

# Committee on the Global Financial System

## CGFS Papers

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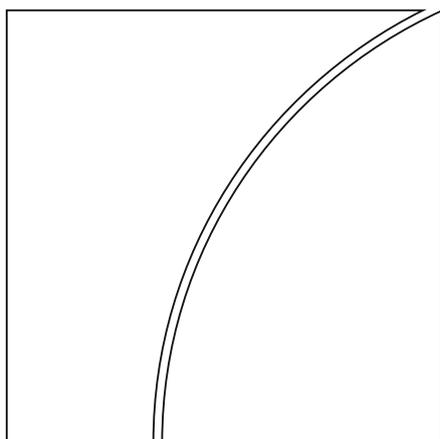
## Repo market functioning

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

The Group was chaired by Sir Jon Cunliffe, Bank of  
England

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## Preface

Repo markets play a key role in facilitating the flow of cash and securities around the financial system, with benefits to both financial and non-financial firms. A well functioning repo market also supports liquidity in other markets, thus contributing to the efficient allocation of capital in the real economy. However, excessive use of repos can also facilitate the build-up of leverage and encourage reliance on short-term funding.

Against this background, the Committee on the Global Financial System (CGFS) mandated a Working Group under the chairmanship of Sir Jon Cunliffe (Bank of England) to analyse current trends in the availability and cost of repo financing. The Group focused on repos backed by government bonds, and analysed how recent changes may affect the ability of repo markets to support the financial system, in both normal and stressed conditions.

The following report summarises the Group's conclusions. The overarching message is that repo markets are in a state of transition and differ across jurisdictions in terms of both their structure and their functioning. The post-crisis environment, an exceptionally accommodative monetary policy including through unconventional measures, and the regulatory reform which has increased the capital requirements for repo market intermediation have all played their role in affecting market functioning. Market adaptations include the expansion of end users' access to central counterparties and intermediaries' greater focus on netting transactions, but also the growth of transactions that, though similar to repos, do not affect the size of banks' balance sheet.

The transitional phase of repo markets requires close monitoring by policymakers. I hope that this report will provide the basis of this monitoring and a framework for the ongoing assessment of market adaptations and possible policy actions.

William C Dudley

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



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## Executive summary

Repo markets play a key role in facilitating the flow of cash and securities around the financial system. They offer a low-risk and liquid investment for cash, as well as the efficient management of liquidity and collateral by financial and non-financial firms. A well functioning repo market also supports liquidity and price discovery in cash markets, helping to improve the efficient allocation of capital and to reduce the funding costs of firms in the real economy. However, excessive use of repos can facilitate the build-up of leverage and encourage reliance on short-term funding.

The CGFS Study Group on repo market functioning was established to analyse changes in the availability and cost of repo financing, and how these affect the ability of repo markets to support the financial system, in both normal and stressed conditions. The Group focused on repo transactions backed by government bonds.

The Group gathered evidence on the changes in repo market functioning from many sources. These included a questionnaire issued to CGFS members, a survey of repo market participants (both intermediaries and end users), complemented with a number of discussions with market practitioners, and a roundtable held with industry representatives. The Group drew on a range of publicly available data, as well as data provided by central banks and private sector contacts.

Repo markets are in a state of transition and differ across jurisdictions in terms of both their structure and their functioning. In many jurisdictions, outstanding volumes of repos have declined significantly from their pre-crisis peaks but have stabilised in recent years. Changes in headline measures of price, such as the spread with risk-free rates, have differed across jurisdictions. In some jurisdictions, there are signs of banks being less willing or able to undertake repo market intermediation, compared with the period before the crisis, and seeking opportunities (including through greater netting) to minimise the use of their balance sheet in repo activity. An emerging pattern of volatility in both prices and volumes around balance sheet reporting dates can be associated with banks in some jurisdictions contracting their repo exposure in order to “window-dress” their regulatory ratios and reduce contributions to resolution funds, taxes and fees.

The report identifies several drivers behind these changes. Exceptionally accommodative monetary policy has played a role in providing ample central bank liquidity to the market and reducing the need for banks to trade reserves through the repo market. At the same time, central bank asset purchases have increased the reserves seeking investment in the repo market, thus putting pressure on the balance sheets of repo intermediaries, but have also reduced the quantity of high-quality collateral in many jurisdictions. The experience of the crisis and subsequent regulatory reform have combined to render banks more cautious about engaging in repo market intermediation. Partly due to a drive towards improved risk management in the post-crisis period, and partly due to stricter regulatory standards that require banks to hold capital in proportion to the size, as well as the composition, of their balance sheets, intermediaries are more cautious in engaging their capital in repo activity. The tightness of the constraints on intermediaries' balance sheets differs as jurisdictions have adopted different timelines in implementing the regulation but also because of differences in the calibration of rules and the frequency of reporting requirements. Balance sheet constraints are tighter when intermediaries have less scope to net repo/reverse repo transactions. The transitional phase of markets is further suggested by the observed growth in transactions in that, while economically similar to repos,

they do not affect the size of banks' balance sheets, such as collateral swaps and derivative or agency structures.

The Group analysed, from the narrow perspective of repo markets, the costs and benefits of these developments, the balance of which differs across jurisdictions.

The financial stability benefits of a potential decline in the availability of repo relate to moderating the vulnerabilities that emerged in the crisis through discouraging the future build-up of institutions' leverage and reliance on short-term funding. The maturity of repos is very short, which creates liquidity risks, and the value of repo collateral can be procyclical. In periods of stress, market participants become more sensitive to perceived counterparty risk and the value of the collateral can also be affected, thus amplifying the procyclical effects of leverage. The channel working through the collateral value is arguably weaker in the case of repos against government securities, and in particular in jurisdictions where government bonds appreciate in value during stress. Nevertheless, a reduction in the availability of repo and a better pricing of the intermediation costs may enhance financial system resilience by acting to limit excessive leverage, a key objective of the post-crisis regulatory reform.

These benefits, however, must be set against the costs of a reduction in repo availability. In a number of jurisdictions, some end users have already experienced difficulties (or increased costs) placing cash in repo markets, but the significance of these costs to the real economy is hard to gauge. A contraction in intermediation capacity may also reduce the degree to which repo markets can respond to demand during future periods of stress. A reduction in repo market functioning might create frictions in cash and derivatives markets, and reduce the ability of financial institutions to monetise assets. The scale of the resulting costs to financial stability and the real economy in times of stress might be significant altogether, although such situations have not materialised on a substantial scale in the most recent past. Repo market adaptations might mitigate the costs to some end users, but could also introduce new risks.

Given the differences in repo markets across jurisdictions and the fact that repo markets are in a state of transition, it is too soon to establish strong links between the different drivers and the observed changes in markets, or to reach clear-cut conclusions on the need for policy measures. A further study undertaken within the next two years should be able to form a clearer view of how repo market functioning has been shaped by, and adapted in response to, the various drivers identified in this report, including for example, the impact of regulations that act on the size or composition of banks' balance sheets, the treatment of collateral, permissible netting and the effects of cross-jurisdictional differences in the way repo exposures are calculated for the purpose of regulation, taxes and fees. To the extent necessary, the future study might provide a more informed assessment of the costs and benefits of any policy action. Any such assessment should consider the wider benefits or costs of these policies for the resilience of firms and the financial system as a whole, going beyond the narrow perspective of repo markets adopted in this study.

Prior to such a review, authorities in some jurisdictions might consider mitigating the adverse effects of a reduction in repo availability via more targeted and temporary measures. These include measures to reduce the scarcity of certain collateral, as well as other policies implemented in certain jurisdictions which, though initiated with the objective of facilitating monetary policy, have nonetheless improved repo market functioning.

## Introduction

Repo markets play a key role in facilitating the flow of cash and securities around the financial system. They create and support opportunities for the low-risk investment of cash, as well as the efficient management of liquidity and collateral by financial and non-financial firms. A well functioning repo market also supports liquidity and price discovery in the cash market, thus helping to improve the cost of funding for firms and governments and the efficient allocation of capital. But the excessive growth of repo markets can also pose risks to financial stability, facilitating the build-up of leverage, and lead to increased reliance on short-term funding. This can give rise to procyclicality, particularly when the underlying collateral is less liquid or of low quality.

Over the past few years, there has been some evidence of changes in the functioning of repo markets, at least in some jurisdictions. While overall volumes of repo transactions backed by government bonds have been relatively stable, in some jurisdictions there have been reports of end users experiencing a deterioration in the quantity and terms under which they are able to place cash or to borrow securities through the repo market.

Given the importance of repo markets and the signs that they are in a state of transition, the CGFS established a Study Group (SG) to analyse these developments and to assess the implications of a change in the cost and availability of repo financing, focusing on repos backed by high-quality collateral (ie government bonds). The primary objective of the SG was to examine how these changes affect the ability of the repo market to support the financial system in the medium to long term, in both in normal and stressed conditions. The SG was mandated to describe changes in repo market functioning and analyse their drivers and impact on different markets, as well as their broader consequences for financial stability and the real economy.

The analysis and recommendations expressed in this report are based on a review of existing literature and have been constrained by the limited availability of consistent quantitative information on repo markets across different jurisdictions. The SG gathered evidence on the changes in repo market functioning through several channels: (i) a questionnaire issued to CGFS members; (ii) a survey of repo market participants; (iii) discussions with practitioners, including a roundtable with industry representatives; and (iv) a collection of data that are publicly available or that were provided by contacts in the private sector. Nevertheless, the report can only present a selective and imperfect overview of key market developments in different jurisdictions.

The main findings point to significant variation in the functioning and structure of repo markets internationally. While markets are in the process of adapting to the post-crisis landscape, it appears that in some jurisdictions there is a decrease in end users' ability to access repo markets and an increase in the costs they incur in doing so. This is associated with banks displaying less willingness and ability to use their balance sheets for repo intermediation than was the case in the past. The increase in market volatility at the end of regulatory reporting periods for banks is symptomatic of this dynamic.

The SG has analysed the relative importance of different drivers of repo market changes. In some jurisdictions, the recent prolonged period of accommodative monetary policy and associated central bank asset purchases have reduced incentives for firms to conduct repo transactions to meet reserves targets, easing the pressures

described above. In others, they may have led to greater scarcity of collateral, and intensified pressures on intermediaries' balance sheets by increasing their holdings of cash. In addition, the lessons from the crisis derived by financial firms, and the new regulatory standards – both the international ones and those specific to certain jurisdictions – have impacted the behaviour of repo market intermediaries.

The SG has evaluated the costs and benefits of a potential reduction in repo market availability. This task has been confounded by differences in both the structure and the developments of the repo market across jurisdictions. These differences include a variety of monetary policy actions, as well as differences in the implementation of new regulations. It is therefore hard to draw general, overarching conclusions as to the balance of these effects. But this report sets out to highlight the different costs associated with reduced repo market activity as well as its potential benefits. In some cases, the balance of the costs and benefits will depend on how underlying collateral responds in times of market stress.

The remainder of the report is organised in four sections. The first section introduces the basic structure and main economic functions of repo markets. Section 2 presents the results of the SG fact-finding concerning the relevant patterns on price- and volume-based indicators. Section 3 analyses the drivers that may have induced such changes – with a focus on unconventional monetary policy and new regulations imposed on bank balance sheets and liquidity requirements – and how these may have impacted the functioning of repo markets. Section 4 provides an assessment of the potential benefits and costs of a reduced reliance on repo funding as well as an assessment of the adaptations that mitigate them. The last section summarises the main factual conclusions from the SG's work and presents a set of policy messages that might be useful for authorities in jurisdictions affected by a decline in repo market functioning.

## 1. Economic functions of repo markets

This section discusses the functions that repo markets perform within the financial system and the economy at large. It serves as a background for the analysis in the next sections.

A repurchase agreement (repo) is an agreement to sell securities (referred to as "collateral") at a given price, coupled with an agreement to repurchase these securities at a pre-specified price at a later date. A reverse repo is the same set of transactions seen from the perspective of the party lending cash and receiving the securities as collateral. A repo is economically similar to a collateralised loan since the securities provide credit protection in the event that the seller (ie the cash borrower) is unable to complete the second leg of the transaction. Collateral haircuts and regular margin payments further protect the lender against fluctuations in the value of the collateral. Repo transactions offer considerable flexibility to counterparties. For instance, the party receiving the collateral can reuse it (eg it can sell the securities outright, obtain cash through another repo, use them for margin calls). In addition, repo transaction settlements usually entail shorter delays than those for outright purchases of the same securities.<sup>1</sup> Finally, in most jurisdictions, repurchase

<sup>1</sup> See CPSS (2010).

transactions are subject to favourable treatment under the insolvency law because they are exempted from automatic stay under bankruptcy. This means that, in the event of a default by the cash borrower, counterparties have access to the securities and the right to liquidate them.

Size of repo markets Table 1

| Jurisdiction             | Repo and reverse repo transactions against government bonds (mid-2016) |                                   |   |
|--------------------------|--|-----------------------------------|---|
|                          | Amounts outstanding (in USD billions)                                  | As a share of global total (in %) | As a share of outstanding government debt securities in jurisdiction (in %) |
| Euro area                | 2,800  | 32                                | 32  |
| United States            | 2,700  | 30                                | 16  |
| Japan <sup>1</sup>       | 2,200  | 23                                | 21  |
| United Kingdom           | 900  | 10                                | 33  |
| Canada                   | 211  | 2                                 | 18  |
| Australia                | 106  | 1                                 | 18  |
| Mexico                   | 79   | 1                                 | 21  |
| Sweden                   | 74   | 1                                 | 44  |
| Switzerland <sup>2</sup> | 10   | 0.1                               | 11  |
| Total                    | 8,800  | 100                               |   |

Only repos against securities issued by the central government are included. Euro area repos include those backed by the central governments of Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and Spain. The global total is defined as the total of the jurisdictions in the table. The numbers may not add up due to rounding.

<sup>1</sup> Includes transactions against non-government bonds; however, most repo transactions in Japan are made against government bond collateral. <sup>2</sup> Comprises only repo transactions denominated in Swiss francs against high-quality liquidity asset (HQLA) collateral (which does not exclusively consist of government debt) conducted in Switzerland.

Sources: Bank of England Sterling Money Market Survey (United Kingdom); other national central banks; ICMA Repo Survey (euro area); Tokyo Money Market Survey (Japan); SIFMA (United States); BIS debt securities statistics.

Repo markets bring together two types of end users that interact through intermediaries. The first type includes those that provide collateral in return for cash (eg asset managers, pension funds, hedge funds and insurance companies). The second type of end users is those investing in cash while receiving collateral (eg money market funds or corporate treasurers). In some jurisdictions, cash providers use the “triparty” repo market, where contracts settle on the books of a clearing agent. Repos are almost exclusively intermediated by leveraged institutions (typically large banks and broker-dealers) that stand between end users.<sup>2</sup> Such repo intermediation activity is sometimes referred to as “matched book” repo, as securities borrowed by the dealer are matched by those lent.<sup>3</sup> Collateral and cash can pass through one or more intermediaries in order to fulfil the needs of cash lenders (borrowers of collateral) and cash borrowers (providers of collateral).<sup>4</sup> Banks and broker-dealers are

<sup>2</sup> Prospectively, it may also be disintermediated via electronic platforms that directly connect borrowers and lenders, or via entities not subject to prudential regulation (Section 2).

<sup>3</sup> Transactions, however, need not be matched in terms of liquidity, credit risk or interest rate risk.

<sup>4</sup> A detailed examination of this inter-dealer activity is provided in Baranova et al (2016).

also significant end users of repos in their own right, for financing their market-making inventory, sourcing short-term funding or investing cash.

There are currently around \$12 trillion of repo and reverse repo transactions outstanding globally, of which nearly \$9 trillion are collateralised with government bonds. Repo markets collateralised by government bonds vary considerably in size across jurisdictions, with the US, euro area and Japanese markets being the largest in terms of outstanding amounts (Table 1). Annex 1 describes the four largest markets.

## What do repo markets do?

Repo markets play an important role in the facilitation of the flow of cash and securities around the financial system. In doing so, they create and support low-risk and timely investment opportunities, as well as the functioning of derivatives and collateral markets. They also help in supporting cash market activity and enabling financial institutions to monetise their assets. These economic functions (EFs) are briefly explained below and summarised in Table 2, which also lists the main categories of market participants that use repos for each function.<sup>5</sup>

**EF1: Providing a low-risk option for cash investment.** Reverse repos are used heavily by money market funds, asset managers, central counterparties and other institutional investors or corporates as a means of investing their cash. In the United States and the euro area, an estimated \$2.2 trillion of cash was placed by money market funds, non-financial institutions, government agencies and central counterparties through repos against government securities in 2013.<sup>6</sup> The low risk provided by reverse repos using high-quality collateral makes them particularly suited for this role. Haircuts alleviate market risk, and the receipt of collateral reduces the credit risk borne by the cash lender. Reverse repos are a very flexible liquid investment that can be structured as one-day transactions that can be rolled over.

**EF2: Transformation of collateral.** Repo/reverse repo transactions provide market participants with a means to obtain specific securities or cash to be used in other transactions. By improving the ability of investors to settle trades and meet margin requirements, repos support the smooth functioning of derivatives markets and contribute to the resilience of the financial system and the real economy. Securities borrowed through repos can, for example, be delivered as part of market participants' obligations towards custodians or securities settlement systems.

**EF3: Supporting cash market efficiency and liquidity.** Repos are used by market participants looking to exploit pricing discrepancies (arbitrage) and finance trading activity which supports market liquidity. Hedge funds and other leveraged institutions use repos to fund trades designed to benefit from market dislocations and mispricing of risk, as well as other forms of speculation. In doing so, they contribute to the price efficiency of underlying cash markets, leading to a more efficient allocation of capital in primary markets.

Leveraged financial institutions also use repos to fund outright purchases or to cover short sales. For dealers, repos are essential to support their market-making activities and to fund the trading inventories. Such intermediation plays a crucial role

<sup>5</sup> The table is illustrative as, in some jurisdictions, institutions might use repos for different functions.

<sup>6</sup> Estimate based on Pozsar (2014).

in alleviating short-term mismatches between the supply of and demand for securities, enhancing secondary market liquidity. To the extent that this activity reduces liquidity premia, it also lowers the cost of issuance in primary markets.

Economic functions (EF) and users of repo

Table 2

| Economic functions of repo                           | Users of repo |             |                    |                         |                          |            |                 |               |      |
|--|---------------|-------------|--------------------|-------------------------|--------------------------|------------|-----------------|---------------|------|
|  | Banks         | Hedge funds | Money market funds | Insurers, pension funds | Long-only asset managers | Corporates | Public agencies | Central banks | CCPs |
| EF1. Low-risk option for cash investment             | ✓             |             | ✓                  | ✓                       | ✓                        | ✓          | ✓               | ✓             | ✓    |
| EF2. Transformation of collateral                    | ✓             | ✓           |                    | ✓                       |                          |            |                 | ✓             |      |
| EF3. Supporting cash market efficiency and liquidity | ✓             | ✓           |                    | ✓                       |                          |            |                 | ✓             |      |
| EF4. Facilitating hedging of risk                    | ✓             | ✓           |                    | ✓                       |                          |            |                 | ✓             |      |
| EF5. Enabling monetisation of liquid assets          | ✓             |             |                    |                         |                          |            |                 | ✓             | ✓    |

**EF4: Facilitating hedging of risk.** Repos can be used to hedge or modify the risk profile of portfolios. Underwriters can finance the hedging of underwriting risk on securities they bring to the primary market. In addition, in some jurisdictions repo markets facilitate the asset and liability management of long-term investors such as pension funds. Such investors can borrow cash against government bonds and use the proceeds to reinvest in bonds of different (typically longer) duration. However, in many jurisdictions insurance companies and pension funds are not allowed by regulators to increase leverage through the repo market because of the risks involved.

**EF5: Enabling investors to monetise liquid assets.** Banks and other financial institutions use repos in liquidity management to cover temporary shortfalls in cash flows.<sup>7</sup> The flexibility of repo transactions allows banks to manage their liquid assets more efficiently. In periods of stress, a well functioning repo market can contribute to financial stability by offering a relatively resilient means of raising cash without forcing institutions to liquidate assets, thus avoiding fire sales and contagion.

In addition to the functions described above, central banks also use repo markets in the conduct of monetary policy operations in order to expand/contract banks' holdings of central bank reserves, steer short-term interest rates and signal the monetary policy stance. The role of repos in periods of stress can be enhanced by central banks implementing, as part of their operations to support financial stability, specific repo operations in order to allow banks to monetise liquid assets.

<sup>7</sup> Such "funding liquidity" plays an important role in ensuring the efficient and stable functioning of the financial system, benefiting the economy as a whole (Carney (2008)).

## 2. Trends in repo market structure and functioning

This section discusses recent trends in repo markets internationally, highlighting commonalities but also differences among jurisdictions. It goes on to describe capacity constraints that at times confront end users in some jurisdictions.

### Overview of trends in repo market functioning

Changes in headline measures of repo market volumes, prices and liquidity show considerable heterogeneity across jurisdictions.

Volumes of outstanding repo transactions have remained broadly unchanged across most jurisdictions over the past few years. Estimates of outstanding transactions in the UK and US repo markets have decreased slightly, while those in Australia and Japan have increased (Graph 1). Nine out of 14 respondents to the CGFS members' questionnaire reported either no change or higher levels of repo outstanding over the past two years.

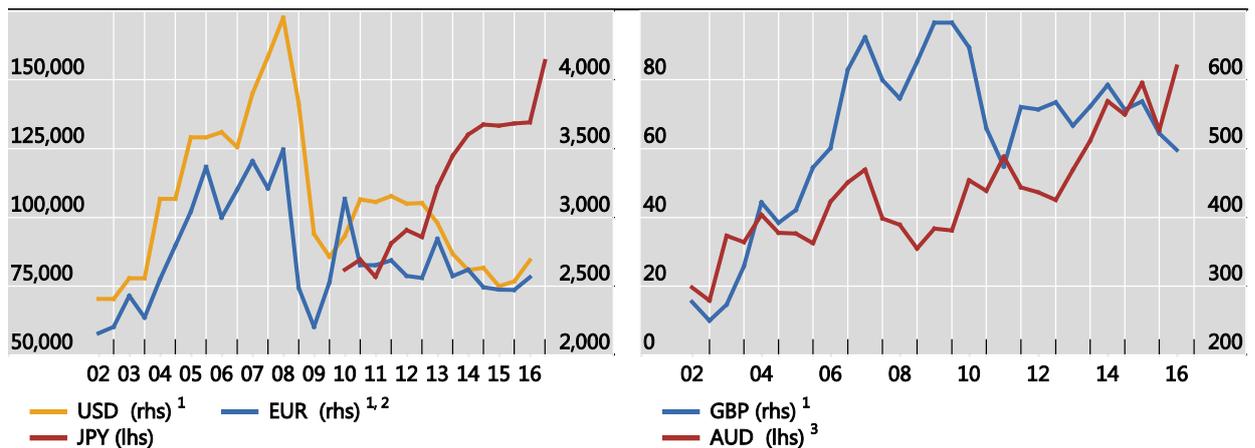
Changes in headline indicators of the price of repo transactions, as measured by the spread between the average repo rate and the risk-free interest rate, have differed across jurisdictions in terms of both size and direction (Graph 2, left-hand panel). While spreads in the United Kingdom and the United States have, on average, increased since 2014, those in Japan and the euro area have declined.

Respondents to the SG survey of repo market participants have also reported that, in some jurisdictions, bid-ask spreads – that is, the difference between the rates at which market participants borrow and lend cash in return for securities – were significantly higher on average in 2016, compared with 2014, although some other jurisdictions noted small contractions in bid-ask spreads (Graph 2, right-hand panel).

### Repo market activity

Outstanding amount in billions of local currency

Graph 1



<sup>1</sup> Includes both repos and reverse repos. US numbers include both triparty and bilateral markets. <sup>2</sup> Includes repos backed by the central governments of Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and Spain. <sup>3</sup> Repos entered into by banks and registered financial corporations (RFCs) using HQLA; data prior to 2009 are unpublished.

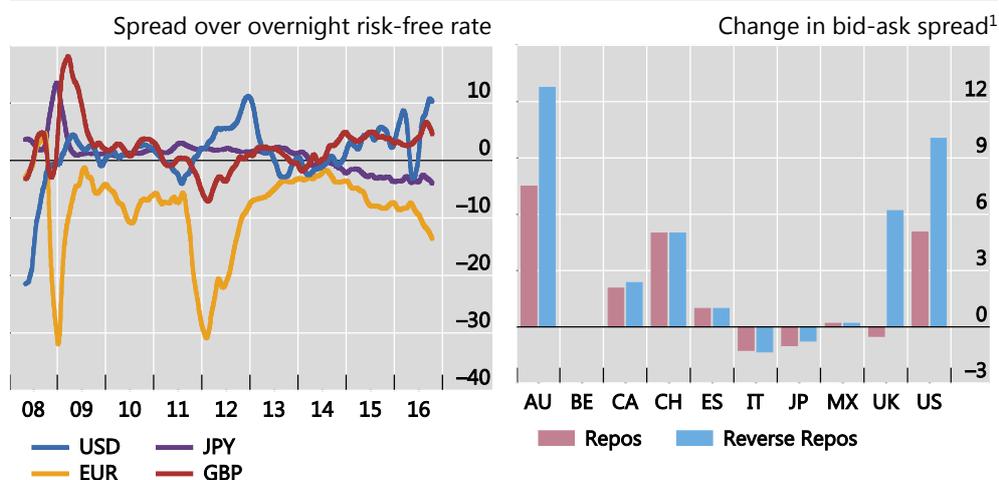
Sources: Reserve Bank of Australia; Bank of England; Australian Prudential Regulation Authority; ICAP; International Capital Market Association; Japan Securities Dealers Association; Securities Industry and Financial Markets Association.

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## Repo market price indicators

In basis points

Graph 2



AU = Australia; BE = Belgium; CA = Canada; CH = Switzerland; ES = Spain; IT = Italy; JP = Japan; MX = Mexico; UK = United Kingdom; US = United States.

<sup>1</sup> Average response by country to survey question. Refers to changes over the period 2014–16.

Sources: Bloomberg; CGFS Survey of repo market participants.

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Sell-side participants in the SG survey reported little change or slight improvements across other indicators of market functioning, including haircuts, internal counterparty limits and repo demand from counterparties.

### Increased cost of repo market intermediation

Despite the stability of many headline measures of repo market activity, there are signs that the provision of repo market intermediation is becoming more constrained across a number of jurisdictions. In particular, there is evidence that the cost faced by end users of repo markets has increased in some jurisdictions.

Repo rates (relative to expectations of policy interest rates) paid by pension funds to *borrow* cash in the UK gilt repo market increased around fourfold between 2014 and 2016 (Graph 3, left-hand panel).<sup>8</sup> At the same time, rates *received* by a sample of cash depositors remained constant and, on occasion, spiked downwards (Graph 3, right-hand panel).<sup>9</sup>

A similar pattern is seen in the US repo market, where the spread between rates in the general collateral finance (GCF) repo market (which is primarily used by smaller dealers to borrow cash) and the triparty repo market (in which larger dealers can borrow from money market funds and other investors against US Treasury and

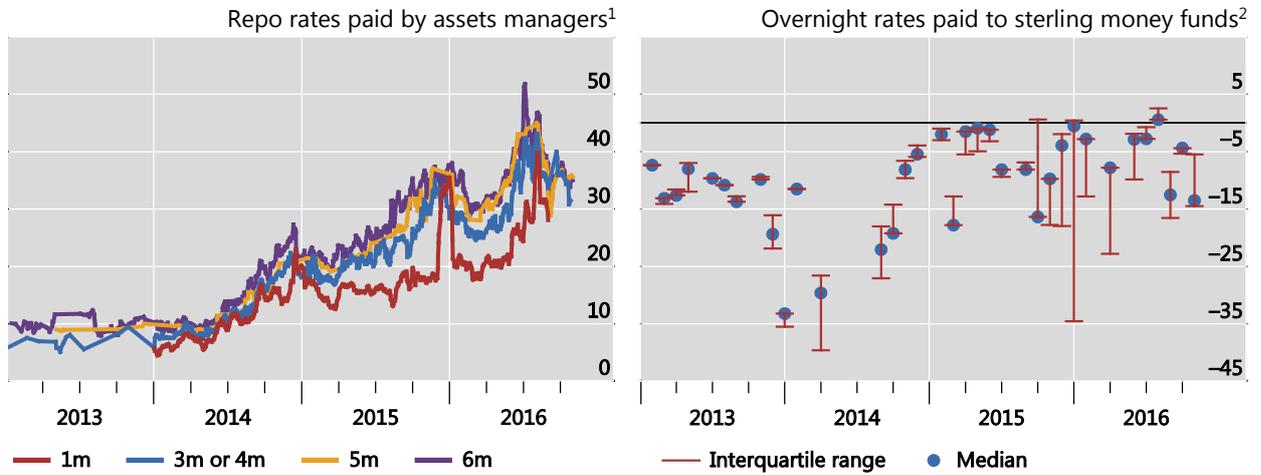
<sup>8</sup> Expectations of policy rates are proxied by rates on overnight index swaps.

<sup>9</sup> This trend is in line with a generalised increase in spreads across money market instruments.

## Rates received by cash depositors and rates paid by pension funds

In basis points

Graph 3



<sup>1</sup> In excess of policy interest rate expectations, on different terms. <sup>2</sup> In excess of policy interest rate expectations, based on a sample of two firms.

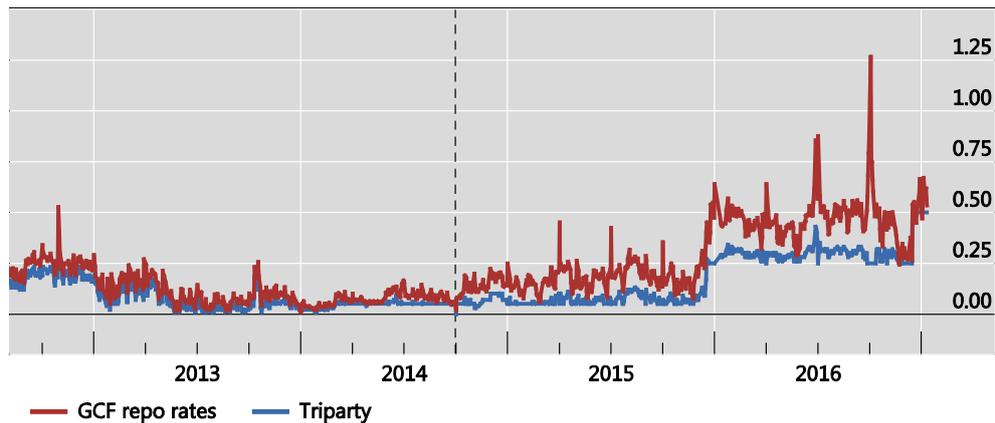
Sources: Data submitted to the Study Group by UK asset managers; Crane Data.

agency collateral) has widened.<sup>10</sup> This spread can change due to multiple structural factors, but it can be interpreted as a proxy for the cost of repo intermediation. Since 2015, there has been an increasing difference between the two rates, which peaked in 2016 but it has narrowed more recently (Graph 4).

## Triparty and GCF repo rates

In per cent

Graph 4



Reference line on 30 September 2014.

Sources: Depository Trust & Clearing Corporation (DTCC); BNY Mellon.

<sup>10</sup> GCF Repo® Service (hereinafter "GCF Repo") is a registered service mark of the Fixed Income Clearing Corporation. See Agueci et al (2014) for further details.

In the euro area, changes in the cost of intermediation have mainly been observed over financial reporting dates.

### Pricing discontinuities at financial reporting dates

This increase in the cost of repo market intermediation is particularly pronounced around financial reporting dates, ie quarter- and, particularly, year-end.

In the euro area, since mid-2015 repo rates referencing German and French collateral have spiked downwards at period-ends, while those against Italian and Spanish collateral have continued to spike upwards. Over the 2016 year-end, repo rates against all types of collateral spiked down, but the spread between repo against Italian and German collateral widened to up to 5%.

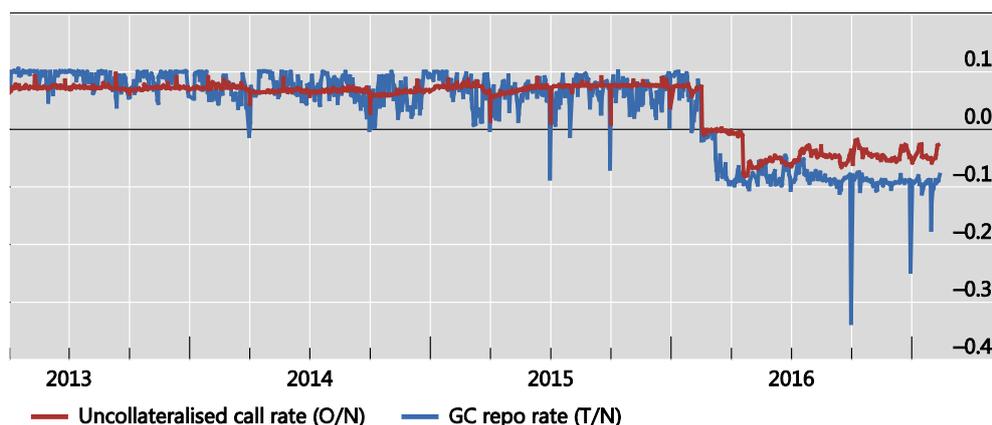
The differing direction of the movement in repo rates reflects, in part, an increase in demand for high-quality collateral. This may be due both to restrictions faced by cash depositors as to the quality of collateral they can accept, and to recent increases in the volume of centrally cleared trades (in both repo and derivatives markets).<sup>11</sup> Furthermore, unconventional monetary policy has also had a twofold impact. First, it has reduced the availability of high-quality collateral via its asset purchases, whereas the large amount of reserves reduced the need to obtain short-term funding at a higher premium at financial reporting dates. Second, some euro area jurisdictions have levied taxes and fees that are based on the size of financial institutions' balance sheets and are measured on financial reporting dates, and hence increase the cost of repos in these periods.

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### Yen market GCF repo rate

In per cent

Graph 5



Sources: Bank of Japan; JSDA.

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Price spikes across period-ends have also been observed across other repo markets. In Japan, repo rates at quarter-ends began to spike down in 2015, with a

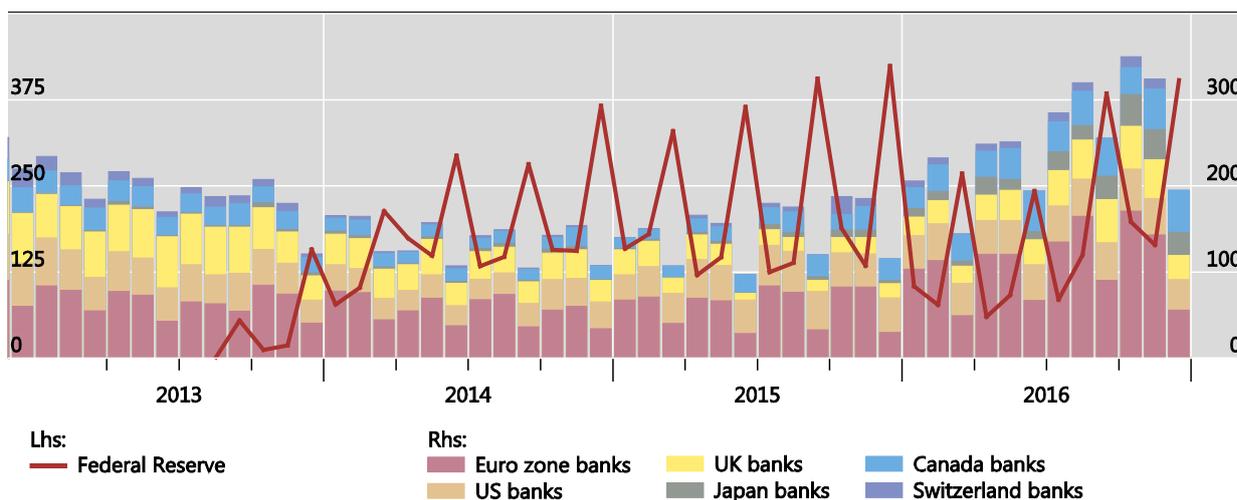
<sup>11</sup> CCPs may require high-credit-quality collateral as the initial margin, and they may also demand high-quality collateral when placing cash margins in the repo market.

large fall in the repo rate in June 2016 (Graph 5). UK repo rates also saw a sharp decline towards the end of 2016, with the overnight repo rates falling to –23 bp.

### Triparty repo USD money funds placing with commercial banks from different jurisdictions, and the Federal Reserve

In billions of US dollars

Graph 6



Source: Office of Financial Research (OFR).

In the United States, period-end fluctuations have been most apparent in repo market volumes rather than rates. This is in part due to how, since 2013, eligible money market funds have been able to place cash directly with the Federal Reserve’s reverse repo programme (RRP).<sup>12</sup> This has provided an effective “floor” under repo rates observed in private markets. The usage of the RRP increases sharply at quarter-ends, with the facility accepting up to \$475 billion at the end of 2015 and \$468 billion at the end of 2016. Over \$300 billion was invested by money market funds. This sharp increase in the usage of the RPP probably reflects the combination of increased demand to place cash in repos by money market funds following recent US rules for the sector and banks’ reduced willingness to do repo intermediation over quarter-ends (Graph 6).<sup>13</sup>

### Quantity restrictions on participants’ ability to access repo markets

In some jurisdictions, end users reportedly face restrictions on the quantity in which they can access repo markets. These restrictions have been particularly pertinent for end users looking to place cash over quarter-ends, when intermediaries are seemingly unwilling to accept this cash, regardless of the rate being offered.

<sup>12</sup> Further details of the Federal Reserve’s RRP programme are provided in Annex 1.

<sup>13</sup> The increase in government bond-backed repo volumes observed in the US triparty repo market is partly due to recent changes in US money market regulation, which have narrowed the range of assets in which constant net asset value money funds are able to invest and increased the proportion of investments in US Treasury repos.

Such quantity restrictions are hard to identify from repo market data alone, since doing so would require identifying demand for transactions that went unmet. But evidence of such restrictions can be seen in the increased demand for short-term government securities that are close substitutes to repos in some jurisdictions (Graph 7). UK Treasury bill yields decreased to –25 bp over the 2016 year-end, and yields on some euro area short-term government bonds also fell markedly.

The feedback received at the SG’s roundtable with market participants also confirmed that some investors faced difficulties in placing cash, in particular over period-ends. Cash managers explained that some of their counterparties would – beyond a certain point – decline to take sterling or euro cash via reverse repos *at any price*. US asset managers – together with a central counterparty (CCP) – reported that they would have also encountered difficulties with their US dollar cash management operations on a daily basis, and particularly at quarter-ends, had they not had recourse to the Fed’s RRP facility (see above).<sup>14</sup>

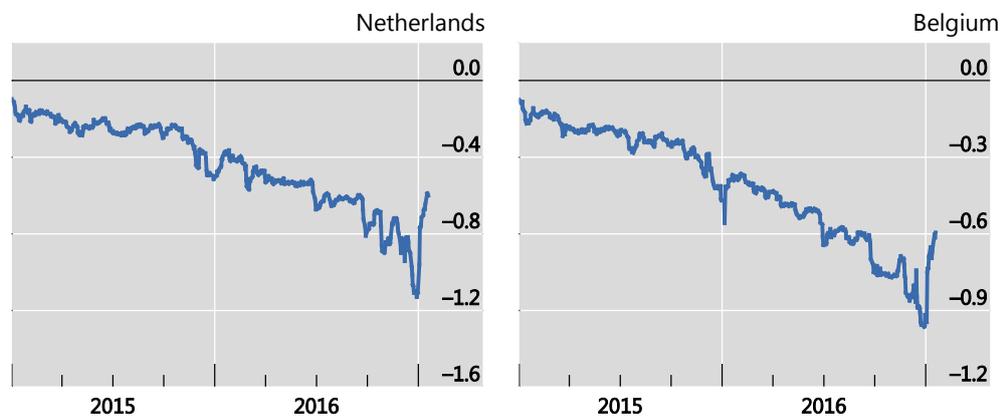
Two UK banks confirmed that they would reject requests by clients to place cash, were these not accompanied by profitable ancillary business that justified the use of the balance sheet. Banks that spoke to the SG also reported that they allocated their balance sheet to repo transactions based on the profitability of the global relationships that they held with their clients. Annex 2 details the adverse impact of this reduction in repo market intermediation on the ability of a large European asset manager to manage its liquidity.

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### Negative yields on short-dated government paper

In per cent

Graph 7



Source: Bloomberg.

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### Increase in repo transactions that do not affect reported balance sheets

Recent changes in the proportion of banks’ repo/reverse repo transactions that are eligible to be netted suggest that banks in some jurisdictions have attempted to

<sup>14</sup> For further discussion on the impact of monetary policy on repo markets, see Section 2 and Box A.

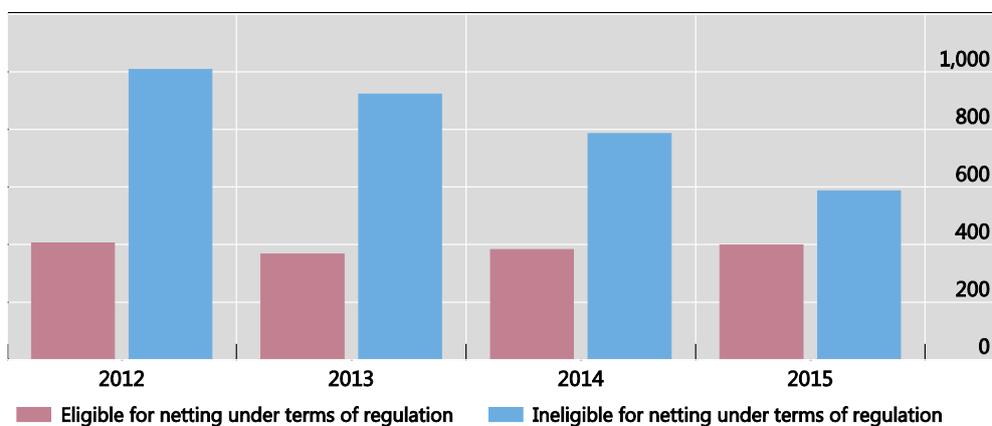
manage their repo market intermediation in order to alleviate the effects of balance sheet constraints.

Although netting rules differ in their details, they generally provide for a cash receivable due from a counterparty to be presented net of a cash payable due back to the same counterparty, provided that the payment dates and settlement mechanisms match. As such, two matching repo/reverse repo transactions, with different underlying bonds but the same settlement date and identical opposing cash flows, do not affect the size of a bank’s balance sheet as reported for regulatory purposes. Graph 8 shows how, over the past few years, the volume of UK and Swiss banks’ repo transactions that are eligible for such netting, under the terms of regulation, remained roughly constant. However, the volume of banks’ repo transactions that are ineligible for such netting has fallen. This evidence is suggestive of the fact that banks are not reducing repo market exposures across the board, but they are responding to balance sheet-constraining regulation with targeted measures. It also suggests that such regulation has a substantial impact on banks’ willingness to engage in repo. Although a strong causal link is difficult to establish in an unambiguous way at this point, Annex 4 suggests that banks with tighter leverage ratio constraints in 2014 made the most substantial adjustments to their repo exposures by mid-2016.

### Repo volumes at UK and Swiss banks

In billions of US dollars

Graph 8



Sources: Bank of England analysis; published financial accounts.

In addition to greater netting, there have been adaptations in repo markets that are also driven by the banks’ desire to reduce constraints on their balance sheets. Three examples of such off-balance sheet transactions are collateral swaps, derivative structures and agency structures.

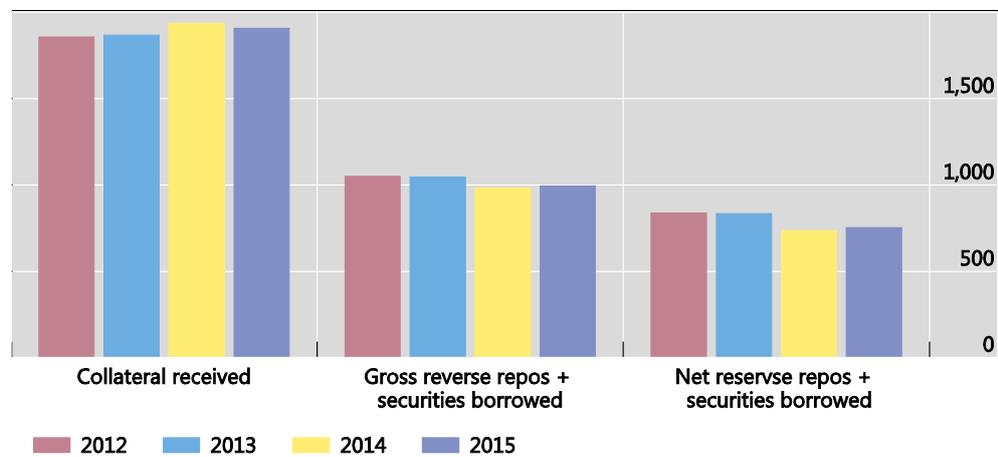
**Collateral swaps** are transactions in which institutions exchange securities for securities, rather than securities for cash. Collateral swaps are identical, economically, to the exchange of collateral created by the cash flow netting described above for the case of matching repo/reverse repo transactions. However, because collateral swaps are traded on a direct security-for-security basis (or exchanged under a pledge agreement rather than a repurchase agreement), they are typically considered “off-balance sheet”. Without uniform and full disclosure, the extent of banks’ off-balance

sheet collateral swaps cannot be assessed exactly. But some estimates of their extent can be made from notes in the financial encumbrance sections of the financial accounts, which disclose the total quantity of securities received as collateral from reverse repo, derivative initial margin and margin lending transactions. Graph 9 (centre set of bars) shows the gross reverse repo/securities borrowing position of three large US broker-dealers. The total collateral received by the three dealers (Graph 9, left-hand set of bars) exceeds gross reverse repos (including securities borrowed) by \$913 billion. Derivative initial margin and margin lending transactions are unlikely to account for all of the difference. The remainder of the gap is likely to indicate collateral swaps substituting for repo transactions.

### Reverse repos at three large US broker-dealers

In billions of US dollars

Graph 9



Sources: Bank of England calculations; published accounts.

**Derivative structures**, such as total return swaps (TRS) or contracts for difference (CFD), enable banks to stand between two repo counterparties on a fully matched basis (ie borrowing collateral from one and lending it to the other), without incurring a material increase in their (reported) balance sheet.

Respondents to the SG survey discussed the potential benefits and drawbacks of using derivative structures as an alternative to repos. Some participants noted that TRS could bring benefits in terms of more advantageous pricing and capacity from banks, given the lower balance sheet utilisation that they entailed.

**Agency structures** enable banks to intermediate between two repo counterparties as an agent that guarantees the performance of the cash borrower to the cash lender, rather than as a principal. This structure allows banks to report reduced balance sheet and leverage ratio exposure despite the fact that the credit risk with respect to the cash borrower, incurred via the guarantee provided to the cash lender, is identical to the risk that the bank would incur if it traded with the borrower as principal, in which case the transaction would incur a 100% weighting in the calculation of the leverage ratio for regulatory purposes.

### 3. Analysis of the drivers of change

The drivers of repo market changes also vary internationally. That said, two common drivers emerged from the responses to the SG's industry survey: first, unconventional monetary policy, particularly in the form of central bank asset purchases; and second, stricter regulatory and risk management standards that affect both the size and the composition of banks' balance sheets. Annex 3 provides further details on other drivers reported by market participants.

This section explains how drivers may have affected repo markets, and why these effects differ across repo markets internationally, depending on their structure. While we discuss these drivers separately, in practice they impact institutions and markets concurrently, amplifying or mitigating the effects of individual drivers acting in isolation. For example, the restrictive effect of balance sheet constraints, which incentivise banks to reduce the size of their balance sheet, has probably been amplified by unconventional monetary policy, which has increased the amount of reserves that the banking system is required to hold.

#### Potential effects of unconventional monetary policy

Sell-side respondents from around half of the jurisdictions covered by the SG's survey cited central bank asset purchases as a driver of lower repo volumes and perceived reduced liquidity in repo markets. Asset purchases have impacted repo markets in a variety of ways:

- In some jurisdictions, where repos are used by banks to manage their holdings of central bank reserves, asset purchases – and the resulting increase in central bank reserves – can reduce the incentives for firms to conduct repo transactions to manage reserves. However, where a central bank adopts a system of tiered remuneration of reserves, this increase in central bank reserves can create incentives for a greater use of repos.
- Asset purchases can reduce the supply of high-quality collateral, which can stimulate the demand for repos to obtain such collateral.
- By expanding the amount of reserves that the banking system holds, asset purchases can increase the pressure on banks' balance sheets and reduce their capacity to intermediate in the repo market.

These effects are examined in turn in the subsections that follow.

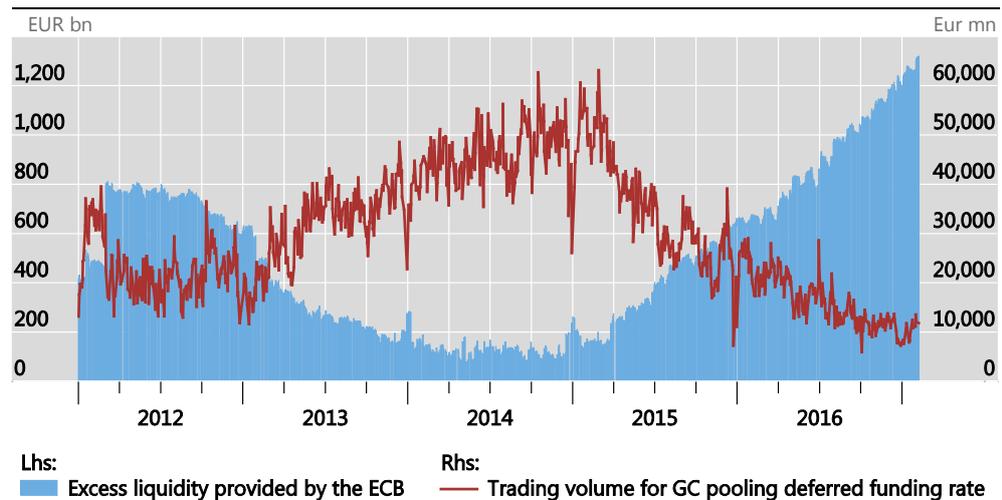
#### Impact of asset purchases on the use of repos to manage reserves

Large-scale asset purchases (LSAPs), and the associated increase in central bank reserves, can reduce the incentives for holders of central bank reserves to engage in repos. In some jurisdictions, such as Japan, Switzerland and the euro area, repo transactions are used, in part, by banks to redistribute central bank reserves, in order to satisfy minimum reserve requirements. A bank that needs to acquire reserves can borrow funds from another bank, and the settlement of that transaction results in a movement of reserves from the accounts of the lending bank to the account of the borrowing bank.

In some jurisdictions, banks are subject to requirements as to the quantity of central bank reserves that they hold, and incur penalties when they hold reserves short of these requirements. Such a system incentivises the redistribution of reserves between central bank counterparties. Where this takes place in the repo market, it can lead to increased repo market activity. Asset purchases, by increasing the aggregate supply of reserves, can reduce the demand for repo trading to adjust individual institutions' holdings of reserves. This effect is illustrated in Graph 10 for the case of the euro area, based on the example of the GC Pooling repo market.

Excess liquidity provided by the ECB and repo trading volume

Graph 10



Source: ECB.

But in other jurisdictions – such as the United States and Sweden – banks do not use repo markets to manage their holdings of central bank reserves. In these jurisdictions, changes in the aggregate level of central bank reserves – including due to central bank asset purchases – would not affect incentives to perform repo transactions for the purpose of reserve management. In the United States, for instance, banks use the unsecured federal funds market to manage reserve balances. Following asset purchases by the Federal Reserve, a decrease in interbank trading was observed in the federal funds market, but not in the repo market.

### *Impact of tiered remuneration*

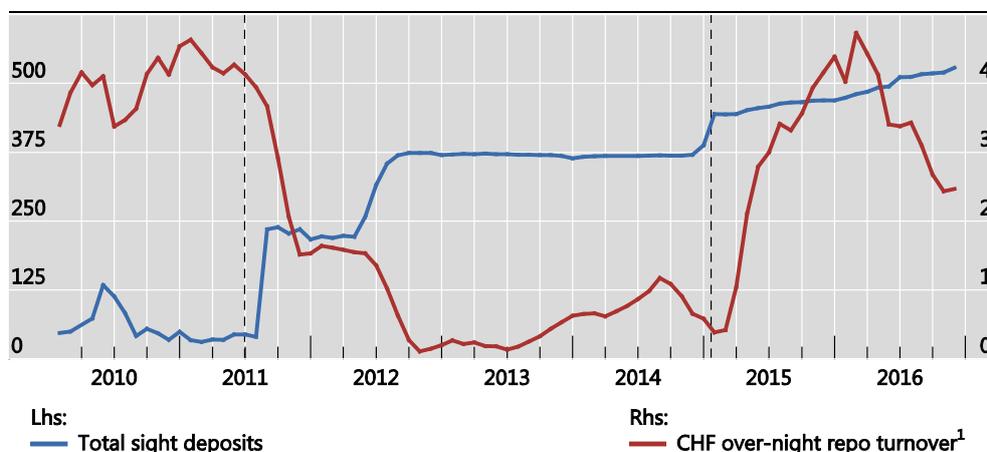
Central banks' monetary policy implementation can also increase incentives for reserve holders to carry out repos if the central bank introduces tiered remuneration for reserves, as was implemented by the Bank of Japan and the Swiss National Bank (SNB). In jurisdictions with tiered remuneration, banks typically earn a relatively high rate on reserve balances beneath some threshold and a lower rate on reserves balances exceeding such a threshold. This creates an incentive for banks that hold fewer reserves to borrow reserves via repos from banks that hold more reserves, in order to increase the rate that they receive on their overall reserve balances. Graph 11 illustrates both how the introduction of the foreign exchange floor in mid-2011 and the associated increase in the supply of reserves by the SNB resulted in a decrease in repo activity, and how the subsequent implementation of tiered remuneration of reserves in early 2015 led to a sharp pickup in market activity.

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## SNB sight deposits and Swiss repo activity

In billions of Swiss francs

Graph 11



<sup>1</sup> Quarterly averages of daily series, sampled at the beginning of each month.

Source: Swiss National Bank; SIX Repo Ltd.

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## Impact of asset purchases on collateral supply

In some jurisdictions, asset purchases have also had a significant impact on the supply and the availability of high-quality government securities that can be used as collateral in repo transactions. This has occurred in parallel to a number of structural and regulatory changes that have increased the demand for high-quality collateral. Scarcity of high-quality assets can be partly mitigated through effective securities lending programmes, which have been implemented in some jurisdictions.<sup>15</sup>

The scarcity of collateral can have a number of, sometimes, conflicting effects on repo markets. When some assets are scarce, market participants may use repo transactions to obtain those assets or move them through the financial system to where they can be used most efficiently.<sup>16</sup> There is evidence of increased repo activity to source comparatively scarce collateral in euro area, Japanese and Swedish repo markets (see discussion of euro area repo rates in Section 2). But in some places, the scarcity of collateral created by asset purchases might also reduce repo volumes and rates. As explained in Section 2, lenders of collateral may be more reluctant to lend securities via repos, especially over regulatory reporting dates, as this will increase the size of their balance sheet. These dynamics would be expected to lead to lower repo volumes and rates, as those market participants sourcing collateral need to pay a higher premium for obtaining those securities and thus forgo the interest on the cash that they provide in exchange for collateral.<sup>17</sup>

<sup>15</sup> For example, the Bank of England lends out its stock of government securities via the UK Debt Management Office.

<sup>16</sup> It should be noted that, in such cases, while the transaction may be legally structured as a repo, the economic motivation is to borrow a security, as would be the case in a securities lending transaction.

<sup>17</sup> In some cases, the rate can be negative, meaning that the borrower receives an interest for borrowing against these securities.

## Effects of unconventional monetary policy on repo markets

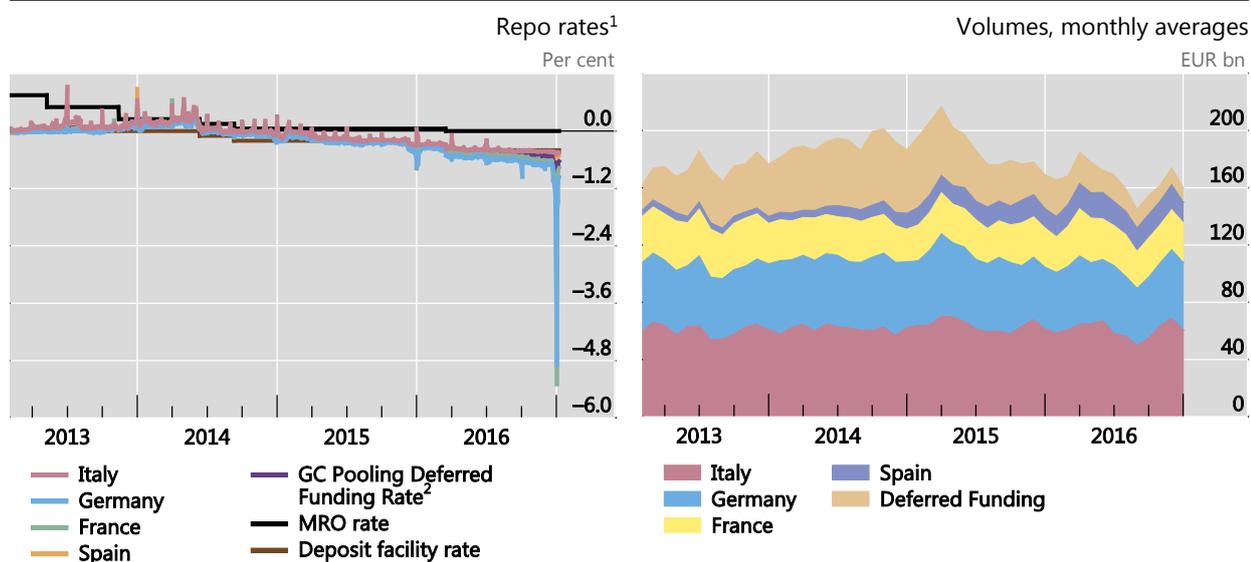
The heterogeneity in headline volumes and prices in repo markets internationally may, in part, reflect various unconventional monetary policy tools that jurisdictions have used over the last few years. In particular, in some jurisdictions the price discontinuities described above seem to have been mitigated by central bank actions.

In the euro area, the expansion of central bank reserves associated with the ECB's targeted longer-term refinancing operations and asset purchases has had a considerable influence on the repo market. Overnight repo rates have declined relative to the central bank deposit facility rate. This has been the case for general collateral and particularly so for specific sovereign collateral that declined to levels significantly below the central bank deposit facility rate (Graph A, left-hand panel). Meanwhile, repo outstanding volumes (Graph A, right-hand panel) remained broadly constant.

### Repo rates and volumes

Overnight, TomorrowNext and SpotNext repos

Graph A



<sup>1</sup> RepoFunds rates are indices based on Special and GC repo transactions against respective sovereign collateral executed on the BrokerTec or the MTS electronic platforms. <sup>2</sup> GC Pooling Deferred Funding rate is an index based on GC repo transactions in the ECB and the ECB extended baskets of the Eurex Repo GC Pooling market.

Sources: Bloomberg; <http://www.repofundsrate.com/>.

The Bank of Japan's large asset purchase programme, introduced in April 2013, has also affected the functioning of the repo market, creating arbitrage opportunities and contributing to the increase in the overall outstanding amount of repos over the last two years. Initially, institutions holding a current account at the Bank of Japan borrowed cash at rates below 0.1% through the GC repo market from those that did not have a current account, and reserved that cash at their current account to earn the interest rate on excess reserves (IOER) of 0.1%, so as to profit from the spread between the IOER rate and the GC repo rate.

With the introduction of the three-tier system in January 2016, institutions with unused allowances in their basic balance or macro add-on balance engaged in arbitrage trading to earn the spread between the GC repo rate and the rates applied to their current accounts.

## Effect of expanding reserves in the financial system

Asset purchases typically involve the central bank creating reserves to purchase the securities. While the purchased securities can be held by banks or non-banks, the resulting central bank reserves can only be held within the banking system. Banks can compensate for this effect by holding fewer assets besides reserves in order to maintain a constant balance sheet size. But assuming no compensating actions, asset purchases necessarily lead to an expansion of the combined balance sheets of the banking system.

By leading to an expansion of banks' balance sheets, asset purchases may also increase the effect of constraints that act on the size – rather than the composition – of banks' balance sheets (see discussion in Section 3). In the United Kingdom, this motivated alterations to the regulation acting on the size of banks' balance sheets (see Box C for a discussion).

### Summary

The various effects of unconventional monetary policy, the direction of their impact on repo market volumes, and the jurisdictions in which they may have taken place are summarised in Table 3 below:

| Type of policy  | Effect on repo market   | Effect on volumes | United States | United Kingdom | Euro area | Japan | Switzerland | Sweden |
|---|---|-------------------|---------------|----------------|-----------|-------|-------------|--------|
| Large-scale asset purchases (and associated increase in reserves) | Reduced incentives to borrow or lend reserves (since all banks have more than enough reserves)  | Decrease          |               | ✓              | ✓         | ✓     | ✓           |        |
|   | Increased pressure on the supply of specific collateral   | Increase          |               |                | ✓         | ✓     |             | ✓      |
|   | Increased effect of balance sheet constraints, as excess reserves increase the pressure on banks' balance sheets  | Decrease          | ✓             | ✓              |           |       |             |        |
| Tiered remuneration policies                                      | LSAPs accompanied by tiered remuneration can create incentives for market intermediaries to trade reserves via repos to optimise their holdings of reserves | Increase          |               |                |           | ✓     | ✓           |        |

## Balance sheet constraints

In this section, we focus on "balance sheet constraints": regulations and other restrictions such as taxes that impose a cost based primarily on the size, but not the composition, of banks' balance sheets.

Balance sheet constraints have the potential to change the incentives to undertake repo intermediation, an activity that is typically low-risk but also with low margins. Activities with low risk weights are more likely to be affected by balance

sheet constraints than by risk-weighted capital requirements.<sup>18</sup> And low-risk activities are likely to have a lower return per unit of balance sheet space, requiring greater balance sheet capacity to generate an equivalent level of return. The potency of these effects will, however, vary with the reporting frequency and the conditions for netting in the measurement of relevant standards.

### Leverage ratio

The leverage ratio is, by design, a non-risk weighted measure that requires banks to hold capital in proportion to the overall size of their balance sheet (namely their assets, including some off-balance sheet positions). Repos lead to an expansion of a bank's balance sheet, and therefore attract a capital charge for the intermediary under the leverage ratio.<sup>19</sup> Banks can hence be expected to adjust prices or limit supply in response to this cost. Respondents to the SG's survey cited the leverage ratio as a particularly influential driver of change (Annex 3).

In practice, the leverage ratio does not seem to have had a uniform effect, with some jurisdictions considering it to be a more significant driver of change than others. This could be partly explained by differing implementation timelines, with some jurisdictions implementing a binding requirement, some making it a reporting requirement, and others implementing requirements above global minimum standards on a more advanced timeline. That said, on a global basis, internationally active banks appear to have been adjusting their repo activity since the publication of the leverage ratio standard and the beginning of the public disclosure requirement for banks (Annex 4). By mid-2016, only a handful of banks representing a trivial share of the repo market failed to meet the 3% minimum leverage ratio standard, with the vast majority of repo market participants (90% of the market) having capital at or above the minimum (ie in the 3–7% range).

### Surcharge on global systemically important banks (G-SIBs)

The G-SIB surcharge is another example of a globally relevant balance sheet constraint that affects a number of banks. The Basel Committee on Banking Supervision (BCBS) assesses the systemic importance of G-SIBs on the basis of year-end figures for a set of indicators that reflect the size of banks' balance sheets, their interconnectedness, the lack of readily available substitutes or financial institution infrastructure for the services that they provide, their cross-jurisdictional activity and their complexity. In contrast to other regulations, the discontinuous nature of the G-SIB surcharge may incentivise banks that are very close to the top of the capital surcharge bucket range to avoid additional repo trades altogether (instead of charging a higher price), so as to avoid moving to a higher G-SIB bucket. This incentive, however, applies only to a small number of banks that are both close to the bucket threshold and have sizeable repo portfolios. For those banks, the benefit of a

<sup>18</sup> For example, assuming a Tier 1 risk-weighted asset (RWA) capital ratio requirement of 6% and a Tier 1 leverage ratio requirement of 3%, any asset on the firm's balance sheet that is risk-weighted below 50% would attract higher capital requirements under the leverage ratio than under the Tier 1 RWA capital requirements. Analysis in Cipriani et al (2017) suggests that the reduction in repo activity for US- and UK-regulated dealers is stronger for safer collateral than for riskier collateral. This is consistent with the idea that balance sheet constraints affect safer activities more than riskier activities. Allahrakha et al (2016) provide similar evidence on the effect of the leverage ratio in the United States by looking at the behaviour of dealers affiliated with bank holding companies.

<sup>19</sup> In contrast, reverse repos do not affect the leverage ratio.

higher repo rate would only apply to the marginal trade, whereas the cost associated with moving to the next G-SIB bucket impacts the whole bank's balance sheet. Sell-side respondents to the CGFS survey recognised the G-SIB surcharge as an influential driver but ranked it as the least influential globally applicable regulatory driver (Annex 3). In addition, for the average bank, the size of the repo book is small relative to the exposure measure (which is the proxy for size in the G-SIB framework) and this effect would be small (Annex 4).

### Additional local balance sheet constraints

In addition to the globally relevant regulations, firms in some jurisdictions are subject to additional balance sheet constraints, which can entail significant costs.

One example of is the euro area's Single Resolution Fund (SRF).<sup>20</sup> At year-end, banks in the euro area must calculate their contributions to the SRF. This annual contribution has a basic component based on the size of the bank's liabilities that is adjusted in proportion to the bank's risk profile (additional risk adjustment). As the amount of an institution's liabilities may increase due to its repo book, it has an incentive to lower this activity at year-ends.

In some countries, banks pay a tax based on the liability side of their balance sheet or, alternatively, on deposits. These taxes are not specific to repos, but repos may be included in the calculation basis. This may incentivise institutions to reduce their repo activity at calculation dates.

### Effects of reporting frequency: quarter- and year-end effects

Section 2 observed that repo markets have recently been characterised by volatilities in prices and volumes over period-ends (quarter-ends and year-ends). This is likely to be driven by incentives that banks face to "window-dress" their balance sheets at period-ends by reducing the size, or improving the composition, of their balance sheets. These incentives include regulatory constraints, such as the leverage ratio, the G-SIB surcharge and the SRF levy, but may also include commercial or taxation considerations. Such factors would reduce banks' incentives to act as repo market intermediaries, particularly over year-ends (when several of them are operational simultaneously).

It is difficult to disentangle precisely the relative importance of each of these potential drivers of period-end volatility. But there is some evidence that regulation calculated on the basis of the banks' balance sheet size (including regulatory ratios as well as taxes and fees) has had a pronounced impact on repo market activity. This can be seen through differences in the patterns of repo market activity across jurisdictions with different regulatory reporting frequencies:

- In some jurisdictions (such as the euro area and Japan), banks' reporting – both of regulatory ratios and of balance sheet statements on which taxes and fees are assessed – occurs at quarter-ends. This creates incentives for banks to contract their repo exposure on these dates, giving rise to short-lived but sharp spikes in repo volumes and prices.

<sup>20</sup> Sweden has similar arrangements with its national resolution fund.

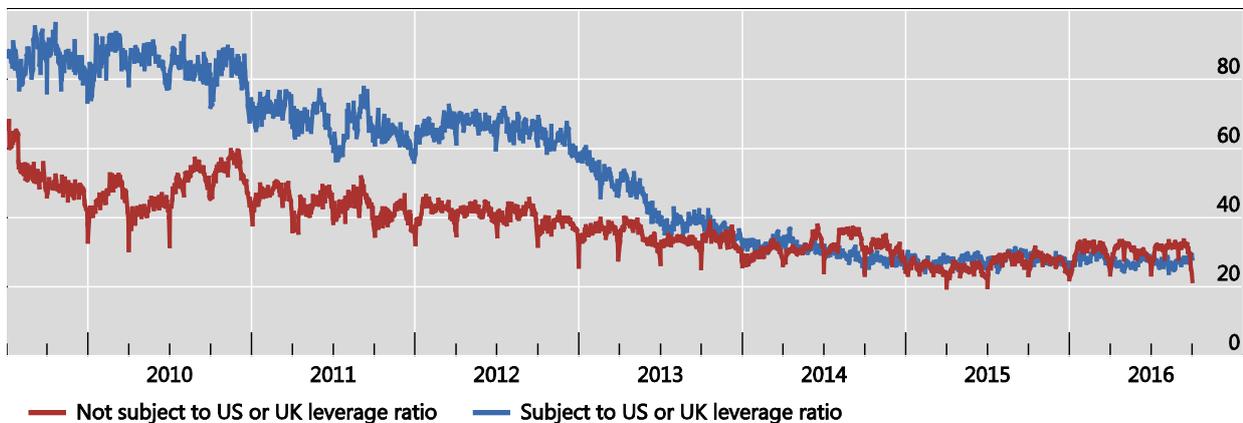
- In other jurisdictions (notably the United States and, since Q1 2017, the United Kingdom), banks' reporting takes place on the basis of period averages. This creates incentives for banks to reduce their participation in repo markets on a more continuous basis.<sup>21</sup>

The behaviour of banks across jurisdictions subject to different balance sheet constraints supports these points. This effect can be seen in two ways. First, there has been a large decline in repos accepted by euro area banks in the US triparty repo market at quarter-ends, while volumes accepted by US and UK banks, which are subject to ratios calculated on a period-average basis, have been more stable (Graph 6).<sup>22</sup> These effects have become particularly apparent since 2013, which broadly corresponds to the date at which enhanced regulatory reporting began to be phased in. Second, dealers that are part of bank holding companies that are regulated in the United Kingdom and United States – thus reporting on a period-average basis – show a larger reduction in activity in the US GC repo market than dealers regulated elsewhere.<sup>23</sup> Graph 12 shows the average volume of repo activity across all collateral classes for institutions designated as US primary dealers, broken down by the jurisdiction of their home supervisor. Those dealers subject to reporting on a period-average basis show a larger reduction in their activity than those subject to only period-end reporting.

### Primary dealers' average daily repo positions by regulatory group

In billions of US dollars

Graph 12



Source: Federal Reserve Bank of New York.

<sup>21</sup> Prior to Q1 2017, the UK leverage ratio was calculated using monthly snapshots of balance sheets. As from Q1 2017, UK banks will begin to report to supervisors, at a quarterly frequency, their leverage ratios averaged over the quarter. Prior to this, UK banks have been submitting their leverage ratio data on the basis of month-end snapshots, in contrast to many jurisdictions that only do so on the basis of quarter-end snapshots. In addition to that, UK banks have been reporting their quarter-end leverage ratios under the Capital Requirement Directive IV since 2014.

<sup>22</sup> Munyan (2015) also shows that, at quarter-ends, banks that have to report their regulatory ratios as a period-end snapshot sharply reduce the amount of cash they borrow through repos, compared with banks from jurisdictions that report them as period averages.

<sup>23</sup> Cipriani et al (2017) provide an econometric analysis of the different behaviour of UK- and US-regulated dealers versus dealers regulated by other jurisdictions.

It therefore appears that repo markets with a large share of market participants reporting their balance sheet constraints on a period-average basis – such as the United Kingdom and the United States – have more stable but lower volume than repo markets with a large share of market participants reporting their exposures on the basis of a quarter-end snapshot.

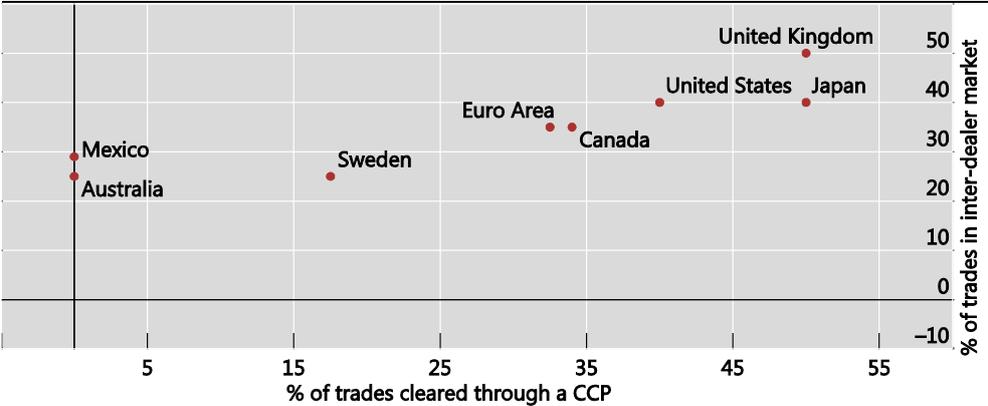
**Balance sheet netting**

All else being equal, constraints on institutions’ balance sheet size are more likely to affect repo markets in jurisdictions where there is more limited scope for intermediaries to net repo/reverse repo transactions. As discussed in Section 2, such netting is a feature of some accounting regimes that has been incorporated into international regulation. By increasing the degree of netting, repo market intermediaries in some jurisdictions appear to have sought to reduce the impact of their repo market intermediation on their balance sheets.

In repo markets where banks are active on both sides of the market (ie as both lenders and borrowers of cash), they can substantially relax balance sheet constraints if they transact via a CCP. Transacting repos through a CCP increases opportunities for banks to net their repo/reverse repo transactions because doing so increases the proportion of trades on which banks face a single counterparty (see top row of diagram in Box B).<sup>24</sup>

**Inter-bank and CCP-cleared trades<sup>1</sup>**

Percentage of total repos outstanding by jurisdiction Graph 13



<sup>1</sup> Calculations are based on the sum of repos and reverse repos. Only repos against securities issued by the central government are included. Euro area repos include those backed by the central governments of Austria, Belgium, Finland, France, Germany, Italy, the Netherlands and Spain.

Sources: Bank of England Sterling Money Market Survey (UK); Federal Reserve Bank of New York and FRBNY calculations (US); national central banks; FICC; ICMA Repo Survey (euro area); Tokyo Money Market Survey (Japan).

<sup>24</sup> Central clearing of repos also allows for settlement netting (ie netting of principal cash flows on a given settlement date) and, reflecting the netting of exposures, it also offers margin efficiencies. For banks and dealers, the incentive to transact repos through a CCP is not limited to their ability to avoid the costs induced by balance sheet constraints, but also lies in the reduction of their counterparty risk and the access to a large pool of participants. In the United States, the fixed income clearing corporation is a CCP for inter-dealer transactions.

The scope for mitigating the constraints on intermediaries' balance sheets by netting through CCPs depends on the structure of each repo market. Central clearing has the greatest potential benefit to repo markets that are predominantly inter-dealer because CCP membership is typically limited to banks and major dealers.

Graph 13 shows how the share of repos outstanding that are inter-dealer trades is correlated with the degree of CCP usage across jurisdictions.<sup>25</sup> And in markets such as the US triparty market, netting opportunities via CCPs are lower because a significant fraction of the repo activity is between end users that are typically not CCP members. There is therefore less scope for bank intermediaries to net off these transactions, through either bilateral or multilateral netting.

One further potential means of increasing netting is to widen participation in CCPs by end users of repos. If both end users of repo markets – ie the cash borrower and the lender – are members of the same CCP as their intermediating dealer, then that dealer is able to net transactions for the purpose of regulation (see bottom row of diagram in Box B). In recent years there have been attempts to expand the membership of existing CCPs to end users of repos, or to create new repo CCPs for the purpose of mitigating balance sheet constraints. Two major CCPs operating in the European Union are developing plans to expand membership. It is too early to judge the success of such direct clearing services but, at least in the United States, these have met with limited success. This is both because the cost of the liquidity and financial resources necessary to satisfy CCP membership makes expanded membership commercially unviable, and because of regulatory capital costs associated with providing committed liquidity to the CCP.<sup>26</sup>

In summary, the analysis in this section suggests that balance sheet constraints (ie regulations and other requirements such as taxes based primarily on the size, but not the composition, of banks' balance sheets) may have led to a greater decrease in day-to-day repo market volumes in jurisdictions that implement such constraints on the basis of period-averaging, such as the United Kingdom and the United States (Table 4). These constraints may be alleviated to a greater degree when market intermediaries have greater opportunities to net repo/reverse repo transactions.

Some effects of balance sheet constraints on the repo market Table 4

| Channels   | Effect on volumes                 | United States | United Kingdom | Euro area | Japan | Switzerland |
|--|-----------------------------------|---------------|----------------|-----------|-------|-------------|
| Balance sheet constraints applied on daily average | Decrease on a continuous basis    | ✓             | ✓              |           |       |             |
| Balance sheet constraints applied on period-end    | Increase volatility at period-end |               |                | ✓         | ✓     | ✓           |

<sup>25</sup> Even in inter-dealer markets, though, it may not always be economically viable to set up a CCP. Australia, for example, lacks a CCP in part because of the small size of its inter-dealer repo market. CCPs typically have large fixed costs. A CCP is more commercially viable if these costs can be spread over a broad membership (see Reserve Bank of Australia (2015)).

<sup>26</sup> The obligation to provide committed liquidity facilities is not necessarily a precondition for participation in repo clearing services. In addition, the Basel Committee has not yet formed a view as to how, under international standards, committed liquidity to the CCP should be included in the leverage ratio exposure measure.

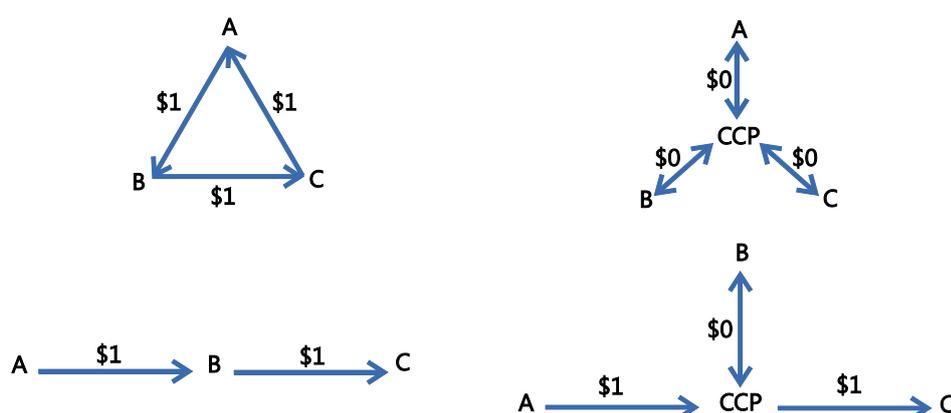
## Balance sheet netting through a CCP

In repo markets where banks are active on both sides – ie as lenders and borrowers of cash – balance sheet constraints can be reduced substantially if participants transact via a CCP.

As an illustration, consider a repo market with three participants, A, B and C (see top row of diagram below). Each participant lends \$1 and borrows \$1 from another market participant. If conducted bilaterally, these transactions would increase the size of the balance sheet of participants. But if conducted via a CCP, repo transactions would have no impact on the market participants' balance sheet and, thus, would not be expected to affect market activity in a significant way.

In some jurisdictions, banks or securities dealers affiliated with bank holding companies use repos to intermediate between cash lenders and cash borrowers. The bottom row of the diagram provides a simple illustration of how this can be applied to the repo market: in contrast to the example illustrated in the top row of the diagram, the intermediary (B) runs a "matched book", lending to a cash borrower (C) through a repo and reusing the collateral to borrow from the cash lender (A). In such a market, netting opportunities are non-existent.

Another answer to the netting issue between banks and their end user clients would be to increase end user participation in CCPs. But the incentive to adhere to a CCP is obviously higher for those facing balance sheet costs. If transactions between A and B and between B and C can take place through the CCP, then B would face the same CCP for both trades, which would allow for netting from the perspective of B's balance sheet.



The bottom row of the diagram is illustrative of a significant share of the US repo market, where B is a broker-dealer affiliated with a bank holding company and, thus, subject to regulation, such as the leverage ratio. A and C are typically not subject to regulation (eg A could be a money market fund and C could be a hedge fund).

## Liquidity and funding regulations

New liquidity and funding regulations may also affect banks' incentives to intermediate in repo markets.

### Net Stable Funding Ratio (NSFR)

The NSFR requires banks to maintain a stable funding profile in relation to the composition and the maturity of their assets and off-balance sheet activities. It is scheduled to be implemented in 2018 and could potentially affect certain segments

of the repo market. Some of these effects are intended consequences of regulation. But asymmetries in the NSFR standard's treatment of repos versus reverse repos may affect repo markets in some jurisdictions more than in others. The impact of the NSFR will depend on the local repo market structure, such as the term, counterparty and collateral composition of repos outstanding and the repo trading motive.<sup>27</sup>

Specifically, the NSFR imposes a stable funding requirement for short-term reverse repos, to reflect banks' incentives to continue a small portion of their funding of leveraged clients in order to maintain their franchise even in a stress period where collateral reuse is impaired. When implemented, this is likely to increase the cost of repo provision by banks (including the cost of high-quality sovereign government-backed repos). This should be monitored to avoid unintended consequences.

It also encourages banks to conduct longer-term (ie more than six months) repos and tends to encourage longer-term transactions to be conducted on an unsecured, rather than a secured, basis. This is because the value of collateral is not acknowledged in longer-term reverse repo transactions. This treatment reflects the improvement in the funding position of the recipient when the funding is unsecured relative to secured.<sup>28</sup> This might lead to an increase in unsecured funding in term funding markets. Moreover, this could restrain the range of longer-term central bank liquidity absorbing operations, as banks might be more reluctant to enter long-term reverse repos.

### Liquidity Coverage Ratio (LCR)

The LCR requires banks to hold an adequate stock of HQLA relative to their expected net cash outflows under stress.<sup>29</sup> The extent to which the LCR affects repo markets depends on a number of characteristics such as the transaction term, the position of a bank as a net liquidity provider or taker, and the magnitude of the difference between regulatory and market haircuts.<sup>30</sup> In addition, country-specific repo market characteristics, such as the collateral standard, haircut practices and the existence of liquidity regulations in the jurisdiction prior to the introduction of the LCR play a role in determining the effect.<sup>31</sup>

In repo markets where liquidity is primarily lent against domestic government bonds (ie Level 1 assets), to the extent that market haircuts are also close to the 0% regulatory haircut, the effects of introducing the LCR will be small or even non-existent, as both cash and securities are considered to be of the highest quality (Level 1) in the LCR rulebook, and exchanging one for the other has minimum LCR impact. However, this will not necessarily hold true for repo transactions against Level 2 or non-HQLA assets (ie lower-quality collateral or collateral denominated in

<sup>27</sup> See Annex 5 for a more detailed description of the impact of the NSFR on repo markets.

<sup>28</sup> Indeed, when receiving unsecured funding, the recipient of cash keeps its liquid assets unencumbered, thus retaining its ability to pledge them in the future, which is in contrast to a situation where it receives secured long-term funding.

<sup>29</sup> The LCR is being phased in step-wise from 1 January 2015. That is, the LCR requirement was 60% in 2015 and it rises by 10 percentage points every year until it reaches 100% in 2019.

<sup>30</sup> Transactions above 30 days do not impact the LCR denominator. Cash takers and providers are affected in opposite ways. To the extent that the market haircut is lower than the regulatory haircut, cash takers incur LCR increases and cash providers face LCR decreases, and vice versa.

<sup>31</sup> Danthine (2013) and Fuhrer et al (2017) discuss potential implications of the LCR in detail.

foreign currencies), in which case banks that are net cash takers are generally negatively impacted.

Another consideration is that certain banks, in particular broker-dealers, are typically net cash borrowers, and use repos as a means to finance their inventory of securities. Cash borrowing via repo transactions would typically decrease their LCR if they conducted operations below 30 days, and, in certain conditions, would increase their LCR for operations above 30 days.

Consequently, the LCR may lead to a segmentation of the repo market across asset classes and transaction maturities, as market participants would be incentivised to trade against specific asset classes and maturities that lead to improvements in their LCR ratios. In turn, this could lead to different interest rate curves (reflecting the difference in the LCR eligibility, differentials between market and regulatory haircuts and differences in transaction terms). In particular, the LCR may incentivise banks acting as cash takers to conduct repo transactions with non-banks against non-HQLA securities with a term longer than one month. This is because non-banks are not subject to LCR requirements. Finally, the regulation may also affect banks' behaviour in central bank operations, as banks may have incentives to deliver non-HQLA securities to obtain reserves (cheapest-to-deliver, LCR upgrade trade) in trades over 30 days.

## Changes in internal risk management practices

The experience of the financial crisis has also altered how firms assess and distribute risk within their organisations. Specifically, the sharp reduction in available short-term funding during the crisis has affected how banks, other non-bank financial firms and their supervisors manage risk. For instance, banks have imposed tighter trading limits, increased Treasury charges for funding, and implemented other improvements to their processes. Higher risk management standards have incentivised firms to reduce their exposure to certain counterparty types and asset classes, having a larger impact on their participation in riskier markets. Supervisors are also pushing in the same direction: on-site supervision and continuous monitoring have become more rigorous, with firms' liquidity profiles often being a focal point of discussion. As an example, over the past five years the Federal Reserve has used the annual Comprehensive Liquidity Assessment and Review (CLAR) to benchmark banks' liquidity risk management practices, including those that pertain to repos, and has encouraged banks to adapt to the best practices identified during this review process.

These developments may explain some of the changes that have been observed in repo markets. For example, large broker-dealers are more cautious in providing repos to leveraged investors as internal changes to risk management take place, moderating the amount of repo activity. In addition, increases in spreads could be indicative of a broader repricing of risks with repo activity, again in part as a result of more prudent risk management.

## Assessing the permanence of the drivers of change

Assessing whether the drivers of repo market changes considered above will be temporary or permanent is difficult. Unconventional monetary policies, such as asset purchase programmes, are often explicitly limited by monetary authorities in terms of time or purchasing amounts, suggesting that they may be temporary. However, as

monetary policy is ultimately driven by underlying macroeconomic conditions, the timescale for policy normalisation depends on the evolution of broader economic trends. Other drivers discussed are explicitly temporary in nature. For example, contributions to the euro area's Single Resolution Fund are assessed under the current methodology from 2016 to 2023.

Regulatory changes are meant to be a permanent adjustment for the repo market, with the leverage ratio and the NSFR in their current form representing fundamental shifts in the way that intermediaries will be required to manage their repo activity. Although some jurisdictions have opted to introduce regulations under an advanced timetable, many of the relevant regulations have not been introduced in all jurisdictions yet, meaning that the final impact of regulation is unknown.

## 4. Evaluation of costs and benefits

This section contains a cost-benefit analysis of a potential reduction in the availability or increase in the cost of repos backed by government bonds. Overall, there may be financial stability benefits from a decline in repo availability. But these need to be set against the costs of such a reduction to various repo end users. Adaptations in repo markets may reduce some of these costs, but at the expense of potentially introducing new risks.

It is worth noting upfront that the scope of this cost-benefit analysis is an evaluation of a *potential* reduction in the availability or increase in the cost of repos, and not of the various changes observed in different repo markets. As such, the analysis draws on evidence from jurisdictions that have experienced such a decline, even though the associated costs do not currently apply to all jurisdictions.

In order to evaluate the impact of such a decline, this analysis inevitably considers the effects of drivers, such as accommodative monetary policy and regulation. However, this is not an examination of the full set of benefits and costs of regulation (or monetary policy), including those that go beyond repo markets, which would lie outside the SG's mandate.

As a result, any policy recommendations that follow from such an analysis should be carefully considered in light of their broader costs and benefits for financial stability.

### Potential benefits of a reduction in repo availability

There are potential financial stability benefits from a reduction in repo availability. Repos can contribute to the fragility of the financial system because: (i) they are typically of short maturity and expose borrowers to liquidity risk; (ii) the value of collateral can be procyclical; and (iii) being a form of borrowing, they can fuel destabilising leverage cycles.

Some of these risks crystallised during the recent financial crisis. Prior to 2008, there was a sharp expansion in the availability of some types of repos (Adrian and Shin (2010)). This allowed a range of institutions, including repo market intermediaries, to increase their leverage as well as their reliance on short-term funding to extend loans of greater maturity.

In the stress period that followed, some securities – including those used as collateral in repo transactions – fell in value. The subsequent increase in margin calls and, as concerns around counterparty credit risk emerged, haircuts reduced the provision of repos backed by such collateral. This forced borrowers to delever, selling assets because they could no longer roll over their short-term funding. This led to a further reduction in the value of assets, including those used as collateral, and a further decline in repo market availability. This mechanism is documented by Brunnermeier (2009).

It can also spark contagion beyond repo markets if the resulting falls in asset prices reduce the ability of other financial institutions to provide financing both to other investors and to the real economy.<sup>32</sup>

As a result of these dynamics, a reduction in the availability of repos – all else being equal – can enhance the resilience of the financial system through two channels. The channel that works through mitigating the excess in leverage would benefit financial stability regardless of the type of collateral used in repos. The beneficial effects from the collateral value channel depend on the quality of that security. In particular:

- It is unclear that these benefits apply to repo transactions that use the highest-quality government bonds as collateral. High-quality government bonds tend to appreciate during stress times, reducing the perniciousness of the destabilising mechanism described above. Indeed, empirical studies suggest that repos backed by high-quality government bonds were relatively resilient during the crisis.<sup>33</sup>
- It is more likely that there is a procyclical reduction in the availability of repo financing for repos offered against lower-quality government bonds that depreciate during periods of stress.
- Any benefits from a reduction in repo availability might be undermined if investors substitute away from repos and into transaction structures that, themselves, create new fragilities (see discussion of repo adaptations in the next section).

The benefits of a reduction in the availability (or increase in the cost) of repos backed by high-quality government bonds, which appreciate in value in times of market stress, are likely to be muted. That said, the ex ante identification of those classes of bonds might not be always possible.

<sup>32</sup> The role of repos in contributing to procyclicality in the financial system is discussed in relation to rehypothecation of client assets and collateral reuse in a recent Financial Stability Board report (FSB (2017)).

<sup>33</sup> In the run-up and during the financial crisis, there was a sharp expansion and contraction in amounts outstanding of repos backed by some high-quality assets, such as US Treasuries. But this probably reflected the procyclical demand for repos, rather than that of repo availability. Copeland et al (2014) suggest that the reduction in repo demand may be due to counterparties' unwillingness to post high-quality collateral, or the fall in market-making activities. As a consequence, haircuts on US Treasury repos were stable during the crisis.

## The costs of a decline in repo market functioning

While most of the financial stability benefits are felt at the financial system level, the costs of a reduction in repo market functioning are likely to be concentrated on particular repo end users. As a result, this section analyses the costs of reduced repo functioning through the lens of three broad types of economic functions (EFs) performed by repos:

- Supporting the low-risk investment of cash (EF1).
- Supporting liquidity in cash and derivatives markets: this group supports the market for collateral and its transformation (EF2), supports liquidity in cash markets (EF3) and facilitates hedging activity (EF4).
- Monetisation of liquid assets (EF5).

The costs on these economic functions are examined in turn below.

### Economic function 1 (EF1): supporting the low-risk investment of cash

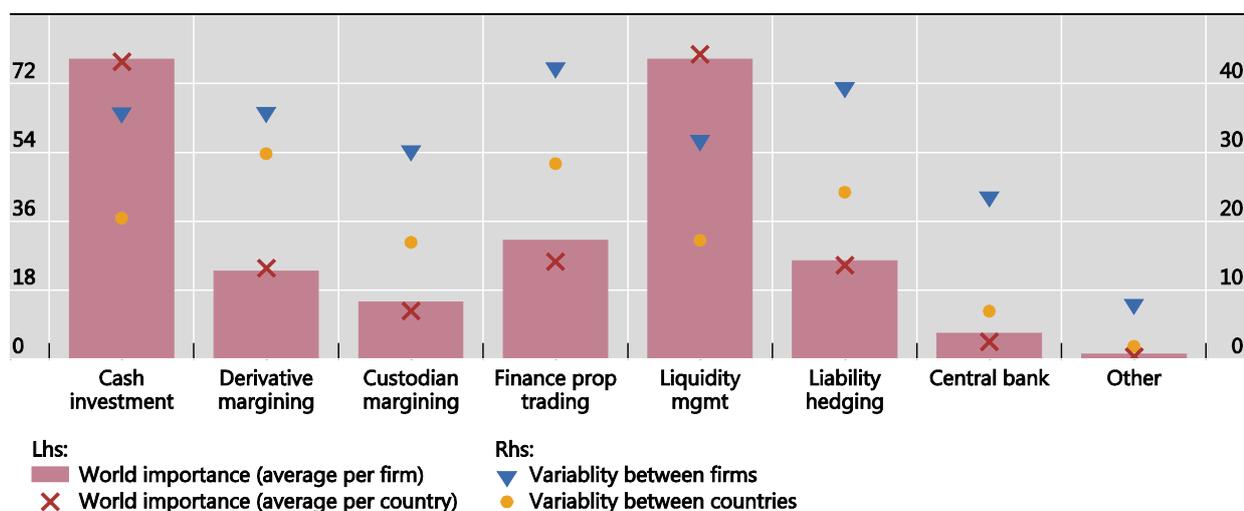
A decline in repo market functioning may have significant costs – through both prices and quantities – on cash investors, as well as create new risks to financial stability. Views can differ, however, as to the importance of these costs.

Impaired repo markets may no longer be able to support the low-risk investment of cash, which is one of the most important functions performed by repos according to the industry survey (Graph 14). This is because repos provide a low-risk and liquid store of value (Section 1) that surpasses that offered by other asset classes. For example, a few government bills – a close substitute for government repos – typically mature on a given day, take longer to settle, and their value is more volatile than that of repos. Cash-rich end users may feel the impact of a reduction in repo market functioning through both higher costs and quantity constraints.

### Importance of repo to buy-side firms, by economic functions

In per cent

Graph 14



Source: CGFS survey of repo market participants.

These costs appear to have materialised in several jurisdictions. As documented earlier in the report, it has become more expensive to place cash over regulatory reporting dates. Repo rates have also become more volatile. There is also evidence that end users trying to place cash face hard quantity constraints. According to the industry survey, buy-side firms that place cash in repos have experienced a reduction in their ability to access repo markets at quarter-ends. Several industry participants also told the SG that these quantity constraints exist throughout the quarter.<sup>34</sup>

A reduction in repo markets' ability to accept cash might also have the potential to create systemic risks, although these have yet to crystallise on a substantial scale. If placing cash in the repo market is more costly, cash investors may seek alternative, riskier investments, including the outright purchase of (potentially risky) securities.<sup>35</sup> If those placing cash invest in longer-maturity, slower-to-settle or lower-quality assets than overnight repos, they may also struggle to meet sudden demands for "cash".<sup>36</sup>

Finally, to the extent that a reduction in the market participants' ability to place cash in repo markets is accompanied by a wider dispersion in short-term money market rates, there might be a reduction in the efficacy and transmission of monetary policy.<sup>37</sup>

The evidence therefore suggests that the repo market's ability to take cash may be impaired in some jurisdictions, implying significant costs to end users and, potentially, to financial stability. However, the evidence for such effects is far less clear in other jurisdictions. It is thus difficult to assess the overall situation due to the heterogeneity across jurisdictions and the lack of data.

#### Economic functions 2, 3 and 4 (EFs 2–4): supporting liquidity in cash and derivatives markets

Repo markets support bond market liquidity and collateral transformation by allowing dealers to source and deliver collateral without being directly exposed to the collateral's underlying risk. This includes the ability to fund securities for their trading inventories, to lend securities without taking ownership, or to facilitate their clients' long and short positions.<sup>38</sup>

In principle, a reduction in repo market functioning might create moderate frictions that increase costs across the financial system. By hindering the flow of collateral and the financing of market-making, it could increase liquidity premia, reduce price discovery and cash market functioning, and lead to an increase in the

<sup>34</sup> Many participants argued that the dealers' repo provision was "binary", ie it was offered either at a reasonable bid price or not at all. Some participants also suggested that they had widened their definition of "acceptable collateral" in order to address the challenges that they face in placing cash.

<sup>35</sup> Examples might include the outright purchase of securities that expose investors to market risk, with the associated possibility of asset fire sales, or increased holdings of cash, with associated reduced resilience to funding shocks.

<sup>36</sup> Iyer and Macchiavelli (2017) provide evidence that cash investors without access to safe assets are more prone to sharp outflows.

<sup>37</sup> Duffie and Krishnamurthy (2016) discuss a similar point in the context of near zero policy rates.

<sup>38</sup> Huh and Infante (2017) provide a stylised model outlining the role of repos in US Treasury market intermediation, and highlight how frictions in repo markets spill over to the cash market.

costs to government primary market issuance.<sup>39</sup> In addition, frictions that restrict the firms' ability to access high-quality collateral through repos can limit their access to derivatives markets that require high-quality collateral as margin (typically for initial margin). An increase in the cost of repos may also result in an increase in the costs of hedging the interest rate risk through repos. This increase in costs would be particularly relevant for underwriting bond issuance or pursuing liability-driven investments that rely on this type of hedging strategy.

There is some evidence that such costs have already materialised. For example, Annex Graph 1 shows a steady rise in fails to deliver in US Treasuries, which might be related to strains in repo markets. At the industry roundtable, one asset manager not only claimed that repo funding was more expensive but was also concerned about the stability of its funding base given its need to increasingly rely on foreign banks with less constrained balance sheets.

That said, for the moment at least, these costs appear fairly low. There does not appear to have been a breakdown in the repo's ability to support cash and derivatives markets. Of course, these issues may intensify in future periods of stress.

#### Economic function 5 (EF5): monetisation of liquid assets

Repo enables banks and other financial institutions to monetise assets as part of their liquidity management and in order to cover any temporary shortfalls in cash flows. The use of repo markets for this purpose can play a particularly important role during periods of market stress, when it may provide a means for institutions to raise cash without selling assets. For this purpose, banks hold large amounts of government bonds, partly in response to recent prudential liquidity regulation.

A reduction in the ability of repo markets to fulfil this economic function might, *in principle*, have serious implications for financial stability. While less dependence on repos can limit the build-up of vulnerabilities, as discussed above, impaired repo market functioning makes it more difficult for investors to monetise assets in response to a shock. The reduction in daily volumes and the number of counterparties observed in some jurisdictions will make it more difficult for institutions to sharply, and covertly, increase their monetisation of assets when distressed.

An institution struggling to raise repo funding might be forced to sell assets, which may cause fire sale spillovers. Additionally, if intermediaries meet their funding needs by diverting lending away from their clients,<sup>40</sup> this may cause further contagion if these borrowers are, in turn, forced to delever. In the longer term, reduced repo market functioning might lead to a precautionary behaviour on the part of market participants (such as increased holdings of cash), which may be economically inefficient.

These costs do not appear to have materialised yet. This may reflect the lack of acute market stress in recent years. In addition, an abundance of central bank reserves, the result of accommodative monetary policy in some jurisdictions, might have reduced the need for banks to monetise their liquid assets.

<sup>39</sup> Cimon and Garriott (2017) find that regulation leads to a reduction of market-makers' intermediation, increasing liquidity premia.

<sup>40</sup> In other words, the bank funds itself (using its own collateral) with cash from, for example, a money market fund that had previously lent to another institution (eg a hedge fund).

That said, there may be a potential for these costs to materialise in future periods of stress, particularly if central banks drain excess reserves. The importance of repos for asset monetisation is likely to increase further as derivatives trading is increasingly cleared, and hence banks and non-banks increasingly need to monetise assets in order to meet cash margin calls (typically for variation margin).

### Repo market adaptations

The overall effect of a reduction in repo market functioning also depends on the ways in which these markets might themselves adapt in response. There are three possible adaptations that warrant particular attention:

1. The disintermediation of banks in the repo market by non-bank institutions and structures. This can be achieved through non-bank intermediaries that facilitate direct transactions between repo end users (“peer-to-peer”). Banks may also act as agents, rather than principals, in such transactions (Section 2).
2. The expansion of access to CCPs beyond dealers to repo end users, such as pension funds, money funds or insurance companies. In principle, wider access to a CCP could alleviate constraints on the dealers’ supply of repos, by generating greater scope for the dealer to net transactions conducted through the CCP and thereby minimise the balance sheet utilisation of repos (Section 3).
3. The transformation of on-balance sheet repos into economically identical transactions presented in new, balance sheet-efficient forms, such as the collateral and total return swaps described in Section 2.

These adaptations have the potential to benefit repo availability. By increasing the range of institutions conducting repos and by reducing the dealers’ balance sheet size, they may alleviate the cost of repo provision, while maintaining the benefits of the new regulatory framework which limits bank leverage. A wider range of repo counterparties and a broader range of products that fulfil the economic functions of repos could also, in principle, result in more diversified funding markets. These may be more resilient to stress or shocks that impact specific counterparties. And some of the repo market adaptations bring specific stability benefits in and of themselves. For example, expanded membership of CCPs may provide centralised and coordinated default management, standardised risk management and increased transparency over a greater proportion of the repo market.

But each of these adaptations has drawbacks that mean that they may not fully satisfy the repo market’s broad spectrum of end users and might also give rise to new financial stability risks. These include:

- i. *Vulnerabilities associated with the disintermediation of the banking system.* Given that non-bank repo intermediaries and platforms do not typically provide maturity transformation, they can only match cash borrowers and cash lenders with the same maturity preferences. As such, the liquidity risk previously managed by banks will reside in other institutions that may not necessarily be better placed to control it. Furthermore, non-bank intermediaries may not be able to provide the operational and credit risk management services performed by banks. Disintermediating the banking system might also mean that some of this activity migrates to less regulated and more opaque intermediaries, which could increase financial stability risks. Finally, direct lending between non-bank counterparties may not be resilient during periods of stress.

- ii. *Vulnerabilities associated with expanding access to CCPs, which are considered systemically important institutions.* However, the development of the Principles for Financial Market Infrastructures (PFMI) to which CCPs are subject, along with the ongoing work of the FSB's CCP workplan, has improved the standards for the financial, operational and business risk management of these entities, increasing their resilience and improving their ability to manage the default of a major participant. As a result, direct access to CCPs is likely to be limited to the most creditworthy non-bank end users, such as pension funds. And for eligible end users, only some non-bank investors do trade enough of both repos and reverse repos to achieve significant netting benefits between these two flows in a CCP. Reflecting these constraints, attempts in the United States to expand the CCP membership have been mixed so far (Section 2).

In addition, the reliance on CCP-netted repos may not necessarily be able to create market liquidity during periods of stress. A distressed firm seeking repo funding requires a directional trade (ie one that is not nettable), so it will face the same marginal cost for CCP liquidity that non-cleared transactions carry at the present.

- iii. *Vulnerabilities associated with banks' use of balance sheet-efficient repo structures.* Structures such as collateral swaps and total return swaps may help end users for EFs 2–4, but they cannot satisfy end users that transact in cash, such as those for EFs 1 and 5, because they do not involve a transfer of cash. And, to the extent that these adaptations carry credit risk that is equivalent to that associated with standard repo transactions, but fall outside the leverage ratio capital framework, they may reduce bank resilience.<sup>41</sup>

## Overall evaluation

It is difficult to estimate the net impact of a reduction in repo market functioning. The effects are hard to measure because they are felt across financial stability, monetary policy and various types of end users. There is also a lot of variation in repo markets across jurisdictions, in terms both of their structure and of their current functioning, making it difficult to draw common themes. And, as highlighted by the discussion of adaptations, repo markets are evolving. The overall balance between costs and benefits may thus vary across jurisdictions.

The financial stability benefits from a reduction in repo availability may be greater in jurisdictions where prices of government bonds used as repo collateral are likely to depreciate during periods of stress, causing repo markets to behave procyclically. But those benefits are likely to be more modest in jurisdictions with the highest-quality government bonds, where a safe haven effect causes such securities to appreciate during periods of stress.

A reduction in repo market functioning may also have economic costs. In a number of jurisdictions, end users have already experienced difficulties placing cash in repo markets or increased costs of doing so. The significance of the resulting cost to the real economy is, however, unclear.

<sup>41</sup> Additional monitoring of these structures is planned as part of the BCBS review of securities financing transactions (SFTs).

Summary of the costs – potential and realised – of a reduction in repo market functioning, and adaptations that might mitigate these

Table 5

| Economic function:  | EF 1   | EFs 2–4   | EF 5  |
|---|--|---|---|
| Would there – <i>in principle</i> – be costs associated with repo markets not being able to meet this economic function? <sup>1</sup> | Moderate<br><br>Financial stability risks if it leads to increased risk-taking<br><br>• Increased costs for end users<br>• Reduction in efficacy and transmission of monetary policy | Moderate<br><br>• Higher liquidity premia in cash securities<br>• Cost/frictions in market for collateral and interest rate hedging | Substantial<br><br>• Fire sales of other assets or withdrawal of client funding<br>• Or economically inefficient hoarding of cash |
| Are we – <i>at present</i> – seeing such costs materialise?   | Yes<br>In some jurisdictions   | No<br>(but could materialise in future periods of stress)   | No<br>(but could materialise in future periods of stress)   |
| Do market adaptations help mitigate costs?  | Somewhat, but introduces new risks   |   |   |
| • The disintermediation of the banking system   | Somewhat   |   |   |
| • Expanded access to CCPs   | Somewhat   |   |   |
| • New, balance sheet-efficient repo structures  | No   | Yes   | No  |
| What is the overall cost of a potential decline in repo market functioning?   | Moderate<br>(There are costs in both theory and practice)  | Low<br>(Although potential cost are material, observed costs are low and can be reduced by adaptations)                             | Potentially substantial<br>(These costs have not yet been observed)   |

<sup>1</sup> The evidence across jurisdictions is not uniform regarding the size of these costs.

But a contraction in intermediation capacity may also reduce the degree to which repo markets can respond to demand during future periods of stress. A reduction in repo market functioning might create frictions in cash and derivatives markets, and reduce the ability of financial institutions to monetise assets. The scale of the resulting costs to the real economy and to financial stability might be significant, but there is little evidence that they have yet materialised on a substantial scale. In addition, to the extent that unconventional monetary policy has helped reduce the liquidity needs of repo market users, policy normalisation may reverse the downward shift in repo market activity.

Repo markets are evolving in response to the pressures identified in this report. Some of these adaptations may increase the availability of repo markets from the perspective of end users. But they may also introduce new risks.

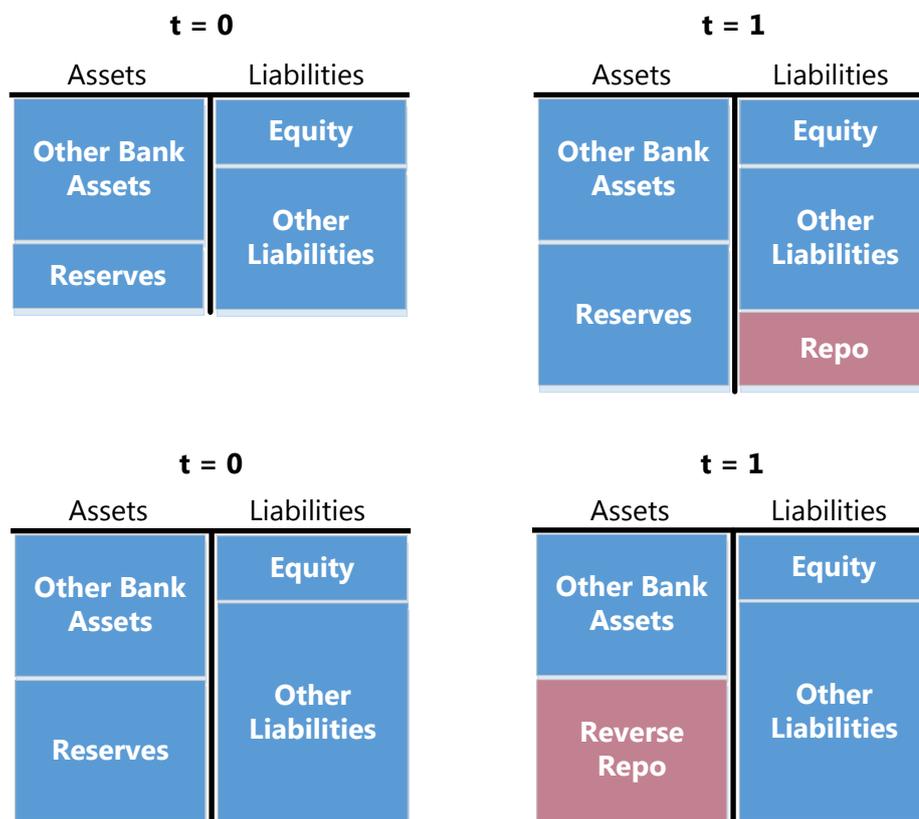
Given the heterogeneity of costs and benefits across jurisdictions, it is impossible to reach a general conclusion about the overall effect of a reduction in repo market activity.

## Central bank reserve exclusion and repo activity

Exempting central bank reserves from the calculation of the exposure measure of the leverage ratio can reduce some of the costs of certain monetary policy measures, such as asset purchases, in terms of regulatory capital potentially making the leverage ratio a less restrictive constraint. The negative implications on banks' resilience of such an exclusion could be neutralised by an upward recalibration of the minimum leverage ratio requirement, subject to specific conditions.<sup>①</sup> Conceptually, exempting reserves could have two opposing effects on banks' incentives to operate in repo markets:

- (i) it would strengthen banks' incentives to issue repos because the cash received when issuing repos will not affect the bank's exposure measure calculation if the bank places it with the central bank (see top row of the diagram below); and
- (ii) it could discourage banks from entering into reverse repos, because the amount of the loan will represent a net increase in the exposure measure, to the extent that the cash lent out was previously held with the central bank and was thus exempt from the exposure measure calculation (see bottom row of the diagram below).

In each jurisdiction, the net impact on repo markets of using this flexibility will depend on the relative importance of the two effects and the accentuation effect from banks piling up reserves over regulatory dates.



<sup>①</sup> For instance, in August 2016 the Bank of England decided to exempt reserves from the exposure measure definition in its leverage ratio framework, an announcement that coincided with a package of expansionary monetary measures. This type of national discretion can be used: (i) in exceptional circumstances; (ii) in order to facilitate monetary policy operations; and (iii) conditional on setting a higher minimum requirement to offset the impact of the exclusion of reserves on the leverage ratio.

## Conclusions and policy messages

The analysis in this report highlights two recurring themes regarding repo markets internationally. The first is that markets differ substantially in structure and functionality across jurisdictions and, in some cases, across market segments within the same jurisdiction. The second is that despite the overall stability in headline volume statistics, repo markets are currently in transition as they respond to a number of drivers such as an accommodative monetary policy and a tightening of balance sheet constraints due to a shift in market intermediaries' risk appetite following the crisis as well as to changes in the regulatory framework. The transition varies across markets, but in some jurisdictions repo market functioning has been adversely affected. The key message of the report is that policymakers should monitor closely the process of adaptation.

In general, outstanding volumes of repos have not changed significantly since the crisis. The picture with other activity proxies is more mixed and varied across jurisdictions. The evolution in headline price measures – such as the difference between repo rates and policy interest rate expectations – has differed across jurisdictions in terms of both their magnitude and direction of change. Turnover and some liquidity statistics point to reduced intermediation activity, which is limited in some jurisdictions but more pronounced in others.

The pattern of market volatility and disruption around reporting period dates is symptomatic of the way different factors combine to catalyse changes in the markets' functioning. In many jurisdictions, end-period balance sheet figures are used for the calculation of regulatory ratios, contributions to resolution funds, taxes and fees. Banks subject to these reporting requirements tend to engage in window-dressing by contracting their repo exposure on those dates (ie quarter- or year-end), giving rise to short-lived but sharp market spikes in prices, thin traded volumes and higher volatility. In some jurisdictions, including the euro area, repo rates on transactions backed by high-quality collateral show sharp declines on those dates. In other jurisdictions, such as the United States, higher volatility of transaction volumes at quarter- and year-ends arguably reflects to a large extent window-dressing by non-US institutions.

Banks in some jurisdictions display reduced willingness and ability to use their balance sheets to undertake repo market intermediation. They actively seek to reduce the impact of repo market intermediation on balance sheet size, including through increased netting. This may be due in part to institutions' experience during the global financial crisis, which prompted a more careful attitude to risk management, and pressures from rating agencies and investors to maintain capital and liquidity ratios in excess of minimum requirements. But it may also be due in part to the introduction of stricter regulatory standards – including the leverage ratio and potentially the G-SIB capital surcharge for some banks – that require banks to hold capital in proportion to the size of their balance sheets, as well as to taxes and fees for financial institutions that are based on the size of their balance sheets. Other regulations that are calibrated on the basis of banks' balance sheet composition – including the NSFR – may also have altered banks' incentives to act as repo market intermediaries. In contrast, some other regulatory initiatives seem to have increased repo market activity. For example, the US money market reform has increased the amount of cash available to fund Treasury collateral, but has also reduced the rates available to investors placing cash through reverse repos.

Either way, this reduction in repo market intermediation in some jurisdictions affects end users looking to place cash in the repo market and leads to pronounced volatility in the rate at which they can do so. There is also anecdotal evidence – including that gathered from the SG’s interactions with private sector market participants – of some end users facing persistent quantity constraints on their ability to place cash via repo. Furthermore, if repo rates obtained by market participants seeking to place cash have decreased in some jurisdictions, in others those paid by participants looking to borrow cash have increased.

A contraction in the intermediation capacity available for repo markets may also signal a reduced ability to respond to end users’ needs in episodes of stress, and impose costs for the real economy by creating frictions in cash and derivatives markets. The dislocations at predictable reporting dates point to a lack of flexibility in repo markets, which differ across jurisdictions. As a result, the issues outlined above may become more acute during future periods of market tension if they reduce financial institutions’ ability to monetise assets. This remains a conjecture, given that there has not been such an episode since the recent changes in repo markets took hold. The potential strength of this effect is hard to gauge, but the implications for financial stability could be important.

These risks need to be weighed against the benefits of having more constrained repo markets. Excessive use of repos can indeed weaken the financial system by facilitating the use of short-term funding and the build-up of leveraged positions backed by collateralised borrowing. It can also increase the interconnectedness within the financial system. In periods of stress, market participants become more sensitive to perceived counterparty risk and the value of the collateral can also be affected, thus amplifying the procyclical effects of leverage. This last effect is arguably weaker in the case of repos against government securities, especially when these securities tend to appreciate in value during stress periods. A reduction in the availability of repo and a better pricing of the intermediation costs may enhance financial system resilience by acting to limit excessive leverage, one of the main objectives of post-crisis regulatory reforms.

In comparing these costs and benefits, the SG has confined its analysis to the narrow perspective of repo markets. It did not consider the wider benefits or costs of regulation or other policies for the resilience of financial firms and the system as a whole. Any future initiatives based on the cost and benefit analysis carried out by the SG should, therefore, carefully weigh their wider implications for financial and economic stability.

The balance of costs and benefits of a reduction in repo market availability is likely to differ significantly across jurisdictions. The benefits of a reduction in repo market functioning may be muted in jurisdictions where a safe haven effect tends to drive up the price of government bonds used as repo collateral in periods of stress. In other jurisdictions, where prices of government bonds used as repo collateral are likely to depreciate during periods of stress, the benefits of a reduction in repo market functioning may be greater. The tightness of balance sheet constraints, and hence the associated costs in terms of reduced repo market functioning, also differ across jurisdictions. This is in part because jurisdictions differ in terms of the timeline against which they are implementing regulation, because some jurisdictions have implemented requirements above global minimum standards, and because some apply regulation on the basis of quarter-end reporting while others require period-averaging.

Effects can vary across jurisdictions depending on the structure of their domestic repo markets. All other things being equal, constraints on balance sheet size are more likely to constrain the repo market in jurisdictions where there is more limited scope for intermediaries to net repo and reverse repo transactions – for instance, through central clearing. This is likely to include markets with fewer opportunities to expand institutions' access to central clearing or with lower levels of inter-dealer activity.

Differences in the setting of monetary policy have also influenced repo markets in a variety of ways. In some jurisdictions, where repo transactions are used by banks to manage their holdings of reserves, central bank asset purchases have increased the supply of reserves and reduced banks' incentives to conduct repos. At the same time, in some jurisdictions central bank purchases of assets from non-banks have increased pressure on repo market intermediaries' balance sheets. Central bank purchases have increased banks' cash holdings even as they have reduced the use of repos in adjusting reserves. When such exceptionally accommodative monetary policy normalises, some of these effects may diminish.

Repo markets are in a transitional phase as they adapt to the drivers of change. A number of recent adaptations are designed to increase the dealers' intermediation capacity. These include the expansion of repo end users' access to central counterparties, which in principle would enlarge the scope for dealers to net repo/reverse repo transactions. There has also been recent growth in transactions that are economically similar to repos but do not affect the size of banks' balance sheets. These include, for example, the development of collateral swaps, as well as derivative and agency structures, which enable banks to intermediate between end users of repo while incurring a smaller impact on their reported balance sheets than would result from a typical repo transaction. Some of these adaptations may increase the availability of repo to end users despite the recent constraints on intermediaries' balance sheets, but they may also introduce new risks. Non-bank intermediaries might prove more prone to withdraw abruptly from the market during stress. In addition, the use of alternative structures may reduce banks' resilience to the extent that they simulate the economic functions (and risks) of repos but are less demanding in terms of regulatory capital.

Given that markets still appear to be in transition, it is too early to reach clear-cut conclusions as to the case for policy measures to address these changes. It is thus recommended that a further study of repo markets be undertaken within the next two years, to examine how the issues discussed in this report have evolved and any new developments. At this point, one would have a better understanding of how repo markets have been shaped by evolving balance sheet constraints and monetary policies, of the permanence of these developments, and of the mitigating effect and risks of market adaptations. Such further work could also draw on more granular data on repo markets as they become available. To the extent necessary, the future study might examine the impact on repo market functioning of regulations discussed in this report that act on either the size or the composition of banks' balance sheets – for example, the treatment of collateral, permissible netting and the effects of cross jurisdictional differences in the way repo exposures are calculated for the purpose of regulation, taxes and fees. It could also further investigate transactions (eg collateral swaps, derivative and agency structures) that, while economically similar to repo, do not affect the size of banks' balance sheets. Monitoring of such developments has also been discussed by the BCBS. Importantly, an assessment of the costs and benefits at that point on the basis of a more mature adaptation process could provide a clearer

picture of whether any policy action is warranted in the context of a more holistic analysis of their implications.

Prior to such a review, however, authorities in some jurisdictions might seek to mitigate adverse effects on repo market functioning via targeted measures of a temporary nature. For example, some of the volatility in repo market rates associated with the scarcity of certain types of collateral might be reduced were central banks to engage more actively in securities lending. And where such facilities already exist, central banks might consider ways to increase their efficacy by reducing barriers to access. Agencies in charge of public debt issuance could also target reissues of securities exhibiting signs of scarcity, and this could be undertaken at relatively low cost when such securities are showing a price premium in repo, even if such measures would also have to be balanced with other considerations affecting public debt management. More generally, any measures need to be carefully assessed as they risk distorting the international level playing field.

Other policy measures that have been implemented in some jurisdictions with the objective of facilitating the transmission of monetary policy may also have the effect of improving repo market functioning. For example, the US Federal Reserve's RRP is helping to ensure continuous access to the repo market for some non-bank end users, particularly on balance sheet reporting dates. Similarly motivated by monetary policy concerns, the Bank of England's exclusion of central bank reserves from the leverage ratio measure may also impact repo intermediation positively if it relieves balance sheet constraints, although it is too early to observe such an impact.

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## Annex 1: Trends in specific repo markets

This Annex describes the major repo markets (by currency), reviewing their relevant price and volume indicators and their structural features.

### Euro area repo market

In the euro area, the repo market has been undergoing a number of changes over the past years.

First, European repo market developments have been strongly affected by the expansion of central banks' reserves that resulted from the ECB's targeted longer-term refinancing operations and asset purchases. This is reflected in the increasing divergence between repo driven by liquidity management needs and repo driven by collateral needs. This is evidenced by a decline in the volume of cash-driven repos, as the increasing surplus of liquidity generated by the monetary policy reduced banks' needs for short-term funding. On the contrary, trading volumes backing repo transactions, which are rather driven by the collateral needs, did not display this downward trend and a negative correlation with the amount of excess liquidity provided by the Eurosystem. Netting out the two impacts, the overall repo market volume in the euro area has remained steady. The divergence was also reflected in the widening gap between the rates for general collateral and other repos (ie trades conducted on specific bonds) that has widened strongly, in particular for high credit quality collateral. Furthermore, with the increasing amount of excess liquidity, overnight repo rates have declined relative to the central bank deposit facility rate. This has been the case for general collateral, but particularly so for specific sovereign collateral that declined to levels significantly below the central bank deposit facility rate. The asset purchases by the Eurosystem played a role in the availability of sovereign collateral in the market, which in turn motivated the establishment of the Eurosystem securities lending programme to mitigate the impact of the purchases on the market functioning.

Second, over the past years repo market rates in the euro area started to show a different behaviour on balance sheet reporting dates. During 2014 and the first part of 2015, all repo rates tended to increase at quarter-ends due to the preference for more liquid positions on reporting dates. However, since mid-2015, repo rates for higher credit quality collateral, such as German and French sovereign bonds, started to fall at quarter-ends. These lower rates may signal a higher demand to invest cash in high credit quality bonds, lower availability of this type of assets, and higher reluctance to accept liquidity and/or to trade, in general terms, on these specific dates. The latter is reflected in reduced repo market volumes traded on these specific dates. It is also interesting to note that the Spanish and Italian repo rates started also to exhibit a downward move at quarter-ends starting in the second half of 2016. Hence, next to the lower availability of high credit quality collateral, the increasing surplus of liquidity generated by the non-standard monetary policy measures contributed to a decline in the repo rates of other collateral as well.

Market analysts have suggested a number of reasons for these quarter-end effects:

- Banks who expand their balance sheets to take cash deposits against euro area collateral intra-quarter may need to reduce their balance sheet at quarterly financial and balance sheet reporting dates.
- Asset managers who own high credit-quality euro area collateral are unwilling to lend it out over quarter-ends because, given the bank balance sheet constraints described above, they cannot place the cash collateral that they would receive in exchange.

In addition, quarter-end effects have been exacerbated at the end of 2016 because of investors' positioning in the bond market with a large amount of short positions in the high credit quality sovereign bonds. Banks were also particularly unwilling to show expanded balance sheets at this reference point for financial analysts, used for assessing the euro area banks contributions to the Single Resolution Fund, for G-SIB categorisation and bank levies in a number of jurisdictions.

Third, looking at the market structure, the share of repo market trading via central clearing counterparties (CCP) increased over the past years, accounting for 50-60% of the euro area repo market volumes, owing to their attractiveness for the balance sheet management. The use of CCPs has been strongly supported by authorities and brings benefits in terms of smooth market functioning, as well as for individual institutions. Eurosystem contacts report a wide difference in the pricing of trades cleared bilaterally and those cleared through CCPs, which may reach the hundreds of basis points on the critical balance sheet reporting dates. At the same time, a higher recourse to the CCPs also increases demand for high credit quality collateral, which is used for both margining and investment of CCP liquidity buffers. As the use of central clearing expands to other market segments, such as derivatives, the demand for collateral in the market is expected to rise,

Overall, the euro area repo market has been impacted by a number of drivers, affecting both supply and demand for collateral in general and demand for high credit quality collateral in particular.<sup>42</sup> While some of these drivers are likely to be transitory in the longer run, such as expansionary monetary policy measures, others may have a more lasting impact on the euro area repo market.

Several studies regarding the relevance of the drivers behind trends in euro area repo markets have already been done. A recent occasional paper of the Bank of Italy examines the impact of the leverage ratio on 70 major euro area banks.<sup>43</sup> The authors document a rapid adjustment to the new framework in the years of 2013–14, with an average leverage ratio of 4.4% and only three banks below the preliminary 3% threshold at the end of 2014. In addition, throughout 2014, leverage-constrained banks have decreased neither Eurosystem refinancing nor trading volume on repo markets. Recent analysis also assessed the impact of the leverage ratio on repo and trading activity.<sup>44</sup> The study shows that banks which needed to improve their leverage ratios to meet the 3% requirement or market expectation have been doing so in part by reducing the size of their balance sheets. This has included reducing their trading assets relative to the amount they would have held if not bound by the leverage ratio; however, neither trading assets nor repos have disproportionately fallen as a share of

<sup>42</sup> See also a speech by Mersch (2017).

<sup>43</sup> See Bucalossi and Scalia (2016).

<sup>44</sup> See EBA (2016).

these banks' total assets since 2010. A recent academic study looking at the European repo market shows that central bank liquidity provisions are effective in reducing repo rates, but only up to a point.<sup>45</sup> Moreover, the authors show that excess liquidity supply can lead to a decrease in secured interbank lending.

## US dollar repo

A significant portion of the US government bond repo market is characterised by the investment of money market funds' and other cash investors' cash (secured via the triparty system against good-quality collateral) with banks and broker-dealers. These institutions may use this cash to fund their own balance sheets or they may lend it on to other dealers or leveraged investors like hedge funds that do not trade with the money market funds directly.

The growth visible in US repo markets has been driven in part by dealer-banks headquartered outside the US. These banks – particularly those headquartered in the euro area or Japan – tend to reduce their market presence significantly at quarter-ends.

Similar to the euro area, US repo markets demonstrate price divergences between markets driven by EF5 – that is, driven by institutions that need cash to fund their balance sheets – and markets driven by EF1 – that is, driven by cash investors who require high-grade collateral to secure their cash investment:

- Rates paid in the cleared general collateral finance repo market (henceforth GCF Repo), a blind-broker market used primarily by second-tier dealers to fund their balance sheets, spiked upwards at quarter-ends. These spikes became more pronounced in the second half of 2016 since the suspension of trades between dealers using different clearing banks.<sup>46</sup>
- Rates paid in the general triparty market, which is used significantly by money market funds and other investors to place cash via US Treasury repo, remained consistently below the GCF Repo rates.

However, unlike the euro area market, where quarter-end rates for cash placed against high-grade collateral drop significantly below the official deposit rate at quarter-ends (and dropped dramatically at the most recent year-end), potential down-spikes in the USD market are contained by the Federal Reserve's Reverse Repo Programme (RRP). Under the RRP, which is a tool for monetary policy implementation designed for situations when excess reserves are plentiful, the Federal Reserve takes cash directly from an expanded set of counterparties, via repo against government securities, bypassing dealer banks and their balance sheet constraints.<sup>47</sup> So, in spite of a reduction in dealer repo activity at quarter-ends, rates paid to money market funds placing cash into the financial system did not display signs of abnormality since the rate paid by the RRP provided a floor.

The volumes in the US Treasury triparty repo market have risen in the past two years. This growth is primarily driven by lending to non-US-domiciled banks. These banks – particularly those domiciled in the euro area and Japan –, tend to pull back significantly from the market at quarter-ends. In contrast, large US bank holding

<sup>45</sup> See Mancini et al (2016).

<sup>46</sup> See Adenbaum et al (2016).

<sup>47</sup> See [https://www.newyorkfed.org/markets/rrp\\_counterparties](https://www.newyorkfed.org/markets/rrp_counterparties) for the list of RRP counterparties.

companies are, in general, not especially sensitive to quarter-end dates, as regulatory reporting is based on averages of each day in the quarter. Interestingly, the quarter-end surges in RRP take-up (averaging about \$200 billion across the past four quarters) are generally larger than the declines in triparty repo volumes on those dates, suggesting that cash investors are using RRP at quarter-ends to replace other types of investments, such as bilateral repos or non-repo cash investments.

In contrast with the systematic growth in money fund cash placings via repos, there is a decline in the GCF Repo market. The clear level-shift in volumes in the middle of 2016 can be attributed to the suspension of trades between dealers using different clearing banks.

In closing this description of the USD repo market, it should be noted that USD GCF Repo rates were stable at the most recent year-end, closing 0.03% below the RRP rate rather than spiking upwards as in previous years. Some market observers attributed this drop in GCF Repo rates to technical demand for collateral netting in the clearing house; others to pre-emptive, pre-year-end funding by dealers who were structural cash borrowers, leaving them with a year-end cash surplus; other observers suggested that the dealer community was generally short of government bonds over year-end in order to position for rising interest rates and that this short position created a cash surplus.

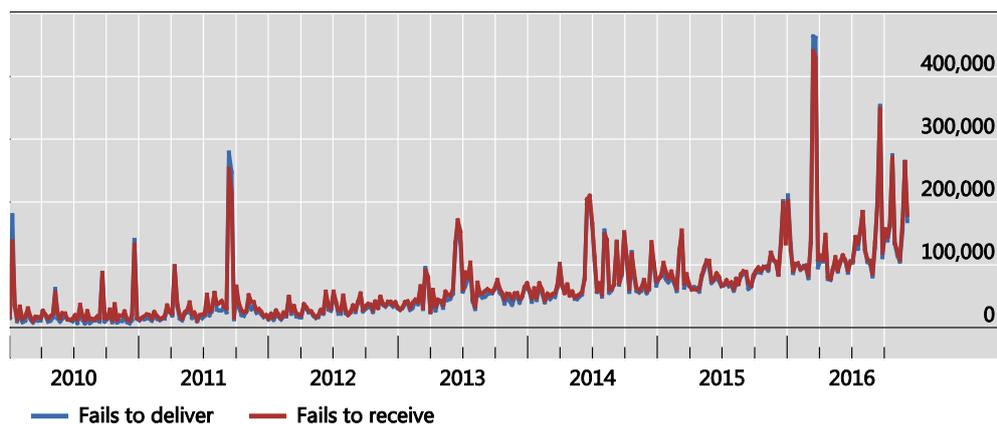
Turning to the availability of borrowed securities as a facilitator of the prompt settlement of cash transactions, data from the Federal Reserve Bank of New York shows that settlement fails involving primary dealers in the US Treasury market grew steadily between 2013 and 2016, having fallen from their very high level during the financial crisis. Furthermore the fails data show consistently higher peaks on peak-fail days. However, the causes of these fails are hard to identify and the increase may have pre-dated recent regulatory initiatives (Annex Graph 1).<sup>48</sup>

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### Fails to deliver in US Treasury market

In millions of US dollars

Annex Graph 1



Source: Federal Reserve Bank of New York

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<sup>48</sup> See Fed data available at: <https://www.newyorkfed.org/markets/gsds/search.html>. See discussion of Fed data available at: <http://libertystreeteconomics.newyorkfed.org/2014/09/measuring-settlement-fails.html> and <http://libertystreeteconomics.newyorkfed.org/2014/09/what-explains-the-june-spike-in-treasury-settlement-fails.html>

## Japanese repo market

From the available quantitative data, the Japanese repo market has not shown noticeable signs of worsening in its market functioning. Overall outstanding amounts of the repo market have increased over the last two years, especially since the introduction of the three-tier system for the outstanding balance in banks' current accounts held at the Bank of Japan in January 2016. The macro-economic environment seems to play a larger role in repo market developments than regulation does.

The Bank of Japan's large asset purchase programme introduced in April 2013 seems to have brought arbitrage opportunities: (i) between central bank's counterparties (eligible to earn an interest rate on excess reserves (IOER)) and others; and (ii) among central bank's counterparties under tiered remuneration.

Until the introduction of the three-tier system, the IOER of 0.1% was applied. Back then, institutions holding a current account at the Bank of Japan borrowed cash from those who did not have a current account via the general collateral (GC) repo market at rates below 0.1%, and reserved that cash at the current account to earn the spread between the GC repo rate and the IOER of 0.1%. It should be noted that there were no limits to the amounts that could earn the IOER.

Since the introduction of the three-tier system, institutions holding a current account at the Bank of Japan were forced to control their current account balance to stay in the amount of which +0.1% (basic balance) and/or +0.0% (macro add-on balance) are applied, or to control the amount of policy rate balance (w/  $\Delta$ 0.1%) as small as possible. Institutions with unused allowances in their basic balance (w/ +0.1%) or macro add-on balance (w/ 0.0%) engaged in arbitrage trading to earn the spread between the GC repo rate and the rates applied to their current accounts (ie 0.1% or 0.0%). It should be noted that while the basic balance amount is fixed, the macro add-on balance grows at a pace that is in line with the quarterly growth of the monetary base. The increase in USD funding premia against the JPY also provides arbitrage opportunities to overseas investors, who gain from the spreads between the JPY funding cost through FX/XCCY swap market and the GC repo rate.

In terms of regulation, the leverage ratio disclosure requirement (introduced in March 2015) has restrained major banks from engaging in arbitrage trading at quarter-ends, which often caused large rate spikes at those periods.

## Sterling repo market

The United Kingdom has experienced a clear decline in repo market functioning – in terms of both price and quantity metrics – driven by a reduction in the provision of repo intermediation by UK banks. There is evidence that this has been caused, at least in part, by balance sheet constraints such as the leverage ratio.

There is a range of participants in gilt repo. Money market funds and other cash-rich investors that have minimum credit appetite place cash at short maturities. Meanwhile, pension funds and other institutions borrow at term in the market. In particular, UK liability-driven investors such as pension funds, which hedge their long-term liabilities by leveraging their bond portfolios through repo, may account for around half of banks' reverse repos. Banks typically intermediate the two sets of end

users. Interbank transactions account for a little over half of gilt repo and these transactions are typically cleared through a CCP.

Headline metrics of repo market functioning in the United Kingdom are mixed. While amounts outstanding are 14% below their 2009 peak, they have been broadly flat since 2012. Transaction volumes, however, fell by 53% between 2012 and 2016, while inter-dealer volumes fell by 30% over the period. Repo rates, outside of reporting dates, have increased relative to risk-free benchmark rates, reflecting the increase in demand for gilt repo financing by pension funds.

There is, however, clear evidence of constraints on UK repo market intermediaries. Repo volumes reported on UK bank balance sheets fell from \$686 billion to \$397 billion between 2012 and 2015. Although foreign banks are increasingly active in gilt repo, this has only partly mitigated the extent of the decline in intermediation by UK banks. Indeed, the gilt repo market has seen larger bid-ask spreads, price discontinuities at reporting dates and increases in off-balance sheet transactions. All of this has led to increased costs for end users, as well as quantity constraints on their ability to place cash (these are documented in Section 2).

These developments are reflected in surveys of market participants. Since 2014, a net balance of respondents to the Bank of England's biannual survey of sterling money markets believe that repo market functioning has declined (Annex Graph 2). That said, the pace of the reduction has recently abated.

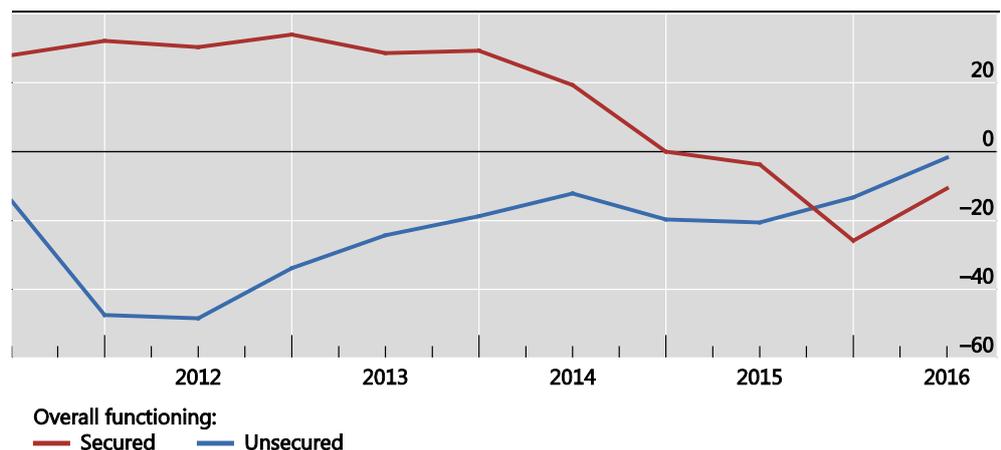
As the United Kingdom transitions towards calculating the leverage ratio on the basis of period averages of bank balance sheets, rather than end-period snapshots, the pressures on repo intermediaries described above may increase again.

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## Respondents' views of overall market functioning

Net percentage balances

Annex Graph 2



<sup>1</sup> Net percentage balance is calculated as the difference between the balance of lenders reporting that, on a scale of 1 to 5, the market was functioning very poorly (1) to very well (5). The net percentage balances are scaled to lie between ±100: more extreme responses (1 and 5) attract a weight of 100%, less extreme responses (2 and 4) attract a weight of 50% and central responses (3) attract a weight of zero.

Sources: MMLC Sterling Money Market Survey; Bank of England.

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## Annex 2: Evidence for difficulties in placing cash

At the SG’s Roundtable with repo market participants, a major European asset manager mentioned that the reduction in repo market functioning had led it to shift its investment of cash from repo markets and into outright purchases of government bills. The proportion of the firm’s cash held in repos had shrunk from nearly 50% at the start of 2014 to just over 10% by end-2016. Only four of the eleven counterparties who had offered repo capacity in 2014 were still willing to do so in 2016 (Annex Graph 3, left-hand panel), and availability was subject to year-end constraints (Section 2).<sup>49</sup>

This shift to outright holdings of bonds raised the risk that the firm may not have sufficient liquidity to meet large margin calls. Recent margin calls had reached levels that consumed over half the cash the firm had invested in repos (Annex Graph 3, right-hand panel). This raised the risk that in a more volatile market environment, a large margin call might exceed the firm’s available short-term liquidity.

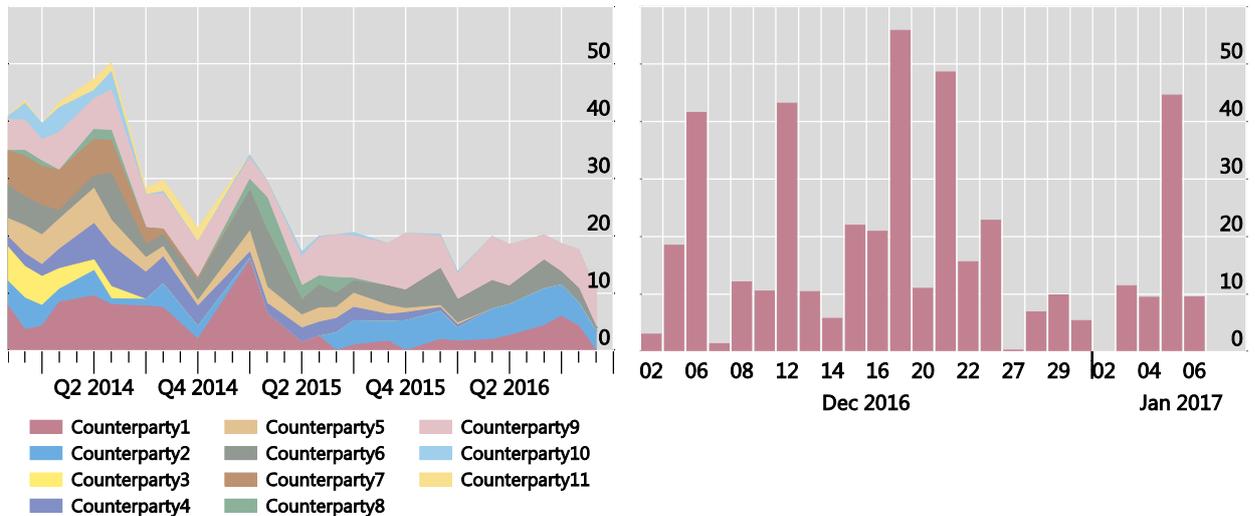
### Difficulties in placing cash in the repo market

In per cent

Annex Graph 3

Proportion of cash balance placed in repo, split by counterparty

Daily margin calls as % of outstanding repo balance



Source: A major European asset manager.

<sup>49</sup> The overall size of the cash balance fluctuated by less than 10% over the period in question.

## Annex 3: Survey of repo market participants

The SG carried out a survey of repo market participants. Separate surveys were sent to buy-side and sell-side firms across the jurisdictions represented by the members of the Study Group. In particular, the survey aimed to shed light on changes and drivers to the demand and supply in government bond repo markets.

Both the buy-side and the sell-side surveys asked why respondents participate in repo markets and the counterparties with which they interacted. Results were used to inform Section 1 of this report. The surveys also asked respondents to provide a qualitative characterisation of the extent of changes in repo market metrics such as:<sup>50</sup>

- Volumes and quantities: repo outstanding, average volumes;
- Counterparties: number of counterparties, demand for/availability of repo balance sheet;
- Terms: price terms like repo spreads, non-price terms like maximum maturity.

The survey also sought views from sell-side respondents as to how the liquidity of repo and underlying cash markets had changed. In addition, the sell-side survey asked respondents to quantify the changes in less visible aspects of repo markets, such as bid-ask spreads. Both buy-side and sell-side respondents were asked to rank the importance of various drivers of these changes.<sup>51</sup> These drivers covered:

- Macroeconomic conditions: level of interest rates, unconventional monetary policy;
- Market microstructure: changes to central clearing policies and trade execution;
- Prudential bank regulations: adoption of new capital and liquidity standards;
- Other regulatory initiatives: SEC money fund reform, triparty reform.

Lastly, both buy-side and sell-side surveys sought written responses on how markets and participants have adapted to changes, respondents' views on how repo markets will evolve, and potential policy measures that could be helpful in improving repo market functioning.

Members of the Study Group started to send the surveys out to respondents in late October 2016. The vast majority of responses were received by late November. Respondents were asked about changes to repo market metrics and the associated drivers over the past two years (ie 2015 and 2016).<sup>52</sup>

Respondents included 76 sell-side firms from 14 jurisdictions. These sell-side firms generally reported, in terms of economic functions of repo markets, market-

<sup>50</sup> In response to the questions about qualitative changes, both buy-side and sell-side respondents can choose between "significantly lower", "somewhat lower", "no change", "somewhat higher", and "significantly higher". The sell-side survey also asks about changes for several different counterparty types, eg other dealers, leveraged investors.

<sup>51</sup> In response to the questions about the importance of various drivers to the qualitative changes, both buy-side and sell-side respondents can choose between "very important", "somewhat important", and "not important".

<sup>52</sup> Missing responses was an issue for certain respondents, who may answer some questions but not others.

making, liquidity and collateral management, and matched book activities as important.

The SG received 36 buy-side respondents from a smaller number of jurisdictions. These firms include asset managers (leveraged or not), pension funds and insurance companies, and clearing organisations. Most cited cash investment and liquidity management as important economic functions.

Survey results inform the analysis throughout the report, and selected results have been included or referenced in individual sections. In addition, selected results are included in four Annex Tables. The Tables focus on participants' views of changes in repo market functioning across a number of market indicators (eg volumes of repo outstanding, repo spreads, liquidity of repo markets), and views of the importance of the drivers behind these changes. Separate results are included from the sell-side and buy-side surveys.

## Changes over the past two years to characteristics of your repo/reverse repo trading operations.

Average of responses to sell-side survey

Annex Table 1

| Country | Outstanding      |                          | Volumes                    |                                    | Counterparties      |                              |                          | Price and Non-Price Terms |                          |          |                       |  | Market Liquidity Conditions |
|---------|------------------|--------------------------|----------------------------|------------------------------------|---------------------|------------------------------|--------------------------|---------------------------|--------------------------|----------|-----------------------|--|-----------------------------|
|         | Repo Outstanding | Reverse Repo Outstanding | Daily Average Repo Volumes | Daily Average Reverse Repo Volumes | Counterparty Demand | Internal Counterparty Limits | Number of Counterparties | Repo Spread               | Typical Maximum Maturity | Haircuts | Other Non-Price Terms | Liquidity in repo/reverse repo markets |                             |
| AU      | 3.4              | 3.3                      | 3.2                        | 3.3                                | 3.9                 | 2.7                          | 3.4                      | 4.6                       | 2.2                      | 2.9      | 2.8                   | 1.8                                    |                             |
| BE      | 2.3              | 2                        | 2.3                        | 2                                  | 2.2                 | 2                            | 1.6                      | 5                         | 2.6                      | 3.4      | 3                     | 1.4                                    |                             |
| CA      | 2.9              | 2.9                      | 2.9                        | 2.9                                | 3.2                 | 2.9                          | 3.1                      | 3.7                       | 2.9                      | 2.9      | 2.8                   | 2.5                                    |                             |
| CH      | 3                | 3                        | 3                          | 3.5                                | 3.5                 | 3.5                          | 3.5                      | 3                         | 3                        | 3        | 3                     | 3                                      |                             |
| DE      | 1                | 2                        | 2                          | 2                                  | 2                   | 3                            | 2                        | 1                         | 4                        | 3        | 3                     | 2                                      |                             |
| ES      | 2.2              | 2.7                      | 2.3                        | 2.8                                | 1.7                 | 2.7                          | 2                        | 2.8                       | 1.5                      | 2.8      | 3                     | 2                                      |                             |
| FR      | 2.3              | 2.2                      | 2.1                        | 2.2                                | 3.2                 | 2.9                          | 2.5                      | 4.1                       | 2.3                      | 3.6      | 3                     | 1.8                                    |                             |
| IT      | 3                | 3.4                      | 3.4                        | 3.6                                | 3.6                 | 3                            | 3.3                      | 3.4                       | 2.5                      | 2.9      | 2.8                   | 3.2                                    |                             |
| JP      | 3                | 3.5                      | 3                          | 3.3                                | 3.5                 | 3                            | 3.3                      | 2.3                       | 3.8                      | 3        | 2.7                   | 2.5                                    |                             |
| ME      | 3.2              | 3.2                      | 3.2                        | 3.3                                | 3.4                 | 3.4                          | 3                        | 3.4                       | 2.7                      | 2.8      | 2.4                   | 3.1                                    |                             |
| NL      | 2                | 1.5                      | 1.5                        | 1.5                                | 2.5                 | 2.5                          | 2.5                      | 2.5                       | 2.5                      | 3        | 4                     | 1.5                                    |                             |
| SE      | 3.3              | 3.5                      | 2.3                        | 2.5                                | 3.3                 | 3                            | 3                        | 4.5                       | 4                        | 3        | 2.7                   | 1.5                                    |                             |
| UK      | 2.9              | 3.2                      | 2.5                        | 2.8                                | 3.7                 | 3.2                          | 3.6                      | 4.1                       | 2.5                      | 3.2      | 2.8                   | 2.1                                    |                             |
| US      | 2.4              | 2.6                      | 2.3                        | 2.6                                | 3.8                 | 3                            | 3.1                      | 4.3                       | 2.7                      | 3.3      | 3                     | 2.4                                    |                             |
| Average | 2.8              | 3                        | 2.6                        | 2.8                                | 3.3                 | 3                            | 3.1                      | 3.8                       | 2.7                      | 3.1      | 2.8                   | 2.3                                    |                             |

Changes are scored on a scale of 1-5, where 1 = significantly lower, 2 = somewhat lower, 3 = no change, 4 = somewhat higher and 5 = significantly higher. Numbers represent simple averages of scores submitted by firms in each jurisdiction.

## Importance of drivers behind the changes identified in Annex Table 1

Average of responses to sell-side survey

Annex Table 2

|   | Outstanding      |                          |                            | Volumes                            |                     | Counterparties               |                          |             | Price and Non-Price Terms |          |                       |                           |     | Market Liquidity Conditions | Overall effect |
|---|------------------|--------------------------|----------------------------|------------------------------------|---------------------|------------------------------|--------------------------|-------------|---------------------------|----------|-----------------------|---------------------------|-----|-----------------------------|----------------|
|   | Repo Outstanding | Reverse Repo Outstanding | Daily Average Repo Volumes | Daily Average Reverse Repo Volumes | Counterparty Demand | Internal Counterparty Limits | Number of Counterparties | Repo Spread | Typical Maximum Maturity  | Haircuts | Other Non-Price Terms | Liquidity in repo markets |     |                             |                |
| Macroeconomic conditions                                | 1.6              | 1.5                      | 1.6                        | 1.6                                | 1.4                 | 2                            | 1.8                      | 1.5         | 1.5                       | 1.9      | 2                     | 1.4                       | 1.6 |                             |                |
| Current and Expected Interest Rates                     | 2                | 2                        | 2                          | 2                                  | 1.9                 | 2.5                          | 2.4                      | 1.9         | 2                         | 2.4      | 2.5                   | 2                         | 2.1 |                             |                |
| Unconventional Monetary Policy: Asset Purchases         | 1.8              | 1.7                      | 1.8                        | 1.8                                | 1.7                 | 2.4                          | 2.3                      | 1.5         | 1.9                       | 2.4      | 2.4                   | 1.6                       | 1.9 |                             |                |
| Unconventional Monetary Policy: Negative Rates          | 1.9              | 1.9                      | 1.9                        | 1.9                                | 1.8                 | 2.5                          | 2.3                      | 1.8         | 2.1                       | 2.4      | 2.4                   | 1.8                       | 2.1 |                             |                |
| Market Microstructure                                   | 1.7              | 1.7                      | 1.7                        | 1.7                                | 1.7                 | 1.9                          | 1.7                      | 1.6         | 1.8                       | 1.9      | 1.9                   | 1.5                       | 1.7 |                             |                |
| Triparty Clearing bank Policies                         | 2.4              | 2.4                      | 2.3                        | 2.3                                | 2.3                 | 2.5                          | 2.4                      | 2.4         | 2.5                       | 2.4      | 2.5                   | 2.2                       | 2.4 |                             |                |
| Central Clearing Policies                               | 2                | 2                        | 2                          | 2                                  | 2.1                 | 2.3                          | 2.2                      | 2.1         | 2.1                       | 2.2      | 2.4                   | 2                         | 2.1 |                             |                |
| Trading Execution (e.g. electronic trading)             | 2.4              | 2.4                      | 2.3                        | 2.3                                | 2.4                 | 2.6                          | 2.5                      | 2.3         | 2.5                       | 2.6      | 2.7                   | 2.3                       | 2.4 |                             |                |
| Changes in market participants (new entrants and exits) | 2.2              | 2.2                      | 2.1                        | 2.1                                | 2.1                 | 2.5                          | 2.1                      | 2.1         | 2.3                       | 2.4      | 2.4                   | 2.1                       | 2.2 |                             |                |
| Capital Regulation                                      | 1.3              | 1.3                      | 1.3                        | 1.3                                | 1.5                 | 1.7                          | 1.6                      | 1.5         | 1.5                       | 1.8      | 1.8                   | 1.3                       | 1.5 |                             |                |
| Basel 3   | 1.7              | 1.7                      | 1.8                        | 1.8                                | 1.9                 | 2                            | 1.9                      | 1.8         | 1.9                       | 2        | 2.1                   | 1.7                       | 1.8 |                             |                |
| Leverage ratio  | 1.5              | 1.5                      | 1.6                        | 1.6                                | 1.7                 | 1.9                          | 1.7                      | 1.4         | 1.6                       | 2.1      | 2.1                   | 1.4                       | 1.7 |                             |                |
| GSIB Surcharge  | 2.1              | 2                        | 2.1                        | 2.1                                | 2.2                 | 2.2                          | 2.2                      | 2.2         | 2.3                       | 2.4      | 2.3                   | 2.1                       | 2.2 |                             |                |

|   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Stress Testing                              | 2.2 | 2.2 | 2.2 | 2.2 | 2.3 | 2.2 | 2.3 | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 | 2.1 | 2.2 |
| BCBS Fundamental Review of the Trading Book | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 | 2.3 | 2   | 2.2 |
| Liquidity Regulation                        | 1.4 | 1.3 | 1.4 | 1.3 | 1.5 | 1.8 | 1.6 | 1.6 | 1.5 | 1.8 | 1.9 | 1.9 | 1.4 | 1.5 |
| LCR   | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 2   | 1.9 | 1.9 | 1.8 | 1.7 | 2.1 | 2.1 | 1.8 | 1.9 |
| NSFR  | 1.7 | 1.6 | 1.7 | 1.6 | 1.8 | 1.9 | 1.8 | 1.8 | 1.8 | 1.6 | 2.1 | 2.1 | 1.8 | 1.8 |
| Other Regulatory and Policy initiatives     | 1.7 | 1.7 | 1.7 | 1.7 | 1.6 | 1.8 | 1.8 | 1.8 | 1.7 | 1.7 | 1.8 | 1.8 | 1.7 | 1.7 |
| SEC MMF Reform                              | 2.3 | 2.3 | 2.3 | 2.3 | 2.2 | 2.5 | 2.3 | 2.3 | 2.3 | 2.3 | 2.5 | 2.5 | 2.3 | 2.3 |
| Triparty Reform                             | 2.5 | 2.5 | 2.5 | 2.5 | 2.6 | 2.6 | 2.6 | 2.6 | 2.5 | 2.5 | 2.6 | 2.6 | 2.5 | 2.5 |
| Firm-Specific Risk Management Practices     | 1.6 | 1.6 | 1.7 | 1.7 | 1.5 | 1.5 | 1.5 | 1.5 | 1.8 | 1.7 | 1.6 | 2   | 1.9 | 1.7 |

The importance of each driver is scored on a scale of 1–3, where 1 = very important, 2 = somewhat important and 3 = not important. Numbers represent simple averages of scores submitted by firms.

## Changes over the past two years to your firm's participation in repo markets.

Average of responses to the buy-side survey

Annex Table 3

|   | AU | CA  | CH | FR  | NL  | UK  | US  | Average |
|---|----|-----|----|-----|-----|-----|-----|---------|
| Volume of repo transactions executed by your firm                         | 4  | 3.6 | 1  | 3   | 2.4 | 4.1 | 3.3 | 3.4     |
| Amount of repo available to your firm from bank counterparties            | 3  | 2.6 | 2  | 2   | 1.8 | 3.1 | 3.1 | 2.7     |
| Amount of repo available to your firm from non-bank counterparties        |    | 3   | 3  | 3   | 3   | 4   | 3.6 | 3.6     |
| Changes to price terms offered to your firm (e.g., repo spread)           | 4  | 3.6 | 3  | 3.5 | 4   | 3.3 | 2.9 | 3.4     |
| Changes to non-price terms  | 4  | 3   | 2  | 2.5 | 3   | 2.8 | 2.8 | 2.8     |
| Number of bank counterparty relationships                                 | 4  | 3.6 | 2  | 4   | 2.6 | 4   | 3.9 | 3.6     |
| Number of non-bank counterparty relationships                             |    | 3   | 3  | 3   | 3.5 | 4   | 3   | 3.4     |
| Ability to access repo markets at month-end                               | 2  | 2.6 | 2  | 2.5 | 1.6 | 2.1 | 2.8 | 2.3     |
| Ability to access repo markets at quarter-end                             | 1  | 2.2 | 2  | 2   | 1.4 | 1.9 | 2.9 | 2.1     |
| Overall liquidity in repo markets collateralized by government securities | 2  | 2.6 | 1  | 1.5 | 1.3 | 2.4 | 2.3 | 2.2     |
| Overall liquidity in underlying government securities cash markets        | 2  | 2.6 | 1  | 3   | 2.3 | 2.4 | 2.6 | 2.4     |

Changes are scored on a scale of 1-5, where 1 = significantly lower; 2 = somewhat lower; 3 = no change; 4 = somewhat higher; 5 = significantly higher. Numbers represent simple averages of scores submitted by firms in each jurisdiction.

Importance of drivers behind the changes identified in Annex Table 3  
Average of responses to the buy-side survey

Annex Table 4

|   | Macroeconomic Conditions | Market Microstructure | Banking Regulatory Initiatives | Other Regulatory Initiatives | Your Firm's Risk Management Practices |
|---|--------------------------|-----------------------|--------------------------------|------------------------------|---------------------------------------|
| Volume of repo transactions executed by your firm                         | 1.8                      | 2.1                   | 1.5                            | 1.8                          | 1.9                                   |
| Amount of repo available to your firm from bank counterparties            | 2                        | 2                     | 1.1                            | 1.9                          | 2.3                                   |
| Amount of repo available to your firm from non-bank counterparties        | 2.5                      | 2.2                   | 1.9                            | 2.1                          | 2.3                                   |
| Changes to price terms offered to your firm (e.g., repo spread)           | 1.7                      | 2                     | 1.3                            | 1.7                          | 2.8                                   |
| Changes to non-price terms  | 2.6                      | 2.4                   | 1.5                            | 2.1                          | 2.3                                   |
| Number of bank counterparty relationships                                 | 2.6                      | 2.1                   | 1.5                            | 1.9                          | 2.1                                   |
| Number of non-bank counterparty relationships                             | 2.6                      | 2.2                   | 1.8                            | 2.4                          | 2.4                                   |
| Ability to access repo markets at month-end                               | 2.2                      | 2.1                   | 1.2                            | 1.8                          | 2.7                                   |
| Ability to access repo markets at quarter-end                             | 2.1                      | 2.1                   | 1.2                            | 1.7                          | 2.7                                   |
| Overall liquidity in repo markets collateralized by government securities | 1.8                      | 2.2                   | 1.2                            | 1.7                          | 2.6                                   |
| Overall liquidity in underlying government securities cash markets        | 1.9                      | 2.3                   | 1.4                            | 1.8                          | 2.7                                   |
| Average   | 2.1                      | 2.1                   | 1.4                            | 1.8                          | 2.4                                   |

The importance of each driver to the changes is scored on a scale of 1-3 where 1 if very important, 2 if somewhat important and 3 if not important. Numbers represent simple averages.

## Annex 4: Repo book importance for the leverage ratio

This Annex provides a brief description of the importance of the repo market book for the leverage ratio using data collected by the BCBS for the six Basel III monitoring exercises between 2013 H2 and 2016 H1.

The two tables below focus on two ratios. The first is the ratio of banks' repo exposures to the leverage ratio exposure measure (as defined by the BCBS rule). This provides a metric of the relative contribution of the bank's repo market activity to the tightness of the constraint. The second ratio is the share of the bank's repo exposures to the sum of similar exposures by all banks reporting to the BCBS monitoring exercise.

Annex Table 5 presents descriptive statistics of the ratios for geographical groupings of banks (ie Asia and Pacific, Europe, North America, and Other). For the universe of reporting banks the (un-weighted) average of the ratio is low (less than 5%) and has fluctuated from 3.82% at the end of 2013 to 4.54% a year later, decreasing afterwards to reach 4.02% in 2016H1. There is considerable variation in the relative size of the repo market book as evidenced by a value for the cross-sectional standard deviation that is at least as high as the cross-sectional average, and the maximum value which is particularly high for individual banks.

There is also considerable heterogeneity in the relative shares of the repo market activity accounted for by banks in different regions between 2013 and 2016. These have fallen for Asia and the Pacific banks, and increased for North American banks. European banks had the largest share in 2016 (about 46%), followed by North American (about 37%) banks.

Annex Table 6 presents the same descriptive statistics for banks grouped by their reported leverage ratio in four buckets (less than 3%, 3-5%, 5-7%, and more than 7%) in 2014H1 and 2016H1. The global standard was published in January 2014 and the disclosure requirement for banks became effective one year later. The comparison between the two points in time provides a gauge of the adjustment in repo market exposures of banks depending on how binding the minimum requirement was at the beginning of the period.

The Table suggests that tighter banks closer to the minimum requirement adjusted their repo market exposures the most. The average ratio of banks' repo exposures to the leverage ratio exposure measure fell from 6.51% in 2014H1 to 3.95% in 2016H1 for banks with a leverage ratio lower than 3%. However, it should be noted that the number of banks included in this bucket is very small (it was 6.8% in 2014 and negligible in 2014). The message from a comparison of the relative shares of banks in different buckets points to the extent of the adjustment. While banks accounting for about three quarters of the overall repo market were in the 3-5% bucket in 2014, this bucket accounted for about 50% share in 2016, while the share of the 5-7% bucket doubled over the same period, to reach about 40%. It should be noted that the average ratio of repo books to the exposure measure for banks with leverage ratios above 5% in 2014 hardly changed in the subsequent two years.

All this evidence suggests that most of banks' adjustments in repo market exposures have already been put in place.

## Repo exposures and the leverage ratio

The share of repo exposures in the exposure measure (in percent)

Annex Table 5

|                   |                         | 2013 H2 | 2014 H1 | 2014 H2 | 2015 H1 | 2015 H2 | 2016 H1 |
|-------------------|-------------------------|---------|---------|---------|---------|---------|---------|
| Asia Pacific      | avg                     | 5.93    | 5.72    | 5.50    | 5.51    | 5.27    | 4.78    |
|                   | std                     | 9.09    | 9.41    | 8.89    | 9.37    | 9.20    | 7.87    |
|                   | max                     | 31.63   | 33.39   | 30.69   | 31.37   | 32.65   | 27.53   |
|                   | repo share <sup>1</sup> | 16.37   | 13.00   | 11.38   | 12.00   | 10.40   | 10.39   |
| Europe            | avg                     | 3.31    | 3.91    | 4.27    | 3.90    | 2.98    | 3.62    |
|                   | std                     | 5.53    | 6.53    | 8.19    | 6.71    | 4.35    | 6.63    |
|                   | max                     | 34.56   | 43.33   | 65.93   | 54.02   | 23.92   | 55.20   |
|                   | repo share              | 48.22   | 47.42   | 47.59   | 45.54   | 41.99   | 45.97   |
| North America     | avg                     | 7.81    | 8.70    | 8.16    | 8.30    | 8.78    | 7.82    |
|                   | std                     | 6.76    | 7.18    | 7.23    | 7.38    | 7.70    | 7.29    |
|                   | max                     | 21.89   | 20.87   | 25.35   | 22.49   | 24.75   | 25.62   |
|                   | repo share              | 28.14   | 30.28   | 32.43   | 32.93   | 39.75   | 36.98   |
| Others            | avg                     | 2.66    | 2.83    | 3.21    | 3.05    | 2.54    | 2.97    |
|                   | std                     | 4.04    | 4.11    | 5.14    | 4.36    | 3.89    | 4.81    |
|                   | max                     | 15.11   | 16.32   | 20.95   | 19.23   | 18.52   | 20.39   |
|                   | repo share              | 7.27    | 9.29    | 8.60    | 9.53    | 7.85    | 6.67    |
| All jurisdictions | avg                     | 3.82    | 4.26    | 4.54    | 4.31    | 3.71    | 4.02    |
|                   | std                     | 5.94    | 6.59    | 7.61    | 6.76    | 5.68    | 6.56    |
|                   | max                     | 34.56   | 43.33   | 65.93   | 54.02   | 32.65   | 55.20   |
|                   | repo share              | 100.00  | 100.00  | 100.00  | 100.00  | 100.00  | 100.00  |

Note: AsiaPacific = {JP, AU}; Europe = {BE, DE, ES, FR, IT, LU, NL + GB, SE, CH}; NorthAmerica = {US, CA}; Others = {MX, AR, BR, RU, IN, ID, TR, ZA, SA, KR, HK, CN, SG}. <sup>1</sup> Repo exposures by banks in region as a share of all banks' repo exposures.

Source: Basel Committee on Banking Supervision, and CGFS calculations.

## Adjustments in banks' repo activity

Changes in the share of repo exposures by tightness of the leverage ratio

Annex Table 6

|               |                         | Banks classified by<br>leverage ratio score in H1 2014 |         | Banks classified by<br>latest leverage ratio score |
|---------------|-------------------------|--|---------|--|
|               |                         | H1 2014  | H1 2016 | H1 2016 H1   |
| LR <= 3%      | avg                     | 6.51   | 3.95    | 1.06   |
|               | std                     | 8.76   | 5.24    | 2.12   |
|               | max                     | 30.55  | 15.27   | 4.23   |
|               | repo share <sup>1</sup> | 6.81   | 6.33    | 0.02   |
|               | count <sup>2</sup>      | 13   | 13      | 4  |
| 3% < LR <= 5% | avg                     | 6.20   | 5.53    | 5.32   |
|               | std                     | 6.43   | 6.20    | 5.57   |
|               | max                     | 30.06  | 27.53   | 27.53  |
|               | repo share              | 72.60  | 74.04   | 49.98  |
|               | count                   | 78   | 78      | 63   |
| 5% < LR < 7%  | avg                     | 3.19   | 3.18    | 3.92   |
|               | std                     | 5.54   | 5.40    | 6.19   |
|               | max                     | 33.39  | 27.38   | 27.38  |
|               | repo share              | 19.32  | 17.97   | 41.12  |
|               | count                   | 59   | 59      | 72   |
| LR >= 7%      | avg                     | 3.44   | 3.22    | 3.49   |
|               | std                     | 7.92   | 9.31    | 8.67   |
|               | max                     | 43.33  | 55.20   | 55.20  |
|               | repo share              | 1.28   | 1.67    | 8.88   |
|               | count                   | 37   | 37      | 48   |

Source: Basel Committee on Banking Supervision and CGFS calculations. <sup>1</sup> Repo exposures by category as a share of all banks' repo exposures. <sup>2</sup> Number of banks in the category.

## Annex 5: Impact of the Net Stable Funding Ratio (NSFR) on repo markets

### The Net Stable Funding Ratio in a nutshell

The Net stable Funding Ratio (NSFR) requires banks to maintain a stable funding profile in relation to the composition and the maturity of their assets, and off-balance sheet activities. The NSFR limits overreliance on short-term wholesale funding, encourages better assessment of funding risk across all on- and off-balance sheet items, and promotes longer-term funding. It is scheduled to be implemented in 2018.

The NSFR is defined as the amount of available stable funding (ASF) relative to the amount of required stable funding (RSF). ASF is defined as the amount of capital and liabilities expected to be reliable over one year. The amount of RSF is a function of the liquidity characteristics, the counterparty type, and residual maturities of assets held as well as off-balance sheet exposures.

### Treatment of repo transactions

For the purpose of illustration, consider the following *Example 1* which illustrates the impact of a repo transaction between two banks subject to the NSFR with a residual maturity of less than six months. Note that the collateral used in the transaction is assumed to be on-balance sheet, ie the example does not consider a leveraged securities purchase but rather a repo transaction conducted for liquidity management purposes executed by/on behalf of the bank's treasury.

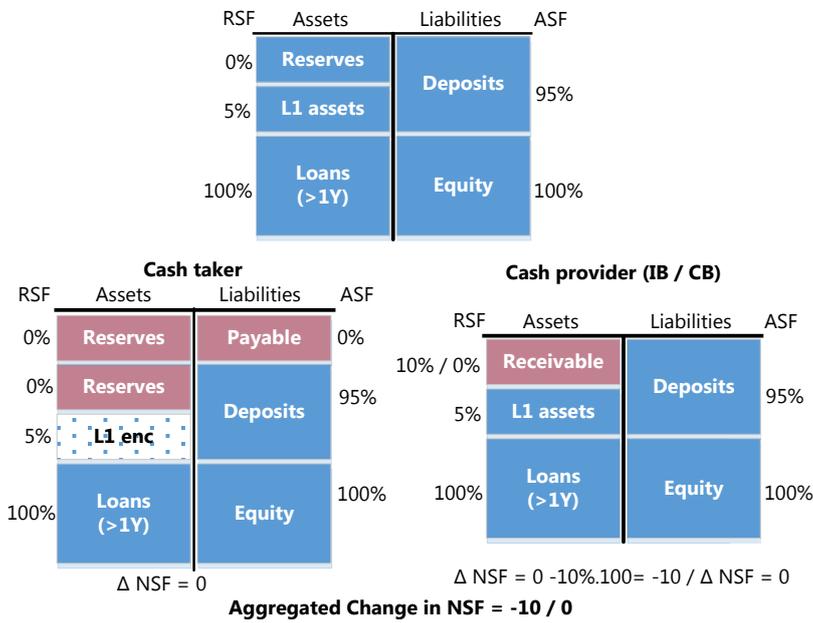
The lending bank (hereinafter, cash provider) lends cash/reserves and obtains collateral in return. The bank thereby converts cash/reserves into a receivable which requires stable funding (RSF = 10%).<sup>53</sup> At the same time the bank receives collateral which is kept off-balance sheet which has no impact on ASF and RSF. In total, the bank's NSFR decreases. The borrowing bank (hereinafter, cash taker) borrows cash/reserves and provides collateral in return. Given that the residual maturity is less than six months, the borrowed cash/reserves (payable) provides no stable funding (ASF = 0%) and the additional cash/reserves requires no additional RSF. On aggregate, the repo transaction decreases net stable funding (NSF) by 10. Note that this aggregate decrease is just equivalent to the NSFR-cost of intermediating repos using matched-book repos in which the collateral is re-used.

*Example 2* illustrates the same transaction but with a residual maturity between six and twelve months. The important change to *Example 1* is that the funding acquired by the cash taker now has an ASF of 50%. However, given that the collateral is encumbered for more than six months, it requires stable funding of 50%. On aggregate, the repo transaction decreases NSF by 45.

<sup>53</sup> Note that in case the transaction is conducted with a central bank, the RSF remains at 0%. Therefore, the overall change of net stable funding is 0 in this example.

Example 1: Impact of a repo transaction with residual maturity of less than six months<sup>1</sup>

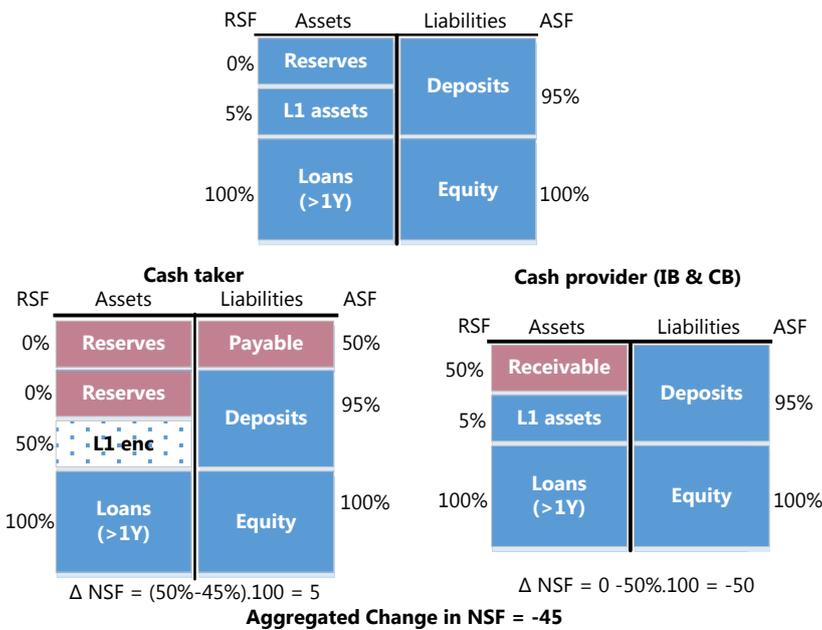
Annex Graph 4



<sup>1</sup> Banks start with an identical balance sheet.  
Source: Swiss National Bank.

Example 2: Impact of a repo transaction with residual maturity between six and 12 months<sup>1</sup>

Annex Graph 5



<sup>1</sup> Banks start with an identical balance sheet.  
Source: Swiss National Bank.

The following table displays the RSF and ASF factors according to the Basel III NSFR rules for repo transactions between FIs. The relevant RSF and ASF factors from Example 1 and 2 are displayed in italics:

| Some effects of balance sheet constraints on the repo market |                 |                |            | Annex Table 7                       |
|--|-----------------|----------------|------------|-------------------------------------|
| Leg / residual maturity                                      | 0-6M            | 6-12M          | >12M       | Collateral                          |
| <b>Cash:</b>   |                 |                |            |                                     |
| Cash taker   | ASF = 0%        | ASF = 50%      | ASF = 100% |                                     |
| Cash provider  | RSF = 10%       | RSF = 50%      | RSF = 100% | HQLA Level 1                        |
| Cash provider  | RSF = 15%       | RSF = 50%      | RSF = 100% | HQLA Level 2, non-HQLA or unsecured |
| <b>Collateral:</b>   |                 |                |            |                                     |
| Cash taker (encumbered)                                      | RSF = unchanged | RSF = min 50%  | RSF = 100% |                                     |
| Cash provider  |                 | No recognition |            |                                     |

## Implications for the repo market

The NSFR could potentially have negative implications for repo market functioning due to the reasons discussed below. Part of these implications are intended consequences of regulation. However, asymmetries built into the NSFR standard may affect repo markets in some jurisdictions more than in others depending on the local repo market structure such as the term, counterparty and collateral composition of repos outstanding and the repo trading motive.

*First*, the NSFR imposes a stable funding requirement for receivables stemming from short-term reverse repo. This requirement is set to 15% of reverse repo amounts and thus identical to receivables from unsecured lending transactions. The requirement is lowered to 10% when the collateral is Level 1.

Repo markets which used to trade against collateral baskets consisting of Level 1 and Level 2/non-HQLA assets might be subject to changing collateral standards and increased market segmentation.<sup>54</sup> As the HQLA type of the collateral affects the NSFR of the cash provider, she might only accept Level 1 assets. Level 2 or non-HQLA assets could be accepted as collateral in repo transactions with a higher interest rate or a higher haircut. Consequently, the spread between repo rates of transactions secured with Level 1 or Level 2 securities might increase due to the NSFR.

*Second*, receivables stemming from longer-term reverse repo transactions, with maturities of more than six months, require significant (50%-100%) stable funding and banks cannot account for the collateral value received as in case of Level 1 assets in short-term reverse repos. Thus, banks subject to the NSFR may reduce the issuance

<sup>54</sup> For instance, the Swiss franc repo market or the Euro GC Pooling Market trade against collateral baskets consisting of Level 1, Level 2 (and non-HQLA assets).

of longer-term reverse repo. This is also true for central bank operations which makes longer-term liquidity absorbing repos virtually unfeasible.<sup>55</sup>

*Third*, combining the previous argument for longer-term reverse repo transactions with the fact that the encumbered collateral on the cash taker's balance sheet requires stable funding, the aggregate change in net stable funding is negative. Note that it is a weak Pareto improvement for the two banks involved in the transaction to conduct this trade on an unsecured basis because there is no additional required stable funding for the encumbered collateral. This could lead to increased risk-taking in term funding markets.

An approach to mitigate potential negative effects of the NSFR in longer-term repo markets could be addressed, for instance, by considering the collateral in a reverse repo in the form of lower stable funding requirements for the receivable (as is the case in the short-term maturity segment). By aligning the RSF factors for HQLA collateral, for instance, one could differentiate repo transactions against high-quality collateral from those against low-quality collateral or unsecured lending transactions.

<sup>55</sup> Paragraph 31 in the NSFR rules text leaves room for adjustments of the stable funding requirements in case of exceptional liquidity providing central bank operations. The rules text is silent about liquidity absorbing central bank operations.

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