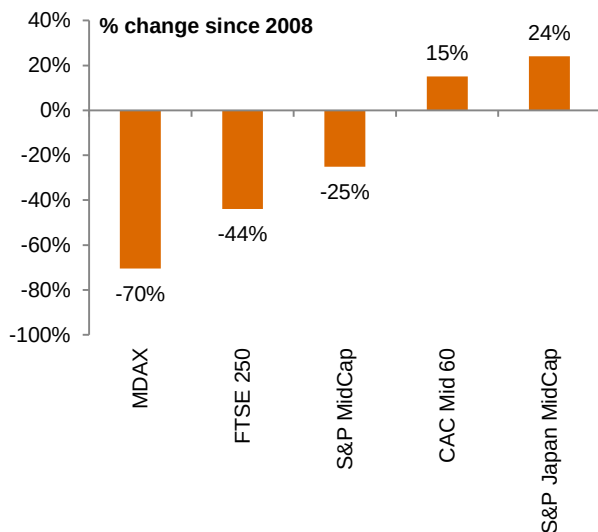


Source: Thomson Reuters

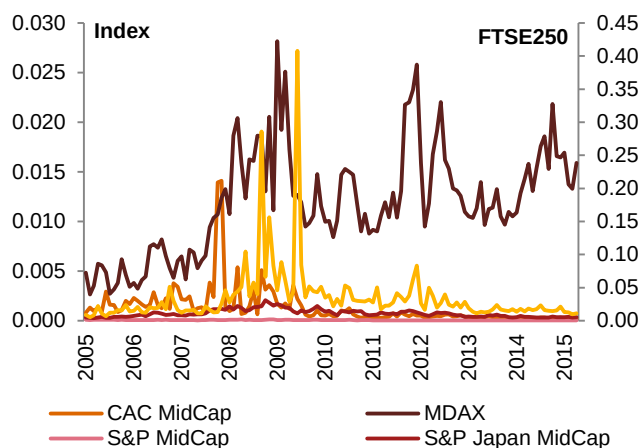
Depth and resilience¹⁹⁵

Trading volumes suggest that liquidity is declining for mid-caps (see Figure 4.85). Volumes have declined in particular in Germany, the UK and the US. Japan and France on the other hand, have seen some small increases in overall volumes. Figure 4.86 shows the Amihud illiquidity measure for mid-cap equities. Germany has seen the highest levels of volatility, and also the biggest drop in trading volumes since 2008. This is intuitive as the least liquid markets face the largest levels of volatility. In comparison, French trading volumes and hence liquidity are increasing, yet there was significant volatility. Japan saw the biggest increase in liquidity, and experienced relatively low levels of volatility as expected.

¹⁹⁵ A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

Figure 4.85: Change in trading volumes since 2008

Source: Thomson Reuters

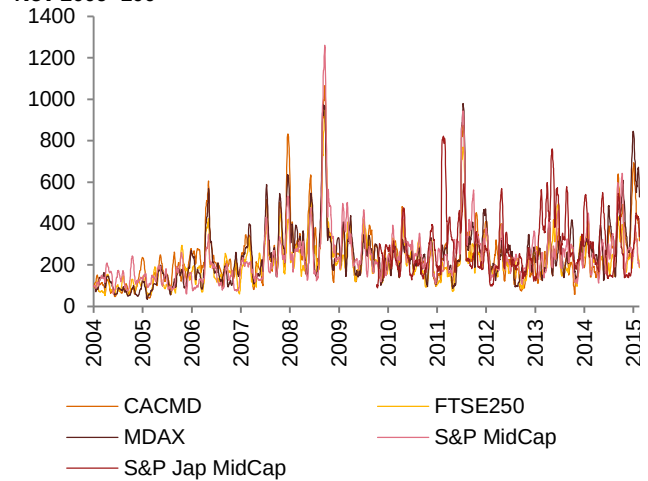
Figure 4.86: Amihud measure of illiquidity: mid-cap

Source: Thomson Reuters

Volatility in mid-cap equities peaked in 2008 and 2011 (see Figure 4.87), similar to their large cap counterparts, then declined. However, the recent data shows that volatility in European markets is on the rise.

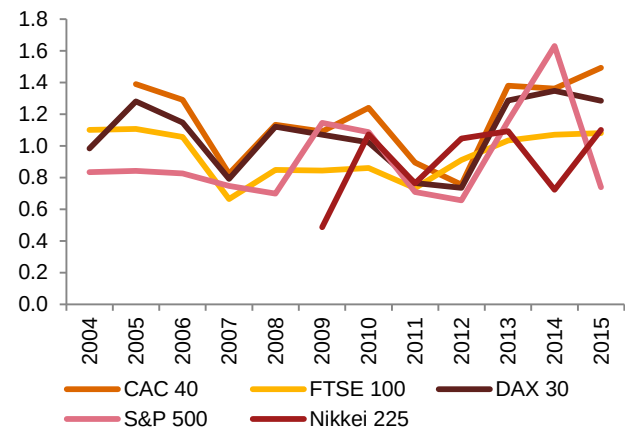
Figure 4.87: Volatility in equity prices: mid-cap

30 day standard deviation of prices, Feb 2004=100, Japan Nov 2009=100



Source: Thomson Reuters

Figure 4.88 shows the market efficiency coefficient for mid-cap equities, followed a similar trend to their large cap counterparts. Although the spikes are relatively smaller, there were distinct peaks in late 2008 and late 2011. Likewise, the trend over time shows an increasingly volatile market for mid and small capitalisation equities.

Figure 4.88: Market efficiency coefficient: mid-cap

Source: Thomson Reuters

Breadth¹⁹⁶

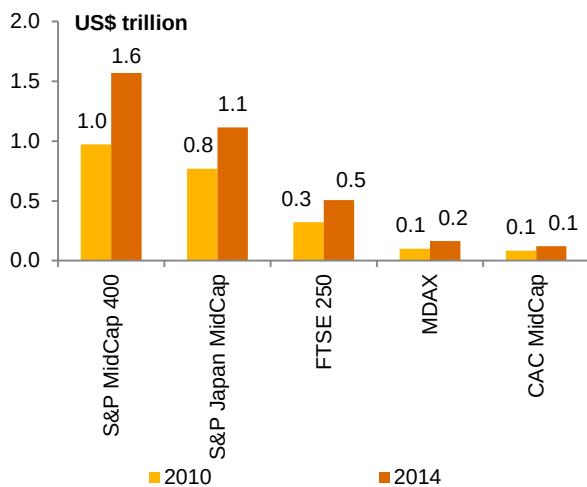
Figure 4.89 shows the total market capitalisation for mid-cap equities in five major markets. Since the crisis, market capitalisation of mid-cap equities has increased significantly, particularly for the UK and

¹⁹⁶ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the

number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

Germany, which reflects the increase in issuance for mid-cap companies.

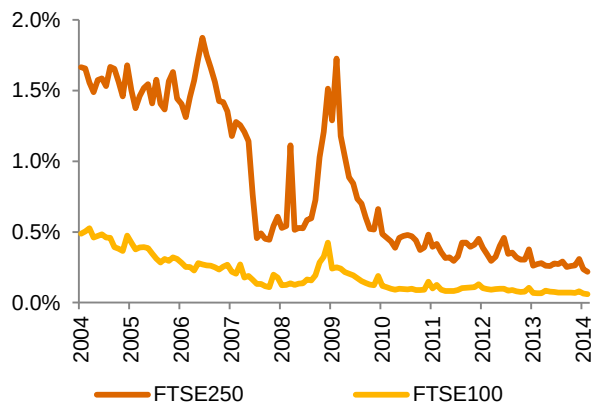
Figure 4.89: Total market capitalisation: mid-cap



Source: Thomson Reuters

Figure 4.90 shows that the gap between relative bid-ask spreads for large- and mid-cap equities have narrowed since the crisis.

Figure 4.90: Relative bid-ask spreads, UK large caps vs mid-caps



Source: Thomson Reuters

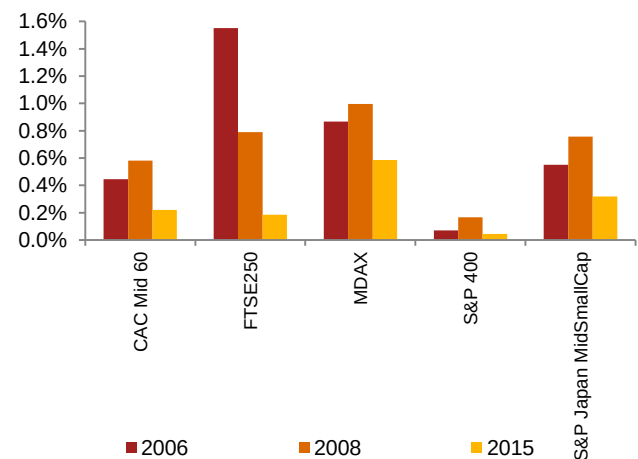
However, a study by the WFE (2013) suggests that despite an increase in the share of mid-cap companies in the total number of listed companies in Asia Pacific and EMEA, their share in value of share trading decreased in these regions. This suggests that on average, equity issues for mid-cap companies are generating lower trading volumes. Data from the WFE suggests that the share of IPOs issued by companies globally with market capitalisation of less than \$1 billion has fallen from around 90% in 2012

to 84% in 2014. This effect is even more pronounced for smaller companies with market capitalisation of less than \$500 million. Research by Dolgoplov (2013) suggests that recent IPO activity in the US has been concentrated within large cap stocks and not with small- and mid-cap stocks.

Tightness¹⁹⁷

Figure 4.91 shows the bid-ask spreads for mid-cap equities for major stock indices. Spreads have declined since the crisis, and in all cases, settling below pre-crisis levels.

Figure 4.91: Bid-ask spreads for mid-caps in major stock indices



Source: Thomson Reuters

4.6.3 Equity derivatives

Market overview

Equity derivatives allow investors to trade certain risks associated with the underlying equity with another party. For example, stock options allow investors to hedge the risk or speculate on the changes of the underlying equity price. Single stock options allow investors to create a cost effective hedge for open stock positions, and protect a long equity position against volatility or short-term drops in the price of the underlying stock. Stock derivatives are traded OTC and on exchanges.

The equity derivatives market can be categorised in three segments: (a) exchange-traded or centrally-cleared standard contracts, (b) centrally-cleared but bilaterally-negotiated contracts, and (c) OTC contracts. The market for exchange-traded contracts is well developed. All exchange-traded equity derivatives are cleared through central counterparty

¹⁹⁷ Tightness typically refers to the financial cost of completing a transaction.

clearing houses (CCPs). For centrally-cleared but bilaterally-negotiated products, market participants are able to negotiate the terms of the contract, which is later cleared via the CCP. By contrast, OTC contracts can be highly bespoke. This means such contracts are fully negotiated and pre-agreed between the counterparties. This allows counterparties the flexibility to negotiate terms, including but not limited to: underlying asset, expiry, strike, pay-off methodology, pricing methodology, lifecycle event scenarios and consequences, adjustment methodologies. As such these products are, broadly speaking, not liquid.

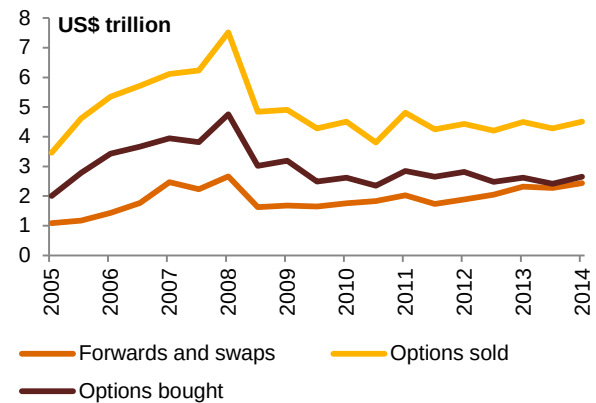
The OTC equity derivatives market accounts for around a third of the equity derivative market. In 2013, trading volumes for exchange-traded equity-linked futures and options amounted to approximately US\$20 trillion, whereas OTC contracts account for around US\$7 trillion in notional values.¹⁹⁸ OTC contracts continue to make up an important part of the overall population of equity derivatives. This reflects the demand for customisation that the listed market is unable to satisfy, for which market makers still act as an important intermediary to match buyers and sellers.

According to a semi-annual study of OTC derivatives markets by BIS, the notional amount outstanding of OTC equity derivatives contracts fell from \$6.82 trillion as of June 2013 to \$6.56 trillion at the end of that year, a decline of 4%.¹⁹⁹

Although the equity derivatives market is undergoing a gradual change towards greater standardisation and exchange trading, the bespoke requirements set out in bilaterally-negotiated contracts mean that OTC equity derivatives are not easily replaced with exchange-traded equity derivatives. ISDA has taken steps to introduce standardised documentation for OTC equity derivatives.²⁰⁰ However, standardisation will take a long time to implement for a wide range of product types where contract terms remain far from standardised.

Total notional values of outstanding OTC derivatives contracts, including forwards, swaps and options, fell following the crisis, amounting to \$6.9 trillion in June 2014 (see Figure 4.92). Within this, European and US equities together account more than 70% of the total.

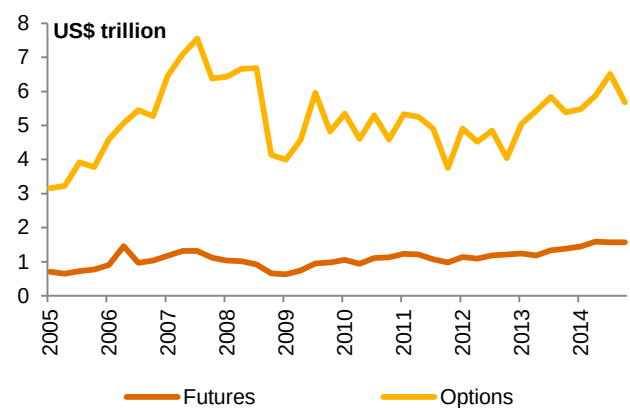
Figure 4.92: OTC derivatives, notional amounts outstanding²⁰¹



Source: BIS

Post-crisis, regulatory reforms contributed to the migration of trading activity from OTC derivatives to exchanges and trading venues for vanilla OTC derivative contracts that have listed equivalents. While overall outstanding OTC derivative values have remained stable, the outstanding amount of exchange-traded derivatives has increased. Figure 4.93 shows that the outstanding notional principal of exchange-traded equity linked futures has increased 42% since the crisis (2009 Q2) while options have also increased over the same period.

Figure 4.93: Exchange-traded equity-linked derivatives – amounts outstanding of notional principle



Source: BIS

In the next section we discuss the liquidity trends in equity-linked derivatives. However, this is primarily in relation to exchange-traded equity derivatives which are broadly speaking, more liquid than OTC

¹⁹⁸ ISDA (2013).

¹⁹⁹ BIS Semiannual OTC Derivatives statistics.

²⁰⁰ 2011 ISDA Equity Derivatives Definitions implementation.

²⁰¹ Separate data on options sold and options bought are recorded on a gross basis, i.e. not adjusted for inter-dealer double-counting. Source: BIS.

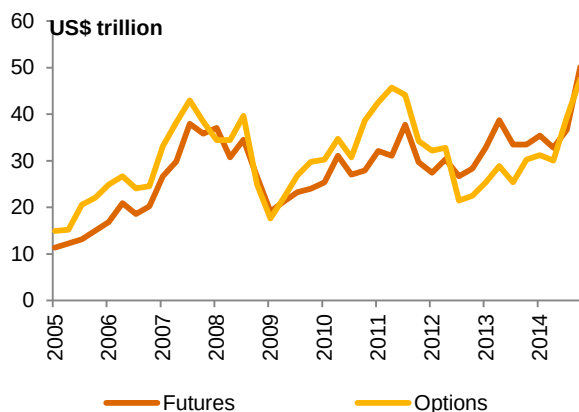
derivatives. The lack of accurate data for OTC equity derivatives and its sub-components (particularly those that are bilaterally negotiated and cleared, and OTC products), makes the identification of liquidity trends for OTC equity derivatives more challenging.

Trends in liquidity

Depth and resilience²⁰²

Overall trading volumes for exchange-traded equity-linked futures and options have more than doubled since the crisis (see Figure 4.94). Data from BIS shows that exchange-traded equity index futures reached \$1.48 trillion at the end of 2013, while trade values increased from \$104 trillion to \$138 trillion. Open interest in exchange-trade equity index options reached \$5.76 trillion, while trade values increased from \$99 trillion to \$113 trillion.

Figure 4.94: Exchange-traded equity-linked derivatives – trading volumes



Source: BIS

Breadth²⁰³

Despite the size of the market, however, trading volumes are concentrated on relatively few indices. A report by ISDA shows that the top five most-traded contracts comprised 98% of total exchange-traded equity-linked derivatives volumes, while the most popular product – the Euro Stoxx 50 index futures – accounted for 52% of volume over the year to March 2014.²⁰⁴

²⁰² A market is deep when there is a large flow of trading volumes on both the buy and sell side on a frequent basis. Large volume flows in both directions also reduces the price impact of transactions, creating resiliency. Measures of depth include turnover, which captures volumes traded relative to the size of the underlying market.

²⁰³ Breadth typically refers to the consistency with which liquidity is distributed within asset classes and the differences in liquidity characteristics across markets. This can be captured through the number and diversity of market participants, and by segregation of assets into different liquidity strata, for example by volumes.

²⁰⁴ OTC equity derivatives are not included in the reported figures.

4.7 Emerging markets

Liquidity assessment:

Although emerging market fixed income trading volumes have increased, they have not kept pace with the significant increase in issuance volumes in recent years. Turnover ratios have declined, indicating a reduction in market depth.

Market overview

Financial instruments of issuers from emerging markets (EM) have historically been treated as an individual asset class, across equities, fixed income instruments, FX and commodities. This is largely because their components are driven by similar economic and financial commonalities.

The geographical scope of emerging markets broadly includes the BRICS (Brazil, Russia, India, China, and South Africa) and the MINT (Mexico, Indonesia, Nigeria and Turkey) with a long tail of other emerging economies. These markets are complex and varied, but there are a number of common themes, particularly in their development and use of financial markets.

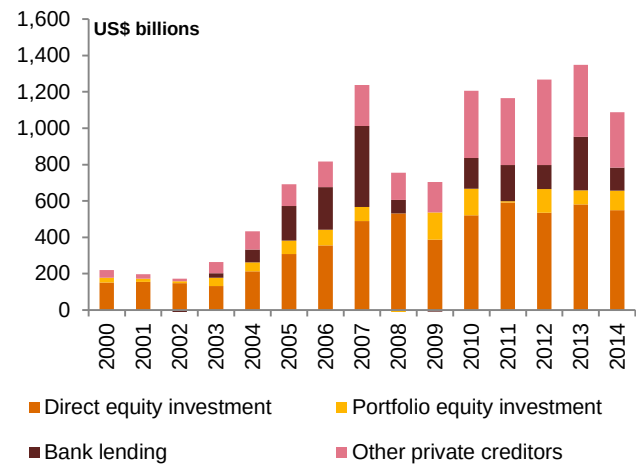
EM investments tend to be more risky, but offer high potential returns, especially in the current low interest rate environment in much of the developed world. EM instruments also offer diversification benefits to investors and as hedging instruments, largely because they tend to exhibit less co-movement with developed markets, which allow investors to reduce the overall risk of a portfolio.

EM financial markets have important linkages with developed world financial markets. Figure 4.95 shows EM capital flows. This is for a number of reasons:

- Financial flows from advanced markets impact emerging financial market;
- A number of financial markets are global in nature (e.g. commodities, FX) so emerging markets form part of these global markets. In such situations, emerging market activity is typically much lower than for developed markets; and
- Companies and governments in emerging markets often tap more liquid international sources finance in preference to less liquid

domestic sources. For example, companies in emerging markets often tap international or Eurobond markets for debt finance needs. These international fixed income markets are more integrated into global financial system.

Figure 4.95: Emerging market financial flows



Source: IIF

Although EM capital markets are relatively less developed than in advanced economies, markets have grown considerably in EMs. Stock market capitalisation has grown from 28% of GDP in 2000 in average to 34% in 2012²⁰⁵. Fixed income issuance for both corporates and sovereigns have also grown – data from Thomson Reuters suggests that total issuance from emerging market borrowers peaked in 2014 at \$ 480 billion.²⁰⁶

Trends in liquidity

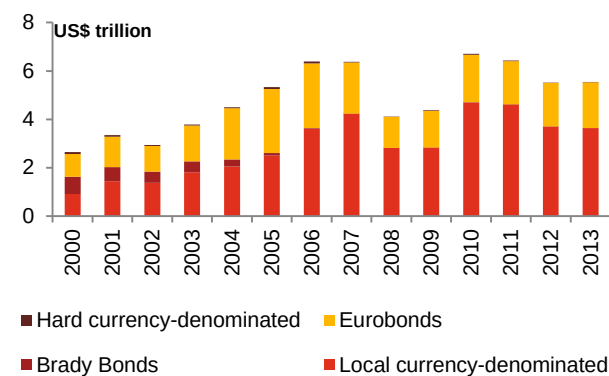
4.7.1 Fixed income

Since the global financial crisis, EMs have seen a substantial influx of capital, particularly in fixed income, in both sovereign and corporate bonds. Low yields as a result of quantitative easing programmes and low interest rates in the US and Europe are driving investors to seek higher returns in EMs.

Figure 4.96 shows fixed income trading volumes, by type. Local-currency denominated assets are traded almost four times as much in 2013 as in 2000, in contrast Brady Bonds have virtually left the market.

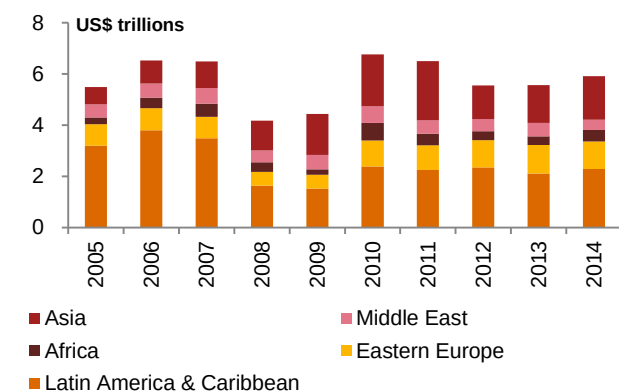
²⁰⁵ Source: World Bank.

²⁰⁶ Reuters (2014) “Emerging market bond issuance hits record high in 2014”, 30 December 2014.

Figure 4.96: Fixed income trading volumes by type

Source: EMTA

Figure 4.97 illustrates trading volumes in EM debt since 2005. Data from EMTA shows that emerging markets debt trading volumes increased to US\$5.9 trillion in 2014, which is a 6% increase from the US\$5.6 trillion in 2013.

Figure 4.97: EM fixed income trading volumes

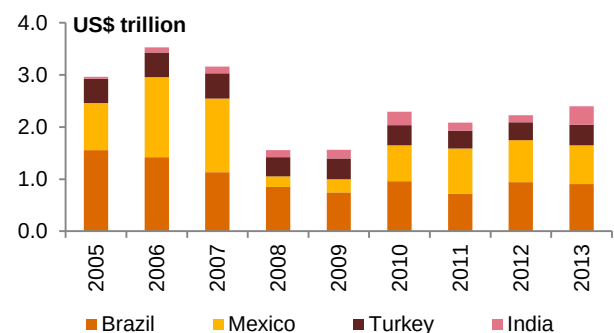
Source: EMTA

An increasing amount of this debt is issued in foreign currencies, as seen in the rise of Euro- and Dollar-denominated debt. The market for EM hard currency bonds is now bigger than the US high yield corporate bond market, and four times the size of Europe's high yield bond market. EM corporate bond issuance has grown particularly strongly: in 1994 hard currency EM corporate bonds were worth \$107 billion, by 2015 this had reached \$2 trillion²⁰⁷. Continuing currency fluctuations could also have an impact on the ability of EM issuers to finance their foreign currency-denominated debt obligations. For example, the Economist notes that "in 2010 a Turkish firm borrowing US\$10 million via a ten year bond with a 5% coupon could expect to pay 22.5 million lira (US\$15 million) over the life of the bond.

²⁰⁷ Source: EMTA.

But the lira is down 43% against the Dollar since then; the payments are now over 39 million lira."²⁰⁸

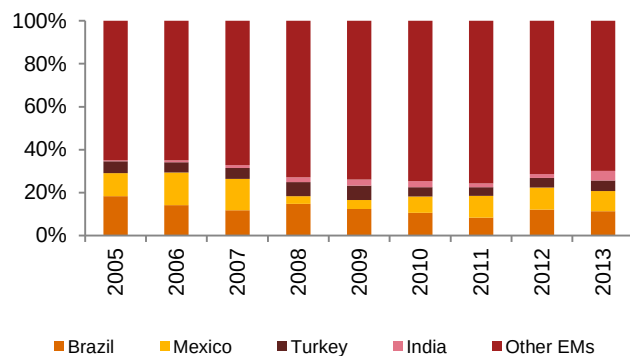
Latin America accounts for a significant share of EM trading volumes in fixed income, dominated by Brazil and Mexico (see Figure 4.98). Trading volumes in Brazil have declined since 2005 (see Figure 4.98). However, between 2009 and 2014 Brazil saw the largest growth in debt issuance in Latin America region. Mexico has also seen a large growth in debt issuance, particularly by corporates over the last few years. The country benefits from relatively strong macroeconomic fundamentals, a well-developed banking system and a liquid currency. Although volumes plunged in 2008 during the financial crisis to less than a fifth of 2007 volumes, it has since recovered to around 70% of pre-crisis levels. Trading volumes in Turkey have remained stable at around \$360 billion since the crisis, whereas India has seen an increase in trading volumes more recently to around \$411 billion in 2013.

Figure 4.98: Fixed income trading volumes in Brazil, Turkey, India and Mexico

Source: EMTA

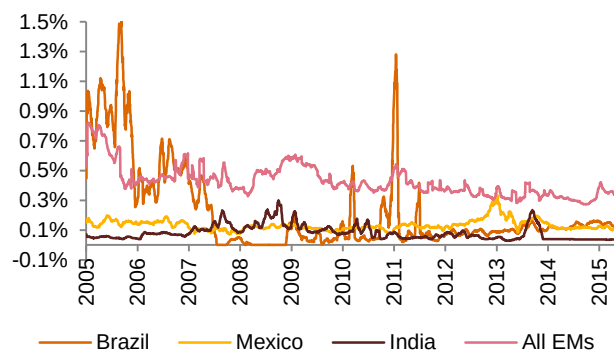
The share of fixed income trading volumes for other EMs (apart from Brazil, Mexico, India and Turkey) have appeared to decline from a peak of 75% in 2010 to 70% (see Figure 4.99).

²⁰⁸ Source: Economist 2015.

Figure 4.99: Share of fixed income trading volumes by market

Source: Thomson Reuters

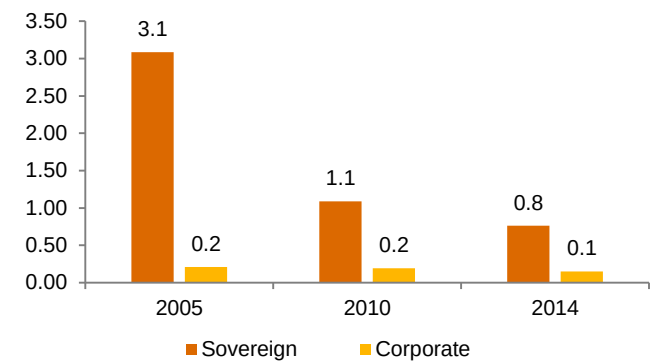
Bid-ask spreads in sovereign bond markets appear to be trending downwards, with several small periods of volatility (see Figure 4.100). Emerging markets have benefited from increased capital flows as a result of quantitative easing in developed economies. There are some studies that show episodes of QE coinciding with modest portfolio rebalancing across emerging markets and the US (Fratzcher, Lo Duca and Straub, 2013). However, spreads spiked in Brazil in late 2010 and early 2011 as a result of investor uncertainty over fiscal policy in the midst of presidential elections.

Figure 4.100: Relative bid-ask spreads for sovereign bonds

Source: Thomson Reuters

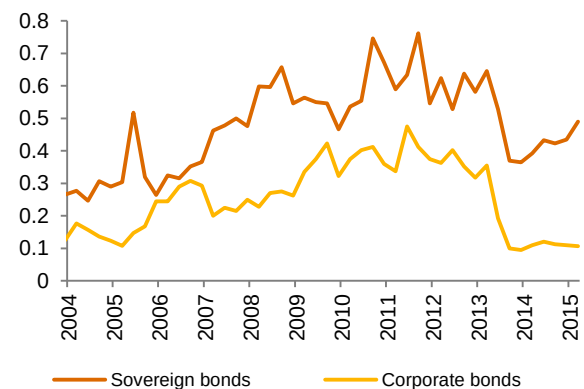
An examination of the turnover ratios for emerging market suggests that there are signs of declining liquidity in sovereign and corporate bonds. Figure 4.101 shows the turnover ratios for sovereign and corporate bonds for Brazil, Turkey, Mexico and India. Turnover ratios have declined significantly since 2005 for both sovereign and corporate bonds as trading volumes have failed to keep up with issuance volumes. Across the four markets, outstanding corporate bonds issued have increased by 16% while trading volumes have only increased by

9% between 2010 and 2014. Similarly, sovereign bond trading volumes have increased by 8.5% while outstanding issuance has declined by 0.7%.

Figure 4.101: Turnover ratios for sovereign and corporate bonds for Brazil, Turkey, Mexico and India

Source: BIS, EMTA

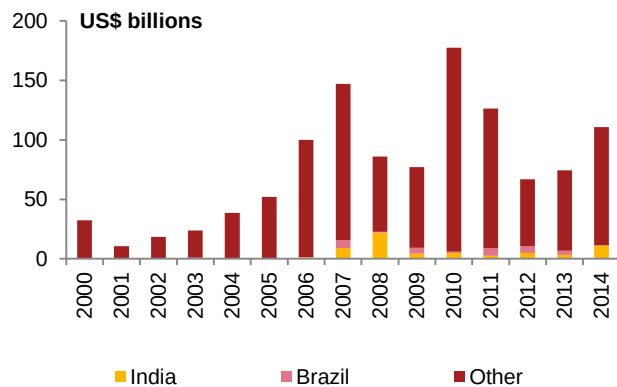
Similar trends are observed for Asian emerging markets. Figure 4.102 shows the turnover ratios for Asian emerging markets. While turnover ratios have increased between 2001 and 2012, the turnover ratio for corporate bonds has fallen back to 2003 levels, while for sovereign bonds the turnover ratio has halved.

Figure 4.102: Ratio of annual trading volumes to outstanding volumes for Asian emerging markets

Source: Asian Development Bank

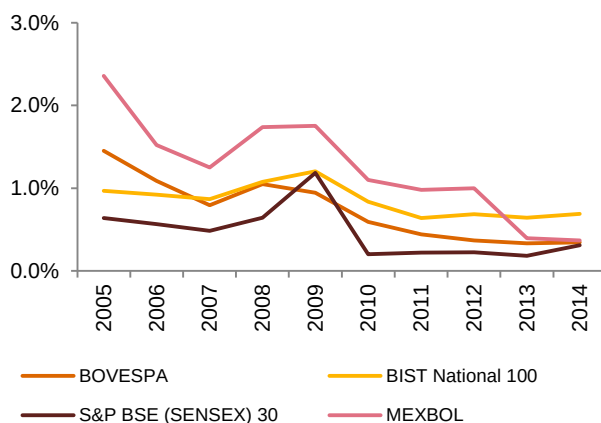
4.7.2 Equities

EM equity issuance has increased since the crisis to around \$102 billion in 2014 (see Figure 4.103). EMs have also benefitted from cross-border equity flows. Direct and portfolio equity investment into EMs increased significantly from \$157 billion in 2000 to \$656 billion in 2014.

Figure 4.103: Emerging market equity issuance, 2000-2014

Source: Thomson Reuters

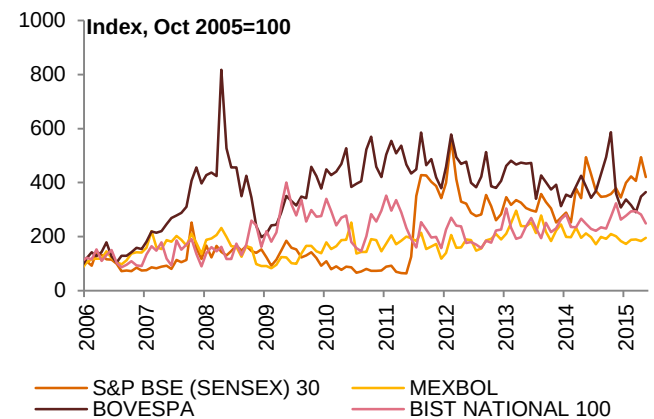
In many ways EM equity markets are stratified in the same ways as developed markets: certain equities have high daily trading volumes and are seen as relatively liquid, others are traded far less frequently and are seen as a buy-and-hold investment. However, the overall level of liquidity is much lower relative to more developed markets. Only 90 companies within EMs have daily trading volumes over \$100m.²⁰⁹ Figure 4.104 shows bid-ask spreads for the top market indices in Brazil, Mexico India and Turkey. Although equity markets suffered a spike in bid-ask spreads during the crisis, spreads have been generally declined since. More recently however, spreads have started to tick up again.

Figure 4.104: Relative bid-ask spreads for EM equity indices

Source: Thomson Reuters

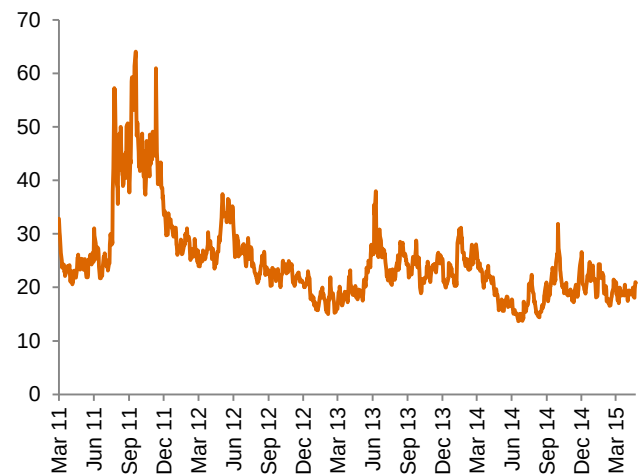
Trading volumes in EM equity markets fell during the crisis, but has largely recovered and has remained fairly stable. Figure 4.105 shows the trends in trading volumes for a selection of equity indices.

Trading volumes for India Sensex 30 increased significantly over 2011, but has remained stable at around \$860 million in average trading volumes since then.

Figure 4.105: Daily trading volumes for EM equity indices

Source: Thomson Reuters

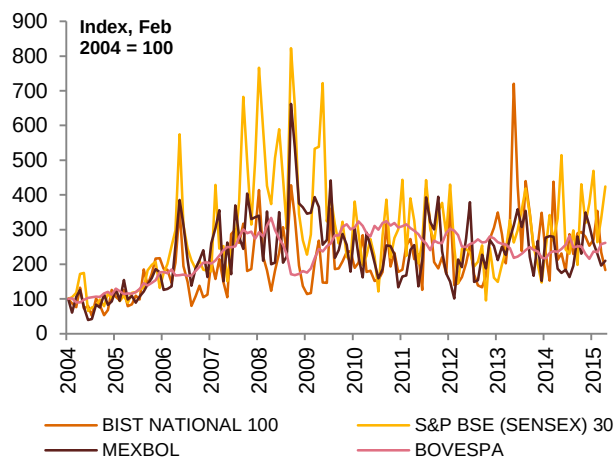
Figure 4.106 shows the CBOE Emerging Markets ETF Volatility Index Options (VXEEM). Volatility appears to be trending down since 2011. This is largely consistent with price volatility in a number of EM equity indices (see Figure 4.107).

Figure 4.106: CBOE Emerging Markets ETF Volatility Index Options (VXEEM)

Source: Thomson Reuters

²⁰⁹ David Reid, BlackRock, quoted in Money Observer 2014.

Figure 4.107: EM equity indices volatility, 30-day standard deviation in price

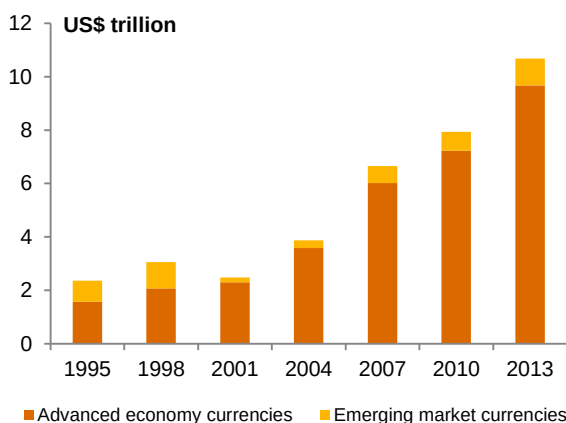


Source: Thomson Reuters

4.7.3 Emerging market FX

Figure 4.108 shows the average daily OTC FX transaction volumes for advanced economies and emerging market currencies. EM currency transaction volumes have grown since 2007, reflecting the increase in investment inflows into EMs. Volumes have increased from \$625 billion to just over \$1 trillion. The largest traded EM currencies are the Russian Rouble, Chinese Yuan, Hong Kong Dollar and the Mexican Peso, which account for 40% of EM FX volumes.

Figure 4.108: Daily average OTC FX trading volumes by currency²¹⁰

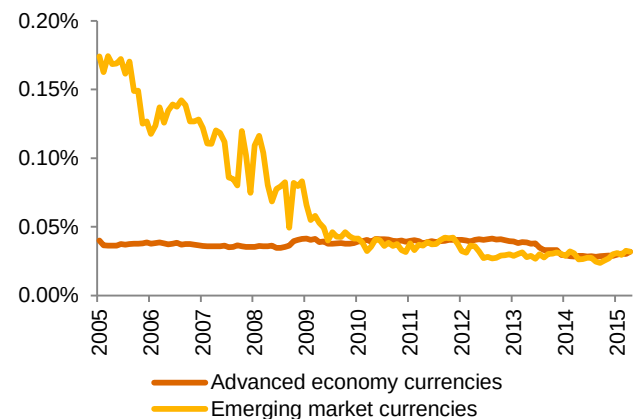


Source: BIS

Figure 4.109 compares the bid-ask spreads for a basket of advanced economy currencies against emerging markets currencies. Although EM

currencies traded at spreads 14 bps larger than hard currencies, EM spreads have declined significantly, and at several points between 2010 and 2013, traded at lower spreads.

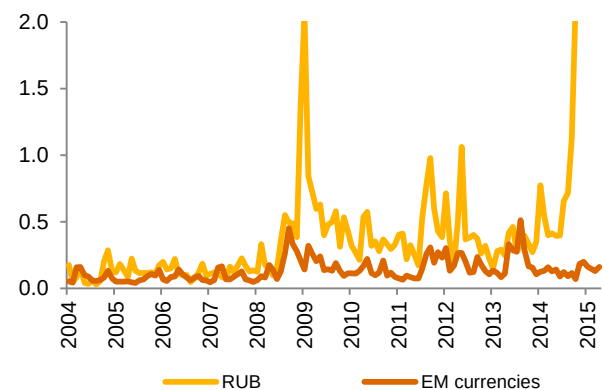
Figure 4.109: Relative bid-ask spreads for advanced economy vs emerging market currencies



Source: Thomson Reuters

Figure 4.110 shows the exchange rate volatility for a basket of EM currencies. Volatility increased during the crisis, but subsequently declined before suffering brief spikes in 2011 and 2013. This suggests that liquidity has broadly held up in these markets, however there are some signs that volatility has started to tick up again towards the end of 2014. This is especially the case for the rouble, which has seen a spike in volatility as Western sanctions bite.

Figure 4.110: Exchange rate volatility for a basket of EM currencies and rouble, 30-day standard deviation in price²¹¹



Source: Thomson Reuters

²¹⁰ Advanced economy currencies include the US Dollar, Canadian Dollar, Japanese Yen, Euro, British Pound, Australian Dollar, Swiss Franc, New Zealand Dollar, Swedish Krona, Norwegian Krone, Singaporean Dollar, and Danish Krone. Emerging market currencies include all other currencies monitored by the BIS

Triennial Bank Survey: Global foreign exchange market turnover in 2013. For the purpose of aggregate volumes, BIS divides the total volumes across different currencies by two.

²¹¹ EM currencies in the chart excludes the Russian rouble.

Box 4.6: Possible impacts on emerging markets from changes in market liquidity

Emerging markets have seen strong growth in issuance, particularly in fixed income instruments, as a result of faster economic growth, albeit from a lower base. The overall trading volumes of emerging market debt rose to US\$1.45 trillion in Q3 2014, up from US\$1.26 trillion the year before, with corporate Eurobond trading exceeding sovereign Eurobonds for a second straight quarter.²¹²

Emerging markets are highly dependent on global liquidity conditions which support the Eurobond market. Liquidity provides emerging market economies with resources for strengthening of their underlying macroeconomic fundamentals.

A liquidity stress event that originates from advanced economies is likely to affect emerging markets as they have been recipients of large amounts of capital inflows during the period of quantitative easing. Around a third of fixed income issues in emerging markets consists of Brady bonds, Eurobonds or hard currency denominated bonds.²¹³

The concerns around the impact of a capital inflows in emerging markets are two-fold. First, the increase in net portfolio flows into emerging markets, partly as a result of lower growth prospects and unconventional monetary policy in advanced economies, has raised some concerns about the possible adverse effects on domestic economies, including the exchange rate appreciation and inflationary pressures. Second, a global reduction in liquidity and a rapid reversal of capital flows will impair the ability of emerging economies to access much-needed capital for investment, which will have

an impact on growth, output, productivity and capital formation.

An example of this dynamic is the Mexican crisis of 1994-1995 ("The Tequila Crisis"): Excessive enthusiasm on the part of foreign investors not based on Mexico's economic fundamentals, combined with a currency mismatch in banks' assets and liabilities, left Mexico vulnerable to a sudden change in investor appetite for Mexican investments. An increase in US interest rates triggered a sudden change in investor sentiment, leading to a balance of payments and banking crisis in Mexico.

A global contraction in liquidity will reduce demand for emerging market debt. In fact there are some signs that regulatory changes in the US and Europe have had an impact on the liquidity of emerging market instruments, as indicated by fast declining turnover ratios. The reversal of QE in the short-term is likely to exacerbate this trend. According to Moody's "the tapering process and its associated increase in US and global financing costs will, on average, have a considerably greater impact on countries in emerging markets than on advanced countries... emerging market economies could face a cumulative 2013-2016 GDP growth loss of between 2.8% and 3.1%."²¹⁴

In the longer term, emerging markets will develop their own domestic financial markets, but are dependent on international financial markets to make this transition.

²¹² Source: EMTA.

²¹³ Based on data for Brazil, Mexico, Turkey and India.

²¹⁴ Moody's Investor services, "QE Tapering: Impact Differs Amongst Emerging Markets", 6 February 2014.

4.8 Summary

Following our review of liquidity across asset classes, we find specific areas where we have detected a reduction in market liquidity, or warning signs that more significant declines may be masked by other factors. This is most pronounced in dealer-driven markets for OTC-traded financial instruments. This has been accompanied by changes to market behaviour to accommodate the new liquidity environment, which help to mitigate its impact.

We have identified four broad areas of weakness in financial markets liquidity. These are:

1. Difficulty of executing trades;
2. Reduction in market depth;
3. Increase in volatility; and
4. Bifurcation in liquidity, i.e. a reduction in liquidity in assets which have traditionally been less liquid.

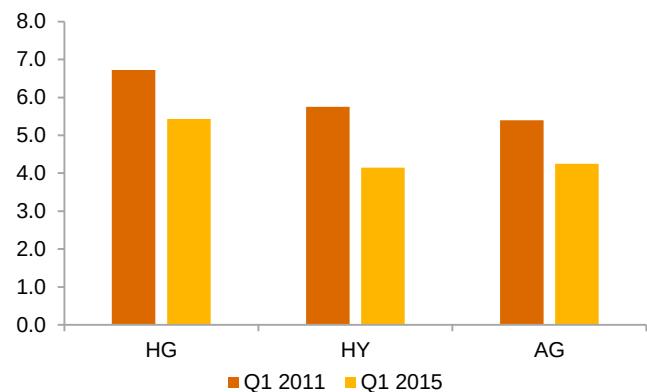
We discuss each in turn.

4.8.1 Difficulty in executing trades

Market data suggests the trading environment has become more difficult and this is supported by the conversations we have had with market participants.

Using proprietary transactional²¹⁵ data for a large sample of US corporate bonds we find evidence to support the finding of increased difficulty in executing trades. As shown in Figure 4.111 below, between Q1 2011 and Q1 2015, the average number of responses each buy inquiry received fell for investment-grade, high-yield and agency bonds. Fewer responses shows that the market is not as fluid in 2015 as in 2011. Data for sale inquiry responses also exhibits a similar trend.

Figure 4.111: Average number of responses each buy inquiry receives (US corporates and agency)



Source: MarketAxess

Note: The averages above are taken from large sample of US bonds which were traded in the respective quarters. HG = High Grade, HY = High Yield, AG = Agency.

There is also evidence that executing trades in Asia is becoming more difficult. Data from the Asian Development Bank shows that average transaction sizes in corporate bonds, for a sample of Asian countries, has been falling from 2010 through to 2013. This is congruent with the observations of market participants, which suggested that larger trades are having to be broken up to achieve more favourable pricing.

Part of the difficulty in executing trades is caused by the fragmentation of liquidity across multiple new trading venues and geographies, resulting in additional complexity and transaction costs for investors. For example, in relation to derivatives, European dealers have opted to trade Euro interest rate swaps with other European dealers rather than be subject to US rules (see Chapter 3 for more information on SEF). Research by ISDA also shows that that global derivatives markets have fragmented along geographic lines since the introduction of the US Swap Execution Facility (SEF) regime in October 2013, which is corroborated by the results from end-user surveys.²¹⁶

As detailed in Chapter 3, in May 2015, the price difference for the same USD swap cleared at LCH and CME increased significantly, exhibiting up to 2 bps difference, which is much larger than the typical bid-ask spread of 0.25 bps. This is an example of how

²¹⁵ Provided by MarketAxess.

²¹⁶ More than half of respondents to ISDA's survey of the derivatives end-user community reported that market fragmentation is occurring along geographic lines as a result of the

regulatory framework. Source: ISDA (2015) "A Survey of Issues and Trends for the Derivatives End-user Community, April 2015".

measures relating to central counterparties have given rise to market fragmentation.

4.8.2 *Reduction in market depth*

One piece of evidence for this reduction in market depth is provided by the reduction in dealer inventories (as set out in Chapter 3). This has removed a portion of liquidity from financial markets. Credit Suisse, in its report on US rates market liquidity²¹⁷, reviewed the number of bid and ask quotes and found a marked reduction since the end of 2012. JPMorgan reached a similar conclusion finding market depth in US treasuries 30% below long-term averages.²¹⁸

A consequence of the increase in the size of many financial markets, in particular fixed income, credit and derivatives has been a reduction in market depth. Whereas the size of fixed income markets has grown significantly (almost doubling in the EU and increasing by 50% in the US since 2007), trading volumes have not kept pace with the growth in issuance. Although, in the case of European corporate bonds, volumes are markedly down; equity trading volumes have also declined.

Brought together, this means that much bigger markets, as a result of increasing issuance, are being supported by a thinner amount of trading activity. Even in markets that are considered to be reasonably liquid, such as US Treasuries, turnover ratios have also declined, which points to a reduction in market depth.

Lastly, price impact measures show that smaller trading volumes are now moving market pricing by large amounts. Whereas very deep markets (with the US Treasuries market usually held up as the best example) can accommodate large trading volumes with minimal price effect, less deep markets exhibit larger price movements. The increase in price impact measures has been identified across asset classes from government bonds through to corporate bonds and equities.

In summary, there is a collection of evidence to suggest there has been a reduction in market liquidity, as captured by market depth. However, current benign financial market conditions mean these structural changes are yet to translate into significant detrimental effects.

4.8.3 *Increase in volatility*

Liquidity and volatility are highly interlinked. Volatility increases the risk of holding inventory for market makers and therefore increases the cost of providing liquidity. But a lack of liquidity (e.g. market depth) can also contribute to higher market volatility.

In general, market volatility has declined substantially since the global financial crisis. Equity volatility, in particular, has reduced as company cash flow generation and company prospects have stabilised. Such an environment with low volatility is therefore helpful in reducing liquidity costs.

Nonetheless, market data points to a more volatile environment, supported by views of market participants. For example, there have been a number of events with erratic price movement outside of normal ranges expected for market movements in response to external events:

- The flash crash in US treasuries;
- The taper tantrum in US treasuries;
- The Swiss Franc move;
- European sovereign bond volatility.

Lastly, there is evidence that overall market volatility is now rising, after declining since the global financial crisis. This is evident in FX markets, but also in some fixed income markets. There is little evidence of any structural increase in volatility in equity markets.

Market volatility, by its very nature, changes through periods of stress and calm. Whereas current volatility is not as high as the extreme levels of volatility witnessed during the global financial crisis, volatility is arguably above where it would be for the current benign economic environment

4.8.4 *Bifurcation in liquidity*

Some market participants have raised concerns of a “bifurcation” across financial markets. Liquidity is increasingly concentrating in the most liquid instruments and falling in less liquid assets.

There is some market evidence to suggest such a bifurcation is taking place. We have found areas where liquidity has particularly declined:

²¹⁷ Credit Suisse, 13 May 2015, “US Interest Rate Strategy Focus”.

²¹⁸ JPMorgan, 2 April 2015, “US Treasury Market Structure and Liquidity”.

Smaller and high yield bond issues. Liquidity conditions for smaller and high yield issues appear to have fallen relative to larger corporate bond issues. This suggests that high quality corporate issues should be relatively less impacted, despite the reduction in banks' market making activity. Lower quality issues, though, are likely to be associated with a lower number of market makers. As a result, high yield corporate bonds are likely to be associated with higher liquidity risk premia. This will increase the overall cost of credit for this part of the corporate credit market.

Longer term forward FX contracts. Whereas there is good liquidity for short-term FX forward contracts, market data, supported by conversations with market participants suggests that it is more difficult and more costly to obtain longer term FX forward contracts. These contracts attract higher regulatory capital charges, which is having an impact on liquidity in this part of the market.

Single name CDS. Issuance, liquidity and number of market participants in single name CDS has dropped over the past five years.

Interest rate derivatives. There are signs of liquidity bifurcation within interest rate derivatives markets, most notable across geographies due to the lack of regulatory harmonisation of trading and clearing requirements. This is illustrated by the

widening gap in trading volumes between interest rate derivatives that are denominated in USD and other currencies.

Mid cap equities. Mid cap equities have historically had worse liquidity than larger capitalised equities. Transaction and spread data suggests that there has been a disproportionate liquidity impact on mid-cap equities, as dealers focus on larger equities.

4.9 Overall assessment

There is clear evidence of a reduction in financial markets liquidity, particularly for less liquid areas of the financial markets, such as small and high-yield bond issues, longer-term FX forwards and interest rate derivatives. However, even relatively more liquid markets are experiencing declining depth, for example US and European sovereign and corporate bonds.

This decline does not currently appear to be significantly impairing overall market functioning.

The favourable economic and monetary environment, and changes in trading behaviour are masking the impact of the underlying decline in liquidity. This could become more apparent in times of market stress. These warning signs on liquidity collectively point to less resilient financial markets in the future.

5 Drivers of future financial markets liquidity

Key points

- Regulations yet to be implemented, such as FRTB, MiFID II, the US G-SIB surcharge, EU bank structural reform and FTT, if inappropriately calibrated, will have a significant impact on the viability of dealers' market-making activities and increase transaction costs for capital markets participants.
- These reforms are likely to have extra-territorial impacts beyond Europe and the US. Although the majority of recently-proposed or implemented reforms originate in Europe and the US, regulators in other parts of the world may follow suit with similar reforms, which will directly affect market participants based in other regions.
- There are three developments that could improve financial markets liquidity in a sub-set of asset classes. First, the growth of exchange-traded funds (ETFs) provides investors with a more tradeable instrument for investment, in the absence of directly investing in the underlying asset, which may not be as liquid. Second, more widespread uptake of electronic trading could further reduce transaction costs for market participants by providing additional platforms to match buyers and sellers. Such platforms will, in some cases, help reduce the time required to locate buyers and sellers and improve the process of price discovery. Although electronic trading platforms have seen growth in recent years, they do not replace liquidity provision by dealers, in particular the ability to bear proprietary risk and thereby provide immediacy. There may also be structural limits to their adoption, particularly in corporate credit and certain derivatives. Lastly, the retreat of banks from financial markets has also been accompanied by the entrance or growth of other market participants taking on some principal risk-taking activities.
- The entry and growth of other market participants increases the diversity of market participants, the range of trading strategies employed, and facilitates market functioning by providing additional trading activity and market linkage.
- However, the collective impact of these three developments and other behavioural adaptations is not likely, in the short- to medium term, to be sufficient to fully replace the current and potential additional loss of market making capacity and trading activity from dealers. Also, it raises questions of whether new market entrants have the necessary risk frameworks to support the new services, or whether end-users and investors understand the changes to market liquidity that have taken place.

In this chapter we review structural drivers of future financial markets liquidity. We are particularly interested in whether these drivers could worsen existing liquidity trends, or alleviate market liquidity pressures. We divide this chapter into four areas:

- Continued banking sector and capital markets regulation;
- The increase in the size of financial markets;
- Impact of electronic trading platforms; and
- Impact and behaviour of new capital markets participants.

5.1 Continued banking sector and capital markets regulation

Banking sector and financial markets regulatory reform is now well advanced. Major reforms covering

capital, liquidity, market infrastructure, structures and resolvability have now been finalised (as set out in Chapter 3). For some reforms which have not been fully implemented, the implementation timescales have now been set and banks are working towards those timescales. Key future dates include the implementation of the Net Stable Funding Ratio in 2018 and the implementation of the retail ring-fence in the UK in 2019.

Once reforms are sufficiently finalised and timescales set, banks typically seek to implement early to reduce compliance risks. However, changes to business and operational models tend to be slower to adapt and there can be a range of market practices during the period when market participants adapt to new rules.

There are then a suite of reforms which are still in the policy formation and initial calibration stage and as such, there is insufficient certainty for banks to have adapted their business and operational models. For these regulations, we are unlikely to have seen any market and economic impact to date, and such reforms could therefore have additional incremental impact on market liquidity.

In this section we focus on three reform areas which remain highly uncertain. These are:

- Fundamental Review of the Trading Book
- EU bank structural reform
- Financial transaction taxes

The transmission mechanisms of these reforms are similar to those set out in Chapter 3, with the exception of FTT, which we set out below.

Fundamental Review of the Trading Book (FRTB)

In May 2012, the Basel Committee on Banking Supervision (BCBS) proposed significant revisions to the market risk framework as part of the FRTB. Overall, the goals of the FRTB are as follows:

- Develop an effective trading book/banking book boundary condition;
- Achieve a regulatory framework that captures and capitalizes all risks in the trading book;
- Improve risk measurement techniques; and
- Create an enhanced and globally consistent supervisory framework, including a more risk sensitive standard approach that allows regulators to remove model approval on a trading desk level.

To achieve these goals, key elements of the proposed framework include:

- New rules to determine what can be included in the trading book and more stringent requirements to address any potential arbitrage between the banking book and the trading book;
- Desk-level supervision and calibration. Both the standard approach and internally modelled capital are calculated and disclosed to supervisors at desk level. This increased granularity is designed to allow model approval to be turned off for trading desks that do not meet the back-testing and validation requirements;
- A more risk-sensitive standardised approach for market risk: the BCBS established the following principles for the design of the revised standardised approach: simplicity, transparency and consistency, as well as

- improved risk sensitivity; a credible calibration and limited model reliance;
- Substitution of Value-at-Risk (VaR) and stress VaR risk measures with Expected Shortfall (“ES”) risk measure to increase capital requirements for the potential loss in the tail of the distribution;
- Introduction of liquidity horizons in the ES calculation to reflect the varying liquidity profiles across the different asset classes and risk factors;
- Replacement of the incremental risk charge (“IRC”) with incremental default risk model (“IDR”) which will only capture default risk as migration risk and will form part of the ES calculation; and
- Enhanced public disclosures on market risk capital charges, including regulatory capital charges calculated using both standardized and internal models approaches.

These wide ranging changes will significantly impact banks operating trading businesses. At the moment, the current market and economic impacts are unclear as many parts of the FRTB framework are still being finalised and the charges are yet to be calibrated.

The proposed standard does not seek to explicitly raise the overall level of capital. However, if not carefully considered, there is an implicit and potentially significant, increase in the level of capital (via higher RWAs) in the implementation of FRTB, particularly under the internal model and sensitivity based approaches.

QIS results (QIS2/3) indicate punitive capital requirements for certain business lines and at the aggregate entity level. This means that the level of capital impact varies across the products in the trading book, which may result in banks shifting towards trading activities that carry a less punitive capital treatment. Current QIS results show RWAs would increase by two to four times (IMA and SBA respectively). This will add to Basel III regulatory capital requirement changes and put further pressure on capital intensive parts of banks’ trading activities. This is likely to further constrain market making activities in dealer-based markets such as fixed income and bespoke derivatives. Some of the most affected products are those with greater impact on the wider economy (e.g. bond markets, SME credit, securitisations, emerging markets, small cap equities, and FX hedges).

EU bank structural reform

The Liikanen Report, which was published in October 2012, provided a set of recommendations by

a group of experts led by Erkki Liikanen. The proposals envisage the continuation of the universal banking model...*“but the trading division will have to hold its own capital, meaning that it stands or falls by its own activities and cannot, in theory at least, knock over the bread-and-butter retail banking operations.”*²¹⁹

In January 2014, the European Commission (EC) published proposals for structural reform of the EU banking sector, based on the recommendations of the Liikanen report.²²⁰ The main elements of the proposals include:

- Entities within scope cannot engage in proprietary trading and are prohibited from investing in or holding shares in hedge funds (or certificates/derivatives linked to these). These activities are also prohibited from being carried out in a separate subsidiary within a deposit-taking banking group.
- Banking groups may also be subject to the separation of markets activities, which include trading and investment banking activities (such as market making, lending to venture capital and private equity funds), in a separate entity from deposit-taking activities, if certain risk thresholds²²¹ are exceeded.

The separation targets large credit institutions and banking groups and requires separate funding, capitalisation and governance within the organisation.²²² The prohibition on proprietary trading activity is scheduled to take effect on 1 January 2017, and the provision for the wider separation of trading activities is scheduled to take effect on 1 July 2018.

The impact of structural reforms on capital markets liquidity is likely to be considerable. The reforms could severely undermine the commercial viability of smaller EU trading entities, resulting in a further loss in EU market making capacity. This could have significant impacts on liquidity costs in these markets. A PwC study on the impact of structural reforms suggests that the increase to the cost of

corporate as a result of the increase in the liquidity risk premia could be up to 30 bps.²²³

It is likely that a modified version of the proposals will be implemented in the EU. Since the Commission's 2014 proposal, the European Parliament's Rapporteur, Gunnar Hökmark, published his draft report for the Parliament's Committee on Economic and Monetary Affairs (ECON), which puts forward several major amendments to the Commission's proposal, including softening the approach to separating trading activities from deposit-taking activities. It also removes the presumption that separation is the primary solution, and allows for the use of other supervisory tools, including raising capital requirements and enhanced supervision, to address banks' risks. Amendments have since been made to the original proposal to take these recommendations into account.²²⁴

In addition, the EU Council set out its negotiating position on 19th June 2015 on bank structural reforms, which proposes to separate banks' proprietary trading activities rather than implement a mandatory ban on such activities. It also provides member states with the discretion to ring-fence core retail banking activities, rather than implement mandatory separation of trading activities for systemically-important banks or banks that exceed certain size thresholds.

Financial transaction taxes

The EC tabled an initial proposal for the implementation of a harmonised financial transaction tax (FTT) in the EU that would apply to a wide range of financial transactions.²²⁵

Although the EC failed to implement the tax at the EU-wide level, 11 member states²²⁶ (or the “EU-11”) were given the approval to go ahead without other EU members²²⁷. The 2013 proposal for a Directive²²⁸ specified the following:

- A minimum tax rate of 0.1% will be levied on the consideration (or in some cases, market value) of non-derivative transactions,

²¹⁹ The Liikanen report decoded, Tom Burgis, FT, 2 October 2012.

²²⁰ EC (2014), ‘Proposal for a Regulation of The European Parliament and of the Council on structural measures improving the resilience of EU credit institutions’.

²²¹ These are yet to be determined by regulators.

²²² European Commission “Banking structural reform (follow-up to the Liikanen report)”.

²²³ PwC (2014), ‘The impact of EU bank structural reforms’. Available at: <http://www.pwc.com/gx/en/banking-capital-markets/impact-bank-structural-reforms-europe.jhtml>

²²⁴ Hökmark, Gunnar (2015) “Amendments 300-608 on the proposal for a regulation of the European Parliament and of the Council on structural measures improving the resilience of EU credit institutions”, report to the European Parliament Committee on Economic and Monetary Affairs.

²²⁵ EC (2011).

²²⁶ These member states are Belgium, Germany, Estonia, Greece, Spain, France, Italy, Austria, Portugal, Slovenia and Slovakia.

²²⁷ The EU-11 were granted permission to do so on 22nd January 2013 under the EU's enhanced cooperation procedure (EC 2013a).

²²⁸ EC (2013).

- including shares, bonds and sovereign debt securities; and
- A minimum rate of 0.01% on the notional value of derivative transactions applicable to most trading in equity, sovereign debt, corporate debt, repurchase agreements (repo) and derivatives.

The tax is applicable even if only one of the financial institutions resides in a member state of the EU-11 FTT. In addition, it also covers trades between entities outside the EU-11 FTT member states in instruments issued in the participating member states. The proposed FTT will be applied to both the buy and the sell side, creating a ‘cascade’ effect that will result an increase in the effective tax rate. Some transactions and parties are exempted: CCPs and Central Securities Depositories (CDSs), primary market transactions (including underwriting), transactions with international bodies or institutions

that form part of a restructuring are also exempt from FTT.

France and Italy have gone ahead with implementing the their own financial transaction tax regimes. The French regime was introduced on 1 August 2012, and applies a tax on equity purchases of listed French companies with a market capitalisation in excess of €1 billion, a tax on the purchase of uncovered CDS on EU sovereign debt and a tax on cancelled or modified orders to capture HFT activity. The Italian regime is similar to the French one but has a wider scope, e.g. it includes contracts for difference used for hedging.²²⁹ Initial studies have shown the significant negative effects on market liquidity as a result of recently-implemented financial transaction taxes.²³⁰

Figure 5.1 shows the transmission mechanism of FTT, and how these taxes translate into impacts on market makers, market liquidity and end-users.

Figure 5.1: Transmission mechanism of FTT



Source: PwC analysis

The implementation of the FTT would increase the costs of trade execution across asset classes, which, in turn, affects the commercial viability of market making activities. The following effects may be observed in different asset classes:

- **Corporate debt markets:** The tax would increase costs, and as we have observed reduce trading volumes. The secondary market effect will ultimately translate into higher costs of funding in primary debt capital markets for non-financial corporates. London Economics (2013) estimates the cost of funding for non-financial corporates to increase by 44-212 bps,

with the cost for non-participating member states being potentially higher than for the EU-11. Oliver Wyman (2013) estimates the additional annual financing cost to corporates to be in the order of €7-€8 billion across the EU. The proposed FTT would also have extraterritorial impacts outside the EU-11.²³¹ In Sweden, a relatively small tax of between 0.002 percent and 0.015 percent was applied to transactions of fixed income securities and their derivatives. This triggered a substantive behavioural reaction: the volume of bonds and futures trading fell by between 80 percent and 98 percent (PwC, 2013).

²²⁹ A contract for difference consists of an agreement (contract) to exchange the difference in value of a particular currency, commodity share or index between the time at which a contract is opened and the time at which it is closed.

²³⁰ Becchetti, Ferrari and Trenta (2013) show that the French FTT has had a significant negative impact on trading volumes. Haferkorn and Zimmermann (2013) show that trading volumes

for French equities dropped significantly following the introduction of the tax, accompanied by an increase in spreads and a decline in top order book depth which increased transaction costs for market participants.

²³¹ London Economics (2013).

- **Derivatives markets:** The FTT will have a significant impact on the derivatives market. The EC estimates that the tax would reduce trading volumes by around 70%-90%.²³² The increase in transaction costs as a result of reduced liquidity could also be significant: Oliver Wyman (2013) estimates that bid-ask spreads under the FTT regime could be 18 times higher even under normal market conditions. The proposals aim to reduce socially undesirable trades but could risk making socially useful trades uneconomical, which will affect the ability of investors and corporates to manage their exposures to the price risk of commodities, currencies, interest rates, and equities.²³³ The lack of exemptions for hedging purposes also means that treasury services such as hedging could be vulnerable to greater volatility.²³⁴ Given the anticipated detrimental impact on volumes the tax revenue generated will potentially be limited.
- **Money market funds**²³⁵: Investors would experience lower returns on their investment as a result of the FTT. EFAMA (2011) estimates that money market funds would contribute around 67% of total tax revenues, if the expected reduction in volumes are not taken into account. Goldman Sachs (2013) expects an effective tax of 100 bps to be levied on typical money market funds, which would ultimately be borne by investors²³⁶. The increase in cost and decline in returns may incentivise investors to switch to products outside the scope of FTT, which reduces demand and liquidity inside the FTT area.
- **Equity markets:** The evidence of other financial transaction tax regimes are mixed for the equity markets: while some studies suggest that the French tax regime reduced market volatility (e.g., Becchetti *et al.*, 2013)²³⁷, other theoretical models have found that such tax increases volatility (e.g. Habermeier and Kirilenko, 2003).²³⁸ Analysis by Credit Suisse (2014) also shows that the implementation of the financial transaction tax regime in Italy has resulted in a reduction in average daily turnover in Italian equities of almost 30% between January and March 2013.

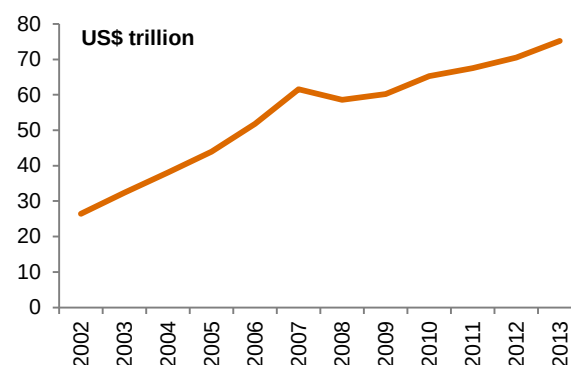
In summary, these three areas of regulatory reform, if implemented in their current form would continue to put downward pressure on market liquidity. These reforms are likely to have extra-territorial impacts beyond Europe and the US. Although the majority of recently-proposed or implemented reforms originate in Europe and the US, regulators in other parts of the world may follow suit with similar reforms, which will directly affect market participants based in other regions.

5.2 Increase in the size of financial markets

The size of global financial markets have grown. Alongside this, global assets under management have increased, accompanying the rise of corporate and sovereign debt issuance in recent years.

In particular, the rise of mutual and exchange traded funds (ETFs) can be observed from their increasing share of global financial assets. Total financial assets of the Monitoring Universe of Non-Bank Financial Intermediation (MUNFI) increased from US\$26 trillion in 2002 to US\$75 trillion in 2013 (see Figure 5.2).²³⁹ Other investment funds, which captures all Investment funds (predominately mutual funds and ETFs), with the exception of Money Market Funds and Hedge Funds, account for 38% of those assets.

Figure 5.2: Total financial assets of MUNFIs



Source: Financial Stability Board

*total financial assets of MUNFIs are all assets held in the financial system which are not assets held by: Banks, Central Banks, Public Financial Institutions, Insurance Companies and Pension Funds

²³² EC (2013), Schulmeister (2011) also found the impacts on transaction volumes to be of a similar magnitude.

²³³ International Regulatory Strategy Group (2010).

²³⁴ Oxera (2011).

²³⁵ Favoured by investors who want safe and stable rates of return, money market funds are investment funds that consist of a portfolio of short-term securities, which aims to maintain a steady net asset value.

²³⁶ McConnell (1995) and Malkiel and Sauter (2009).

²³⁷ Becchetti, L., Ferrari, M., and Trenta, U. (2013) "The impact of the French Tobin tax".

²³⁸ Habermeier, K and Kirilenko, A. A. (2003) "Securities transaction taxes and financial markets", IMF Staff Papers, 50, 165–180.

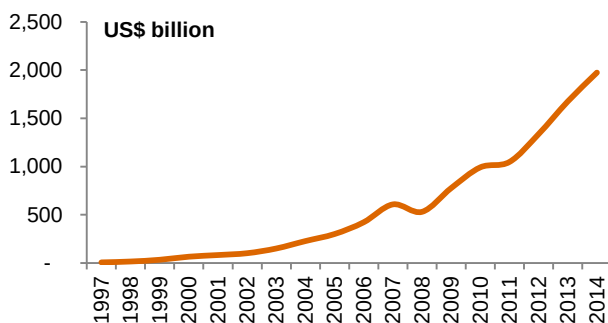
This long term increase in the size of funds looks set to continue, and has coincided with the decrease in the size of banks' balance sheets which are available for market making. These combined trends are driving concerns about long term market liquidity conditions because of the growing relative imbalance between the two.

The growth of market-based financing

Within the long term growth of investment funds is the relatively new innovation of exchange traded funds (ETFs). ETFs are created by fund managers with the aim of replicating performance of a particular index. The fund is then traded, like equities.

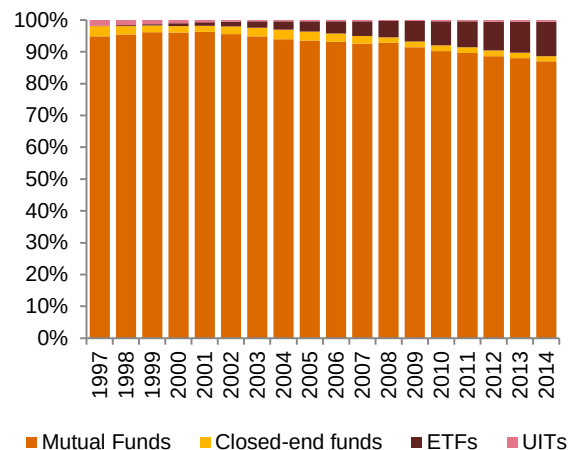
The market for ETFs has grown significantly. Total net assets of US listed ETFs are now valued over US\$2 trillion (Figure 5.3), which now represents 10% of total fund assets under management (Figure 5.4). Discussions with market participants suggest that ETFs are a welcome innovation that allow "equity-like" trading in less liquid assets.

Figure 5.3: Net assets of US Listed ETFs



Source: Thomson Reuters, Investment Company Institute

Figure 5.4: Breakdown of US listed fund types, percentage of total fund assets



Source: Thomson Reuters, Investment Company Institute

ETFs are formed using 'creation units' – bundles of ETF shares varying from 10,000 to 600,000 (50,000 is most common) which are provided to an Authorised Participant(s) in exchange for a portfolio of securities. These shares are then sold on the open market. When there is strong demand for the ETF, the size of the fund expands as authorised participants create new creation units.

The underlying assets within ETFs often become distinct from the rest of their asset class. For instance, US high yield bonds which are held by ETFs turn over at eight times the average rate of US High yield bonds; for US investment grade bonds, the figure is four times the average. This suggests that the liquidity of assets held by ETFs is higher as a result of their trading.

In order to liquidate an ETF investment, an investor can simply sell the share(s) on the open market. An ICI survey found that four fifths of bond ETFs trade this way (and therefore do not require trading the underlying assets)²⁴⁰.

For the remaining one fifth, authorised participants can redeem creation units with the ETF directly, reducing the AUM of the ETF. These redemptions can take two forms: in kind, where creation units are exchanged for a percentage of the assets held by the fund; or, in cash, where creation units are exchanged for cash (usually for an associated fee) by forcing the fund to liquidate a portion of the assets. ETFs can typically insist on redemptions in kind, rather than

in cash during extreme stress events, to protect the value of the fund for other investors.

There are some concerns over the performance of ETFs in difficult liquidity conditions.²⁴¹ However, we note the performance of ETFs has been reasonably resilient – Bond ETFs have accommodated recent small stress events such as the ‘flash crash’ and ‘taper tantrum’ without much difficulty. In such events there can be a disparity between the market value of the ETF and its underlying assets, but arbitrage is typically offset by traders buying the ETF and selling the associated portfolio, or vice versa.

In summary, we consider ETFs are a valuable addition to the range of investment options available to investors. While they improve the liquidity of underlying assets, they have not been really tested during a stress event where aligned trading strategies could result in additional liquidation pressure on underlying assets. Therefore, while recognising the benefits that ETFs bring for investors, we do not consider that the continued growth of ETFs will provide a solution to the liquidity challenges we set out in Chapter 4.

5.3 Impact of electronic trading platforms

An electronic trading platform (ETP) allows traders to place orders for financial products across a computer network. ETPs are an alternative way to trade in markets which have been dominated by more traditional methods such as open outcry and telephone trading through dealers. Electronic trading has been developed notably in order to service clients at a lower cost. An ETP can be a single or multi-dealer platform, where the network is connected to one or many financial institutions. Theoretically, by removing geographical restraints and allowing multilateral interaction, ETPs can enhance liquidity by matching buyers and sellers more effectively. There is some evidence to suggest that ETPs decrease spreads²⁴², increase trading volumes²⁴³ and decrease volatility²⁴⁴. Electronic trading can facilitate the dissemination of trading information and improved transparency.

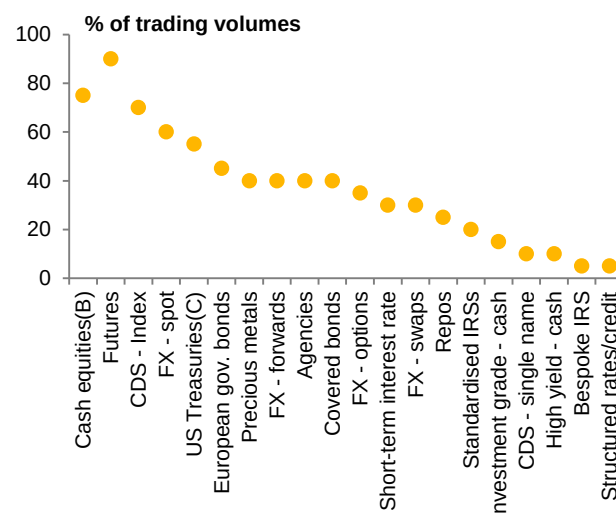
However, several factors limit the impact of ETPs on market liquidity, particularly in quote-driven markets.

Structural market factors

Trading platforms are best suited to standardised products and smaller size transactions for which a sufficiently large number of orders can be matched on a regular basis; this is the case for spot FX markets for the most liquid currencies. The demand for diversity in issuance in fixed income markets means that it is less suited to electronic trading than other asset classes such as cash equities and futures. Later in this section we also discuss the benefits for flexibility in bond issuance.

As a consequence, ETPs have generally failed to gain traction in fixed income markets and the bulk of the trading is executed over the phone. There is significant variation in the use of ETPs in trading across asset classes. Figure 5.5 shows the development of the electronic market by asset class, with a clear relationship of high levels of electronic trading for more standardised products and lower levels of electronic trading for more customised products.

Figure 5.5: Electronic market development by asset class, 2012



Source: FEMR²⁴⁵

Note: includes multi-dealer RFQ

²⁴¹ See for example IMF (2015), “Navigating Monetary Policy Challenges and Managing Risks”, Global Financial Stability Report, April 2015.

²⁴² Aitken, M. J., Frino, A., Hill, A. M., and Jarnecic, E. (2003) “The impact of electronic trading on bid-ask spreads: evidence from futures markets in Hong Kong, London, and Sydney”.

²⁴³ Orlowski, L. T. (2015) “From Pit to Electronic Trading: Impact on Price Volatility”.

²⁴⁴ Al-Khouri, R. and Al-Ghazawi, N. (2008) “The effect of electronic trading on market volatility and liquidity in emerging markets: Evidence from Amman Stock Exchange”.

²⁴⁵ FEMR (2014) “How fair and effective are the fixed income, foreign exchange and commodities markets?”, Consultation document.

As set out in Figure 5.5, with the exception of US Treasuries trading, the use of ETPs in fixed income and bespoke derivative markets remains less than 50%. Whereas electronic trading of US treasuries is around 55% of total trading, this falls to around 10% for high-yield corporate debt. This is consistent with our discussions with market participants. Dealer-to-dealer trades in fixed income are predominantly electronic while dealer-to-client trades are less so.

Discussions with market participants suggested Treasuries and some real estate financing instruments were those instruments within fixed income with most potential for electronic trading.

According to the Treasury Market Practices Group:²⁴⁶

- E-trading represents more than half of the overall trading volume in the US Treasury securities.
- Automated trading strategies account for more than half of the trading activity in on-the-run US Treasury securities that occurs on e-platforms.
- The development of automated trading came together with a concentration of volumes (the top 5 dealers accounting for more than 55% of dealer-to-client volumes according to Greenwich Associates).

Over the longer term market participants expect the share of electronic trading to gradually rise. However, there is still expected to remain a need for trading to take place OTC for the foreseeable future, given issuer demand for flexibility in funding choices. A study by ICMA (2014) also suggests that although the electronification of the credit market is making an impact in Europe, it is not a substitute for OTC liquidity.

One proposed solution for achieving greater standardisation, particularly in corporate bonds, is to concentrate market activity in a smaller number of bonds with greater issuance volumes and similar features²⁴⁷. This has occurred to some extent in government bonds, futures contracts and CDS that benefit from much better liquidity and the ability to be exchange traded as a consequence of larger and more standardised features. There are also some examples of structures used to aggregate borrowing

requirements for broadly similar lenders but adoption of such structures has not been widespread.²⁴⁸

However, we have found little evidence of support for greater standardisation in the corporate bond market. As indicated in the Bank of England's Fair and Effective Markets Review, issuers value the flexibility of having specific maturity and coupon structures to match their underlying cash flows. Treasurers tend to issue debt for a specific purpose and term, and they value the flexibility of raising funding as and when it is required. Greater standardisation may also lead to greater fragmentation, in that banks and multinationals are in a better position to issue standardised corporate bonds, whereas smaller issuers may end up issuing debt via private placements (which are ineligible for index inclusion), which will further perpetuate the bifurcation of liquidity between large and small issuers.

A study by the International Capital Markets Association (ICMA) shows that issuers were also concerned about the implications of standardisation on maturity concentration and roll-over risk. Large amounts of debt due for repayment at the same time would concentrate refinancing risk for issuers, and make it more difficult for investors to establish relative values between bonds with different tenors. A concentration of standardised maturities may also create additional volatility, which would not be the case under staggered maturities, which appeal to investors with different investment strategies and horizons. In addition, while banks and investors observed that standardisation could realise liquidity benefits, a more homogenous corporate bond market could make portfolio management more difficult from a diversification perspective.²⁴⁹

Liquidity fragmentation

Second, the growth of ETPs, which has been partly driven by regulatory changes, has given rise to liquidity fragmentation, where the liquidity of main markets are diffused across alternative trading venues. This results in more competitive, but less deep markets, with any less ability for an individual venue to absorb large trades, reduced price discovery and reduced efficiency. For example, there are 13 different exchanges and 40+ dark pools in US equity

²⁴⁶ Treasury Market Practices Group (2015) "Automated Trading in Treasury Markets: white paper".

²⁴⁷ BlackRock (2014) "Corporate bond market structure: The time for reform is now", September 2014.

²⁴⁸ For example, the smaller UK water companies - with the assistance of RBS - created a pooled financing structure called the Artesian Finance facility. It worked by containing issuers with

similar credit risk and a used credit wrapping from a monoline insurer to protect investors.

²⁴⁹ ICMA (2014) "The current state and future evolution of the European investment grade corporate bond secondary market: perspectives from the market".

markets, and it is unclear whether these platforms provide a unique offering to investors.²⁵⁰

Discussions with market participants were also sceptical at this time about the potential of ETPs to attract sufficient “critical mass” of trading volumes and to retain liquidity without further consolidation in platforms.²⁵¹ Many participants commented that the large range of bond trading platforms made it difficult to know where liquidity is concentrated and therefore which were worth investing in. Although larger firms were in a position to test the viability of different trading platforms, smaller firms are likely to delay their adoption until they can identify the trading platform that is likely to meet their trading needs, with sufficient volumes, into the long-term.

Respondents were also sceptical of whether ETPs would succeed with a ‘buy side to buy side’ model, with dealers excluded as they felt this undermined an important additional source of liquidity.

Liquidity in a stress event

Finally, there is some scepticism currently over the ability of ETPs to maintain market liquidity in stress situations.

In summary, the introduction of ETPs are unlikely to result in a step-change in liquidity conditions in financial markets in the short-term. The development of ETPs is still in its early stages, and could potentially have a positive impact on future liquidity and improving market efficiency. As noted by SIFMA’s Asset Management Group, the development of new ETP protocols that bridge the gap between the RFQ and central limit order books (CLOB) could help reduce dependency on dealer capital by bringing latent liquidity to the market.²⁵²

5.4 Impact of new and different market participants

Regulatory changes combined with pressures to improve banks’ financial performance have resulted in some bank exits from market making activities, which has negative implications for liquidity conditions for some markets. As discussed in Appendix F, there is a statistically significant relationship between the number of market makers and the liquidity risk premia on corporate bonds. This has been accompanied by a change in banks’

business models from a principal- to agency-based role, as banks pull back from committing risk capital to market making.

However, the retreat of banks from financial markets has also been accompanied by the entrance or growth of other market participants, which may mitigate against the negative liquidity effects from reduced bank market-making activity. Below we discuss the potential liquidity impacts of other market participants, such as:

- High-frequency traders;
- Regional champions;
- Commodity trading firms;
- Hedge funds;
- Independent market makers; and
- Specialist brokers.

High frequency traders

High frequency trading (HFT) is the use of powerful computer algorithms to analyse markets and execute trades at very high speeds, without traders’ manual input at the time of trade. High frequency traders generally don’t hold positions for long time periods, but move in and out of short term positions in order to capture fractional margins, in high volumes.

HFT covers a wide range of trading strategies, which include:

- Latency arbitrage, which can be achieved through receiving public information fractionally before other market participants. It can also cover arbitraging minute price differences across exchanges.
- Pattern trading, which is the use of algorithms to spot patterns and trade accordingly, until they become unprofitable.
- Anticipatory trading, which is trading in between chunks of institutional trades.

There have been a number of reports and regulatory scrutiny on HFT.²⁵³ Some reports distinguish HFT strategies which are considered as “predatory” from those that benefit markets and end-investors. HFT can also be difficult to distinguish from algorithms or computer-based trading tools to execute orders, which are characterised by automation and low latency.

²⁵⁰ BlackRock (2014).

²⁵¹ Network externalities are a crucial factor in the ability of ETPs to bring together large groups of users, and to consolidate sections of the market that rely on bilateral communication.

²⁵² SIFMA (2015) Letter to the SEC: Potential Market and Regulatory Changes to Strengthen Liquidity in the Fixed Income Markets”.

²⁵³ See PwC (2012), “The future computer generated trading (CGT) in Financial Markets” Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289065/12-1085-wr3-future-of-equity-market-structures.pdf.

There is some evidence that HFTs activity is associated with an improvement in price discovery, tighter bid-ask spreads and reduced adverse selection.²⁵⁴

However, HFT can also have adverse market effects. The demand for market transactions they create can disappear when liquidity is most needed in the market. This raises the question of whether HFTs are a reliable source of trading activity in times of stress. Academic research provides evidence that HFTs withdrew from the market during the flash crash of 6 May 2010, and indeed, some turned into liquidity demanders.²⁵⁵ Our discussions with market participants suggest that when volatility exceeds two standard deviations HFTs are likely to exit the market. In addition, while some research finds that the increase in HFTs has tightened bid-ask spreads, our discussions with market participants have proposed that this is likely to be the result of increased trade flows, rather than HFTs committing funds from their balance sheets to provide liquidity.

HFT has also been identified as a factor in exacerbating episodes of market volatility during events such as the 2014 Treasury “flash crash”. The frenetic nature of liquidity as a result of high frequency trading can exaggerate price movements on low volume trades, particularly in the event of a crash. Research, supported by a CFTC investigation into the 2010 flash crash shows that although HFTs were not responsible for triggering the flash crash, their responses to the unusually large selling pressure on that day exacerbated the decline and contributed to market volatility.²⁵⁶

Research by Zhang (2010) shows that HFT is positively correlated with stock price volatility and impairs price discovery, by impairing the ability of markets to incorporate information about firms’ fundamentals into asset prices. This causes stock prices to overreact to changes in fundamentals when HFT trading volumes are high.

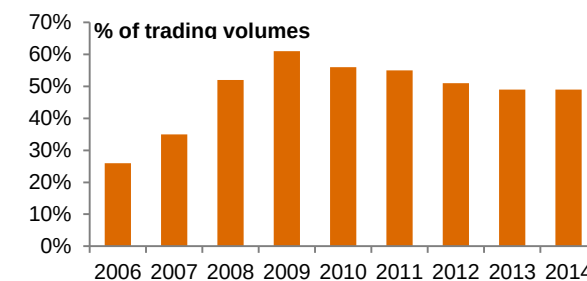
Predatory HFT activity can have significant adverse impacts on investors. For example, HFTs can take advantage of large trades made by institutional investors by engaging in order anticipation. An HFT that detects large orders from an institutional investor can buy in front of a large buy order, and then subsequently attempt to sell to the large buyer at a higher price.²⁵⁷ This impact on large investors is

exacerbated by the change in trading strategies, from high value, low volume trades, to lower value trades in higher volumes, necessitated by the reduction in market liquidity. HFTs can also engage in momentum ignition, or igniting rapid price movements in one direction through a series of submissions and cancellations of orders, which drives up intraday price volatility and investors’ trading costs.

Regulatory authorities are responding to such concerns: MiFID II²⁵⁸ requires algorithmic trading and HFT firms to be authorised and more heavily supervised. HFT firms will be required to keep records of all their orders including cancellations and therefore subject to regulatory supervision. They will be required to disclose information regarding their algorithms, and obligations will be placed on exchanges to control where the incidence of HFT falls. Exchanges may also impose penalties on the incidence of cancelled orders, which could limit the negative liquidity effects of HFTs.

As shown in Figure 5.6, since 2009, HFT activity has stabilised and is currently in slight decline. A number of HFT firms have exited the market and the profitability of HFT firms has significantly decreased. Rosenblatt Securities estimated that HFT profits fell from a peak of US\$5 billion in 2009 to US\$1.25 billion in 2012²⁵⁹. This suggests a widespread adoption of HFT technology across the market and fewer arbitrage opportunities – indeed the success of HFT has been its undoing as exchange markets have become more efficient. This suggests the impact of HFT on changes in future market liquidity will be modest. Indeed, there is a risk that a heavy regulatory and/or political response to HFT could reduce a portion of market activity which helps the efficiency of markets in normal times.

Figure 5.6: Proportion of HFT trades (US equities)



Source: TABB Group, 2014 figure based on estimates

²⁵⁴ See Hendershott *et al.* (2011), Riordan (2013) and Menkveld (2012).

²⁵⁵ Kirilenko *et al.* (2011), Easley *et al.* (2011a).

²⁵⁶ Kirilenko *et al.* (2011).

²⁵⁷ Hirschey, N. (2013) “Do high-frequency traders anticipate buying and selling pressure?”.

²⁵⁸ Directive on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU, 2014/65/EU and Regulation on markets in financial instruments and amending Regulation No 648/2012, EU No 600/2014.

²⁵⁹ Rosenblatt Securities Inc.: http://www.rblt.com/news_details.aspx?id=221.

Regional champions

While American and European banks – the traditional market makers in global markets – have been reducing their market making activities for the reasons we have explored previously, a number of regional banks are taking the opportunity to start or expand activities, particularly in the APAC region. Market participants we spoke to cited examples of Australian, Canadian, Japanese and Chinese banks all expanding market making activities. Most of these banks are focussing on their home markets by leveraging their local expertise and customer relationships.

Market participants welcomed this trend as it is replacing some of the capacity which the global banks have reduced, although overall dealer capacity has still reduced. Regional banks can focus on specific market areas, but many of them lack the balance sheet capacity to support large-scale market making activities. Market participants also highlighted that these regional champions are focussing on small ticket sizes in relatively liquid assets (one respondent cited trades up to US\$ 2 million).

Their relatively small scale limits the ability of regional champions to fully step into the role of market making previously done by the global dealers.

Commodities trading firms (CTFs)

Commodity Trading Firms (CTFs) are specialised commodity trading companies, often with an associated commodities transformation business (transportation, storage or refinement/processing).

Since 2011 there has been a marked decline in the number of banks and their involvement in commodity trading as regulation and a more difficult trading environment has reduced their willingness to trade.

Much of this shortfall has been picked up by CTFs as they have taken advantage of lower capital requirements to increase their share of the market. Consequently they are increasingly seen as a key source of market trading activity (but not market makers). However, during periods of extreme market stress and volatility, the market trading activity they provide can rapidly fall away, in much the same way as the HFTs. Furthermore, while CTFs are currently exempt from EU rules governing capital requirements for financial institutions, this exemption is set to be removed, and they are

expected to be subject to the Capital Requirements Directive IV regulation. This will raise their capital requirements, thereby reducing capacity for proprietary trading in commodity markets.

Hedge funds

Hedge funds have grown in recent years and this trend is expected to continue. Citibank suggests that the total pool of capital being advised by hedge fund managers could rise from \$2.9 trillion in 2013 to \$5.8 trillion in 2018, worth around 10% of institutional assets invested across mutual funds and hedge funds.²⁶⁰ Traditionally hedge funds have been able to select wide ranging and contrarian trading strategies, but with growth comes the need to adopt more traditional asset allocation and trading strategies. This suggests that the largest hedge funds will begin to have much in common with mainstream asset managers.

Hedge fund trading activity can have a short-term focus and this adds to market trading activity, but hedge funds still make directional trades, for example shorting oil as the market fell, as opposed to market makers who provide (tradable) buy and sell quotes.

Hedge funds can be a helpful source of demand when prices fall in a stress event – they can therefore help to reduce volatility by helping markets find their clearing price, when other market participants would not have the appetite to trade.

Independent market makers

The growth of independent market makers has been enabled by a technology-centric approach using electronic platforms and the movement of traders away from global banks. Such market makers provide simultaneous buy and sell quotes in more liquid markets, such as equities. For less liquid asset classes an agency model is used. This means that a commercially viable client service can be provided using a fraction of the balance sheet used by banks.

Independent market makers help clients find available liquidity, but their current scale means they are unable to replace the market making activities of global dealers.

Specialist brokers

One final category worth mentioning are the specialist brokers, or the brokers' broker. These are non-risk taking boutique trading firms who execute trades on behalf of clients. They have benefitted from

²⁶⁰ Citi (2014) "Opportunities and Challenges for Hedge Funds in the Coming Era of Optimization".

the increased complexity and difficulty of trading in current markets.

This new market activity is welcome, but does not replace the market making activities provided by global dealers. Although these firms help to match buyers and sellers of financial assets - they do not make markets, as they use an agency business model. This is contrast to dealers who perform the role of market-making, and have a customer-driven business model which means that liquidity is provided on a more continuous basis. This is discussed in further detail in Section 2.4.

We summarise the key characteristics of these market participants in Table 5.1. New entrants are unlikely to be able to match the balance sheet capacity of banks. Banks generally have significant balance sheet capacity, with the largest global banks typically having total assets in excess of US\$1 trillion.

High frequency traders, have minimal committed capital beyond the end of the trading day. Hedge funds and independent market makers also tend to have relatively small balance sheets. Although regional champions and commodity trading firms have larger balance sheets, these still fall short of the capacity provided by large global banks.

In summary, the entry and growth of other market participants increases the diversity of market participants, the range of trading strategies employed, and facilitates market functioning by providing additional trading activity and market linkage. However, the fundamental differences in their business models, trading strategies, investment horizons and balance sheet capacity mean that they are not currently sufficient to compensate for the loss of market making capacity provided by global dealers.

Table 5.1: Assessment of liquidity impacts of new market participants

	Dealers (for comparison)	High-frequency traders	Regional champions	Commodity trading firms	Hedge funds	Independent market makers
Size (typically measured by balance sheet)	Global banks' balance sheet typically exceeds US\$1 trillion	Minimal balance sheet required, as trades are executed quickly	The largest regional champions are around a third the size of global banks	The largest commodity trading firms are around a tenth the size of global banks	Own balance sheet is small, but access to significant funds under management, subject to mandate	Focus on most liquid markets limits the need for a large balance sheet
Business model	Client-driven market making activity	Client-driven trading or trading on own account	Client-driven trading, primarily deposit-funded	Trading activities complementary to commercial operations	Pool capital from investors with the aim of generating long-term investment returns	Market making in liquid assets. Agency model in less liquid assets.
Trading strategy	Market making by executing trades as principal until a buyer/seller match can be found	Typically day trading, with no significant, unhedged positions carried overnight	Small ticket sizes, agency model rather than principal trading model	Largely trading on own account, possibly to hedge commercial operations	Range of trading strategies motivated by maximising long-term returns for investors	Trading to provide client execution
Impact on financial markets liquidity	Most durable source of liquidity to capital markets, especially in less liquid markets	Provides additional intra-day liquidity but could potentially make trades more expensive for some market participants	Smaller balance sheets limit ability to replace global market-making activity	Some positive impact on commodity markets trading activity	Source of day to day trading activity, which can differ to other market participants. Can provide backstop demand in times of crisis	Limited impact on less liquid markets on account of size

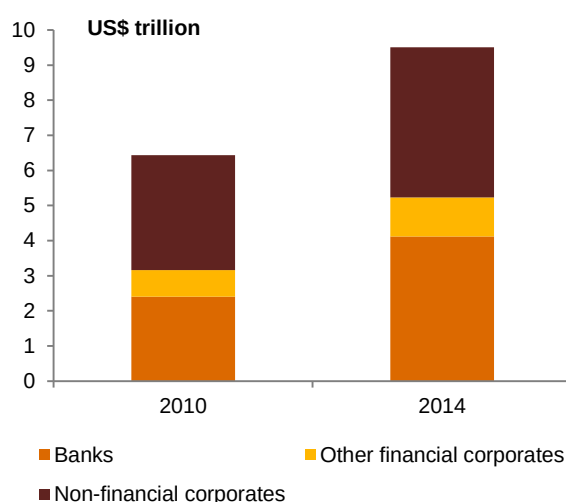
Source: PwC analysis

6 Policy considerations

6.1 Introduction

The introduction of post-crisis regulation which aims to promote financial stability has had an impact on market liquidity. One of the consequences of lower liquidity is an increase in cash holdings throughout the economy. As shown in Figure 6.1 below, banks, firms and funds are all holding more cash than they used to. In aggregate the collective increase is approximately US\$3 trillion (cash holdings are estimated for the S&P Global 1200).

Figure 6.1: Cash holdings of banks, non-financial corporates and financial corporates



Source: S&P Capital IQ, PwC analysis

A further consequence of post-financial crisis regulations aimed towards promoting financial stability is the negative impacts upon market liquidity. It is policy considerations around market liquidity that we develop in the remainder of this chapter.

6.2 Policy considerations

In the previous chapters of our report we set out the linkage between banking and financial market regulations and financial markets liquidity followed by a review of financial markets liquidity across various asset classes. This topic has received significant attention recently, and has been recognised as an area for further examination by financial market regulators. In a recent speech, Mark Carney, Chairman of the Financial Stability Board, laid out a plan for the FSB to identify financial stability risks associated with market liquidity in fixed income markets. Separately, the European

Commission launched an initiative to create a Capital Markets Union, which will include an examination of an appropriate regulatory framework and its impact on liquidity. These initiatives and others like them are helpful. In that context, this chapter sets out our findings and considerations for policy makers and financial market participants.

Banking and financial markets regulations have altered the market structure and behaviour of some participants in dealer-based financial markets, particularly fixed income and OTC derivatives. Regulations are a key driver of reduced balance sheet capacity at market makers, which has not been replaced by other market participants. This has led to reduced market depth; the implementation of further reforms are also likely to have significant implications for future market liquidity.

We find that market participants have adapted to this environment of lower liquidity with new ways of trading and managing portfolios. In the current benign economic environment this has significantly, although not completely, contained the impact (e.g. bid-ask spreads and price impacts on trading have not increased significantly).

However, the functioning of financial markets has not been properly tested in a more difficult macroeconomic or market environment, and there is a risk of more volatile and disruptive markets in times of stress. Indeed QE is likely to be masking the impact of the changes in the structure of markets and reduced market liquidity.

These findings suggest banking and financial market regulations have had a detrimental impact on market liquidity, and have induced changes in the trading behaviour of market participants in order to adapt to an environment of lower liquidity. That said, even though this section will focus on regulatory policy considerations, regulation is not the only driver of reduced markets liquidity, as some of the reduction in financial markets liquidity can be attributed to other factors including a post-financial crisis change in risk appetite of market participants.

Financial regulators most likely anticipated that banking sector reforms would have an impact on the amount of financial markets activity and the prices of

financial services,²⁶¹ but it is unclear whether the extent of the changes to market liquidity, which may lead to an increase in financial system risk, was fully intended.

We recognise that there are substantial benefits to the range of banking sector regulations which have now been implemented, in the form of a lower probability and impact of future banking crises. A number of studies have shown the benefits to be substantial in economic terms.²⁶² This is a strong rationale for these reforms.

Within the overall package of reforms, there are some which make a strong contribution to financial stability with minimal impact on financial markets liquidity and other measures that have a less clear financial stability benefit with larger detrimental impact on financial markets liquidity.²⁶³ Our findings suggests there would be value in distinguishing the former from the latter.

Seven years on from the global financial crisis, we also consider that the policy question should be broadened: putting aside the question of whether banking sector and financial market reforms are beneficial, both individually and in aggregate, it should be considered whether *incremental* reforms will be beneficial. The turning point for when reforms move from being incrementally beneficial to costly to the economy depends on the incremental benefits (do further reforms add to financial stability?) and incremental costs (do further reforms have detrimental effects, for example on financial markets liquidity?).

A low incremental benefit and high incremental cost would result in a rapidly closing gap between economic benefits and costs and could result in a clear risk that banking sector and financial markets regulation goes beyond an 'optimal' point.

This leads to a number of policy considerations, which we set out below. We don't make specific recommendations for how to implement or refine individual regulations, which would require a fuller assessment. Rather, we provide four policy considerations for how financial markets liquidity could be better incorporated as a consideration in the

ongoing programme of banking sector and financial markets reform, which we set out below.

Consideration 1: Gather and analyse market data and insight for a better understanding of liquidity conditions and the link between regulation and market liquidity.

Having implemented a broad reform agenda, some data is already accumulating on the impact of different rules.

Recognising that some rules might be more effective and less harmful to liquidity than others, ideally policymakers and regulators would analyse each rule's benefits and costs and thus distinguish the rules that have a demonstrable impact on financial stability and minimal impact on liquidity, from those with negative impacts on market liquidity and less clear stability benefits.

Regulators might consider a number of additional analyses that would be complementary to this process. Firstly, there is a need to improve data quality and availability.

During the course of our work, we have found an incomplete patchwork of data on financial markets liquidity, which is not surprising given its multi-faceted nature. Regulators could gain a better alignment of understanding around liquidity, e.g. by enhancing monitoring of market liquidity conditions, and could take the lead in collating and publishing these datasets, particularly in dealer-led markets. This data collection should go beyond transaction level data and examine and monitor liquidity conditions on both sides of markets, for example buy and sell quotes and their associated durability. It should also focus on those areas of traditionally weaker liquidity (such as high yield and emerging market debt) which should be particularly good indicators of liquidity conditions.

Secondly, regulators, such as the Financial Stability Board and BCBS, could carefully review the causes and impacts of recent mini-stress events (such as the European sovereign bond movements in May and June 2015) for potential indicators of market performance in times of greater stress. A review of the effectiveness of existing regulations, their

²⁶¹ Most regulatory impact assessments for banking sector reforms do not explicitly incorporate market liquidity effects and often use a cost pass through assumption which assumes all operational, funding and capital costs are passed through to end-users. While there may be associated demand-side effects (from higher prices of financial services), most regulatory impact assessments do not incorporate other supply-side effects (such as reduced liquidity in financial markets).

²⁶² BIS (2010) "Assessment of the long-term economic impact of stronger capital and liquidity requirements".

²⁶³ As set out in Chapter 3, higher risks weights on certain trading assets, the use of non-risk based capital ratios, and regulatory definitions of liquid assets are examples of regulations which have smaller stability benefits, but more detrimental financial markets liquidity in certain asset classes.

impacts on market liquidity as well as any unintended consequences would be beneficial. To this end, the Federal Reserve recently stated its intention to conduct a data-based analysis of changes in the resilience of market liquidity, as well as to understand how different participants contribute to market liquidity and how they are adapting to changes in the liquidity environment.^{264,265}

Lastly, we also suggest a more systematic approach to the assessment of the cumulative impact of both market-based and prudential regulations on individual asset classes. This could be done by reviewing all the regulations that impact the economics of acquiring, holding and selling each type of asset. This will make it easier to detect whether the cumulative impact of individually appropriate reforms is unduly detrimental to an individual asset class. We believe that the most effective way to conduct such an analysis is by asset class or activity. Thus, for a given asset – say, an investment grade corporate bond, or an interest-rate swap – it would be beneficial for all stakeholders if there were an inventory of all the rules – capital, liquidity, clearing, margin – that affect the cost of holding and financing that asset, and then examine whether the integrated regulatory requirements accurately reflect, overstate, or understate its risk.

Consideration 2: Assess existing and future regulatory decisions to strike the right balance between solidifying banking sector stability and maintaining financial markets liquidity.

There are multiple reforms in the process of final calibration and a number of reforms at earlier stages of policy development. Examples of the former include the finalisation of the NSFR, G-SIB capital surcharges, MiFID II, BCBS-IOSCO margin requirements, and CCP counterparty rules, and examples of the latter include FRTB and EU bank structural reforms (as set out in Chapter 5). For example, the fact that securities borrowed to support secondary market making attract the same RSF factor as other loans to non-banks, regardless of the underlying asset and maturity of transaction, is likely to further reduce bank activity in repo markets. In all these cases, we conclude there are clear links from these reforms to reduced financial markets liquidity.

²⁶⁴ We note that the European Systemic Risk Board (ESRB) is planning to assess the potential financial stability effects from the current low interest rate environment and structural changes in the financial sector. Source: “Press release: ESRB General Board meeting in Frankfurt”, 25 June 2015.

²⁶⁵ Speech by Governor Lael Brainard entitled “Recent changes in the resilience of market liquidity”, at the Policy Makers’ Panel on Financial Intermediation: Complexities and Risks for “The Future

This suggests there is a need for careful assessment of future reforms – both their stability benefits and financial markets liquidity effects.²⁶⁶

Consideration 3: Review the global regulatory landscape, across different rule areas (market infrastructure, capital and liquidity requirements and structural reforms) to ensure coherence and to avoid detrimental financial markets liquidity effects.

There are inherent tensions between different reforms which can stifle the effectiveness of individual reforms and add complexity and unintended consequences. The way in which reforms interact with one another may result in unintended negative impacts on financial markets liquidity. Further, there are some reforms which may not add significantly to financial stability, but are detrimental to financial markets liquidity. We provide a few examples below:

- Unlike the risk-weighted capital requirements, the leverage ratio requirement does not allow for the netting of repo exposures in interbank/inter-dealer repo transactions as it does not take into account received collateral (equities or bonds) or the creditworthiness of the counterparty. As a result of these differences, the leverage ratio imposes a higher capital requirement than is required by the risk-weighted capital requirements, especially in low-risk products.
- The leverage ratio framework does not recognise the exposure-reducing effects of the segregated initial margin in cleared derivatives exposures, which has the effect of overstating the exposures of cleared transactions. This imposes high capital requirements on cleared transactions and runs counter to the regulatory push under EMIR and Dodd-Frank towards central clearing for derivatives transactions.
- Within the G-SIB framework, banks do not get reduced capital requirements following the implementation of NSFR, LCR and TLAC which contribute to lower bank risk. Such a layering of capital and liquidity requirements, each individually sensible, can be excessive in aggregate.

of Financial Intermediation: Banking, Securities Markets, or Something New?” Salzburg Global Forum on Finance in a Changing World, Salzburg, Austria.

²⁶⁶ SIFMA’s response to the SEC also notes that regulators may wish to pause and consider the impacts of future regulations on liquidity. See SIFMA (2015) Letter to the SEC: Potential Market and Regulatory Changes to Strengthen Liquidity in the Fixed Income Markets”.

- Although MiFID II aims to increase the efficiency and resilience of capital markets by introducing pre- and post-trade transparency, the way in which liquidity is defined could have a detrimental impact on liquidity for certain instruments: market makers may be discouraged from committing capital to facilitate trades in illiquid instruments that are classified as liquid and are therefore subject to transparency requirements. This, combined with the trading obligation and mandatory clearing requirements, are likely to affect relatively illiquid instruments such as corporate bonds.
- MiFID II also has significant extra-territorial impacts as the equivalence and reciprocity requirements and the need to establish branches for services into the EU will reduce the ability of non-EU market participants to gain access to EU markets.²⁶⁷ This could lead to further market and liquidity fragmentation.
- The lack of exemptions for inventory held for market-making and underwriting creates a disincentive for dealers to underwrite or make markets, which would decrease the liquidity of dealer-driven markets.
- Standardised approaches for assessing credit and market risk, or indeed others, combined with a floor requirement could become a binding constraint for all participants and undermine risk sensitivity, which reduces the incentive to use and develop improved and advanced models-based approaches for risk management. It would also create many of the same problems as a binding leverage ratio requirement. It would force a misallocation of capital, drive uniformity in business models and reduce market diversity. This is typically unhelpful because it encourages similar market behaviours, particularly in times of stress.

Such examples are difficult to anticipate in the rule making process. We suggest that now is a good time to review and evaluate existing reforms. Such reviews should consider whether the reforms are performing as expected (in terms of firm behaviour, risk taking, pricing effects etc.), as well as whether there are avoidable detrimental impacts on financial markets liquidity.

Where there are cases of detrimental impacts on financial markets liquidity and rule revisions would not reduce stability benefits, then we consider there is a clear case for change. At the margin there may be

cases where rule changes have a negligible impact on financial stability benefits, but significant improvement in financial markets liquidity. Such cases are likely in specific asset classes (e.g. repos, longer dated forwards, single name CDSs), where reduced financial markets stability is likely to be small in relation to significant liquidity improvements in individual markets.

Consideration 4: Review the regulatory landscape for consistency across international borders, to avoid unnecessary liquidity fragmentation.

A finding of our study is the fragmentation of liquidity across multiple trading venues and geographies, resulting in additional complexity and transaction costs for investors. This has been partly driven by banks retrenching to domestic or regional markets, and partly due to an increase in the number of trading venues, but also by regulatory rules which differ across territories and across markets. The uneven application of regulations on different market participants has contributed to the fragmentation of liquidity.

Such regulations reduce incentives for banks to provide liquidity across both territories and markets. This results in a more difficult trading environment, smaller trade sizes and longer timeframes to execute trades. The requirements for third country equivalence and reciprocity in current regulations such as MiFID II and MiFIR also create a further barrier to entry for non-EU firms. This means that for a jurisdiction to be equivalent, it must subject firms that it authorises to legally-binding requirements of equivalent effect to MiFID II and MiFIR. Absent equivalence, a non-EU firm cannot provide services to the EU, and would be required to provide services through a properly licenced (and passported) subsidiary within the EU.

Regulations differ both by type and by method of implementation. Examples include the different approaches to structural reform across the US, UK and Europe and different pre and post-trade reporting requirements. This could result in established cross-border trading relationships becoming broken as smaller sources of regional liquidity emerge (ISDA, 2015). Not only does this lack of coherence add operational cost, but it also forces market participants to be more selective across geographic markets. Further examples of a

²⁶⁷ We note that the discretion to require in-state branches is left to member states.

lack of international consistency in the regulatory rules include:

- MiFIR requires certain derivatives contracts – those that are both cleared through a central counterparty (CCP) and deemed sufficiently liquid – to trade on a trading venue. The co-existence of different regulatory regimes could increase the costs of hedging for firms where trades are subject to overlapping EU and non-EU regulatory regimes.
- SEF rules require ETPs to register with the CFTC if they provide market access to US market participants. However, similar rules are not in place elsewhere, i.e. these requirements do not exist for non-US market participants. Since the SEF rules came into force, European dealers have become reluctant to trade with US counterparties. This has led to European dealers trading Euro IRS with other European dealers rather than trading in the US.

Further work by key stakeholders, including market participants and policymakers, to review the coherence and any overlaps of current regulatory reforms, and identify areas of divergence, would be helpful.²⁶⁸

We acknowledge that international coordination of regulations is not simple and different national regulators will have different priorities, but the fragmented approach results in undesirable market fragmentation and there are likely to be instances where a more common approach will be more beneficial.

All of these considerations suggest increasing the emphasis on market liquidity in the next wave of banking and financial markets regulation. While it will continue to be important to focus on enhancing the resilience of banks through the regulatory process, it will be equally important to consider the regulatory effects on market liquidity, as more liquid, diverse, and effective financial markets will have long-term benefits on the global economy.

²⁶⁸ We note that via the Financial Stability Board (FSB), the G20 countries adopted a cross-border approach to a comprehensive

reform agenda for OTC derivatives markets to ensure policy coherence.

Appendix A: Glossary

Algorithmic trading: An electronic trading system that uses mathematical models (or algorithms) for executing pre-programmed trading instructions in financial markets.

Assets under management (AUM): The value of assets managed by an investment manager, hedge fund or sovereign wealth fund.

Bid-ask spread: The 'bid' is the price that someone is willing to pay for a security at a certain point in time, while the 'ask' is the price at which someone is willing to sell the same asset. The difference between the two prices is called the bid-ask spread.

Centralised clearing: A system whereby all financial transactions are cleared by a single counterparty.

Certificates of deposit (CD): A certificate of deposit is a financial product generally sold in the United States. It operates as a savings account that holds a fixed amount of money for a period of time. When the CD matures the investor receives the original investment amount plus any accrued interest.

Commercial paper: An unsecured short term loan issued by banks, corporations and governments to finance their short term credit needs.

Contingent capital: A contingent capital instrument is a debt instrument that automatically converts to equity when there is a crisis or when certain conditions are met.

Continuous linked settlement (CLS): The CLS is a global settlement system that seeks to eliminate FX settlement risk by providing simultaneous settlements.

Credit Default Swap (CDS): A CDS is a credit derivative contract whereby the seller of the CDS will compensate the buyer in the event of default.

Fixed interest rate: A fixed interest rate refers to any debt instrument that has a stationary rate of interest which does not fluctuate over the life of the instrument.

Floating interest rate: A floating interest rate refers to any debt instrument that does not have a fixed interest rate over the life of the instrument.

Forward rate agreement: An agreement between two parties that determines the rate of interest, or currency rate, to be paid or received on an obligation at some point in the future.

High-yield bonds: A higher paying bond that has a lower credit rating (below BBB) than investment-grade corporate bonds and sovereign bonds. Because of the higher risk of default, these bonds pay a higher yield than investment grade bonds.

Interest rate swap: A transaction where cash flows from a debt instrument with a fixed interest rate are exchanged for cash flows from a debt instrument with a floating interest rate, and vice versa.

Investment-grade bonds: This refers to the quality of an issuer's credit. Investment grade securities are those which have been assigned ratings of BBB, or Baa, and above.

Liquidity risk premia: A premium that is paid on a security when it cannot easily be converted into cash. A high risk premia is indicative of low levels of liquidity.

Market efficiency coefficient: The market efficiency coefficient measures the impact of execution costs on price volatility over short horizons. It is measured as the ratio of the variance of long-term stock returns to the variance of short-term stock returns.

Minimum requirement for own funds and eligible liabilities (MREL): This refers to the BRRD's requirement for banks to have enough liabilities which could be eligible to bail-in, meaning that banks' creditors will be written down or converted into equity in case of resolution.

Notional value: The underlying amount in a derivatives trade which is used to price payments on that derivative.

On-the-run (Off-the-run): The most recently issued instruments are known as 'On-the-run', while instruments that were issued before become known as 'Off-the-run'.

Over the counter (OTC): An OTC transaction is one that occurs between two parties without going through an organised exchange.

Proprietary trading: Banks and other financial institutions trading using their own money, rather than on behalf of a client.

Repo: A repo is a sale and repurchase agreement which allows the holder of a bond to sell it in order to raise cash, while at the same time entering into an agreement to repurchase the bond at a future date for the same price plus interest.

Total Loss-Absorbing Capacity (TLAC): This refers to the Financial Stability Board's proposed minimum requirements for banks to hold a minimum level of loss absorbing capacity and recapitalisation capacity. Similar to the MREL, it consists of liabilities that can be effectively written down or converted into equity during resolution of a G-SIB.

Turnover ratio: A turnover ratio expresses trading volumes as a proportion of the total value of bonds outstanding for a particular time period, and thus captures the extent to which the current stock of bonds is being traded in the market.

Value at risk: Value at risk is a measure used to monitor risk in a given trading portfolio. It produces an estimate for the maximum potential loss of a portfolio given a certain confidence level and a specific time period.

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Appendix C: Review of regulations affecting liquidity

In this chapter we describe in more detail the regulatory changes that have an impact on market liquidity.

C.1 Capital and liquidity requirements

Basel III

Basel III is a comprehensive set of reform measures, developed by the BCBS, which seeks to strengthen the regulation, supervision and risk management of the banking sector. These measures aim to improve the banking sector's resilience to shocks, improve risk management and governance, and strengthen banks' transparency and disclosures. The new rules consist of four main requirements:

- The new rules increase the minimum risk-based capital ratios and introduce a new common equity risk-based capital ratio (Common Equity Tier 1, or CET1). Banks must therefore hold a greater level of capital and a higher proportion of higher quality capital against more conservatively calculated risk weighted assets (RWAs). Additional capital buffers are also required, including a systemic risk buffer for systemically important banks, a capital conservation buffer, and a countercyclical capital buffer.
- Basel III also increases the risk weights for counterparty credit exposures relating to derivatives transactions entered into with financial institutions (although these will be lower in respect of cleared transactions) and introducing requirements for institutions to set aside regulatory capital to cover credit valuation adjustment (CVA) risk (in addition to counterparty default risk).²⁶⁹
- The Liquidity Coverage Ratio (LCR) requirement is aimed at improving the short-term resilience of the institution by holding a buffer of high quality liquid assets (HQLA), which includes cash, central bank reserves and sovereign debt. Specifically, LCR requires institutions to hold sufficient HQLA to be able

to meet at least 100% net liquidity outflows under a 30-day stress scenario by 2019.

- The Basel III rules also aim to address liquidity mismatches by incentivising institutions to use stable sources of longer-term funding. The Net Stable Funding Ratio (NSFR) requirement ensures that a firm has an acceptable amount of stable funding to support its assets and activities. The NSFR requires banks to have available stable funding that is at least 100% of required stable funding over a one-year time period. Available stable funding is defined as the portion of those types of equity and liability financing expected to provide reliable sources of funds over a one year time horizon. The required amount of stable funding will be measured on the basis of the broad characteristics of the liquidity risk profiles of a firm's assets, off-balance sheet exposures and other selected activities.
- Basel III also introduces a minimum leverage ratio requirement of 3%, which is a non-risk based "backstop" measure which aims to restrict the build-up of excessive leverage in the banking sector. Banks must hold sufficient Tier 1 capital against their total assets and on- and off-balance sheet exposures.

Regional and national implementation of Basel III

These rules are implemented in the EU through the Capital Requirement Regulation and Directive (CRD IV). The US Basel III Final Rule also implements the major aspects of the Basel III regime and incorporates changes as required through the Dodd-Frank Act. Basel III implementation is also advanced elsewhere in a number of countries that have been deemed compliant or largely compliant by BCBS' Regulatory Consistency Assessment Programme, for example Singapore, Hong Kong and Australia.²⁷⁰

In a number of circumstances, countries have gone beyond Basel III requirements and implemented higher capital requirements. US regulators have introduced a supplementary leverage ratio (SLR) of 5% for US GSIBs (and 6% for their insured banks). Although the deadline for complying with the SLR is 1 January 2018, some US banks have met or are on

²⁶⁹ CVA risk is the risk of loss caused by changes in the credit spread of a counterparty due to changes in its credit quality.

²⁷⁰ <http://www.bis.org/bcbs/implementation/l2.htm>.

track to meet this requirement: Citi's current SLR stands at 6.4% at the holding company level, while JP Morgan and Bank of America Merrill Lynch have an SLR of 5.9%.²⁷¹

Capital requirements impacting SFTs and for client clearing

The leverage ratio requires banks to hold capital against the gross nominal value of their assets, and applies, whether or not lending is collateralised or whether netting arrangements are in place to reduce banks' exposures. This could have a particular impact on SFTs, such as repo and reverse repo agreements, CDS, securities lending, borrowing agreements and margin lending transactions.

The Basel III rules require banks to hold capital against any counterparty exposures net of the collateral received on the repo or securities loan, together with an add-on for potential future exposure. Capital must also continue to be held against lent or repo-ed securities. This requirement is designed to prevent counterparty defaults from transmitting trading losses between banks and around the financial system. Basel III also increases capital requirements held against securities and derivatives trading.

Derivatives clearing

CRD IV rules also aim to minimise the negative effects of counterparty default risk and encourage the use of central counterparties (CCPs), particularly European CCPs. These CCPs are authorised under the Regulation on OTC derivatives, central counterparties and trade repositories (also known as the European Market Infrastructure Regulation "EMIR"²⁷²). CRD IV allows firms to apply lower risk weights for capital held as margin at CCPs which obtain EMIR authorisation. Exposures to CCPs that are not EMIR-authorised or recognised in the case of CCPs outside of the EU, incur a higher capital charge. Non-centrally cleared derivatives incur the greatest capital charge. The G20 agreed on reforms to OTC derivative markets in 2009 which require most standardised derivatives to be centrally cleared. Similar requirements for central clearing also exist under Dodd-Frank.

Risk retention for securitisations

The Dodd-Frank Act requires sponsors of securitisation to retain a portion of the credit risk of their transactions, which is generally 5% of the size of interests issued in the offering (but may be less

than 5% if the assets that are used to collateralise the transaction meet certain conditions).

In Europe, under CRD IV, bank investors are restricted from assuming a credit risk exposure to a securitisation position unless certain requirements are met, including where the originator has disclosed that it will retain a net economic interest of not less than 5%. In turn, this has an impact on organisations or market participants that rely on or heavily use the securitisation market.

The finalised RWA rules that raise risk weights for securitisation exposures held by banks will also have an impact on banks' willingness to make markets in securitisation. These rules feed directly into the FRTB rules for securitisations and require materially higher default risk capital than prior rules, in particular for non-US banks.

Valuations for liquid assets and less liquid/illiquid assets

The LCR stipulates that assets included in the liquid assets buffer are included at market value less appropriate supervisory haircuts. These haircuts include those reflecting duration, credit risk, and liquidity risk, as well as repo haircuts in periods of general market stress. The average level of haircuts is estimated to be at least 15% for transferable HQLA, however some high quality instruments such as US Treasury bonds have no haircut.

Prudent valuation is a direct capital charge (CET1 deduction). It consists of a systematic, conservative reassessment of all fair valued exposures. Highly liquid exposures may be exempted under certain conditions. However, less liquid products are subject to significant and possibly punitive mark down, which could lead to further liquidity bifurcation.

Trading book capital reforms

In July 2009, the Basel Committee introduced a set of revisions to the market risk framework as part of the Basel 2.5 package of reforms. This included a series of rules that regulate capital charges on banking institutions in order to properly account for the market risk of their trading books. There are four specific areas of focus:

- Stressed value-at-risk (VaR): Banks' capital requirements now need to take into account a stressed VaR-based requirement, which captures the tail risks that the conventional VaR approach does not capture, i.e. it

²⁷¹ Citigroup's Q1 2015 Results - Fixed Income Investor Review, Bank of America's (BAC) CEO Brian Moynihan on Q4 2014 Results - Earnings Call Transcript, JP Morgan 2014 Q4 results.

²⁷² Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC Derivatives, CCPs and Trade Repositories.

underestimates the risk of a trading position during a crisis period.

- Incremental risk charge (IRC): This capital charge captures default and credit migration risk, and mainly affects banks' credit exposures, e.g. corporate bonds, CDS etc., and takes into account losses from defaults and also credit downgrades. However, the IRC is not implemented in a globally consistent manner: The PRA requires the computation of the IRC to include sovereign debts, whereas according to the US rules, US Treasuries are excluded from the IRC.
- Comprehensive risk measure: This capital charge captures correlation risk associated with underlying correlation-based positions, such as CDOs, and takes into account the risk of a hedge becoming ineffective.
- Standardised charges for securitisation and resecuritisation positions that are similar to the banking book charge.

Further trading book regulatory reforms are expected with the ongoing Fundamental Review of the Trading Book (FRTB), which is discussed further in Chapter 5.

C.2 Market infrastructure and transparency

Dodd-Frank

The Dodd-Frank Act introduces extensive rules on transparency and accountability, with the aim of protecting investors. The main components of the Act that improve transparency and accountability include:

- Enhancing transparency on OTC swaps, securitisations as well as transparency on hedge funds, mortgage brokers and payday lenders.²⁷³
- Requiring swap dealers and swap transaction participants to be registered and transactions to be centrally cleared.
- Higher margin requirements for swap transactions.

Banks' swap activities are also faced with: broader restrictions around proprietary trading in a wide array of instruments (including swaps), and a push-out provision under the recently amended Section

716 (or "Lincoln provision"). This provision requires insured depository institutions to "push out" certain types of non-hedging related derivatives trading to separate affiliates. While the Lincoln provision's scope has been limited such that only structured finance swaps now need to be so segregated, banks will nonetheless need to re-structure trading operations if they want to hold such instruments.²⁷⁴

The Dodd-Frank Act also requires mandated swaps to be executed on a designated contract market (DCM) or swap execution facility (SEF). SEF trading became operational in October 2013 and mandatory execution requirements for certain interest rate and credit derivatives came into force in February 2014. Non-financial end-users who use trades to mitigate commercial risks are exempt from executing trades on SEFs or DCMs.

European Market Infrastructure Regulation (EMIR)

EMIR is focused on the stability of OTC derivative markets by enhancing transparency and establishing minimum standards for derivative risk management. EMIR entered into force in August 2012 and consists of three main requirements for European derivative counterparties:

- Regulatory reporting requirements for all derivative transactions (both exchange-traded and OTC) to EMIR trade repositories (TRs). The reporting requirements allow regulators to monitor the build-up of systemic risk through excessive risk concentrations.
- Central clearing of OTC derivatives deemed eligible for clearing by ESMA with authorised CCPs. Central clearing requirements interpose a CCP between the two sides of a trade, thus managing the credit and operational risk of the transaction. EMIR also sets out margin and collateral standards for authorised CCPs. Non-financial counterparties²⁷⁵ are subject to clearing requirements only if their derivatives positions exceed a clearing threshold set out under EMIR.
- For uncleared contracts, market participants must fulfil regulatory minimum margin and collateral requirements. Firms must also comply with certain risk management requirements for uncleared contracts (including timely trade confirmation, daily

²⁷³ US Senate Committee on Banking, Housing and Urban Affairs (2010) "Brief summary of the Dodd-Frank Wall Street Reform and Consumer Protection Act".

²⁷⁴ The Act also empowers regulators to pursue financial fraud, conflicts of interest and provides shareholders with a say on executives' compensation.

²⁷⁵ 'Financial counterparties' include banks, insurers, investment firms, fund managers, spread betting firms and pension schemes. 'Non-financial counterparties' include any counterparty established in the EU that is not defined under EMIR as a financial counterparty, including non-financial firms, CCPs, TRs, and trading venues.

mark-to-market or mark-to-model valuation, reconciliation, compression and dispute resolution).

EMIR also contains an extra-territorial requirement that extends its scope to derivatives trading undertaken between entities outside of the EU, under certain circumstances.

Markets in Financial Instruments Directive (MiFID) II and Markets in Financial Instruments Regulation (MiFIR)

MiFID II and MiFIR, which come into effect on 3 January 2017, introduces trade transparency and trading obligations for some financial instruments. It also extends the range of financial instruments and investment services regulated in Europe within its scope, and strengthens the existing pan-European organisational and conduct standards for regulated firms.

Significant changes will occur in the trading of non-equity asset classes. The new rules will implement the G20 2009 OTC derivative reform commitment to move more OTC derivative trading onto trading venues and will establish a new classification of trading venue for fixed income instruments, i.e. Organised Trading Facilities (OTFs). This classification will join Regulated Markets (RMs) and Multilateral Trading Facilities (MTFs) as trading venues.

MiFIR also extends the pre- and post-trade transparency regime to equity-like instruments (e.g. depository receipts, ETFs and certificates and other similar instruments) and to non-equity instruments (e.g. bonds, structured finance products, emission allowances and derivatives). These rules are expected to have significant impacts on non-equity instruments, such as fixed income and derivatives. Under the pre-trade transparency regime, current bid and offer prices, and the depth of trading interest at the advertised prices, must be made public by operators of RMs, MTFs and OTFs.

Important features of MiFID II and MiFIR include:

- MiFID II proposes to introduce a liquidity calibration indicating how liquidity is to be determined, which will have an impact on the scope of instruments that become subject to pre- and post-trade reporting requirements.
- RMs, OTFs and MTFs, together with the introduction of trading obligation and transparency requirements are intended to stimulate the development of electronic trading platforms in order to deliver greater transparency, liquidity and price discovery. These venues are required to publish current bid and offer prices and depth of trading interest at those prices continuously during normal trading hours.
- MiFIR introduces pre- and post-trade transparency requirements for SIs²⁷⁶: SIs must make public pre-trade firm quotes on shares, depository receipts, ETFs, certificates and similar financial instruments traded on a trading venue for which they are SIs and for which there is a liquid market. In terms of fixed income instruments, investment firms will be required to make public firm quotes for bonds, structured finance products, emission allowances and derivatives traded on a trading venue for which they are an SI and for which there is a liquid market when prompted for a quote by a client and the SI agrees to provide the quote.
- The reforms require commodity derivatives traded on RMs, MTFs and OTFs and economically-equivalent OTC derivatives to be subject to limits on the size of a net position in a commodity derivative (i.e. position limits). Although there are exemptions for non-financial corporate hedging purposes, market participants will still be subject to position reporting requirements.
- The reforms introduce specific provisions for algorithmic and high-frequency trading (HFT) to promote orderly markets and to ensure that electronic trading does not have an adverse effect on market quality or integrity. Investment firms who use market-making strategies on trading venues will be required to enter into market-making agreements with the venues. This rule is designed to ensure investment firms provide liquidity on a consistent basis.
- The new regulations require trading venues and CCPs to provide non-discriminatory and transparent access to one another to promote competition in trading and clearing markets.
- MiFID II materially extends the “best execution” obligation which requires investment firms to take all reasonable steps to obtain, when executing orders on behalf of clients, the best possible result for their

²⁷⁶ SIs are market makers that execute client orders on their own account and outside a regulated market without operating a multilateral system.

clients, taking into account the execution factors - price, costs, speed, likelihood of execution and settlement, size and nature of the order or any other consideration relevant to the execution of the order. Firms are also required to explain their execution policy.

- MiFID II also establishes a regime for the provision of an EU consolidated post-trade tape.

C.3 Structural reforms

Volcker Rule

Section 619 of the Dodd-Frank Act, commonly known as the Volcker Rule, bans proprietary trading by banks and their affiliates unless subject to one of the exemptions around market-making, underwriting or certain types of hedging. The rule also significantly limits bank's ownership of or relationships with certain kinds of fund vehicles, referred to as 'covered funds', which are defined quite broadly. The Volcker Rule covers US banking entities globally and US subsidiaries of non-US headquartered banks. Transactions outside the US may be subject to the Rule if any party is subject to the Rule via affiliation (i.e. a non-US subsidiary of a US bank), or because a trader, structurer or sales person based in the US is involved in a transaction. The extraterritorial reach of the Volcker rule is material as the documentation of the "TOTUS" (totally outside the United States) requirements are complex.

The purpose of the Volcker Rule is to limit banks trading for the firm's own profit without the link to client servicing (proprietary trading) and limit involvement in purportedly riskier categories of investment funds. Proprietary trading refers to trading of financial instruments with the sole intent to profit from the difference between the purchase and the sale price, while market-making is proprietary trading that is designed to provide 'immediacy' as a service to investors.²⁷⁷ The proprietary trading restrictions apply to trading in a wide range of securities (including options) and derivatives, as well as commodities for future delivery. However, the Volcker Rule exempts US government securities and under a specific circumstance, foreign sovereign debt. This can be interpreted as recognition by policymakers that such regulation would harm the US government as an issuer if the Rule were to be applied to its own debt issues.²⁷⁸

The Volcker Rule also forbids banking entities from serving as principals in transactions in which they directly or indirectly obtain or keep ownership interests in certain types of 'covered funds.' These include private equity, venture capital, and hedge funds, as well as certain commodity pools under the Commodity Exchange Act and certain foreign funds that resemble US covered funds. Due to the breadth of the definition, covered funds also include certain securitisations, covered bonds, ETFs, and other products. The implementation of the proprietary trading ban comes into force on 21 July 2015. However, the implementation of certain aspects of the Volcker Rule (those pertaining to banks' exposures to covered funds that have been in place as of 31 December 2013) has been delayed to 21 July 2017. However, for covered funds not in place by 31 December 2013, compliance with the rule will be required on 21 July 2015 (note that a security or fund that was in place, when traded, may no longer be considered in place and compliance will be required).

UK retail ring-fencing

In 2011 the Independent Commission on Banking (ICB) presented the recommendations for bank structural reforms in order to improve financial stability and increase competition. The ICB proposed the ring-fencing of vital banking services from the risks posed by other banking activities. The Financial Services (Banking reform) Act 2013 became law in December 2013. The Act requires banks that undertake "core activities", i.e. regulated activity of accepting deposits, to place these activities into ring-fenced bodies. The Act also defines "core services" that are subject to ring-fencing, which include payment services and overdraft facilities. These requirements are intended to help ensure that these core services can be available continuously to individuals and small businesses

The Act also prohibits ring-fenced bodies from undertaking certain activities, including trading as principal in investments and commodities, and incurring exposures to certain other financial institutions. There are some exemptions for simple derivatives, securitisation of own assets, debt-equity swaps and activities ancillary to own risk management, and management of liquidity buffers. Ring-fenced entities may also have exposures to financial institutions for correspondent banking services, payments, trade finance and for liquidity management purposes.

²⁷⁷ Duffie, D. "Market Making Under the Proposed Volcker Rule", Stanford University, January 2012.

²⁷⁸ Ibid. p.4.

Other structural reforms at the national level

In France, the reform introduced by the law dated 26 July 2013 required banks whose trading activities exceed a certain threshold must ring-fence proprietary trading and certain unsecured transactions with leveraged funds, with restrictions on the use of high-frequency trading strategies. All foreign branches and subsidiaries of credit entities incorporated in France are subject to the new rules.

Similar rules also exist for Germany. In addition, market-making activities may also be ring-fenced or banned outside the ring-fenced trading entity, subject to the national regulator's discretion.

The Belgian Banking Law of 25th April 2014 seeks to prohibit deposit-taking banks from undertaking proprietary trading, with five categories of exemptions for activities conducted on behalf of customers, activities that are essential to risk management and maintaining financial markets liquidity.

Short selling restrictions

Short selling is the sale of a security that the seller does not own, although the seller will subsequently need to buy the security in order to be able to deliver the security to the buyer. There are two types of short-selling:

- Covered short selling, where the seller has borrowed the securities or made arrangements to ensure they can be borrowed, and
- Naked or uncovered short selling, where the seller has not borrowed the securities, nor made arrangements to ensure they can be borrowed at the time of the short sale.

Short selling regulations in the US date back to 2005, when the US Securities and Exchange Commission (SEC) implemented Regulation SHO²⁷⁹, prohibiting broker-dealers from executing equity short sale orders unless they have reasonable grounds to believe that the security can be borrowed by the time delivery is due. Furthermore, Regulation SHO requires broker-dealers to close out failures to deliver usually within T+4 of the settlement date, or face future restrictions around short-selling that particular instrument. Regulation SHO was significantly amended in 2010, when the SEC adopted a new short sale price test restriction. This is commonly referred to as the "alternative uptick rule"

which was designed to restrict short selling from further driving down the price of a stock that has dropped more than 10 percent in one day compared to the closing price on the previous day.²⁸⁰

In Europe, the Short Selling Regulation (SSR) was introduced from 1 November 2012.²⁸¹ The regulation is aimed at increasing the transparency of short positions held by investors in EU sovereign debt and equities that are primarily traded in the EU. The regulations also seeks to reduce settlement and other risks, and in particular, risks to the stability of sovereign debt markets (as a result of uncovered sovereign debt and sovereign CDS positions).

The most important aspect of this regulation is, prohibiting uncovered (naked) short-selling of EU sovereign debt or equities that are primarily traded in Europe. An uncovered sovereign CDS (SCDS) position exists when a person holds a (short) position in a SCDS without either a corresponding (long) position in the sovereign issuer referenced in that CDS or another position with a value that is correlated to the value of the sovereign debt. In order to establish a permitted sovereign CDS position, investors must now hold offsetting risk, such as the underlying sovereign bond or other exposures correlated to sovereign debt.

Exemptions are provided for market makers or banks involved in the issuance of government bonds. Another main provision includes the prohibition of entering into short positions in EU sovereign debt through uncovered CDS, for market participants other than market makers or banks involved in the issuance of government bonds. Member states are also empowered to intervene in order to reduce systemic risks and risks to financial stability and market confidence arising from short selling and the CDS market.²⁸² For example, competent authorities are also empowered to suspend short selling or limit transactions when the price of various instruments (including shares, sovereign bonds, corporate bonds and ETFs) fall by set percentage amounts from the previous day's closing price.

In addition the European Regulation on settlement and Central Securities Depositories (known as "CSDR") provides for mandatory buy in provisions where the financial instruments are not delivered within four business days of the intended settlement date. This will also apply to the end-leg of all SFTs, and the start-legs of term SFTs that are 9 days or longer in the case of liquid underlying securities, and

²⁷⁹ <http://www.sec.gov/investor/pubs/regsho.htm>.

²⁸⁰ <http://www.sec.gov/answers/shortrestrict.htm>.

²⁸¹ Regulation (EU) No 236/2012 on short selling and certain aspects of credit default swaps.

²⁸² <http://www.esma.europa.eu/page/Short-selling>.

15 days or longer in the case of illiquid underlying securities. The European fixed income markets will become a ‘guaranteed delivery’ environment, with the exception of the start-legs of very short-dated repos. External factors play a role in improving or worsening settlement efficiency (T2S, cash penalties, falling SFT liquidity, QE, etc.) and the provisions are seen as increasing risk to market makers, particularly where they offer securities that they do not physically hold, and may necessitate changes in market-making behaviour as well as pricing.

Regulators in other parts of the world have also put restrictions on short selling in place. For instance, in August 2013, the Japanese Financial Services Agency (FSA) published its final version of regulations that amended the Japanese short selling regulations. These amendments, which took effect on 5 November 2013, included major changes to the reporting and disclosure requirements of short selling positions as well as significant changes to the uptick rule. It also introduced anti-avoidance type provisions relating to the ban on naked short selling.²⁸³

C.4 Bank recovery and resolution

In the US, a resolution framework for systemic financial institutions under the Dodd-Frank Act 8 has been in place since 2010. Title I of the Dodd-Frank Act requires large US financial institutions to prepare and submit written plans to US regulators for orderly resolution under the bankruptcy code without government financial assistance. Title II empowers the FDIC to take a failing firm into receivership if the firm’s failure would have serious

adverse effects on financial stability. The business is then transferred to a new entity or wound down with losses and costs allocated to shareholders and creditors to the necessary degree.²⁸⁴

The Bank Recovery and Resolution Directive (BRRD) in Europe came into force on 1 January 2015. This Directive establishes a framework for the recovery and resolution of banks and investment firms across the EU. The policy intentions are to maintain financial stability and confidence in the banking sector, minimise the loss to society from banking crises, reduce moral hazard and strengthen the EU internal market. There are three core elements to the Directive:

- Firms must prepare recovery and resolution plans and barriers to resolution must be removed;
- Early intervention: Regulatory bodies are endowed with the powers to impose certain requirements on institutions in financial difficulty (e.g. if they are at risk of breaching capital requirements) before resolution becomes necessary, to restore the institution to an improved financial position; and
- Resolution tools: Resolution authorities are endowed with the tools and powers to facilitate the resolution of failing institutions. As part of the resolution tools, distressed firms can sell part of their organisation to one or more purchasers, transfer business to a temporary structure (e.g. a “bridge institution”), separate toxic assets using the asset separation tool, and bail in creditors.²⁸⁵

²⁸³ Financial Services Agency of Japan (2013) “Comprehensive Review of the Short Selling Regulation: An Overview”.

²⁸⁴ “Resolving Globally Active, Systemically Important, Financial Institutions”, a joint paper by the Federal Deposit Insurance Corporation and the Bank of England.

²⁸⁵ European Commission (2014) “EU Bank Recovery and Resolution Directive (BRRD): Frequently Asked Questions”.

Appendix D: Summary of impacts of regulations on liquidity

Table D.1 itemises the impacts of different regulations on market liquidity and the asset classes that are impacted.

Table D.1: Summary of regulatory impacts on market liquidity

Regulatory area	Regulations	Main impact on liquidity	Asset classes affected
Capital, liquidity and leverage reforms	Basel III capital reforms	Increased capital requirements lead to the repricing of, shrinkage of, or withdrawal of market makers from capital-intensive and funding-heavy areas of the business, such as trading in fixed income markets due to higher risk weights for trading activities. CVA charges also affect longer-dated derivatives, uncollateralised exposures, low credit-rated counterparties and counterparties with no liquid CDS market.	Fixed income, derivatives and repo markets (more capital intensive)
	Liquidity requirements	The effects of banks increasingly hoarding HQLA and the application of RSF factors under NSFR are likely to further depress activity in repo markets and markets for collateralised instruments.	Repo markets
	Leverage ratio	The leverage ratio requirement and its interaction with capital reforms amplify the constraints imposed by capital requirements. The restrictions on netting repo exposures will also negatively impact banks' activity in repo markets.	Fixed income, derivatives and repo markets (less capital intensive)
	Basel 2.5 / Fundamental Review of the Trading Book	Implicit and potential significant increase in the level of capital (via higher RWAs) in the implementation of FRTB, particularly under the internal model and sensitivity based approaches. Introduction of liquidity horizons creates a cliff effect on capital charges, which means banks may be less willing to underwrite new issues or reduce market-making activity.	Fixed income and derivatives markets
Market infrastructure and transparency	MiFID II and Dodd-Frank	The risk of exposure from increased pre- and post-trade transparency, particularly for less liquid instruments such as corporate bonds and longer-dated derivatives will reduce the incentives for market makers to continue providing liquidity in these markets.	Fixed income and derivatives markets
	EMIR and Dodd-Frank	Liquidity fragmentation from the lack of harmonisation of CCP regulations across regions will reduce market liquidity for swaps and derivatives.	Derivatives markets
Structural reforms	European bank structural reforms	Banks are likely to scale down trading activities in response to the ban on proprietary trading and bank separation reforms. Separation could impair the long-term viability of universal banks' separated trading operations, particularly in fixed income.	Fixed income and derivatives markets, and other markets

	Volcker Rule	The ban on proprietary trading will remove one source of liquidity. The difficulty in distinguishing prohibited proprietary trading from legitimate market-making may result in banks taking a more conservative approach to trading, which may limit legitimate market-making.	Fixed income (excl. US treasuries) and derivatives markets
	Short-selling regulation (SSR)	Trading restrictions also reduce sovereign debt trading activity (including sovereign CDS), and redirection of trading activity.	European sovereign bond markets
Recovery and resolution	TLAC requirements	Lower ratings and lack of investor appetite for convertible debt will increase banks' cost of funding. The regulations push banks towards longer-term funding structures that are less suited to trading activities. The interaction of the MREL requirements with other reforms, such as capital and leverage requirements may add more pressure on banks' market-making activities	Fixed income and derivatives markets
Bank taxes	FTT	FTT would increase the costs of trade execution across asset classes, which, in turn, affects the commercial viability of trading activities	Fixed income, derivatives and equity markets

Appendix E: Summary of other studies

Table E.1: Summary of literature on recent developments in capital markets liquidity

Reference	Summary
CGFS (2014) “Market-making and proprietary trading: industry trends, drivers and policy implications”, CGFS Papers No. 52, November 2014	The study by CGFS notes that market makers play an important role in financial markets by providing liquidity to facilitate market efficiency and functioning. Changes in behaviour of market makers and other liquidity providers can therefore have an impact on liquidity in fixed income markets. The report identified the following trends: • Increased signs of liquidity bifurcation and fragility, with market activity concentrating in the most liquid instruments and falling in less liquid ones. • Decline in dealer risk-taking capacity and willingness. • Increasing differentiation and greater focus on core markets, which contributes to further bifurcation. • Diminishing proprietary trading by banks. • Growing and more concentrated demand for immediacy services. • Adjustment in trade execution. • Expansion of electronic trading. The CGFS also interviewed a number of market participants, who expect ongoing changes in regulations to raise the cost of providing immediacy services during normal times, potentially reinforcing the observed trend towards liquidity bifurcation. Market based and regulatory drivers have also resulted in a decline in dealers’ risk tolerance, and are thus raising the risk premia they demand. There are some signs that liquidity risks were underpriced prior to the crisis. Compressed pricing of immediacy services observed in the past will give way to liquidity premia more consistent with actual market-making capacity and costs. The report also finds that the diverging trends for market-making supply and demand could imply upward pressure on trading costs, reduced market liquidity in secondary markets, and potentially higher costs of financing in primary markets.
Fender, I. and Lewrick, U. (2015) “Shifting tides – market liquidity and market-making in fixed income instruments”, Bank of International Settlements	This paper builds on the findings of CGFS (2014), which found signs of liquidity bifurcation. Bid-ask spreads, trading volumes and the average size of transactions in sovereign bond markets have returned to pre-crisis levels, indicating that liquidity has largely recovered in major sovereign bond markets. However, corporate bond markets have witnessed a decline in liquidity in many jurisdictions. Bid-ask spreads remain wider than levels observed before the crisis. Market participants also report that trading large amounts of corporate bonds has become more difficult. The authors note that these trends are driven by changes in market maker behaviour. Banks have reappraised their risk appetites following the financial crisis. Regulatory action to strengthen banks’ balance sheets and funding models has increased the costs of market-making. Market makers are therefore focusing on activities that require less capital and risk, or focusing on core markets and clients. Proprietary trading has diminished for banks in most jurisdictions, which will limit market makers’ ability to redistribute risky positions. Market makers are increasingly reluctant to absorb large positions and need more time to execute trades. Market-making is therefore shifting from a principal trading model towards client-driven brokerage model. The implications of these changes are that the reduction in market-making supply (and increased concentration) and the increase in demand will increase trading costs and reduce secondary market liquidity. Reduced liquidity could also impair the ability of markets to function in response to shocks or broad changes in market

sentiment. Lower dealer risk appetites mean that they are likely to reduce their exposure more decisively during periods of elevated illiquidity. However, liquidity conditions may better reflect actual market-making capacity and costs, which mitigate the risk of liquidity illusion.

The authors make several policy recommendations, including: (i) regulators could implement liquidity stress tests; (ii) regulators could implement disclosure requirements of market maker inventories and risk-taking, and (iii) ensuring liquidity backstops are available during shock events by establishing or expanding securities lending facilities.

Oliver Wyman and Morgan Stanley (2015) "Wholesale and investment banking outlook. Liquidity conundrum: shifting risks, what it means", March 2015

The authors suggest that the impact of less liquidity has been masked by a benign, ultra-low interest rate environment. This is set to reverse in the US and could reveal the side effects of QE pushing investors to less liquid securities. Financial regulation and quantitative easing are causing a shift of liquidity risks from banks to the buy-side, which is increasingly a concern for policymakers. Liquidity in fixed income markets is likely to fall further as regulation shrinks banks' capacity in fixed income markets by 10-15% over the next two years. Asset managers have highlighted their concerns over scarcer secondary market liquidity, particularly in credit markets (emerging market and high yield) and in Europe. Some have also raised concerns in rates markets and emerging markets currencies.

The report also suggested market participants have also raised concerns about the risks to financial stability from changes in quantitative easing and changes to market structure. Although electronic trading is growing, there are limitations to how much it can develop given instrument heterogeneity, particularly in fixed income markets. The authors also warn that the increase in electronic trading does not improve liquidity per se. This requires more fundamental changes to increase standardisation, which brings trade-offs for issuance flexibility and investment portfolio construction.

Barclays (2015) "The decline in financial market liquidity"

This research paper suggests that regulations have incentivised banks to improve their capital structures and business models to enhance the safety of the banking system and to reduce the probability of crises. Excessive reliance on short-term financing exposed banks to runs when investors withdrew from short-term money markets during the crisis, which caused bank failures and system-wide funding issues. To reduce the risk of future fire-sales, regulators have targeted repo and other short-term liabilities. However, in an effort to reduce the risk of future fire-sales financed by short-term debt, regulations have also reduced the supply of safe, short-term liquid assets such as repurchase agreements.

These changes are increasing the transaction costs for market participants such as hedge funds and insurance companies, which are facing difficulties in financing securities and repositioning their portfolios.

The reduction in the supply of short-term safe assets and the decline in liquidity in fixed income markets has created incentives for investors to look at non-traditional sources of liquidity, such as exchange-traded funds (ETFs) and mutual funds. However, as liquidity in the underlying investments declines this may result in a transfer of 'fire-sale' risk to assets such as leveraged loans, and investment grade and high yield bonds.

Salmon, C. (2015) "Financial market volatility and liquidity – cautionary note", speech given at the National Asset-Liability Management Europe symposium, London, 13 March 2015

Chris Salmon, in his speech, showed that volatility during the summer of 2014 was exceptionally low across a range of financial markets. Since then however, volatility has picked up, characterised by several short-lived episodes of extreme volatility and impaired market liquidity, examples being the 15 October increase in US Treasury yields and the 15 January appreciation of the Swiss franc.

This volatility suggests that major asset markets have become more sensitive to market events, so that shocks cause greater volatility. This is borne out by the increased sensitivity of corporate debt and equity markets volatility in response to price shocks in the post-crisis period, compared to the pre-crisis period.

These trends are partly driven by macroeconomic uncertainty and central bank activity. However, changes in the FICC market structure are also a key factor. Market makers are becoming less willing to commit capital to warehousing risk, which reflects reduced risk tolerance since the crisis and regulatory factors. At the same time, assets under management by the buy-side have increased. This amplifies the implications of reduced risk warehousing capacity and liquidity provision of market makers during times of market stress. Electronic trading also pools liquidity in normal times, but could contribute to discontinuous pricing during stress periods. Mr. Salmon warns that the increased sensitivity of market liquidity to shocks could mean that market dislocation becomes more persistent, increasing the scope of spillovers across markets, with significant impacts for financial stability. Traders should therefore appropriate price risks and central banks should raise awareness of these risks.

Furse, C. (2015) “Liquidity matters”, speech given to regional business contacts, Birmingham

Dame Clara Furse of the Bank of England notes that the experience of the financial crisis suggests that the cost of excessive reliance on bank finance can be debilitating, which is why securing the benefits of capital markets and market-based finance is important. Liquid financial markets are a key element in facilitating investment in the economy and to support economic growth.

Although recent reforms have increased financial stability, they have also caused a decline in capital markets activity, making some markets more fragile. Funding liquidity, the ease with which banks and other financial intermediaries can raise funding, and monetary liquidity, the counterpart to credit creation in the financial system, can create a veneer of abundant liquidity. Rising demand for assets in relaxed funding and monetary conditions can undermine the price discovery process, leading to apparently stable prices, an under-pricing of tail risk and insufficient compensation for liquidity risk.

Market makers are key to providing liquidity in capital markets. However, trading losses since the crisis and regulatory developments have triggered a reassessment of risk profiles and business models, resulting in banks retreating from market-making activities. This decline is structural, with banks moving to agency trading away from principal trading. As a result, the financial system has less capacity to absorb market shifts and periods of higher volatility are more likely. Clara raises concerns that although some measures of liquidity risk premia seem compressed, fragile liquidity conditions could render them vulnerable to correction. It is important to take stock of the cumulative impact and interaction of reforms, and to achieve the right calibration for a financial system that works to support growth.

JP Morgan (2015) “US Treasury market structure and liquidity”

This research paper by JP Morgan recognises that the decline in liquidity in US Treasury markets is a growing concern among market participants. Although bid-ask spreads in the Treasury market remain close to pre-crisis levels and trading volumes are steady, Treasury market depth has declined to levels below its long-term average. Primary dealer demand of Treasuries has declined while buy-side investment managers have taken up a bigger share. Regulatory developments have caused declines in dealer positions in US fixed income instruments, as dealers are not incentivised to hold large inventories. This impairs their ability to provide extra liquidity during market stress.

The authors also note that active queue management has also made market makers more likely to withdraw liquidity in times of heightened volatility. The vicious circle of low market depth and high volatility has led to further declines in liquidity.

JP Morgan (2015) “US corporate bond market liquidity – an update”

This research paper by JP Morgan raises market participants’ concerns over their day-to-day ability to manage portfolios, and the risk of market dislocation if the current strong demand for US credit products reverses. Credit trading activity has slowed and growth in trading has failed to keep up with issuance growth. Bond market turnover is therefore declining. The rise of funds that offer daily liquidity (mutual funds and ETFs) are a concern because flows in and out of these funds are correlated, and a sudden shift in portfolio adjustments in the same direction could reduce liquidity. Dealer positions are now smaller compared to market size and

	turnover due to regulatory changes, which reduces their ability to absorb market shocks. However, the authors suggest that credit markets are less at risk to changes in investor demand than other products, due to the long-term holding behaviour of credit investors.
Citi Research (2015) “The liquidity paradox”	This research paper by Citi shows that although market liquidity as measured by the bid-ask spread has narrowed and trading volumes have increased, it notes that market participants are concerned about the lack of depth (turnover ratios) and increasing frequency of “flash crashes” that occur without obvious causes. Regulatory drivers have been highlighted as a key factor, which have driven up the cost of funding and have reduced banks’ risk appetites and ability to warehouse risk. Even in less capital intensive areas, such as FX and equities, central banks’ distortion of markets has reduced heterogeneity of the investor base, which creates markets that are more prone to sudden corrections.
Deutsche Bank (2015) “Declining liquidity: The markets and the Fed”, Global Economic Perspectives	Traditional metrics suggest that Treasury market liquidity is not impaired relative to history. However, there is some evidence of a decline in market depth, i.e. it is more difficult and expensive to transact in size as the scale of market maker activity has declined. Volatility has increased in anticipation of an increase in interest rates. A reduction in primary dealer balance sheets point to lower liquidity in corporate bonds. The report notes that its analysis does not find a significant impact of lower Treasury market liquidity on industrial production or employment. However, although lower liquidity has not translated into broad market impairment yet, liquid markets could quickly turn illiquid in response to a shift in Fed policy or some other shock, which could amplify any adverse market response.
Goldman Sachs (2015) “Assessing market functioning through liquidity developments”	The report finds that liquidity in sovereign and corporate bonds is generally lower in Europe than in the US (e.g. higher transaction costs). Banks also play a more important role in determining market liquidity in the Euro area than the US. In addition, the ECB’s unconventional monetary policy programmes are currently substituting for market activity. The report also notes that market participants cannot permanently rely on central bank support, but notes that it has helped to restore confidence and willingness to trade among market participants. The report also proposes that gaining a better understanding of market liquidity is essential to reviewing whether financial markets are functioning effectively.
BlackRock (2014) “The liquidity challenge: Exploring and exploiting (il)liquidity”	This study by BlackRock shows that market liquidity is on the decline in US corporate bond markets, and more so in Europe. Turnover ratios are declining as trade sizes have declined. It has become more difficult to transact in block sizes. Traditional liquidity providers have pulled back due to regulatory reforms and risk aversion. The study also finds that the more illiquid the asset, the greater the expected rate of return. The report also notes that ETFs continue activity during times of market stress: although market participants may be at a price disadvantage, they were still able to execute ETF transactions.
Bank of England (2014) “Financial Stability Report: December 2014”	The Bank of England notes that since the summer of 2014, government bond yields across advanced economies have declined, which reflects a weaker outlook for longer-term global growth and inflation prospects which are associated with lower policy rates. There have been periods of heightened short-term volatility, with associated falls in the prices of riskier assets. Investors appeared to demand greater compensation for holding riskier corporate bonds, which led to an increase in spreads, especially for high yield and emerging market corporate bonds. Market volatility also increased, notably in US fixed income markets. The fall in market liquidity reflects the evolution of banks’ business models in response to regulation and experience following the crisis. This is associated with a reduction in dealer inventories and a retreat from market-making. Future episodes of illiquidity could become more persistent, particularly if triggered by fundamental shocks or in the event of large-scale self-reinforcing asset disposals. The report warns that a sudden reappraisal of economic prospects could cause a severe adjustment to asset prices and increase in volatility, especially if investors have not fully reflected structural

changes in market liquidity in their liquidity risk assessment. Additional margin calls could cause participants to exit positions, which could lead to further volatility, and trigger further liquidation in other markets, thereby causing contagion in other markets.

IMF (2015) “Global Financial Stability Report: April 2015”

In the most recent Global Financial Stability Report, the IMF analyses the impact of asset management firms on financial stability. There are increasing concerns over the risks posed by the industry, as a result of rapid growth and structural change in financial markets. Funds have been investing in less liquid assets due to the search for yield, and the overall volume of investment products has increased. However, even plain vanilla funds (mutual funds and ETFs) can pose risks. The IMF finds evidence of both fund share pricing rules creating a first-move advantage and herding among portfolio managers. These can create run risks, with the resulting price dynamics spreading to other parts of the financial system through funding markets and balance sheet and collateral channels. The IMF proposes that the industry should be strengthened, with better microprudential supervision and through the adoption of a macroprudential orientation. Risk management tools such as liquidity requirements fees and fund share pricing rules should be examined in light of the industry’s role in systemic risks.

Appendix F: Methodology for assessing liquidity impacts in corporate bond markets

F.1 Introduction

In this appendix we set out the approach used to analyse the drivers of corporate bond yields, with a particular focus on how liquidity impacts corporate borrowing spreads. We use an econometric technique to specify these relationships. Our approach is also underpinned by a review of key academic studies in this area, which we summarise below.

F.2 Previous studies

There has been considerable research into the drivers of corporate bond spreads, stretching back to Merton (1974). While credit risk has been frequently identified as a key driver of bond spreads, other studies have suggested a range of additional drivers. Dick-Nielsen, Feldhütter, and Lando (2010) show that yield spreads above swap rates are explained, in part, by a liquidity component and a liquidity risk component, based on their analysis of corporate bonds from the US TRACE data. The liquidity component consists of the Amihud (2002) liquidity measure, two proxies for bid-ask spreads²⁸⁶, and trading volumes scaled by amounts outstanding. The liquidity risk component is captured by the standard deviation of the bid-ask spread and the Amihud liquidity measure²⁸⁷. The study shows that each component of liquidity is statistically significant and analysis of these drivers shows that they are individually important, but vary in importance.

Similarly, the Bank of England (Churm and Panigirtzoglou, 2005) decomposed credit spreads into a credit risk component and the liquidity risk premia. Their specification is based on structural models such as the Leland and Toft (1995) model and the Merton models (1974) of corporate bond spreads, which show that spreads are driven by the expected and unexpected loss of default of the issuer, and a residual term that captures the liquidity risk

premia. The Bank of England have used two model specifications to decompose corporate bond spreads into the credit risk and liquidity risk premia: (i) the residual term after estimating credit risk component through price volatility and structural parameters for measuring corporate performance, and (ii) the residual term after using the cash CDS market spreads to estimate the credit risk component. Both of these approaches yielded consistent results on the liquidity risk premia.

F.3 Overall approach

Our overall approach to estimating the impact of liquidity on corporate bond spreads is based on the academic studies set out above. We have been able to use a broader set of data than some previous studies, by including data on the number of market makers for individual banks and proprietary liquidity scoring metrics.

Our main dependent variable is the z-spread, which is the spread that would be captured by the investor over the entire Treasury spot-rate yield curve if the bond is held to maturity.

We restricted our analysis to a representative sample of 745 investment-grade corporate bonds for 4 time periods in Europe, resulting in approximately 3000 data points. Capital markets data provider – Trax provided us with a representative sample from within their bond universe, by eliminating non-vanilla corporate bonds and those that have a trading history over our whole time period.

We specified a panel data econometric model that includes the drivers of corporate bond spreads which includes various metrics of liquidity, corporate credit quality and other bond-specific factors. The specification is set out below, and the definitions and sources of the variables in our analysis are set out in

²⁸⁶ Two proxies are used: (i) Imputed roundtrip trades are calculated by matching closest buys/sells to estimate the actual bid-ask spread. (ii) The roll measure (Roll 1984) is based on estimating bid-ask spreads through the covariance between consecutive returns.

²⁸⁷ The model is a panel data regression, which controls for bond specific factors by running separate regressions for each rating

class. Corporate specific factors and heteroscedasticity in residuals are taken into account by using two-dimensional cluster robust standard errors. The study also shows that liquidity is state dependent as the make-up of liquidity and its impact on spreads differs between pre-subprime crisis period and post-subprime crisis period.

more detail in Table F.1. We used various data sources to inform our analysis, including Trax, Thomson Reuters and UBS Delta.

$$\begin{aligned}
 Z - spread_{i,t} = & \alpha + \beta_1 Liquidity\ variability_{it} \\
 & + \beta_2 Amihud\ liquidity_{it} \\
 & + \beta_3 Number\ of\ marketmakers_{it} \\
 & + \beta_4 Liquidity\ score_{it} \\
 & + \beta_5 Bid\ ask\ spread_{it} \\
 & + \beta_6 Coupon\ rate_{it} \\
 & + \beta_7 Hazard\ rate_{it} \\
 & + \beta_8 Time\ to\ maturity_{it} + \varepsilon_{it}
 \end{aligned}$$

Where α is a constant, and i represents the bond issue at time t .

Table F.1: Definition and sources of variables used in the analysis

Variable		Definition	Source
Dependent variable	Z-spread	The spread between the bond yield and the specific country's equivalent Libor curve.	UBS Delta
Independent variables			
Liquidity drivers	Liquidity variability	30-day standard deviation of bid-ask spreads.	Trax
	Amihud liquidity	The Amihud (2002) measure of liquidity is a price impact measure that captures the daily price response (in basis points) scaled to turnover. Specifically, the following ratio is used: Average of (absolute daily return / trading volumes).	Trax and Thomson Reuters
	Number of market makers	Number of market makers quoting bid and ask spreads for the specific bond in that month.	Trax
	Liquidity score	A weighted score for each bond issue that is aggregates quoted price, volumes traded, amounts issued, amounts outstanding and trade enquiries information.	UBS Delta
	Bid-ask spread	The spread quoted by market makers for buying and selling bonds, scaled to price.	Trax
Control variables: time varying bond-specific and firm specific characteristics	Coupon rate	The interest that is stated on the bond when it is issued.	Trax
	Hazard rate	Model-based measure of a firm's default risk.	UBS Delta
	Time to maturity	The time left, in years, before the bond matures and is redeemed.	Thomson Reuters

Table F.2: Summary statistics for variables used in the analysis

Variable	Observations (over the 4 time periods)	Mean	Std. Dev.	Min	Max
Z-spread	2938	113.2	98.5	-286.0	857.8
Liquidity variability	2955	6.0	6.2	0.0	42.2
Amihud liquidity	2947	1.0	16.6	0.0	777.9
Number of market makers	2968	7.7	2.5	0.2	15.8
Liquidity score	2963	5.9	1.1	2.0	8.0
Trading volume	2980	28600000	166000000	10000	699000000
Bid-ask spread	2969	55.1	40.8	0.3	439.4
Coupon rate	2980	5.1	1.3	0.5	9.8
Hazard rate	2967	256.8	144.9	-190.4	989.8
Amounts issued	2980	768766	1854495	13500	50000000
Yield	2938	2.6	1.6	-1.9	10.6
Time to maturity	2947	9.1	37.5	0.1	994.5

Source: PwC analysis

The summary statistics for the data used in our analysis are shown in Table F.2.

We used a panel data approach as it allows us to control for individual heterogeneity across our bond sample, such as time-invariant variables that cannot be observed or measured, e.g. differences in the business practices across the corporations that issues the bonds; or variables that change over time but not across bonds such as international market factors. This then allows us to isolate the impact of variables that vary over time on corporate bond spreads.²⁸⁸

We use a fixed effects approach with robust standard errors (so that the model is robust to heteroscedasticity) in our panel data model, which assumes that individual-specific effects are uncorrelated with the independent variables. Under the fixed effects approach, each unit (in this case,

each bond issue) has its own systematic baseline. We used a number of specification tests all of which found the fixed effects model to be preferred over the random effects model.²⁸⁹

F.4 Key findings

The results in Table F.3 show that each of the liquidity drivers have a statistically significant relationship with z-spread at the 10% level, meaning that a decline in liquidity (as measured by the number of market makers, bid-ask spread, Amihud liquidity and volatility in bid-ask spreads), increases the z-spread on corporate bonds. Furthermore, the signs of the coefficients are consistent with prior expectations, for example, a one-unit reduction in the number of market makers increases the z-spread by 1.9 basis points.

²⁸⁸ “The key insight is that if the unobserved variable does not change over time, then any changes in the dependent variable must be due to influences other than these fixed characteristics.”, Stock and Watson, (2003).

²⁸⁹ In order to test whether a fixed effects or random effects model is appropriate in this context, we use the Hausman test which compares the two models with a null hypothesis that the random

effects model is preferred. We consistently get a p-value less than 0.05, which suggests that the fixed effects model is preferred to random effects. In addition, we also used the Sargan-Hansen test, which unlike the Hausman test, is robust to the presence of heteroscedasticity. The Sargan-Hansen test also found the fixed effects model to be the preferred model.

Table F.3: Results for the impact of market makers on corporate bond spreads

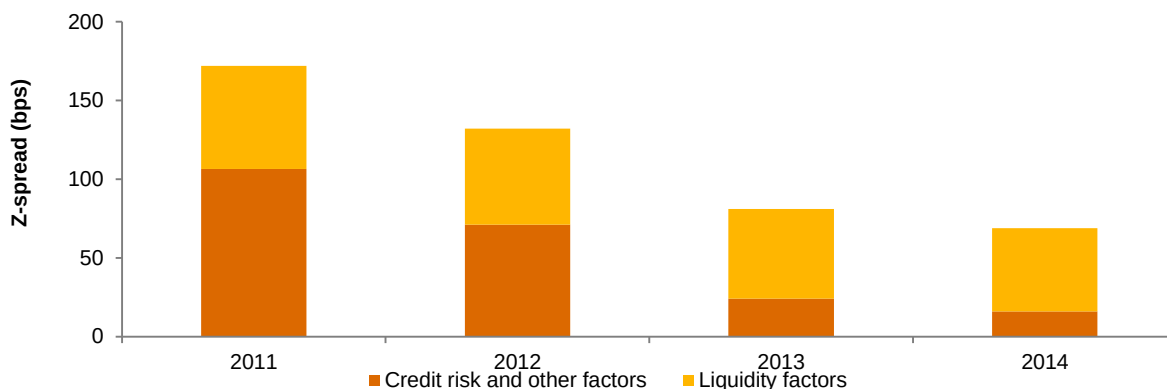
Z-spread	Coefficient	Robust standard error
Liquidity variability	0.334*	0.196
Amihud liquidity	0.646*	0.210
Number of market makers	-1.913*	0.681
Liquidity score	-4.95*	1.641
Bid-ask spread	0.227*	0.055
Coupon rate	60.333*	16.707
Hazard rate	0.554*	0.017
Time to maturity	-9.011*	1.152
Constant	-224.393*	84.488
Number of observations	2847	
Bond fixed-effects	Yes	
Wald chi2(27)	634.94	
Probability > chi2	0.000	

*** Significant at the 1% level; ** Significant at the 5% level; *Significant at the 10% level

Source: PwC analysis

Using the regression results from Table F.3 we provide a simple separation of the contribution of liquidity drivers to the z-spread on average across the bond sample. This separation is shown in Figure F.1. Despite a declining average z-spread across the sample, the contribution of the liquidity drivers has remained broadly stable over the 4 year period. This suggests there has been no material changes in liquidity risk premia investors require for holding European corporate bonds (in contrast to the falling premium for credit risk) and is consistent with our analysis of CDS spreads and work by the Bank of England.

Within this analysis, the liquidity drivers are working in different directions. We find that the reduction in bid-ask spreads over the period has put downward pressure on our calculation of the liquidity risk premia. These low bid-ask spreads may have been influenced by changes in trading behaviour, as discussed in Chapter 4 and may be a poor measure of changes in market liquidity. They may have dragged down our estimate of the liquidity risk premia in Figure F.1.

Figure F.1: Composition of z-spread for European corporate bonds

Source: PwC analysis. We note that there may be interactions between the different factors that explain the liquidity risk premia. We have not explicitly accounted for these but we note that results are consistent with our CDS analysis and the Bank of England's findings.

Contacts

To discuss this report, please speak to your PwC contact or one of the following:

Miles Kennedy

Financial Services Advisory

Direct: +44 207 212 4440

Email: miles.x.kennedy@uk.pwc.com

Adam Gilbert

*Global Regulatory Leader,
Financial Services Advisory*

Direct: +1 646 471 5806

Email: adam.gilbert@us.pwc.com

Aviral Rai

*Capital Markets Strategy & M&A
Consulting*

Direct: +1 646 471 6407

Email:
aviral.ra@strategyand.us.pwc.com

Nick Forrest

Economics and Policy

Direct: +44 207 804 5695

Email: nick.forrest@uk.pwc.com

Manda Shemirani

Financial Services Risk

Office: +44 207 802 7963

Email: manda.shemirani@uk.pwc.com

James Chrispin

Capital Markets Strategy

Office: +44 207 804 2327

Email: james.chrispin@uk.pwc.com

Yong Jing Teow

Economics and Policy

Direct: +44 207 804 4257

Email: yong.jing.teow@uk.pwc.com

Thomas Fisher

Economics and Policy

Office: +44 207 212 5271

Email: thomas.j.fisher@uk.pwc.com

Robert Churcher

Capital Markets Strategy

Direct: +44 207 804 0519

Email: robert.churcher@uk.pwc.com



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