

## C Recent developments in euro area repo markets, regulatory reforms and their impact on repo market functioning

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*Effectively functioning repo markets are of key importance for both financial stability and monetary policy, but the excessive use of repos may also be a source of systemic risk as witnessed during the recent financial crisis. Regulatory reforms introduced since the start of the crisis have aimed to contain systemic risk related to the excessive build-up of leverage and unstable funding, but recently some concerns have been raised about their potential effects on the functioning of the repo market. This special feature presents new evidence on the drivers of banks' activity in the repo market with respect to regulatory reforms. In addition, it takes a closer look at the repo market structure and pricing dynamics, in particular around banks' balance sheet reporting dates. While the observed volatility around reporting dates suggests that the calculation methodology for some regulatory metrics should be reviewed, overall, the findings indicate that unintended consequences of regulatory reforms on the provision of repo services by euro area banks have not been material.*

### Introduction

**Repurchase agreement (repo) markets play a key role in facilitating the flow of cash and securities around the financial system and are crucial for the implementation of monetary policy.**<sup>176</sup> Repos are a means for various financial and non-financial institutions to place cash, obtain funding or source collateral. Moreover, central banks often implement monetary policy by providing banks with secured funding. Banks may then pass liquidity on to the interbank market via the repo market.

**However, the excessive use of repos in the creation of leverage and in financing long-term assets with short-term funding was one factor that contributed to the Great Financial Crisis (GFC).**<sup>177</sup> Before the GFC, repos were one of the factors contributing to the build-up of both leverage and unstable funding profiles. The reliance on repo funding increased steadily in the run-up to the GFC, before dropping sharply during the crisis, leading to negative repercussions on financial institutions' solvency and funding. The GFC further revealed that financial institutions tended to over-rely on short-term wholesale funding, including repos, to meet their funding needs. The GFC demonstrated that this type of funding can be

<sup>176</sup> See "[Repo market functioning](#)", CGFS Papers No 59, Committee on the Global Financial System, Bank for International Settlements, April 2017.

<sup>177</sup> See, for example, "[Policy Framework for Addressing Shadow Banking Risks in Securities Lending and Repos](#)", Financial Stability Board, August 2013, "[The role of margin requirements and haircuts in procyclicality](#)", CGFS Papers No 36, Committee on the Global Financial System, Bank for International Settlements, March 2010, and Gorton, G. and Metrick, A., "[Securitized Banking and the Run on Repo](#)", Yale ICF Working Paper No 09-14, November 2010.

extremely volatile and can quickly disappear in times of market or idiosyncratic stress.

**Regulatory measures have been introduced in the aftermath of the GFC to address excessive leverage and the use of unstable funding structures.** This special feature focuses on analysing whether these reforms may have had a material negative impact on the functioning of repo markets. To this end, it starts by reviewing longer-term developments in repo markets and describing the relevant regulatory reforms and how they may impact these markets. It then examines volatility in repo market volumes and rates around recent balance sheet reporting dates and finds that it intensified in 2016 and peaked at the end of 2016, but has become less pronounced more recently. Among other important factors contributing to this improvement, the adaptation of market participants' behaviour as reflected in significant pre-funding activities and the entry of new players into the repo market, as well as the central bank securities lending facilities, appear to be relevant. While this suggests that markets can adapt to a changing regulatory environment and other factors, it is necessary to better understand whether the modalities of regulatory reporting need to be adapted to mitigate any unintended consequences of regulations. Further analysis thus appears warranted to assess whether the current calculation methodology for regulatory and other metrics is appropriate and whether it should potentially be based on more than a single snapshot of the balance sheet at the quarter-ends.

**The special feature also presents new evidence on the drivers of banks' activity in the euro area repo market with respect to regulatory reforms.** The analysis finds that while regulatory reforms have contributed to a decline in the share of outstanding repos and reverse repos in the overall business activity of euro area banks over the past two and a half years, the magnitude of the decline has been contained. The positive effects of regulatory reforms, such as increases in resilience in stressed periods, are not considered in the analysis.

## A longer-term view of developments in the repo market and the factors driving them

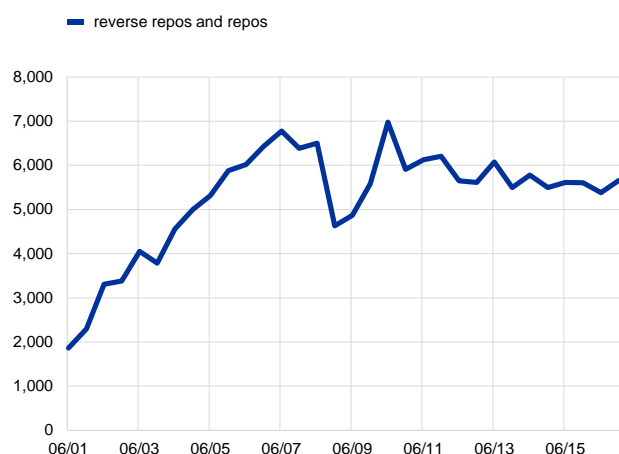
**The repo market has gained in importance, while the turnover in the unsecured market has declined strongly, making the repo market the main interbank market segment in the euro area.** The semi-annual repo survey conducted by the International Capital Market Association (ICMA) shows a steady increase in the outstanding amounts of repos in European financial markets since June 2001 (see [Chart C.1](#)). Similarly, the ECB's Euro Money Market Survey (EMMS) and money market statistical reporting (MMSR) data show that between 2003 and 2017 the share of secured transactions has increased significantly in euro area money markets, while a significant decline of total trading volumes has been recorded in the unsecured market (see [Chart C.2](#)).

### Chart C.1

Repo markets have increased steadily since 2001, but declined significantly during the financial crisis, and have exhibited a sideward trend lately

#### Evolution of outstanding repo and reverse repo amounts in Europe

(June 2001 – Dec. 2016; outstanding repos and reverse repos in €billions)



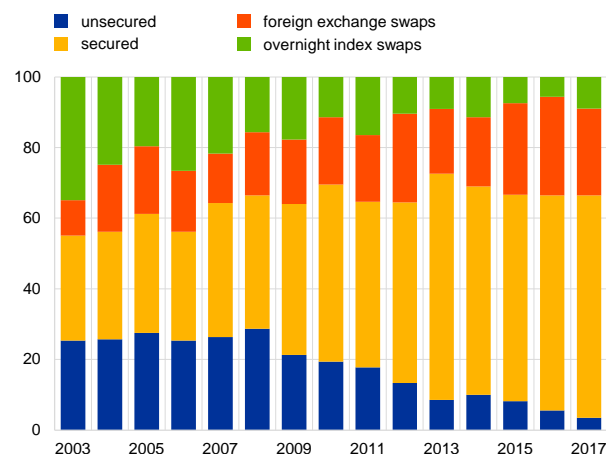
Source: ICMA December 2016 European Repo Market Survey.

### Chart C.2

The repo market has gained in importance over the years, while turnover in the unsecured market has declined significantly

#### Evolution of money market turnover in different categories in the euro area

(Q2 2003 – Q2 2017; market turnover in percentages)



Sources: EMMS, MMSR and ECB calculations.

Note: The sample includes the constant panel of 38 banks reporting in the EMMS until the second quarter of 2015 and in the MMSR from the third quarter of 2016 onwards.

**The features of repo trading have also changed since the GFC.** Despite the overall increase in market activity, trading volumes in repos used primarily for cash management purposes have declined lately, whereas collateral-driven repo trading volumes have increased. Moreover, the share of centrally cleared transactions has increased to above 60% in 2017 from around 30% in 2009. Finally, repo market activity has become increasingly concentrated in short-term transactions, with transactions up to one week making up more than 90% of total trading volume.

**A number of factors, including unconventional monetary policy and regulatory reforms, have affected repo markets in the euro area in the recent past.** Asset purchases by central banks have reduced the availability of collateral in the repo market, although central banks have made assets available through their securities lending facilities, thus aiming to mitigate the impact of the asset purchase programmes on collateral availability. The increasing amount of liquidity provided through asset purchases and long-term refinancing operations has reduced banks' demand for short-term funding and thus appears to have led to a decline in the repos used primarily for cash management and short-term funding purposes.<sup>178</sup> Besides unconventional monetary policy, regulatory reforms enacted after the GFC have affected market participants' incentives to enter into repo transactions and have also increased the demand for high-quality collateral.

**Regulatory measures have been introduced with the intention to address concerns about excessive leverage and unstable funding structures.** In

<sup>178</sup> For more details, see CGFS (2017), op. cit.

particular, the Basel Committee on Banking Supervision has developed a regulatory minimum leverage ratio (LR) to address the build-up of excessive leverage, a net stable funding ratio (NSFR) which introduces a stable funding requirement for short-dated securities financing transactions, and a liquidity coverage ratio (LCR) to ensure banks can withstand short-term liquidity dry-ups. Furthermore, the Financial Stability Board has developed a minimum haircut framework for a sub-set of securities financing transactions aimed at constraining the build-up of procyclical leverage outside the banking system.

**In the context of evaluating the impact of post-crisis regulatory reforms, concerns have been raised that some of the measures introduced have had a negative impact on the functioning of repo markets.** Market analysts and industry associations<sup>179</sup> have argued that regulatory reforms have significantly reduced the willingness of banks to provide repo services and contributed to volatility and market dislocations around the balance sheet reporting dates. These concerns have been raised on the grounds that the regulatory metrics may incentivise banks to reduce their repo assets and liabilities.

**The LR framework affects banks' incentives to enter into repo transactions in different ways.** In the LR framework, the marginal repo transaction increases the LR exposure measure as the cash received increases the assets side of the balance sheet and, at the same time, the asset used as collateral is not derecognised. For reverse repos, while the marginal transaction does not impact the exposure measure significantly as essentially cash is exchanged for a repo asset, ultimately the repo assets stemming from reverse repos enter the exposure measure and therefore impact banks' LR. Moreover, the LR framework allows for netting of repos and reverse repos with the same counterparty (subject to a few additional conditions), providing incentives to clear transactions with central counterparties and thus contributing to the increasing role of these institutions in the repo market.<sup>180</sup>

**Liquidity requirements also change the incentives for banks to enter into repo transactions.** With regard to the NSFR, there is an asymmetric treatment of short-term repo and reverse repo transactions. Short-term reverse repos require stable funding, whereas short-term repos are not recognised as stable funding. The asymmetry aims to create incentives to reduce the reliance on short-term funding transactions. Finally, the effects of the LCR depend on a number of factors, including the nature of the collateral used, the counterparty involved, as well as the haircuts applied.<sup>181</sup>

**A study group set up under the auspices of the BIS Committee on the Global Financial System (CGFS) published a report in April 2017 on repo market functioning.** The report finds that despite the relative stability in headline measures

<sup>179</sup> See "Closed for business: a post-mortem of the European repo market break-down over the 2016 year-end", ICMA, February 2017.

<sup>180</sup> Furthermore, within the capital framework, for most banks the LR is likely to be the more constraining capital constraint than the risk-based framework for repo activity. Whereas in the risk-based framework, collateral is recognised as exposure-reducing, the LR framework does not allow this as a general principle.

<sup>181</sup> See CGFS (2017), op. cit.

of activity and pricing in the repo market, there are some signs of tensions, in particular around banks' balance sheet reporting dates, as reflected in a high volatility in prices and volumes. Regulatory reforms have been identified by the group as one important potential driver of these recent developments. This special feature follows up on the CGFS repo market report by providing a more in-depth analysis of volatility in euro area repo markets around reporting dates and how regulatory reforms have affected the provision of repo services by euro area banks.

## Volatility in repo markets around recent quarter-ends and in particular at the end of 2016

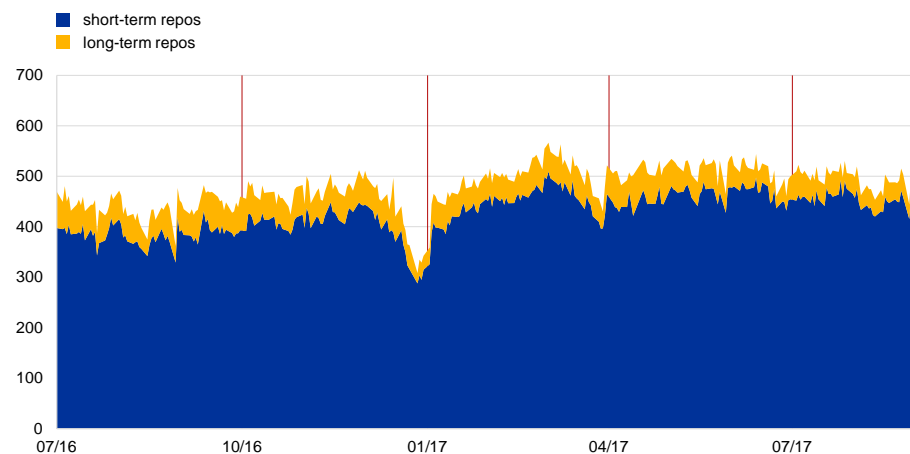
**Volatility of repo rates and trading activity at the balance sheet reporting dates has increased gradually over the past years, peaking at the end of 2016.** During 2014 and in the first part of 2015, all repo rates tended to increase at quarter-ends due to the preference for liquid assets and cash on reporting dates. However, since mid-2015, repo rates for higher credit quality collateral, such as German and French sovereign bonds, have started to fall at quarter-ends. Since the second half of 2016, Spanish and Italian repo rates have also started to exhibit a downward move at quarter-ends, indicating the market preference for holding securities, contributing to a lower supply of collateral and a higher premium paid for collateral in the repo market on those dates. Indeed, trading volume data reveal that around quarter-ends significantly lower trading activity is witnessed than in-between the quarter-ends (see [Chart C.3](#)).

### Chart C.3

Volatility of trading activity around balance sheet reporting dates peaked at the end of 2016, but has declined significantly recently

#### Evolution of money market turnover in different categories in the euro area

(July 2016 – Sep. 2017; secured market turnover in € billions)



Sources: MMSR and ECB calculations.

Notes: Repo transactions are grouped according to their maturity. Short-term repos include trades with a maturity of up to one week, while long-term repos are an aggregate of contracts with longer maturities. Forward trades are not included.

**Window-dressing of regulatory metrics, combined with a higher demand for high credit quality bonds and the lower availability of this type of asset, appear**

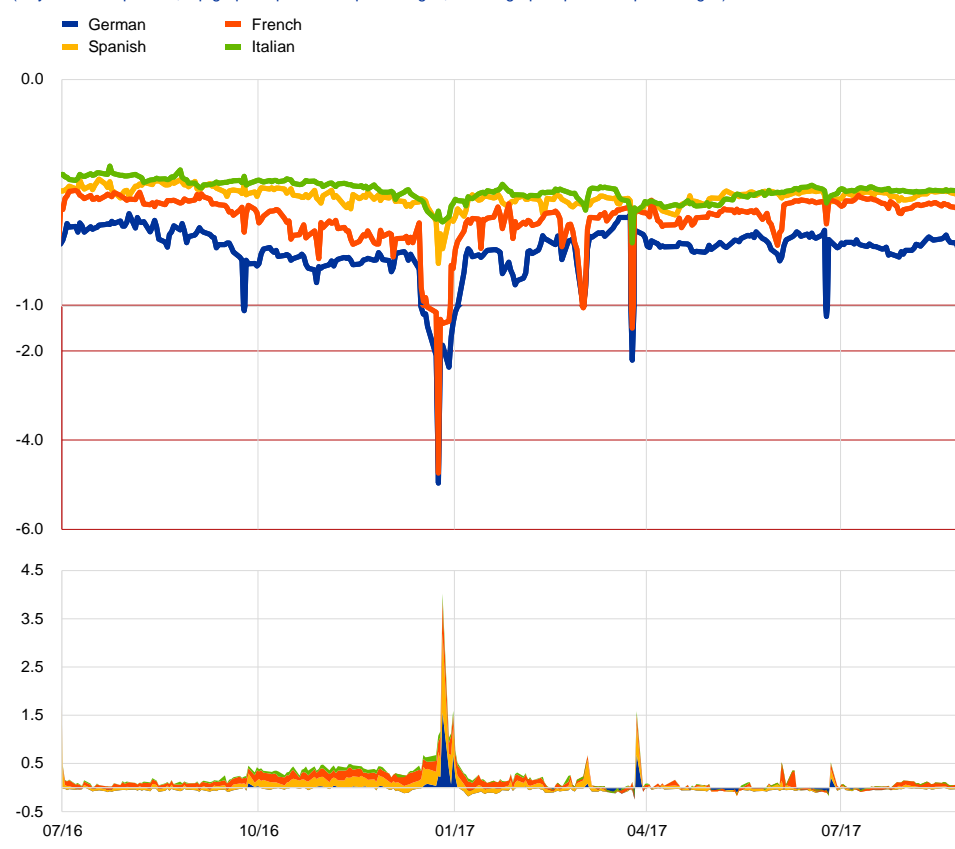
**to be behind these recent developments.** To the extent that repo activity impacts regulatory metrics as described above, its often short-term nature makes it easy to adjust around these dates. Banks are therefore incentivised to use this margin of adjustment to report “better” balance sheets at these dates. This is reflected in reduced repo market volumes traded on these specific dates. As discussed in Box B, repo trading activity between European banks and US money market funds provides complementary evidence of window-dressing activity in repo markets around reporting dates. Window-dressing effects are complemented by broader structural factors. First, there is an increasing demand for high credit quality bonds, which is driven by several factors, such as higher demand for high-quality liquid asset (HQLA) buffers for the LCR, the need to post margin for centrally cleared transactions, and increased demand for the secured investment of cash against high-quality collateral by various market players. Second, the increasing surplus of liquidity generated by non-standard monetary policy measures has contributed to a decline in the rates on repos backed by other collateral as well.

### Chart C.4

Volatility of repo rates and the spread between bilateral and centrally cleared repos can be observed around reporting dates

Evolution of repo rates and repo market premia for centrally cleared vs bilateral repo market trades

(July 2016 – Sep. 2017; top graph: repo rates in percentages; bottom graph: spreads in percentages)



Sources: MMSR and ECB calculations.

Notes: Repo rates for German, French, Italian and Spanish collateral include repos and reverse repos with spot/next maturity. The spreads between bilateral and centrally cleared repos are calculated by isolating the volume-weighted average rate for transactions with a counterparty that qualifies as a central clearer.

**The year-end of 2016 saw a very pronounced balance sheet reporting date effect, with a large decline in volumes and a high dispersion of repo rates, raising concerns that the market might be dysfunctional.** Large changes in trading volumes were observed around the end of 2016, with repo market activity declining by around 40% to a low of around €325 billion on 27 December from €500 billion on 1 December and remaining at subdued levels for the subsequent two to three weeks before returning to a normal level of market activity (see Chart C.3). The price impact, shown in Chart C.4, was also very pronounced as repo market trades were concluded at rates as low as -10% on certain German or French securities. Overall, the price distribution around the year-end was strongly skewed towards very negative repo rates.

**Repo market developments at the end of 2016 highlighted the limitations of banks' balance sheet capacity and the high premium charged for its usage as also reflected in the price differentiation between centrally cleared transactions and bilateral trades.** Regulatory measures and the preference for risk reduction during the financial crisis have contributed to a shift to centrally cleared transactions in the repo market. As a result, the share of non-centrally cleared trades has decreased, also reflecting the previously mentioned benefits of balance sheet efficiency and netting provided by central counterparties (CCPs). According to MMSR data, price differentiation can be observed between cleared and non-cleared trades, with CCP-cleared repos trading at a premium reflected in lower repo rates, especially on reporting dates. This premium reached several hundred basis points at the end of 2016 (see Chart C.4).

**At the end of 2016, a number of factors in addition to the aforementioned regulatory aspects contributed to the more pronounced effects that were witnessed.** Year-end balance sheets form the basis for the calculation of the contributions to the Single Resolution Fund (SRF), the global systemically important bank (G-SIB) designation and categorisation, as well as bank levies in a number of euro area jurisdictions. Furthermore, market participants' position-taking around the year-end and the need to fund those positions also played a role. The combined effect of these factors appears to have exerted downward pressure on repo rates, reflecting the higher compensation or return required for banks to be willing to trade, resulting in significantly larger drops in activity and repo rates than at other quarter-ends.

**The observed developments raise the question whether secured markets were dysfunctional at the year-end or rather exhibited exacerbated tensions in still-functioning markets.** MMSR data indicate that there were two-way markets and still reasonable levels of activity in December 2016, despite the significant decline in market turnover. Market tensions were essentially visible in the pricing of repo transactions, as an unusually high number of securities were sought after and traded at deeply negative rates.

**Since the end of 2016, the volatility at reporting dates in secured markets has declined significantly.** The following quarter-end dates were significantly less affected by high volatility and a decline in activity compared with the year-end. Chart C.4 shows that at the March and June 2017 quarter-ends the decline in



trading volumes and the volatility in repo rates were much less pronounced than at end-December 2016.

**Better usage of Eurosystem cash/securities lending facilities and advance preparations by market participants were two important factors behind the lower volatility at the most recent quarter-ends.** Firstly, a more targeted usage of Eurosystem cash/securities lending facilities, as well as the introduction of the cash collateral option, have helped to ease collateral tensions in repo markets in 2017. Indeed, the average balance of loan and cash collateral received in the context of public sector purchase programme (PSPP) securities lending reached €47 billion and €18 billion in March 2017, respectively, compared with €24 billion and €7 billion in December 2016.<sup>182</sup> Secondly, advance preparations by market participants have helped to secure the bonds that could be required at reporting dates already prior to the reporting period. Market feedback suggests that new entrants to the market have also contributed to the supply of collateral, attracted by high repo market premia for their securities holdings. This has helped to reduce the number of bonds trading at deeply negative levels around the reporting dates.

### Assessing the impact of regulatory reforms on repo market activity

**In the recent past, concerns have been raised that regulatory reforms have had a negative impact on the availability of repo services provided by banks.** The above analysis based on turnover data shows that banks window-dress their regulatory metrics around reporting dates. A related question in the context of evaluating the effects of regulatory reforms is, therefore, whether banks have significantly reduced their provision of repo services. Moreover, aggregate repo market developments may mask any significant impact of regulatory reforms at the individual bank level. This suggests that an analysis of the impact of regulatory reforms on repo market activity is warranted at both the aggregate and the bank level. To this end, this section presents an analysis based on quarter-end balance sheet data reported by banks to the ECB since the third quarter of 2014.

**While euro area banks have gradually adapted to the new regulatory framework, aggregate amounts of euro area banks' outstanding repo transactions have been relatively stable in recent years.** Since the third quarter of 2014, euro area banks have improved their leverage ratio by 0.91 percentage point, from 4.84 to 5.75 on average (based on data for a large set of significant euro area banks representing the vast majority of repo market activity; see [Chart C.5](#)). At the same time, the aggregate amounts of reverse repos and repos outstanding have declined only modestly, although year-end dips can be observed (see [Chart C.6](#)).

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<sup>182</sup> See the [ECB's website](#).

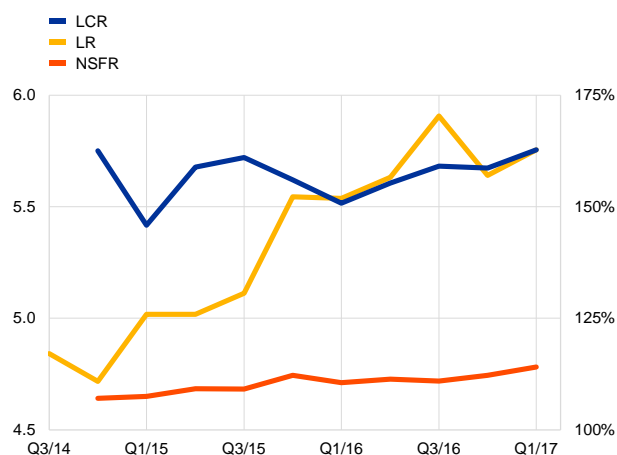


### Chart C.5

Banks have improved their regulatory metrics over the past two and a half years

#### Evolution of banks' regulatory metrics in the euro area, based on supervisory data

(Q3 2014 – Q1 2017; left-hand scale: percentage points for the LR; right-hand scale: percentages for the LCR and NSFR)



Source: ECB.

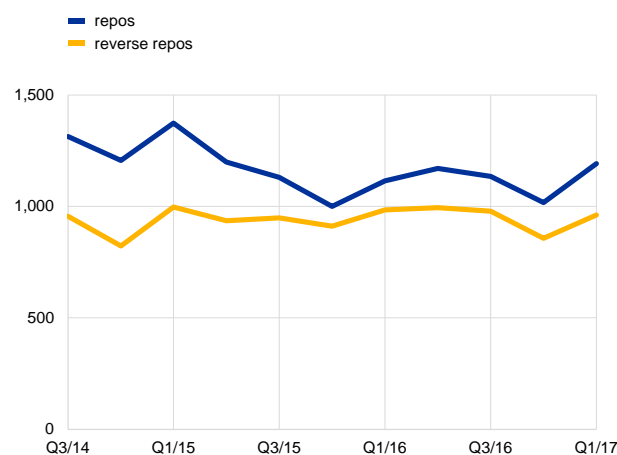
Notes: Balanced samples, based on unweighted averages of the individual metrics. The LCR is based on 52 banks, the NSFR on 48 banks and the LR on 52 banks.

### Chart C.6

On aggregate, the changes in outstanding repos and reverse repos appear to be modest, while year-end dips in volumes can be observed

#### Evolution of banks' outstanding repo and reverse repo transactions in the euro area, based on supervisory data

(Q3 2014 – Q1 2017; outstanding repo and reverse repo transaction volumes in € billions)



Source: ECB.

Note: Aggregate repo and reverse repo volumes are based on samples of 52 and 42 banks, respectively.

**To better understand whether regulatory reforms have impacted the provision of repo services, an empirical analysis at the individual bank level has been conducted.** A comprehensive dataset including information on banks' repo and reverse repo volumes, regulatory measures and other variables has been collected based on supervisory data, which are available for quarter-ends. Furthermore, a multivariate regression model has been developed to test whether adjustments in the various regulatory measures are associated with modifications in repo volumes at the individual bank level (see Box A for further details of the dataset and the underlying methodology of the model).

**The findings suggest that at the individual bank level, regulatory reforms did not lead to a material reduction in repo volumes<sup>183</sup> relative to the overall size of banks' exposures.<sup>184</sup>** While the impact of the LCR and NSFR seems to be of little relevance for adjustments in repo volumes, banks' adjustments to higher LRs seem to be somewhat correlated with a reduction in their repo volumes. In particular, the empirical results point towards a robust and negative relationship between the leverage ratio and the repo volume over total exposures measure, although of only a moderate size. For the average bank, an increase in the LR by 1 percentage point is

<sup>183</sup> It should be noted that the analysis here excludes repos with central banks.

<sup>184</sup> Our findings are broadly in line with two other studies focusing on similar issues. First, Bucalossi and Scalia (2016) suggest that neither LR-constrained nor unconstrained euro area banks reduced their repo trading volumes. Second, EBA (2016) suggests a limited impact of the LR on the provision of repo services by European banks at reporting dates. See Bucalossi, A. and Scania, A., "Leverage ratio, central bank operations and repo market", Banca d'Italia Occasional Paper No 347, 2016, and EBA report on the leverage ratio requirements under Article 511 of the CRR, European Banking Authority, August 2016.

correlated with a reduction of approximately 0.5% in the ratio of the bank's repo volume to its total exposures, reducing it from 5.44% to 5.41%. This suggests that when banks have adjusted to higher LR levels, they have not done so materially at the expense of repo volumes relative to other exposures.

**At year-end, larger drops in banks' outstanding repo volumes relative to overall exposures can be observed.** Even after controlling for the impact of regulatory metrics specifically at the year-end, there is still a role for other factors, such as contributions to the SRF or bank levies. It turns out that average declines in repo volumes at year-end amount to more than four times the average impact of the LR. Notably, the effect of the LR on relative repo volumes appears to be smaller at year-end compared with its effects at quarter-end.

**The effects on outstanding reverse repo transactions are in a similar direction, but are generally less robust and smaller.** The findings suggest that banks also reduce their share of reverse repo volumes following an increase in the LR. However, the adjustments in reverse repos are smaller compared with the previous results for repos. Furthermore, accounting for other factors at year-end (such as SRF contributions, etc.), declines in banks' relative share in reverse repo business are also of a smaller magnitude. These results are not unexpected given that at the margin the LR is not affected by reverse repo transactions as explained above.

**An analysis of the potentially non-linear effects of regulatory reforms suggests that no significant further impact may be expected given the current levels of banks' leverage ratios.** Changes in repo activity appear to also depend on the level of the LR. In particular, a threshold analysis suggests a non-linear effect of the LR on repo business: banks adjust relatively more if they are closer to the 3% minimum requirement, while banks with a greater cushion exhibit more modest declines in outstanding amounts of repo transactions.<sup>185</sup> Considering the fact that most banks have already improved their LR well beyond the envisaged minimum requirement (see **Chart C.5** above), it can be inferred that on average no further substantial adjustments are to be expected.

**While our analysis does not establish a causal effect, our results are well in line with aggregate developments.** Our econometric setting does not allow the causal effect of the introduction of regulatory metrics on repo market activity to be isolated. Nevertheless, the correlation results obtained in our analysis are in line with the aggregate evolution of regulatory metrics and the outstanding amount of repo transactions. They confirm the hypothesis that banks' adjustment to the new regulatory measures constrains banks' use of repos, as intended by the regulatory reforms to avoid future excessive use of repos. At the same time, moderate declines of repo volumes relative to banks' overall business suggest that the regulatory reforms did not have a material unintended effect on euro area banks.

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<sup>185</sup> This is supported by the results for changes in repo volumes as the dependent variable. For changes in repo volumes, defined as  $\Delta Repo = (Repo_t - Repo_{t-1}) / Exposure\ measure_{t-1}$ , the results suggest declining adjustments as the LR increases.

## Box A

Econometric model for assessing the relationship between regulatory measures and repo market activity<sup>186</sup>

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### Fixed effects panel data regression model and threshold analysis

We conduct a panel analysis in order to assess the impact of regulatory reforms on repo markets. The following multivariate panel regression model tests for correlations between banks' repo activity and various regulatory measures:

$Y_{i,t} = \beta_0 + \beta_1 LR_{i,t} + \beta_2 LCR_{i,t} + \beta_3 NSFR_{i,t} + \beta_4 LR - constrained_{i,t} + \beta_5 LR - bound_{i,t} + \beta_6 Q4_t + \beta_7 Q4_t * LR_{i,t} + \beta'_8 X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$  where  $Y_{i,t}$  stands for (1) repos and reverse repos (all outstanding volumes excluding those vis-à-vis central banks) over the exposure measure (standardised), (2) the log of repos and reverse repos, and (3) changes in repo and reverse repo volumes<sup>187</sup>.  $LR_{i,t}$  is the leverage ratio,  $LCR_{i,t}$  is the liquidity coverage ratio, and  $NSFR_{i,t}$  is the net stable funding ratio.  $LR - constrained_{i,t}$  is a binary variable equal to one if the bank's leverage ratio is below 4% in the previous period and zero otherwise.  $LR - bound_{i,t}$  identifies whether banks are constrained by capital requirements related to the LR or by risk-based capital requirements.<sup>188</sup> The variable is equal to one if banks are restricted by the LR or by risk-based capital requirements and zero otherwise.<sup>189</sup>  $Q4_t$  is a binary variable for year-end effects which is equal to one for the year-end quarter and zero otherwise;  $X_{i,t}$  is a vector of bank and country-specific control variables (such as non-performing loans over total assets, unemployment, etc.). Quarterly time fixed effects ( $\lambda_t$ ) as well as bank fixed effects ( $\mu_i$ ) are included in the model;  $\epsilon_{i,t}$  is an i.i.d. error term. Table C.1 presents our empirical results.<sup>190</sup>

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<sup>186</sup> Prepared by Claudia Lambert and Lea Steininger.

<sup>187</sup> Changes in repo volumes are defined as:  $\Delta Repo = (Repo_t - Repo_{t-1}) / Exposure\ measure_{t-1}$ .

<sup>188</sup> Please note that common equity Tier 1 does not directly enter the equation due to multicollinearity issues and the resulting high variance inflation factors.

<sup>189</sup> We proxy this variable by interacting the leverage ratio with the risk-weighted asset (RWA) density. The RWA density is the ratio of risk-weighted assets to total assets. Banks with a low RWA density, i.e. below 35%, hold capital primarily to fulfil the leverage ratio. The output is omitted since very high variance inflation factors raise concerns about multicollinearity. Note that outcomes do not change qualitatively with the inclusion of the binary variable.

<sup>190</sup> It should be noted that our results remain qualitatively the same if we control for banks' market-making activities, and are hence robust to the inclusion of reverse repo activity in the repo regressions and vice versa.

**Table C.2**

Regression on selected financial and macro variables

	Repo / Exposure measure			ΔRepo	RevRepo / Exposure measure			ΔRevRepo
<b>LR</b>	-0.004** (0.002)	-0.005*** (0.002)	-0.005*** (0.002)	-0.005*** (0.002)	-0.0002 (0.001)	-0.001* (0.001)	-0.002** (0.001)	-0.003*** (0.001)
<b>NSFR</b>	0.016 (0.022)	0.021 (0.022)	0.013 (0.024)	0.019 (0.015)	0.02 (0.017)	0.024 (0.016)	0.025 (0.018)	0.029* (0.016)
<b>LCR</b>	-0.003 (0.003)	-0.005 (0.003)	-0.006* (0.003)	-0.005** (0.002)	-0.001 (0.001)	-0.002 (0.002)	-0.002 (0.002)	-0.0005 (0.002)
<b>LR-constrained</b>	-0.005* (0.003)	-0.005** (0.003)	-0.002 (0.003)	-0.003 (0.003)	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.002)	-0.001 (0.002)
<b>Q4</b>	-0.009** (0.004)	-0.030*** (0.008)	-0.037*** (0.007)	-0.051*** (0.01)	-0.004 (0.002)	-0.020*** (0.005)	-0.020*** (0.005)	-0.031*** (0.008)
<b>Q4*LR</b>		0.004*** (0.001)	0.004*** (0.001)	0.006*** (0.001)		0.003*** (0.001)	0.003*** (0.001)	0.004*** (0.001)
<b>Bank-specific covariates</b>	No	No	Yes	Yes	No	No	Yes	Yes
<b>Macro covariates</b>	No	No	Yes	Yes	No	No	Yes	Yes
<b>No of banks</b>	52	52	51	51	42	42	41	41
<b>No of obs.</b>	480	480	461	461	396	396	380	380
<b>Within R2</b>	0.383	0.404	0.434	0.120	0.237	0.278	0.264	0.162

Source: ECB.

Notes: The regressions include a constant, bank fixed effects, time fixed effects, lagged dependent variables, as well as a binary variable indicating whether banks are bound by the leverage ratio or the risk-based capital requirements ratio. Standard errors are in parenthesis. The \*\*\*, \*\* and \* stand for significant coefficients at the 1%, 5% and 10% levels, respectively. Results are robust to the exclusion of the lagged dependent variable. The analysis is based on supervisory data (FINREP, COREP and Short Term Exercise (STE)); macro variables are obtained from the ECB's Statistical Data Warehouse.

In addition to the panel estimation, we test for potentially non-linear effects of the LR on the dependent variables in question. Put differently, the average effects of the LR on repo activity may depend on the respective range of the leverage. Accordingly, the model determines data-driven thresholds. Following Hansen (1999), the panel threshold regression model is defined as follows:

$$Y_{i,t} = \begin{cases} \beta_0 + \beta_{11} LR_{i,t} + \beta'_2 X_{i,t} + \epsilon_{i,t} \\ \beta_0 + \beta_{12} LR_{i,t} + \beta'_2 X_{i,t} + \epsilon_{i,t} \end{cases}$$

The leverage ratio  $LR_{i,t}$  is the threshold variable dividing the observations into different regimes.  $\gamma$  is the unknown threshold value and  $X_{i,t}$  is a vector of covariates, including regulatory metrics, binary variables and control variables.

## Box B

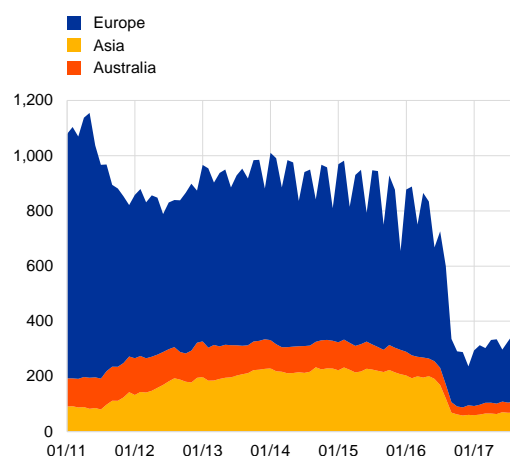
### Evidence of window-dressing in the money market<sup>191</sup>

The reforms of US institutional prime money market funds (MMFs), which entered into force in October 2016,<sup>192</sup> are estimated to have reduced European banks' US dollar funding by about USD 200 billion (see Chart A.1). However, over the same period, European banks gained approximately USD 260 billion of dollar funding by engaging in repurchase agreements with other categories of US MMFs (see Chart A.2). In particular, European banks obtained around USD 240 billion of additional dollar funding from repo trades backed by US government securities with government MMFs.<sup>193</sup>

**Chart A.1**

US prime MMFs' total investments in each region

(Jan. 2011 – Aug. 2017; monthly data, USD billions)

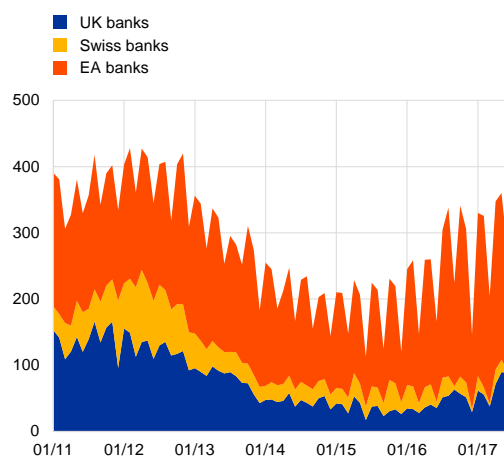


Source: US Office of Financial Research.

**Chart A.2**

US MMFs' European counterparties in repurchase agreements

(Jan. 2011 – Aug. 2017; monthly data, USD billions)



Source: US Office of Financial Research.

Regional differences in the implementation of the rules on the leverage ratio – defined as banks' Tier 1 capital over their exposure – may have facilitated the observed rise in repos with US MMFs by euro area and Swiss banks.<sup>194</sup> The Basel III leverage ratio framework foresees that the leverage ratio should be reported and disclosed based on the balance sheet of the last day of the quarter, but it also allows the use of more frequent calculations (e.g. daily or monthly averaging of balance sheets). Banks in the euro area, Switzerland and Japan compute their leverage ratio using the end-

<sup>191</sup> Prepared by Paola Donati, Martina Jancoková and Thomas Kostka.

<sup>192</sup> Until October 2016, all US MMFs had a constant net asset value of USD 1 and their shares could be bought or sold for USD 1 with no uncertainty. The reforms require "prime" MMFs with an institutional investor base to let their net asset value float with the value of the underlying securities, and to adopt liquidity fees and restrictions on redemptions ("gates") to limit cash outflows under conditions of market stress. Prime MMFs invest primarily in corporate debt securities.

<sup>193</sup> US MMFs fall under three main categories: (1) prime MMFs; (2) tax-exempt MMFs; and (3) government MMFs. The latter invest their assets in cash, government securities and repos backed by US Treasuries, government agency securities and other collateral. Some government MMFs have neither fees nor gates and these are the MMFs with which European banks have traded almost exclusively.

<sup>194</sup> See also Egelhof, J., Martin, A. and Zinsmeister, N., "Regulatory Incentives and Quarter-End Dynamics in the Repo Market", *Liberty Street Economics*, Federal Reserve Bank of New York, 7 August 2017; Mackenzie Smith, R., "L'exception française: why French banks dominate US repo trading", *Risk.net*, 1 September 2016; and Devasabai, K., "Can US money funds rely on French banks for repo liquidity?", *Risk.net*, 1 September 2016.

of-quarter balance sheet. Instead, UK and US banks consider the daily averages of their leverage ratios over the quarter. In spite of these differences, Chart A.2 shows that UK banks also expanded the volumes of their repo funding from US MMFs intra-quarter, although the increases observed in Swiss and in particular euro area banks' positions are more pronounced.

Regulatory measures such as the leverage ratio have been introduced to reduce the risks stemming from banks' funding structures and especially from excessive leverage built up through wholesale short-term funding. In particular, these measures aim to ensure that the risks associated with excessive leverage are internalised by market participants. As such, they are meant to also have an impact on banks' repo funding. Against this background, the observed patterns in the repo trading of European banks with US MMFs call for further analysis of the impact of the different leverage ratio calculation methodologies possible under Basel III and whether there is a need for a unified methodology.

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## Conclusions

**Overall, the analysis presented in this special feature supports the notion of an overall functioning repo market in the euro area and the view that regulatory reforms have not had a material unintended effect on the amount of euro area banks' outstanding repo transactions.** Analysis based on the MMSR data shows that the recent tensions observed in the repo market have been driven by a combination of various factors, among which regulatory reporting and non-standard monetary policy measures also played a key role. While these tensions have receded in 2017, further monitoring and analysis of the impact of various factors, including regulatory reporting, is warranted. Empirical analysis based on individual bank data suggests that while regulatory reforms have indeed been able to reduce the excessive use of repos as intended, they have not led to a significant reduction in the share of repo and reverse repo activity of euro area banks. This supports the view that the reforms have not had a material unintended effect on the amount of euro area banks' outstanding repo transactions. Thus, changes to the treatment of repo transactions in regulatory standards cannot be justified on these grounds. Beyond that, a more lenient treatment of repos could lead to the re-emergence of risks related to the build-up of excessive leverage and over-reliance on short-term wholesale funding in financial markets related to securities financing transactions and the re-use of collateral.<sup>195</sup> Nevertheless, the findings suggest that window-dressing behaviour by banks appears to be an important factor behind volatility around reporting dates and thus could be an unintended effect of regulation. Hence, further analysis is warranted to establish whether some regulatory and other metrics could be calculated based on averaging rather than the balance sheet on a single date. This could help reduce the volatility observed and contribute to a smoother functioning of markets around these dates.

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<sup>195</sup> The FSB Re-hypothecation and Re-use Expert Group also highlighted the LR as the main brake put in place after the crisis to address these concerns. See "[Transforming Shadow Banking into Resilient Market-based Finance – Re-hypothecation and collateral re-use: Potential financial stability issues, market evolution and regulatory approaches](#)", Financial Stability Board, January 2017.