



BANCA D'ITALIA
EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

The fundamental role of the repo market and central clearing

by Cristina Di Luigi, Antonio Perrella and Alessio Ruggieri

July 2024

Number

48



BANCA D'ITALIA
EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

The fundamental role of the repo market and central clearing

by Cristina Di Luigi, Antonio Perrella and Alessio Ruggieri

Number 48 – July 2024

The papers published in the 'Markets, Infrastructures, Payment Systems' series provide information and analysis on aspects regarding the institutional duties of the Bank of Italy in relation to the monitoring of financial markets and payment systems and the development and management of the corresponding infrastructures in order to foster a better understanding of these issues and stimulate discussion among institutions, economic actors and citizens.

The views expressed in the papers are those of the authors and do not necessarily reflect those of the Bank of Italy.

The series is available online at www.bancaditalia.it.

*Printed copies can be requested from the Paolo Baffi Library:
richieste.pubblicazioni@bancaditalia.it.*

Editorial Board: STEFANO SIVIERO, LIVIO TORNETTA, GIUSEPPE ZINGRILLO, GUERINO ARDIZZI, PAOLO LIBRI, GIUSEPPE MARESCA, ONOFRIO PANZARINO, TIZIANA PIETRAFORTE, ANTONIO SPARACINO.

Secretariat: ALESSANDRA ROLLO.

ISSN 2724-6418 (online)
ISSN 2724-640X (print)

Banca d'Italia
Via Nazionale, 91 - 00184 Rome - Italy
+39 06 47921

Designed and printing by the Printing and Publishing Division of the Bank of Italy

THE FUNDAMENTAL ROLE OF THE REPO MARKET AND CENTRAL CLEARING

by Cristina Di Luigi*, Antonio Perrella* and Alessio Ruggieri*

Abstract

The repo market plays a crucial role in terms of central bank policies and of the funding of the banking system. In this paper, after reviewing the different economic functions of repo contracts, we provide an overview of the structure of government bond repo markets in core advanced economies. We then analyse the main drivers of euro-area repo market dynamics in the last decade: collateral quality, excess liquidity and collateral scarcity, as well as regulatory reforms. Finally, we explore the role of central clearing services – whose extensive use can help increase the stability and efficiency of the repo market – and the impact of the development of new client clearing models in the repo market, arguing that greater use of these models may lead to greater market efficiency and resilience.

JEL Classification: E40, E58, G15, G20.

Keywords: repurchase agreements; leverage ratio; window dressing; central counterparties; client clearing; money market structure.

Sintesi

Il mercato dei pronti contro termine (repo) gioca un ruolo cruciale per l'attuazione delle politiche delle banche centrali e per il finanziamento del sistema bancario nel suo complesso. Il lavoro, dopo avere passato in rassegna le diverse funzioni economiche dei contratti repo, offre una panoramica della struttura dei mercati repo su titoli di Stato nelle principali economie avanzate ed esamina i principali fattori che hanno determinato le dinamiche del mercato repo nell'area dell'euro nell'ultimo decennio: qualità del collaterale, liquidità in eccesso e disponibilità di titoli, e riforme regolamentari. Infine, il lavoro approfondisce il ruolo dei servizi di compensazione centralizzata –il cui utilizzo estensivo può contribuire ad accrescere la stabilità e l'efficienza del mercato repo– e l'impatto dello sviluppo di nuovi modelli di client clearing, argomentando che una più ampia adozione di questi ultimi può favorire l'efficienza e la resilienza del mercato.

* Bank of Italy, Directorate General for Markets and Payment Systems.

© 2023 Copyright held by the owner/author(s). Published in Proceedings of the 26th International Conference on Extending Database Technology (EDBT), 28th March-31st March, 2023, ISBN 978-3-89318-092-9 on OpenProceedings.org.

This paper is distributed under the terms of the Creative Commons license CC-by-nc-nd 4.0

CONTENTS

1. Introduction	7
2. The repo market: stylized facts	8
2.1 Economic functions and risks	8
2.2 Market structure and trends	11
3. Factors driving the repo market	14
3.1 Collateral quality	14
3.2 Excess liquidity and collateral scarcity	15
3.3 The role of regulation	17
3.4 Window dressing and quarter-end dynamics	19
4. Central clearing in the repo market	21
4.1 The role of CCPs in the repo market	22
<i>Box - Trading and clearing in the Italian repo market</i>	24
4.2 Client clearing: challenge and innovation	27
4.2.1 The economics of client clearing	28
4.2.2 Towards new access models	29
5. Conclusion	32
6. References	35

1. Introduction¹

The repo market is often defined as the “plumbing mechanism” of the financial system. This work aims to explore the main features of the repo market, focusing on its dynamics in recent years, and to provide a detailed overview of the role of central counterparties (CCPs) and their framework. Considering the large prevalence of government securities-backed repos worldwide, the focus of this paper will be exclusively on “government securities repo markets”, even when no explicit reference is made.

First, we present the economic functions of repos and describe the structure of the government bond repo market. Repos allow the exchange of monetary flows against securities: banks and other agents (e.g. non-bank financial institutions) may use repos for several reasons that include short-term funding, investing their funds or borrowing specific securities they need. For their intrinsic features, repos are heavily traded in the global financial system and have gained increased prominence in the last decade, as demonstrated by the significant growth of repo trades registered in several advanced economies. Any material dysfunction of the repo market may hamper the smooth transmission of monetary policy and threaten financial stability. Therefore, this market is carefully monitored by central banks.

Second, we explain the dynamics of repo activity and rates in recent years focusing on: the role played by the collateral quality in affecting the investors’ appetite, the impact of excess liquidity and collateral scarcity on activity and prices, the changes in the behavior of market participants in response to developments in the relevant economic and regulatory context and the consequent quarter/year-end effects.

Third, we explore the role of CCPs in the repo market and possible ways to extend access to their services. After the Great Financial Crisis (GFC), the Financial Stability Board (FSB) asked authorities to evaluate the costs and benefits of proposals to introduce CCPs in interdealer repo markets where CCPs did not exist and, where they existed, to consider the pros and cons of broadening participation, in particular of important funding providers (FSB, 2013). The initiative relied on the assumption that more clearing implies less counterparty risk and less systemic risk. Thereafter, the share of the cleared repo market has grown dramatically, especially in the interdealer segment. On the other hand, entities that are typically out of this segment and have no direct access to CCP services (known as ‘clients’) still make only limited recourse to central clearing for their repo transactions. We describe the economics of client clearing, as well as new CCP access models that could facilitate a greater recourse to central clearing by clients, analyzing both benefits and challenges that these new models may bring.

Furthermore, we provide a thorough analysis of the Italian repo market describing the microstructure, size and trends of MTS Italy Repo (MTS Repo, from now on), the most important wholesale regulated market for trading repos backed by Italian government securities, and discussing the crucial role of central clearing for the market.

The remainder of the paper is organized as follows. Section 2 introduces the main features of the repo market; section 3 analyses the drivers of the repo market; section 4 deals with the role of CCPs and provides insight into the evolution of client clearing; the last section summarizes the main conclusions of the work.

¹ The authors wish to thank Stefano Siviero, Claudio Impenna, Giuseppe Grande, Luca Filidi, Gioia Guarini, Pietro Steconci, Gaetano Marseglia, Giovanna Cicardo, Onofrio Panzarino, members of the ESRB Expert Group on Clearing, and the anonymous referee for their support and valuable comments. The views expressed are those of the authors and do not necessarily reflect those of the Bank of Italy. Any error or omissions are the responsibility of the authors.

2. The repo market: stylized facts

The repo market plays a highly relevant role in the financial system, as it can be considered core from both a central bank policy and a bank funding perspective, resulting crucial in terms of financial stability and monetary policy transmission. But, what is a repo? A repurchase agreement (repo) is a contract where one party (cash borrower *or* security provider) sells an asset to another party (cash lender *or* security receiver) at a price and commits to repurchase the same asset from the second party at a future date at a price determined by the agreed repo rate; indeed, the repo rate is actually the annualized relative difference between the sale and the purchase price. The security receiver is often described as doing a reverse repo. The security acts as collateral² and mitigates the buyer's exposure to counterparty credit risk, i.e. the risk of not receiving cash at maturity due to the default of the counterparty. Provided that the asset is liquid, the security receiver can reuse it by lending it to a third party and thus refinance himself at any time during the repo life, which mitigates liquidity risk³. In fact, the large majority of repos (around 85% in the euro area and between 60% and 80% in the US)⁴ are backed by government securities because of their intrinsic characteristics related to high credit quality and liquidity.

The repo market is divided into two segments: general collateral (GC) and specific collateral or special repo (SR). In the first mode the cash is lent against one or more assets taken from a basket of securities having substantially the same characteristics. Therefore, one can say that in a GC repo the cash lender is indifferent to which security he will receive. In this case, the transaction is generally driven by the need for liquidity of the cash borrower, and for this reason the GC market is defined as a cash-driven market. On the other hand, in the SR segment each asset is traded individually, and as a result, all securities have a specific rate since transactions are often driven by the need to find a particular security. For this reason, the SR market is often referred to as a security-driven market.

2.1 Economic functions and risks

The repo market plays several fundamental functions and is considered one of the core markets in the financial system. This justifies the interest and concerns of central banks.

To begin with, the repo market is a money market that allows the smooth circulation of liquidity, helping market participants to manage their funding needs efficiently. On the one hand, a well-functioning repo market is crucial to reduce the liquidity risk of intermediaries, helping to mitigate the systemic risk in the financial system. On the other hand, it plays a pivotal role for collateral management. The regulatory reforms⁵ of the last decade, aimed at better preserving financial stability, have led to a huge demand for collateral, especially for high quality liquid assets (HQLA) (ECB, 2023). At the same time, quantitative easing by central banks has reduced the amount of HQLA available to the market, creating an additional pressure on these assets (see Section 3.2). Collateral management has become even more important, considering its implications for the functioning of payment and settlement systems, derivatives exchanges, and securities financing transactions (SFTs) in terms of fails prevention, margining requirements and collateral allocation and transformation, respectively.

² In the remainder of the paper we will interchangeably use the terms “security” and “collateral”.

³ Liquidity provided through a repo may be needed by the lender during the life of the contract. Therefore, entering into a repo contract as a lender involves a liquidity risk.

⁴ Based on ECB (2021) and SIFMA (2022). For the US, the percentage varies across different market segments.

⁵ In particular, we refer to: (i) Basel III, which includes heightened capital requirements, stricter rules for measuring exposures and incentives to push banks towards centralized clearing of derivatives contracts; (ii) the Dodd-Frank Act in the US, which outlines a set of reforms that are designed to reduce systemic risk and increase market transparency; (iii) the European Market Infrastructure Regulation (EMIR) in the European Union, which focuses on addressing banks' counterparty risk, central clearing and trades repositories.

Second, market liquidity in the secondary government bond market depends on the ability and willingness of its market makers to continuously quote prices at which they commit to buy and sell:

- in order to quote readily executable selling assets, a market maker relies on the inventory at his disposal. However, recourse to the repo market is an efficient way to limit the size of costly inventories: when a market maker does not hold the quoted asset in his inventory, he can borrow that security in the repo market until the time he is able to make an outright purchase;
- on the other hand, when a market maker quotes the buying side of the book and an investor hits the quote and concludes the trade, the market maker can either try to immediately sell the purchased assets – taking no funding and inventory risk – or keep the security onto his trading book: the latter requires to fund the long position, by borrowing money through a repo operation guaranteed by that specific security.

Thus, a well-functioning repo market dramatically improves the liquidity in the secondary bond market by reducing the need for market makers to hold larger inventories, which would raise the cost of their activity and prevent them from performing efficiently their function. This could undermine the resilience of the secondary market, making portfolio management riskier and more onerous and government securities investments less attractive, eventually raising the cost of debt-financing for issuers.

Third, and related to the above, repos allow dealers to fund their offers in the primary market, as well as to hedge the interest rate risk on a long position in a new issue by taking an off-setting short position in an existing issue with similar risk, borrowed in the repo market (therefore these securities trade often special⁶ close to issuance auctions).

Consequently, an efficient repo market promotes the price discovery process in primary and secondary cash markets. The process is fostered by the trading and arbitrage activity of the investors, who rely on the repo market to borrow cash to fund purchases and to borrow securities to cover short positions. In particular, short selling strategies may favour price discovery by smoothing unjustified upward pressure and bringing the market back to rational price levels.⁷ Furthermore, the relationship between the cash and the futures market is crucial: from a technical standpoint, repo rates are a key component of the carry cost of long and short positions in securities, and thus of their forward prices.⁸ An active repo market is therefore a prerequisite for liquid markets in derivative instruments (ICMA, 2019), and consequently for an effective price discovery process.

Fourth, the repo market represents a meaningful operational conduit for open market operations by central banks. It enables them to implement monetary policy more efficiently by allowing for a smooth redistribution of liquidity across banks and non-banks. This, among other factors, has led some jurisdictions to choose a secured rate as the reference risk-free rate⁹ (RFR): for

⁶ A special is a security that is subject to either high demand or low supply in the market, leading market participants to offer cheap cash to borrow the security in the repo market.

⁷ Short selling strategies may also hide risks. Excessive shorting of a given security can cause the price to fall significantly, not because of fundamentals, but mainly because of this aggressive strategy. In some cases, this can represent a market abuse behavior.

⁸ In this regard, it is important to mention the basis trading strategy, which involves arbitraging the difference between a spot and a futures contract price. In particular, long basis strategy is an arbitrage trade that involves a short futures position, a long cash position, and the recourse to the repo market to fund the purchase. Basis trading strategy may feed the liquidity of the market, but it could represent a financial stability vulnerability: before March 2020, the strategy in Treasuries market proved to be quite profitable and repo borrowing by hedge funds was at very high levels. However, at the outbreak of the Covid-19 crisis volatility picked up and margins surged. Once the hedge funds were no longer able to meet variation margins, their leveraged positions were unwound, pushing prices lower (see Schrimpf *et al*, 2020, Barth and Kahn, 2023). This in turn gave rise to a classic price spiral and the Federal Reserve was forced to intervene promptly.

⁹ The RFRs are overnight rates, computed on a daily basis from transactions conducted on the money market, typically including those involving non-bank financial institutions (NBFIs). The approaches and methodologies discussed for the

example, in the US and Switzerland, RFRs are based on repo transactions and are defined respectively Secured Overnight Financing Rate (SOFR) and Swiss Average Rate Overnight (SARON). On the contrary, in the euro area, the choice was for an unsecured rate (Euro Short Term Rate, ESTR), also due to the existing segmentation in the repo market related to heterogeneity in collateral (government bonds of different credit standing; see Section 3.1).

Fifth, the repo market can be used by central banks to implement their securities lending programmes with the aim to alleviate potential “scarcity”¹⁰ in the financial system, as well as by debt management offices to satisfy their cash management purposes. Since 2015 the Bank of Italy – in agreement with the Eurosystem – has been carrying out a securities lending activity, initially provided by the Bank indirectly via the main international central securities depositories (ICSDs).¹¹ Starting from mid-2019, the Bank of Italy also lends directly to counterparties through the MTS Repo platform and the trades are guaranteed by the Italian central counterparty Cassa di Compensazione e Garanzia (CC&G).¹² Moreover, the Italian Ministry of Economy and Finance (MEF) launched its repo activity in 2021 for cash management purposes.¹³

Lastly, repos play an important role in preventing settlement failures in the secondary market,¹⁴ since intermediaries can borrow the security sold in the market to ensure a timely delivery. Without the ability to borrow securities, delivery failures might propagate through the market, leading to disorderly conditions and, in extreme cases, to a trading halt, which could damage investor confidence (ICMA, 2019).

Repo activity also entail risks that may not only affect the parties involved in the repo transaction, but also spill over into the broader financial system.

The main risks that affect the repo counterparties are credit counterparty risk, market risk¹⁵ and liquidity risk. Risks are low in repo transactions due to the intrinsic characteristic of the contract: (i) credit counterparty risk is mitigated by the posted collateral, which can be sold in the event of a default, and, possibly, by the presence of a CCP; (ii) market risk is mitigated by overcollateralization and variation margins; and (iii) liquidity risk is mitigated by the posted collateral, which can be re-used to borrow cash.

In addition to these traditional risks associated with repo trades, there are issues relating to repo market dysfunctions. In this regard, it is important to remark that the repo market is the most important money market worldwide and repo rates constitute the target operational rate of monetary policy impulses by central banks. Therefore, its impairment could lead to severe consequences in terms of monetary policy transmission and financial stability. One of the most notable examples of market dysfunction is the September 2019 episode in the United States, when repo rates spiked dramatically, rising to as high as 10% intraday.¹⁶ The combination of a Treasury settlement and corporate tax deadlines created a mismatch between repo supply and demand, which drove rates higher and required the Federal Reserve to provide additional liquidity in the market. This episode

determination of new indices were numerous and the overall picture is rather heterogeneous. For further details, see Della Gatta (2022).

¹⁰ Scarcity occurs when the supply of securities on the market is not enough to meet the demand.

¹¹ Clearstream Luxembourg and Euroclear Bank. Each depository adopts its own operating procedures within the framework of the strategic guidelines drawn up by the Bank of Italy and in accordance with those indicated by the Eurosystem.

¹² Since April 2021, following entry into the Euronext Group, CC&G has been renamed Euronext Clearing for commercial purposes.

¹³ More details at https://www.dt.mef.gov.it/it/debito_pubblico/gestione_liquidita/repo/.

¹⁴ A trade is said to fail if on the settlement date either the seller does not deliver the securities in due time or the buyer does not deliver funds in the appropriate form.

¹⁵ The risk that the value of the securities used as collateral declines and the cash lender may not be able to recover the full value of the loan.

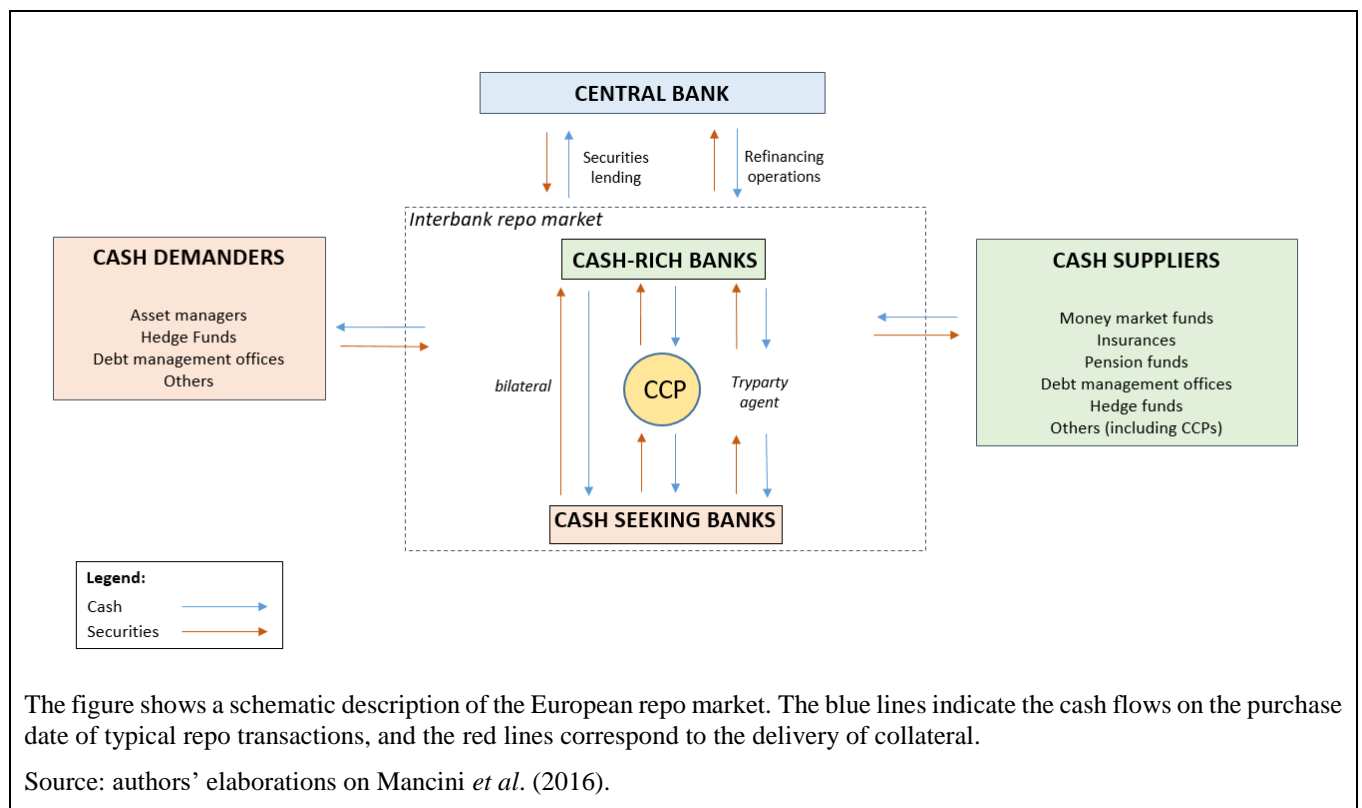
¹⁶ At the time repo rates were around 1.5% on average.

demonstrates how the segmented structure of the market can contribute to its fragility (Paddrik *et al.*, 2023), and shows that even ample excess liquidity levels may not guarantee that short-term interest rates reflect policymakers’ desired levels at all times (Cœuré, 2019).

2.2 Market structure and trends

The repo market matches the needs of two types of investors: cash borrowers (security providers) and cash lenders (security receivers). Those in the midst are often institutions from the banking sector that give rise to the so-called interbank repo market. Of course, banks are also significant end-users of repos for different purposes. Mancini *et al.* (2016) have very well structured the euro repo market: Figure 1 shows a schematic description of the euro repo market based on their work. Following this scheme, the players in the repo market can be divided between those who have access to central bank’s funding and those who do not, which are the so-called non-bank financial institutions (NBFIs). The NBFIs sector includes insurance undertakings, money market funds, pension funds, investment funds and other financial institutions.

Figure 1: Schematic description of the European repo market



Repo market structures across the globe show similar characteristics and tend to be more homogenous compared to cash markets, whose setups instead vary widely across jurisdictions. Repo markets can be classified along three significant dimensions: (i) access criteria, (ii) trading modalities and (iii) post-trading arrangements.

As for (i), it is typically possible to draw a distinction between interdealer platforms, where access is generally restricted to banks or authorised dealers, and dealer-to-customer platforms. In the former, a minimum size for orders is generally envisaged (e.g. €0.5 million for MTS Repo, £1 million for the Gilt market), and they are also called “wholesale” markets, while such a requirement does not exist in the latter, which are also called “retail” markets. As for (ii), the key characteristic concerns the way transactions are executed: repos can be traded on exchanges, posting orders on an electronic

platform, or over the counter (OTC). In the first case the price is either defined by the match of orders in a central limit order book (CLOB)¹⁷ or through request-for-quote protocols (RFQ)¹⁸, while OTC prices are negotiated bilaterally by voice or chat. Lastly, related to (iii), repo markets can be divided in: CCP-based, triparty and bilateral. In a CCP-based transaction, the CCP intervenes between the two counterparties and assumes the counterparty risk of the transaction. Tri-party repos are transactions for which post-trade processing (including collateral selection, valuation, custody, monitoring and substitution, as well as payments and deliveries on both legs of the transactions) is outsourced to a third-party agent, usually either a custodian bank or a central securities depository. They differ from CCP-based transactions because the counterparty risk remains with the repo traders. The triparty segment is particularly relevant for the US repo market (McCormick *et al.*, 2021). Bilateral contracts are connected to traditional OTC activity in which the counterparties trade directly with each other by agreeing on the details of the contract and clear the trade bilaterally.¹⁹

According to the FSB (2022), interdealer repo markets in core advanced economies²⁰ are largely electronic and centrally cleared, although the share of transactions intermediated by a CCP varies across jurisdictions: in Italy and Japan it is equal to 99% and 100% respectively, while in France and the US the size of the bilateral market is material (Table 1). Overall, the larger is the share of electronic trading, the higher is the share of centrally cleared trades. For what concerns trading modalities, transactions are mostly executed through RFQ protocols, although CLOB are also quite developed.

Table 1: Characteristics of interdealer repo markets in selected advanced economies

Countries		Key characteristics	Trading venues and clearing arrangements	Share of centrally cleared repos
EU	DE	Mostly electronic and centrally cleared	Electronic via centrally cleared platforms (Eurex Clearing/BrokerTec) and cleared through Eurex Clearing and LCH RepoClear	80%
	IT		Electronic CLOB (MTS Repo), almost entirely centrally cleared (CC&G and LCH); RFQ	99%
	FR		High proportion traded on BrokerTec, MTS and Bloomberg Chat and cleared through LCH Repo Clear	50%
JP	All interdealer trades are cleared through Japan Securities Clearing Corporation (JSCC)		100%	
UK	Mostly electronic (BrokerTec/Tradeweb) and cleared through LCH RepoClear		>50%	
US	Electronic interdealer broker (IDB) platform. Participants that are not Fixed Income Clearing Corporation (FICC) or sponsored members trade bilaterally		>50%	

Source: authors' elaboration on FSB (2022).

On the contrary, dealer-to-customer markets are a mixture of electronic (RFQ) and voice (i.e. OTC) systems and are mainly cleared bilaterally, although in the US (and, to a much lesser extent, in

¹⁷ A CLOB acts as a central hub where market participants can submit their buy and sell orders, which are matched based on specific rules and executed accordingly.

¹⁸ RFQ protocols imply that the client makes a pricing request to which one or multiple dealers can respond with binding proposals; the client then "applies" to the best offer and the trade is concluded.

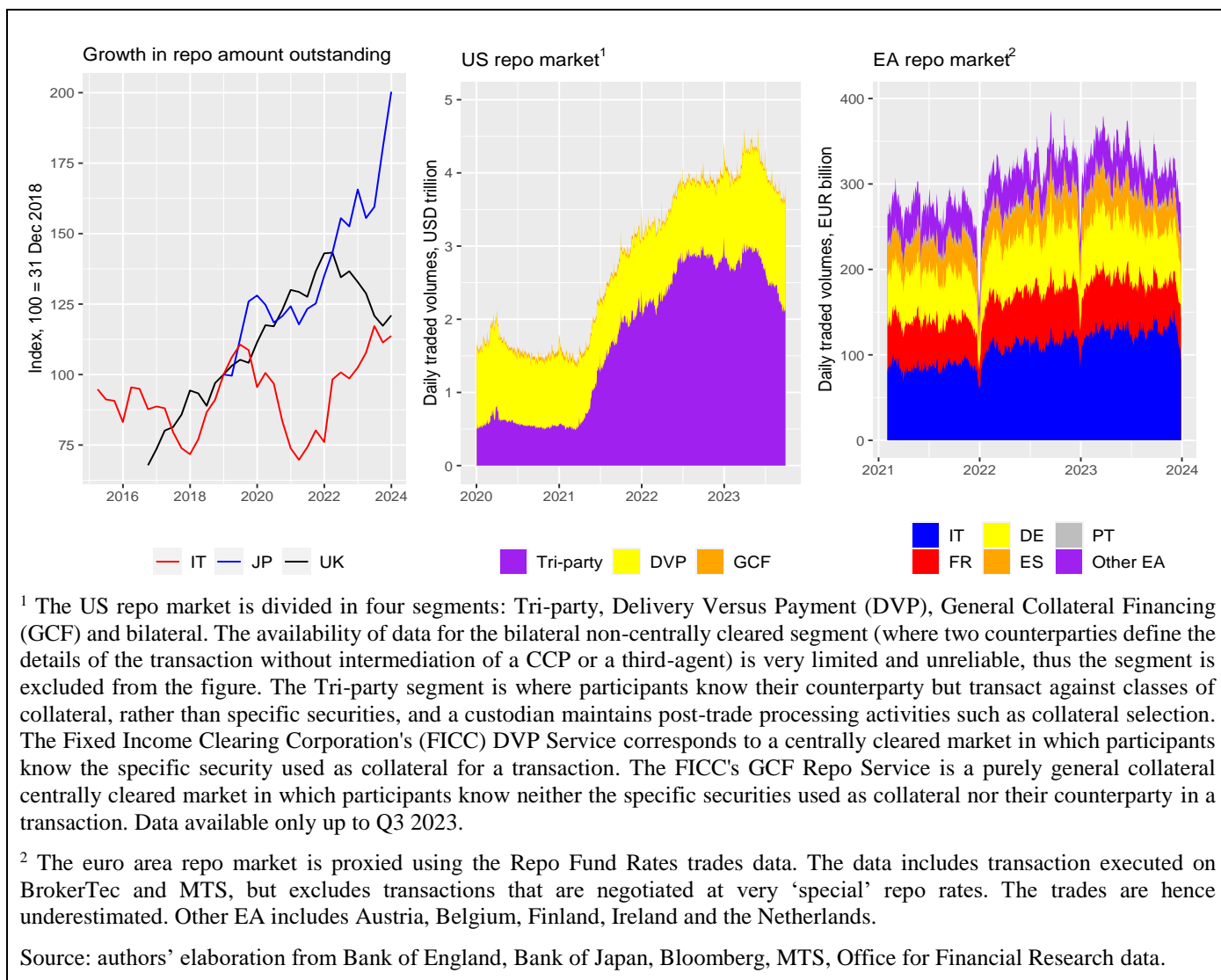
¹⁹ Sometimes they record the transaction on a CCP, benefiting from all the clearing services provided (turning de-facto into CCP-based transaction).

²⁰ The report refers to the euro area, the US, the UK and Japan.

the UK) sponsored access models²¹ have opened up access to central clearing in this segment (FSB, 2022).

In recent years, also in connection with the rapid increase in issuances of government securities and the exceptional interventions by central banks, the size of the repo market has grown significantly worldwide (see ICMA, 2023). In a context of high excess liquidity, trading activity has been mainly carried out on the special segment, especially in Europe, due to the need by market participants to exchange high quality collateral. In the UK the total outstanding amount of repo contracts backed by government securities experienced a sustained growth and reached record highs in 2022, before backtracking to high but lower levels, while in Japan the same amount has doubled since 2019 (Figure 2 lhp)²².

Figure 2: Size of government securities repo markets in selected advanced economies



Although repos can have longer and tailored maturities, they are largely concentrated in the one-day maturity bucket, implying that they need to be rolled on a (almost) daily frequency. This contributes to explaining the very large daily turnover that repo markets have in several advanced

²¹ See Section 4.

²² In this section the values are referred to both GC and SR segments.

economies. In 2023, the US repo market turnover exceeded \$4 trillion in a single day (Figure 2, chp) and this figure does not even include the non-centrally cleared bilateral trades which represent a major segment of the US repo market²³ (see Hempel *et al.*, 2023). In Europe, the repo activity is conducted both bilaterally and across several trading venues; by only considering transactions on two of the largest ones (BrokerTec and MTS), the average daily turnover is equal to €330 billion in 2023, with Italy accounting for the highest country share (Figure 2, rhp).

3. Factors driving the repo market

The repo market has become the reference money market of the international financial system, replacing almost entirely the unsecured segment. During the GFC the interbank deposit market froze, as no market participant trusted to lend cash holdings to other intermediaries.²⁴ As a result, intermediaries were more keen to trade with the presence of an underlying security as guarantee for the cash lender in the event of the counterparty's default. Besides, the potential presence of a CCP in the operation constituted an additional level of protection for the transaction.

In more recent years, the repo market has undergone profound transformations mainly due to both unconventional monetary policies and the huge regulatory reform programme triggered by the Basel process. In this section we analyze these and other drivers for the repo market activity.

3.1 Collateral quality

Repo rates reflect the amount of liquidity in the financial system, the level of monetary policy rates and, not less importantly, the characteristics of the posted collateral, including its price volatility and the creditworthiness of the issuer.

This is well epitomized in the euro area, where there are several government bond repo markets. Despite an integrated banking system with harmonized rules and a single monetary policy, repo rates often show divergent trends or different values. For example, Italian and Spanish repo rates have often diverged from those of other countries in the past because of the greater volatility and the higher credit risk of the underlying collateral. To put it differently, a market participant willing to lend out its cash through the GC market will most likely not accept the same rate knowing that he could get either German or Italian government securities as collateral.²⁵

This implies a structural fragmentation of the European repo market (Cœuré, 2019) that has raised concerns about the effectiveness of monetary policy impulses in the various countries of the euro area. A very good example is given by the different behavior of European repo rates during the acute phase of the Covid-19 crisis in March 2020, when the Italian government securities were not considered a “safe-haven asset”, due to both lower credit rating of Italian public debt and to the fact

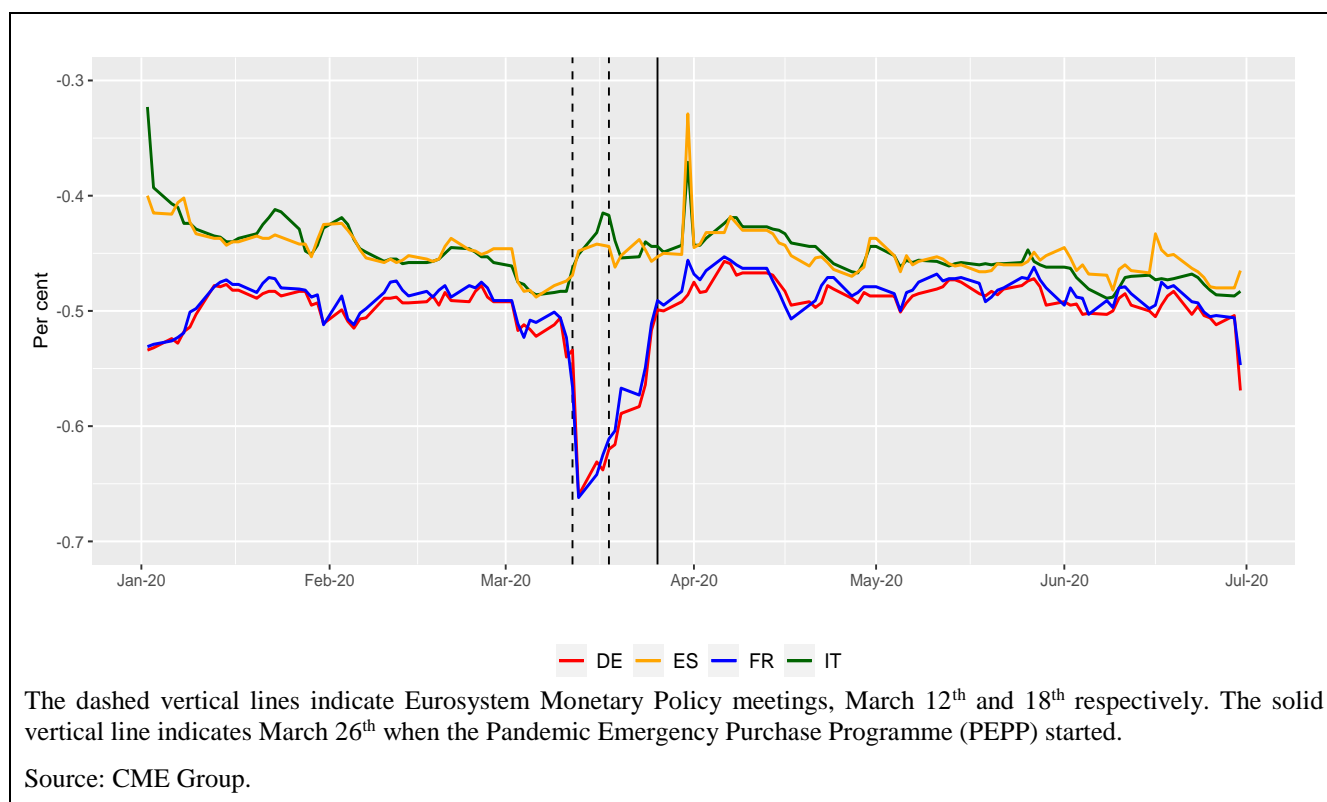
²³ The non-centrally cleared bilateral repo (NCCBR) transactions are conducted between two firms without the involvement of a central counterparty or a third-party custodian. The bilateral nature of these trades implies that there is no central source of data and poor transparency on this segment. The NCCBR market has an estimated size exceeding \$2 trillion outstanding.

²⁴ In this context, financial intermediaries, especially security brokers and dealers, reduced their leveraged position and, consequently, the assets on the balance sheet (Adrian *et al.*, 2018). Gorton and Metrick (2012) argued that the US repo market suffered a run during the GFC, in turn acting as a crisis amplifier. Krishnamurthy *et al.* (2014) showed that some systemically important banks with a high share of repo funding with private collateral were the most vulnerable and the most likely to access emergency programmes by the Federal Reserve. By contrast, Copeland *et al.* (2014) found no evidence of any run on repos during GFC and claimed that margins had barely moved and funding remained very stable for dealers.

²⁵ Schaffner *et al.* (2019) claimed that in recent years signs of segmentation have increased, since repo market participants have shifted from funding to trading of collateral, and the credit quality of assets varies among countries.

that the country was one of the most hit by the pandemic. After the implementation of lockdown measures in Italy in March 2020, concerns about the resilience of the sovereign bond markets fueled the sell-off of the riskiest securities, triggering a fly-to-quality movement toward the safest assets. The trading activity in the Italian repo market remained high, although the repo rates on GC started to move out-of-sync with respect to the others (Figure 3). Indeed, while the Italian (and Spanish) repo rate in the GC segment continued to be just above the deposit facility rate (DFR), French and German repo rates experienced a sharp decline. Borrowers in the repo market were willing to pay a ‘specialness premium’²⁶ to receive better quality government bonds (Billio *et al.*, 2020). This evidence suggests that differently from the US – where the selling pressure of Treasuries was triggered by a dash for cash phenomenon – European markets experienced an increase in demand for Bunds and OATs, namely a ‘flight to safety’ or a ‘dash for collateral’.²⁷

Figure 3: European repo rates during the acute phase of Covid-19



Generally speaking, the search for high quality collateral typically exerts downward pressure on repo rates, since market participants are willing to lend their liquidity at a cheaper rate in order to borrow a safer security. Therefore, the higher is the credit quality of the collateral the lower will be the rate of the transaction. This dynamic is even clearer when one observes the reverse spikes at year-ends (see Section 3.4): the demand for collateral from countries with larger fiscal space is higher, leading to a more intense downward spike of the repo rates for these countries compared to those with limited fiscal space.

²⁶ The specialness is the relative cost of specific security transactions, which can also measure the scarcity of single issues: it is computed as the difference between the GC rate and the SR rate of the security. The specialness of the market is the difference between the GC rate and the average SR rate of all the traded securities. For further details, see Duffie (1996) and Fisher (2002).

²⁷ The sharp decline lasted only few days and reverted as soon as the ECB Pandemic Emergency Purchase Programme (PEPP) was announced; in April 2020, repo rates flowed back around pre-pandemic level.

3.2 Excess liquidity and collateral scarcity

On top of the differences related to the quality of the underlying collateral, repo rates divergences may be linked to the asymmetry in the concentration of excess liquidity within and between countries due to expansionary monetary policies. In a 2019 speech, ECB Executive Board member B. Cœuré said that *‘stressful episodes in the repo market in the United States²⁸ were related to the highly uneven distribution of excess liquidity across individual banks. In the euro area, it relates to an uneven distribution across jurisdictions. And in both cases, it also relates to the growing role of intermediaries without access to central bank balance sheets’*.

Moreover, several empirical studies demonstrate that central banks’ asset purchases have been associated with collateral scarcity effects. Focusing on the Italian government bond repo market, Corradin and Maddaloni (2020) found evidence that Securities Market Programme (SMP) purchases led to a higher specialness through a reduction of available assets on the market. One consequence of the higher specialness was an increase of fails on deliveries. Arrata *et al.* (2020) explored empirically the interactions between the PSPP and European repo rates. The authors showed that the PSPP contributed to depressing repo rates by increasing the scarcity of the bonds and by increasing the amount of excess liquidity. Corradin *et al.* (2020) found that prior to 2015 heightened financial market volatility coincided with the worsening of money market conditions, while higher central bank liquidity provision was associated with reduced money market stress. After 2015, the evidence is consistent with central banks’ asset purchases inducing scarcity effects in some money market segments. Brand *et al.* (2019) showed that repo premia have been systematically affected by bank funding stress, safe asset scarcity, and fragmentation in the sovereign space.²⁹

When referred to the interbank sector, money market rates – especially GC rates – typically do not fall below the rate level set by the central bank for deposits (DFR), because banks can always deposit excess liquidity on their central banks’ accounts. However, GC rates may also move below the DFR, especially when there is an excess of liquidity in the system, implying less demand for cash and an increasing demand for collateral, which exerts a downward pressure on the GC rate. The explanation for this can be traced back to the fact that an investor holding a government security that could be lent either in a GC basket or in the SR market has an arbitrage opportunity across the two segments (Arrata *et al.*, 2020).³⁰

Figure 4 shows that European repo funds rates (RFR) of the GC segment started to be traded below the DFR after the ECB adopted measures that increased dramatically the excess liquidity in the financial system. First for Germany and France, then also for Spain and Italy, GC rates fell below the supposed lower bound (DFR): the unconventional monetary policy implied a dramatic increase of liquidity in the Eurosystem, leading to some scarcity of euro area government bonds. This is also evident looking at the trend in Italian repo rates: at the end of 2020, GC rates started trading below the DFR, reflecting a greater excess liquidity in the Italian banking system with respect to previous years.

To address the issues related to the gradual reduction of the securities’ availability in the market (the scarcity effect), in 2015 the national central banks of the Eurosystem have stepped up their securities lending activities, providing an additional support to the overall market liquidity. Because of the growing excess liquidity in the financial system and to alleviate collateral scarcity in

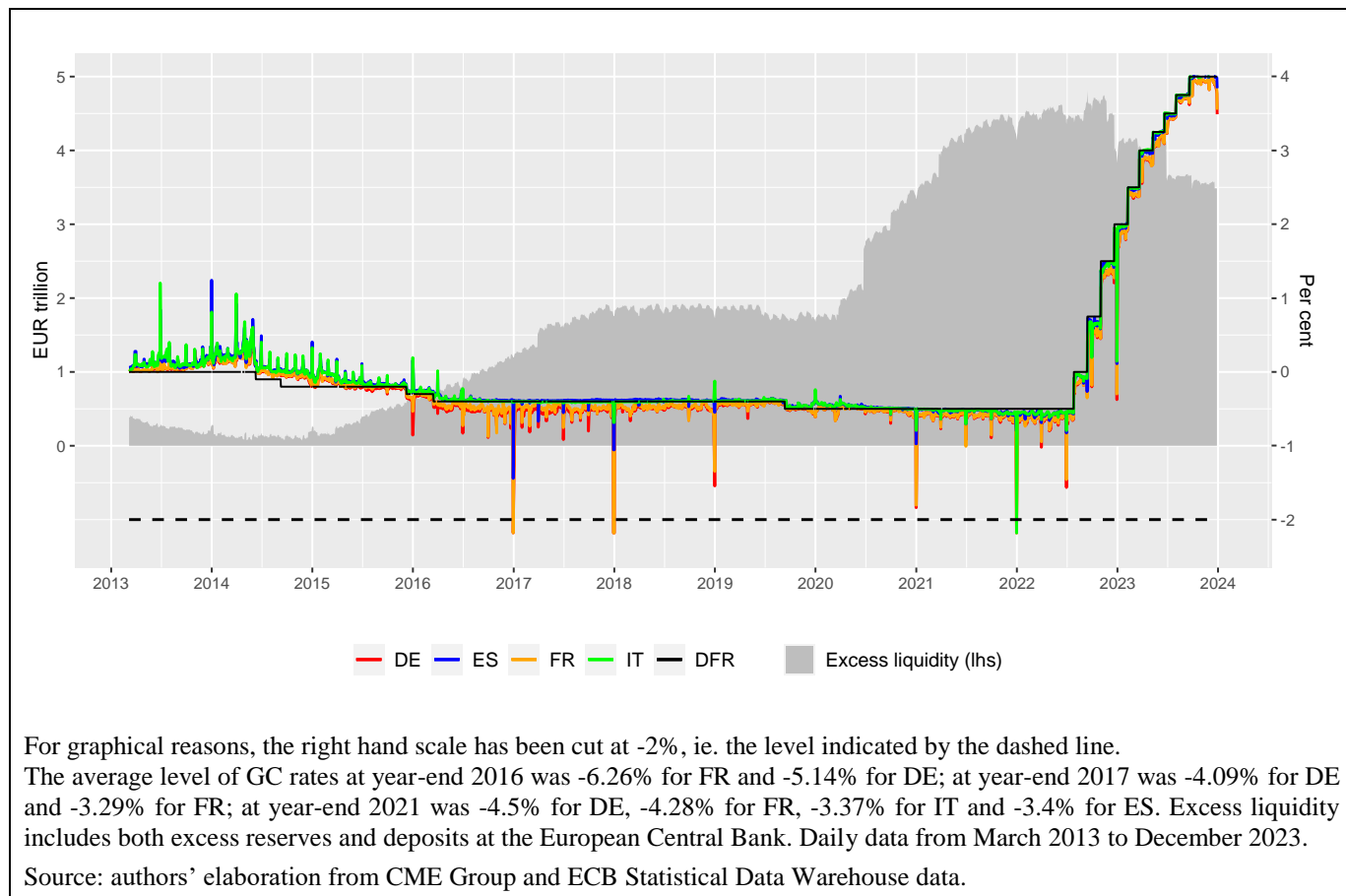
²⁸ For more details, see Federal Reserve Bank of New York (2020).

²⁹ See also Duffie (2022).

³⁰ If a specialness premium exists, meaning that the SR rate for that security is lower than the GC rate, it would be economically convenient to earn that premium by lending the security at a lower SR rate and investing the cash obtained at a higher GC rate. Therefore, the GC rate is pushed towards the SR rate by market participants that exploit these arbitrage opportunities.

the market, on 8 December 2016 the ECB decided to give the possibility to central banks to also accept cash as collateral in their PSPP securities lending facilities, without having to reinvest it in a cash-neutral manner.³¹ Securities lending has proved useful in allowing market operators to temporarily borrow specific securities in order to limit unsettled trades and alleviate tensions when securities were scarce.

Figure 4: European GC repo rates and excess liquidity in the euro area



3.3 The role of regulation

As described in section 3.2, monetary policy has had a material impact on the repo market over the last decade. Moreover, the post-GFC regulatory response³² aimed at strengthening the banking system and supporting financial stability, albeit not directly addressing repo markets, has played a non-trivial role, not only by reducing the balance sheet space of bank intermediaries, but also by enhancing the role of collateral (e.g. with the need to post collateral to meet derivatives margin requirements)³³. The Committee on the Global Financial System (CGFS, 2017) affirms that, partly due to stricter regulatory standards requiring banks to hold capital in proportion to the size and composition of the balance sheets, intermediaries have been more cautious in engaging their capital

³¹ In order to preserve cash neutrality (no changes to the amount of cash in circulation), combined repo and reverse repo operations are carried out. Under certain market conditions, securities may be lent without making a cash reinvestment.

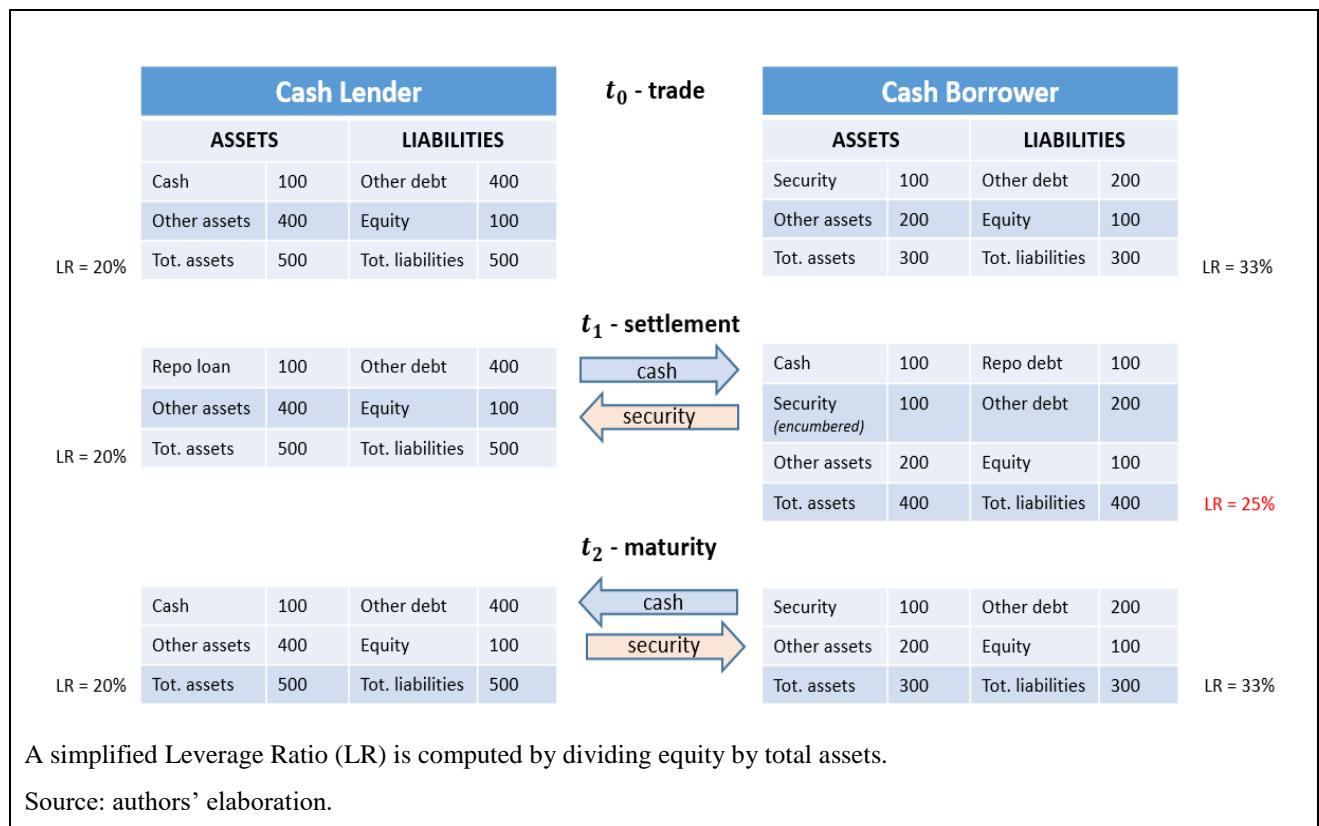
³² The leverage ratio and the liquidity coverage ratio are highly relevant regulations impacting market dynamics and functioning; other examples include the Net Stable Funding Ratio, the G-SIB surcharge, and in the US, the money market mutual fund reform (MC, 2019).

³³ Under either the clearing obligation or the margin rules for non-centrally cleared derivatives.

in repo activity. The Markets Committee (MC, 2019), based on the outcome of a survey addressed to central banks that activated large-scale asset purchase programmes and non-standard lending operations, claims that regulatory change has been the main driver of money market functioning. In particular, the MC (2019) states that the leverage ratio³⁴ (LR) has reduced dealers' repo capacity, at least during the period in which banks adjusted their business models to the new regulatory environment.

The LR has been the most debated measure.³⁵ The ratio is not risk-weighted and therefore does not consider the mitigation of the risk given by the (high quality) security of repo operations. The impact of the LR is particularly relevant for cash borrowing transactions, whereby the security encumbered remains on the balance sheet of the cash borrower³⁶ while borrowed cash increases the size of the balance sheet, worsening the ratio. By contrast, a reverse repo transaction (cash lending) is broadly neutral in terms of balance sheet size, as the cash lent on the asset side is replaced by the reverse repo claim (see Figure 5). It ought to be noted, however, that repo and reverse repo with the same counterparty, the same collateral and the same settlement date can be measured on a net basis, thus freeing balance sheet space. This is especially relevant for transactions cleared through CCPs, as exposures with the same CCP, like the trades concluded on an electronic trading venue, can be netted out if they settle on the same date.

Figure 5: Repo, reverse repo and leverage ratio in a simplified balance sheet



³⁴ Leverage ratio is computed as the ratio between Tier 1 capital and the exposure measure. The exposure measure takes into account total assets and off-balance sheet exposures. Therefore, an increase in total assets or off-balance sheet exposures leads to a reduction of the ratio, which requires an increase in capital.

³⁵ See Bicu-Lieb *et al.* (2020), Bucalossi *et al.* (2016), Ranaldo *et al.* (2021).

³⁶ Specifically, the encumbered security constitutes an off-balance sheet item and, therefore, is still counted in the denominator of the ratio.

The current formulation of the LR framework in the EU establishes that banks are required to report quarter-end figures. By contrast, in other jurisdictions like the US and the UK, banks' reporting for LR (and therefore for repos) takes place on an average basis. The CGFS (2017) states that, on the one hand, this can lead to a reduction in volatility at the end of the quarter, but on the other, it creates incentives for banks to reduce their participation in repo markets on a more continuous basis.³⁷ Accordingly, Kotidis and van Horen (2018) found evidence that the LR in the UK repo market has effects in terms of lower rates and reduced repo activity in transactions between dealers and small clients. Bicu *et al.* (2020) demonstrated that Gilt repo liquidity worsened during the period when the LR policy was introduced in the UK. Furthermore, Allahrakha *et al.* (2018) found that in the US the announcement of supplementary LR³⁸ (SLR) caused a borrowing reduction through triparty repo by bank dealers, while Munyan (2015) suggested that daily averaging of capital requirements deters window dressing, improving the effectiveness of bank regulation.

In addition to the LR, other balance sheet costs might have affected the behavior of banks in the repo market, such as the contribution to the Single Resolution Fund, whose amount is determined on the basis of the size and riskiness of each bank's balance sheet.³⁹ New liquidity and funding regulations may also influence banks' willingness to trade in the repo market. In particular, the Net Stable Funding Ratio (NSFR) imposes a stable funding requirement in the medium term, while the Liquidity Coverage Ratio (LCR) requires banks to hold an adequate stock of HQLA relative to their expected cash outflows under stress.⁴⁰ However, Corradin *et al.* (2020) reviewed the interaction between liquidity requirements and repo functioning, and the evidence points to a limited impact on the latter, especially if referred to repos backed by government bonds.⁴¹

3.4 Window dressing and quarter-end dynamics

The forces driving the repo market (as described in Sections 3.1 to 3.3) unfold their effects more markedly at quarter-ends, when banks are due to calculate the regulatory ratios and other charges based on their financial statements (Ranaldo *et al.*, 2021). Regulatory constraints, such as the LR, affect particularly the behavior of European dealers (Anbil and Senyuz, 2018; Baldo *et al.*, 2020) while US dealers have less incentives to engage in window-dressing activities as they report capital ratios based on daily averaging (Munyan, 2015). Bassi *et al.* (2023) have documented the existence of an economically sizeable and long-lasting reduction in balance sheet repo activity for large euro area banks, by around 12.5% prior to quarter-ends and by up to 25% before year-end. This window dressing activity, especially at year-ends, is detrimental for the market liquidity and price efficiency of the repo market, with potential repercussions on the smooth transmission of monetary policy or on other linked financial markets (CGFS, 2017).

³⁷ Window-dressing refers to the practice of banks changing their business in a limited time period to obtain better regulatory ratios. In order to address window-dressing behavior relating to the LR framework, the EU legislators amended the Capital Requirement Directive and Regulation. In addition to the 3 per cent LR minimum capital requirement at quarter-end, starting from June 2021 large institutions must report specific components of the LR – including repos – as averages over the reporting period and the data used to calculate those averages. For further detail see Article 430(2) of Regulation (EU) 2019/876 (CRR II).

³⁸ The supplementary leverage ratio is the US implementation of the Basel III Tier 1 leverage ratio, with which banks calculate the amount of common equity capital they must hold relative to their total leverage exposure. Large US banks must hold 3%. Top-tier bank holding companies must also hold an extra 2% buffer, for a total of 5%.

³⁹ Since 1st January 2016 credit institutions in the euro area are required to participate to the Single Resolution Fund by annual contributions, whose amount is determined on the basis of the size and riskiness of their balance sheets. Moreover, a number of resolution regimes in place in some euro area jurisdictions are financed by bank levies determined on the basis of the amount of banks' liabilities at year-end.

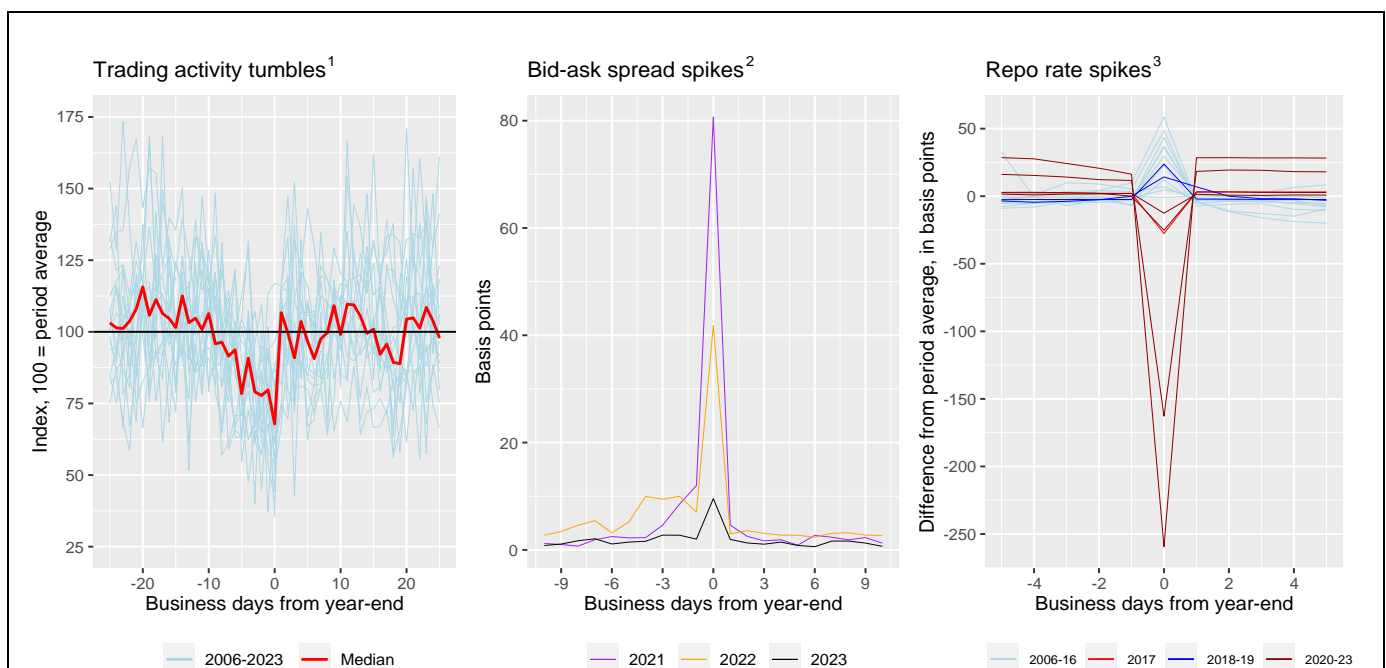
⁴⁰ For further details, see CGFS (2017).

⁴¹ Corradin *et al.* (2020) found that, in the euro area, liquidity requirements did not affect money market significantly, possibly also due to the excess liquidity that, in the sample period, facilitated the fulfilment of the ratios requirements.

Dealers' reluctance in trading repos at reporting dates is also reflected in the observed sharp dynamics of repo rates. In the euro area, the dynamic can be explained by the interplay of the regulation on banks and the implications of the ECB quantitative easing. Koijen *et al.* (2017) showed that the final counterparties of Eurosystem's asset purchases under the PSPP were mostly counterparties with no direct access to the DFR in the euro area. Therefore, the non-banking sector needs to deposit the accumulated liquidity at the banking sector: one option is the repo market, which allows NBFIs to lend money safely against a high quality security as collateral. However, at quarter-end the LR may hamper the bank borrowing activity in the repo market, especially in the case of transactions that cannot be netted through the use of a CCP. Repo transactions between banks and non-banks are usually not CCP-cleared and, thus, are less likely to be netted under the LR framework. Indeed, repo transactions are capital absorbing unless they can benefit from the "netting of exposures" when repos and reverse repos are conducted with the same counterparty. Banks that cannot net such new costly exposures (in terms of capital requirements) bargain for lower repo rates. In other words, the lower repo rates applied at quarter-ends can be seen as a premium applied by banks to compensate for the extra balance sheet cost involved in the repo operation.

Window dressing effects can be observed vividly in the Italian GC repo market. The median trading activity declines by more than 25% in the 10 days before the end of the year (Figure 6, lhp) while the bid-ask spread deteriorates only in correspondence of reporting dates (Figure 6, chp), showing also more substantial widening of the intraday volatility.

Figure 6: Year-end effects evidence from MTS Repo Italy GC



The sample period includes the same number of observations before and after the year-end. For the turnover the sample period has a total of 50 days, for the bid-ask spread 20 days and for the repo rates 10 days.

¹ The traded values are indexed to the sample period average in order to make them comparable over the years. They are grouped by trading date.

² Bid-ask spread refers to the daily average of the best bid-ask spread offered in the market every five minutes, grouped by settlement date and referring to one-day transactions only.

³ Average daily repo rates are indexed to the sample period average in order to make them comparable over the years. They are grouped by settlement date and referring to one-day transactions only.

Sources: authors' elaboration from MTS data.

As for rates, from 2016 to 2020 the Italian market was only partially affected by this behavior (with the notable exception of end-2017), due to the lower demand for Italian government bonds compared to countries with a very high credit rating on their sovereign debt. However, starting from year-end 2020, Italian repo rates have experienced reverse spikes at reporting dates, since market participants have shown a strong interest in Italian government bonds, in a context of rapid growth of excess liquidity (Figure 6, rhp). The year-end effects in 2023 were less intense than the previous two years, due to the gradual reduction of the excess liquidity and the higher availability of securities on the market.

A more extensive recourse to central clearing by NBFIs (that typically do not have direct access to CCPs, but rather may act as ‘clients’) would imply a more extensive use of netting under the LR framework, freeing up balance sheet space and, in turn, could also help mitigate these quarter-end market dysfunctions (see Section 4).

4. Central clearing in the repo market

Central clearing is the set of processes operated by a central counterparty (CCP) that takes place after trading and before settlement, including the netting of obligations between the parties involved in a financial trade. The interposition of a CCP typically occurs through a process known as novation, whereby each cleared trade is transformed into two transactions, both having the CCP as one of the counterparties, so that the CCP becomes the seller to each buyer and the buyer to each seller. After novation, the CCP assumes the counterparty risk of both parties (referred to as ‘clearing members’), meaning that the CCP guarantees to both parties that it will honor the execution of the transaction even if either of them defaults before fulfilling their obligations.

Provided that CCPs are resilient,⁴² central clearing fosters financial stability by simplifying the complex network of exposures arising from financial transactions and reducing overall counterparty risk in the financial system. This led G20 leaders to commit to have all standardized OTC derivative contracts cleared through CCPs after the GFC. In the European Union, the clearing obligation was introduced in 2012 for OTC derivative contracts, under Regulation (EU) No 648/2012 (European Market Infrastructure Regulation or ‘EMIR’), and two years later extended to derivatives traded on regulated markets, under Regulation (EU) No 600/2014 (Markets in Financial Instruments Regulation or ‘MiFIR’). Although a similar obligation was not deemed necessary for repo transactions, the role of central clearing in the repo market was also subject to scrutiny after the GFC, as certain repo markets had proved to be a less reliable source of funding liquidity than expected (CPSS, 2010; FSB, 2011).

⁴² To protect themselves against the risks deriving from their activity (including the counterparty risk of clearing members), CCPs establish different lines of defense. To begin with, CCPs impose participation requirements upon their clearing members (in relation to their solvency, size, operational capacity, etc.). They also ask clearing members to post collateral in the form of margins and default fund contributions and set aside a buffer of their own capital (known as ‘skin-in-the-game’) to act as a cushion against potential future losses stemming from default events. Although very remotely, in the event these tools are not enough, the European regulatory framework requires mandatory recovery and resolution plans to ensure, to the greatest extent possible, that EU CCPs set out measures to recover from financial distress and continue to play their critical functions, thus limiting contagion risk and preserving financial stability. Since the GFC, authorities and standard setters have devoted significant efforts to enhance CCPs’ resilience. At international level, CPMI and IOSCO adopted the *Principles for financial market infrastructures* (PFMI), which were later supplemented by further guidance on the resilience of CCPs and on the recovery of financial market infrastructures. In parallel, the FSB carried out work on CCP resolution. Within the EU, a new regulatory framework was put in place starting from 2012 when EMIR entered into force.

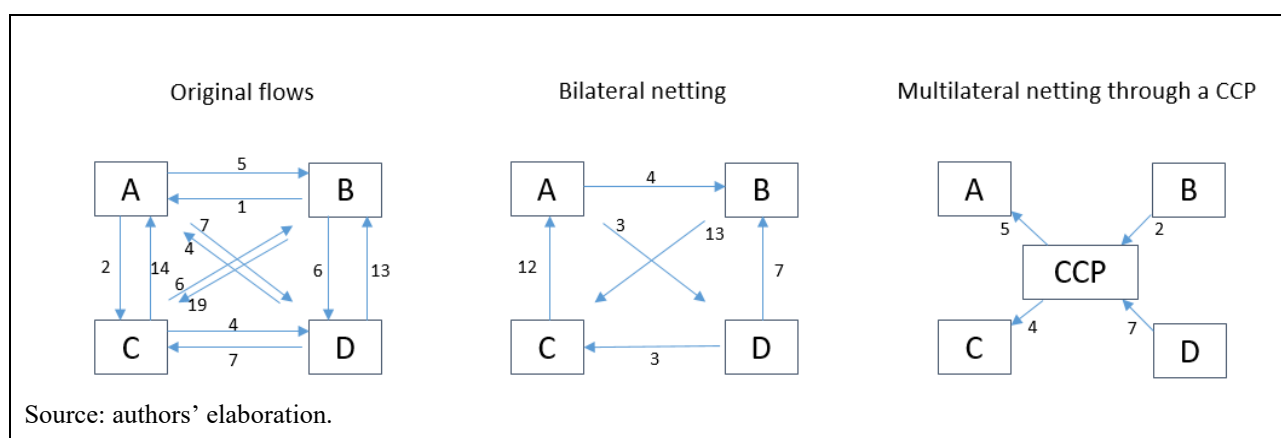
More recently, the dysfunction that occurred in the world’s most liquid market – the US Treasury market – following the outbreak of the Covid-19 pandemic in March 2020 led to a debate about possible solutions for improving the resilience of market infrastructures. Among others, Duffie (2020) stated that introducing a broad central clearing mandate in the US market would improve financial stability, increase market transparency, and reduce the current heavy reliance of the market on the limited space available on dealer balance sheets for intermediating trade flows. Fleming and Keane (2021) found that central clearing of all outright trades in Treasuries would have lowered dealers’ daily gross settlement obligations by roughly 60% in the weeks preceding and following the market disruptions of March 2020, but nearly 70% when trading was at its highest. They also found that expanded central clearing would have substantially lowered settlement fails. In 2021, the Depository Trust & Clearing Corporation (DTCC) published a white paper (DTCC, 2021) to persuade the market to make greater use of central clearing by stressing the idea that a greater adoption of central clearing in the US Treasury market would significantly reduce risk and improve resiliency, which is critical to the strength and stability of the US economy.⁴³ The debate in the US led to the adoption of a rule by the US Securities and Exchange Commission (SEC) at the end of 2023, which expands the clearing mandate for Treasuries. This rule will come into effect starting in 2025.

While referring to Menkveld and Vuillemeij (2021) for a wider introduction to the economics of central clearing, in this section we review the benefits of CCPs in the repo market and focus on the possibility to further encourage recourse to their services through innovative access modalities.

4.1 The role of CCPs in the repo market

CCPs in repo markets yield benefits that are comparable to those in other financial markets. The most significant advantage relates to multilateral netting, whereby CCPs are able to transform a complex network of bilateral relations into a simpler and more transparent network (see Figure 7). This has positive implications in terms of better ability to monitor and manage risks, lower exposure to credit and liquidity risks, reduced potential for settlement fails, and enhanced operational efficiency. Additional benefits become evident in the event of a clearing member’s default, as CCPs’ standardized procedures can facilitate the orderly closeout of positions and the liquidation of collateral. This, in turn, reduces the risk of contagion and spillover effects.

Figure 7: Netting benefits of CCPs



⁴³ The extensive use of CCPs, which would drastically reduce counterparty risk and guarantee the anonymity of trades, is also seen as a prerequisite for the development of a new trading framework relying on the disintermediation of dealers – defined as all-to-all trading. This trading model could bring some benefits, in particular during stress periods, when dealers’ balance sheets may be constrained and a lower need for dealer intermediation could increase the resilience of the market.

Similarly, when considering risks, a broad categorization can be made without distinguishing the repo market from others. Most risks pertain to the potential for CCPs to either amplify stress or generate it in the event of their failure. There has been extensive discussion surrounding the risk of CCPs' risk models leading to excessively high margin requirements during stressed periods, with negative procyclical implications, and more generally around liquidity risk related to margin calls falling upon participants (Cont, 2017; Panetta, 2023). At the same time, due to their high level of interconnectedness, the potential for CCP failure poses systemic risk and gives rise to a too-big-to-fail problem, even more so in light of the significant growth of CCPs over the last decade (Wendt, 2015). Interactions between CCPs and their bank clearing members may, under certain circumstances, trigger destabilizing feedback loops (Faruqui *et al.*, 2018).

That said, there are some aspects that are worth special attention when discussing the role of CCPs in the repo market.⁴⁴ First, concerning multilateral netting, there are two concepts to consider:

- exposure netting, which refers to the reduction of counterparty risk exposures through the offsetting of centrally cleared repo trades;
- settlement netting, whereby gross settlements are reduced by the CCP to a single net long/short position in each security, at each settlement date and for each participant, thus reducing settlement risk and costs.

The former concept is particularly relevant for the repo market, as exposure netting allows releasing space on clearing members' balance sheets (see Section 3.3 on the treatment of repo exposures with the same CCP under the LR framework). The efficiency of netting, and therefore the extent to which the interposition of a CCP allows to reduce risk and optimize capital, ultimately depends on market structure, the number of participants, and trading patterns.

Second, special value should be attached to the ability of CCPs to balance margin increases in times of market stress, ensuring the preservation of their resilience, while also considering the potential procyclical implications for market participants (Panetta, 2023). The effectiveness of policies and tools⁴⁵ implemented by CCPs to prevent excessive margin increases during periods of stress, and therefore to alleviate pressure on market participants when liquidity conditions are tight, is of paramount importance for the repo market (Miglietta *et al.*, 2019). Given its crucial role as a primary funding source for financial institutions, excessive margin calls have the potential to significantly impair the funding capacity of market participants.⁴⁶

Third, market participants may include a variety of NBFIs and institutional investors. NBFIs are typically not able to access CCP services directly, and need to be intermediated by a clearing member. The possibility for these entities to make wider recourse to central clearing and take advantage of the related benefits is examined in Section 4.2.

Importantly, while all of this pertains to the role and benefits of CCPs in supporting their participants, it is worth noting the CCPs themselves are active in the repo market for investment purposes. The legislative framework embedded in EMIR requires CCPs to invest at least 95% of cash collateral deposited by clearing participants in a secure and highly liquid manner. This typically

⁴⁴ See Baklanova *et al.* (2017).

⁴⁵ Differently from the international setting bodies, which adopted a principle-based approach, the European approach to procyclicality assumed a prescriptive form requiring the use of specific tools. These are enumerated in Article 28 of Commission Delegated Regulation (EU) No 153/2013 and consist in the application of at least one of the following: (i) a margin buffer at least equal to 25% of the calculated margins, to be temporarily exhausted during stressed periods; (ii) a 25% factor to weight stressed observations in the lookback period used for calculating margins; (iii) a 10-year historical lookback period to estimate volatility, as a floor.

⁴⁶ According to Benos *et al.* (2023) a self-reinforcing cycle is at play where clearing members rely on the repo market to access the liquidity needed for meeting margin obligations associated with their activities in various market segments.

involves lending the cash on a secured basis, investing in safe bonds, or placing it in a central bank account. Benos *et al.* (2023) showed that the activity of CCPs in repo markets can affect repo rates, and particularly that when CCPs reintroduce cash to the financial markets via reverse repos and bond purchases, it can exert downward pressure on repo rates.

Box – Trading and clearing in the Italian repo market

According to data provided by primary dealers,⁴⁷ the repo trades backed by Italian government securities are largely negotiated on electronic venues, with the OTC activity accounting for a residual share.⁴⁸ Since 2016, the daily turnover of repos backed by Italian government bonds has grown significantly, reaching record highs in 2023 (above €250 billion), and MTS Repo is by far the most used trading venue.

MTS Repo is a wholesale market, as only a predefined set of financial institutions and (with limitations) non-financial institutions can access it;⁴⁹ the minimum order size is relatively large⁵⁰ and it is divided into two segments: GC and SR. MTS Repo is a fully electronic order-driven market, where the orders sent by the dealers, if not immediately fulfilled, contribute to the creation of a CLOB. There are two types of orders on the market: limit orders – characterized by a quantity and a predetermined price – and market orders – that, by specifying only the quantity, directly match the best offers on the page. The book is composed of both anonymous orders – implying the presence of the CCP – and non-anonymous orders; unlike the cash market, the orders are not aggregated by price but constitute individual trading orders on the central book. Dealers have no obligation to quote prices and can submit both types of orders. Trades may also be concluded following the acceptance of a proposal sent by one of the counterparties the dealer has selected in response to a previous request for competitive quotes, referred to as “Request-for-Quote” (RFQs). Furthermore, MTS Repo offers a trade-registration facility that allows dealers to register trades – and benefit from CCP services – which were independently proposed and agreed OTC or through a functionality of a bilateral request of quotation. Contracts maturity is on 90% of transactions lower than 7 days, particularly 70% of trades have a one-day maturity⁵¹. However, if one considers the nominal value exchanged, on average 99% of traded bonds are returned back within one-day. Market turnover has grown considerably over the last 15 years, moving on average from a €55 billion (considering both the GC and the SR segment) in 2006 to a record high of roughly €160 billion in 2023 (Figure A).

The GC segment is mostly cash-driven, being widely active when the liquidity needs of market participants arise. Consistently with repo activity in the euro area, GC turnover has been negatively affected by the introduction of unconventional monetary policy instruments by the ECB, which offered an alternative source of liquidity to credit institutions. More recently, GC market turnover increased considerably in 2019, when the net purchases of the Eurosystem’s public sector purchase programme (PSPP) were suspended, and gradually declined after the extraordinary responses by the ECB to the Covid-19 crisis in March 2020. However, liquidity injections by the ECB tended to ease funding conditions, with positive implications for the smooth exchange of liquidity in the market. In

⁴⁷ Primary dealers have obligations as to subscribe government bond auctions and trading on the secondary market. These obligations are balanced by some privileges, like e.g. the exclusive participation in supplementary placements of issuance auctions (see articles 4 and 9 of the “Specialists Decree - Selection and Evaluation of Specialists in Government Bonds (of Nov 2011 and amendments of Dec 2023)” published in the Laws and regulations section).

⁴⁸ Source EMAR (Euro Market Activity Report) data on Italian government bonds.

⁴⁹ Market participants (also called dealers) are the following: credit institutions and investment firms authorised to trade on their own account, multilateral development banks, monetary authorities, central banks, government entities responsible for managing the public debt, insurance companies, asset managers, CCPs and non-financial companies (with the limits of using the market strictly for individual cash management purposes, or alternatively for the belonging group needs). Dealers, inter alia, guarantee trading strictly on a proprietary basis, without acting for a third party such as providing “DEA” (Direct Electronic Access) services.

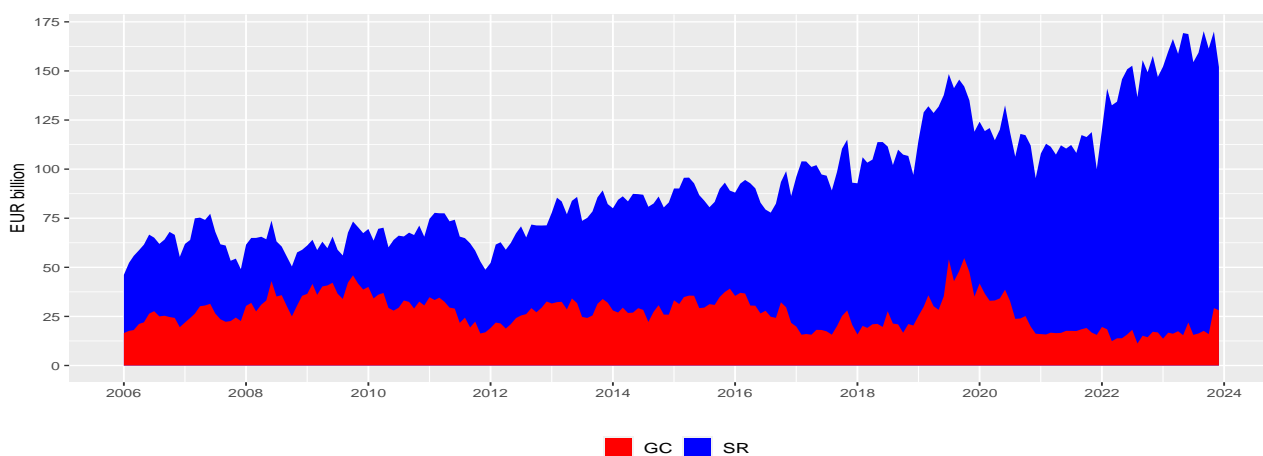
⁵⁰ The size of the minimum order is €0.5 million, with minimum increment of the same size.

⁵¹ One day maturities include overnight, tom-next and spot-next tenors.

the final part of 2023 GC turnover started to rise again, and the progressive reduction of the excess liquidity may have played a role in this trend.

On the contrary, the SR segment is mostly security-driven, being widely used when the collateral searching needs by market participants arise. It is strictly linked to the cash market of government bonds, as dealers rely specifically on the SR for their market making activity (see Section 2.1). Trades in this segment significantly increased after the introduction of unconventional monetary policy instruments, because of the collateral scarcity resulting from the outright purchases of government bonds by the ECB on the secondary market (see Section 3.2). These dynamics are in line with a gradual shift from cash-driven to securities-driven transactions experienced in the European repo market over the period 2010-2018 (Brand *et al.*, 2019). Since 2015, when the excess liquidity in the euro area started to grow significantly, turnover in the SR segment has more than doubled. In 2023, despite the gradual reduction of the excess liquidity, SR activity reached a new record high (average daily turnover of €140 billion), slightly declining only in the final part of the year.

Figure A: Repo activity on MTS Repo Italy



Monthly averages of daily data.
Source: MTS and authors' calculations.

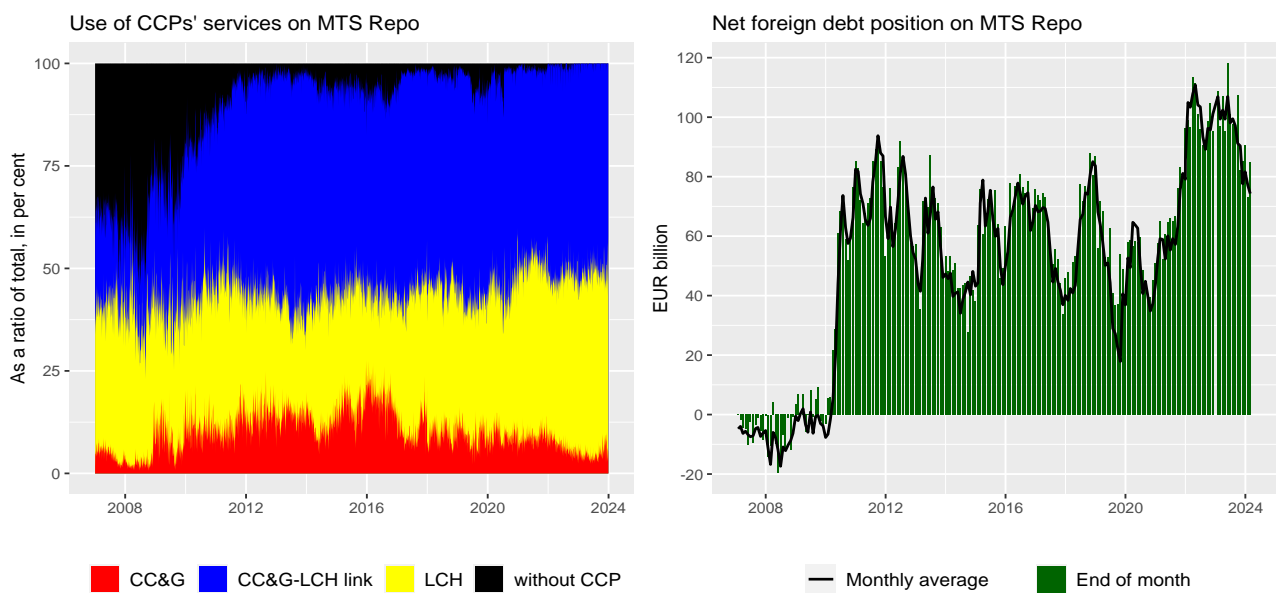
Albeit recourse to CCPs has markedly increased after the GFC, mostly as a result of regulatory interventions, their use in the Italian repo market has a longer history, which shows how various forces can interact in driving the growth of central clearing. CCP services in the Italian interdealer repo market (MTS Repo) have been available since 2002 on an optional basis and are jointly provided by two CCPs: the Italian CCP, CC&G, and the French one, LCH SA. Traditionally, domestic institutions are members of CC&G, while non-residents are members of LCH SA. Despite CCP services being optional, market participants have considerably increased their use in the wake of the GFC. This behaviour, apparently driven by an increased focus on counterparty risk, has been further incentivized by the above mentioned benefits of exposure netting and lower capital requirements. As a result, most transactions made on the Italian repo market are now centrally cleared. At the end of 2023, CCPs' share of total MTS Repo turnover was above 99% (up from 62% in December 2006). The overall increase in the share of centrally cleared transactions can also be explained by the growing number of active participants using CCP services over the years: they more than doubled in 15 years, with over 100 market participants using CCP services in 2023, up from 50 in 2007. The greater participation has allowed for a fuller exploitation of central clearing benefits.

Since 2003 CC&G and LCH SA have been linked by an interoperability arrangement for Italian government bonds, that has been updated several times and was lately revised in order to

ensure compliance with EMIR. Thanks to the arrangement, intermediaries participating in either CC&G or LCH SA can conclude transactions with each other on MTS, as if the two partner institutions formed a single “virtual” CCP.⁵² This facilitates the smooth exchange of collateral between intermediaries of different jurisdictions, with positive consequences also for the liquidity of the secondary market of government bonds, and makes it easier for Italian intermediaries to access financing from abroad even during acute phases of market volatility.

Trades made via the interoperability link between CC&G and LCH SA have increased over time and at the end of 2023 constituted about half of all market transactions (Figure B, lhp). The cross-border exchange of both funding and collateral can be measured by the borrowing and lending activity of Italian players⁵³ with foreign market participants on MTS Repo (foreign net debt position, Figure B, rhp). The debtor position is generally high when: (i) domestic liquidity needs arise (e.g. in conjunction with tax deadlines or when, due to the introduction by the ECB of the two-tier remuneration system for reserve holdings,⁵⁴ the Italian banking system borrowed liquidity from abroad to cap the exempted allowance) ; (ii) collateral demand from foreign investors arises (e.g. to meet delivery obligations on derivatives or to cover short positions on Italian government bonds). On the contrary, the debtor position is generally low when: (i) domestic liquidity needs drop (e.g. after the implementation of extraordinary monetary policy measures facing Covid-19 crisis); (ii) collateral demand from foreign investors drops. The index often shows considerable variation in the quarterly reporting dates, given the window dressing activity that generally takes place on those trading days (see Sections 3.3 and 3.4).

Figure B: CCPs` adoption for clearing wholesale Italian repos and net foreign debt position



Source: MTS and authors' calculations.

⁵² See Anderson *et al.* (2013), Cont and Kokholm (2014), Núñez and Valdeolivas (2019).

⁵³ That is, all Italian banks active on MTS Repo as well as the Ministry of Economy and Finance (MEF) and the Bank of Italy.

⁵⁴ The two-tier system introduced a different rate of remuneration for part of a credit institution's current account holdings in excess of minimum reserve requirements. In particular, the two-tier system can be used to exempt part of these holdings from the DFR when the rate is negative. The two-tier system applied as of the seventh maintenance period of 2019, starting on 30 October 2019.

4.2 Client clearing: challenge and innovation

As previously stated (see Section 2.2), in most jurisdictions the interdealer repo market is traded on electronic trading venues and centrally cleared. However, the percentage of centrally cleared repo transactions tumbles if one considers also the dealer-to-customer segment (Baranova *et al.*, 2023). The possibility to make recourse to central clearing for dealer-to-client transactions – often traded bilaterally – depends on whether counterparties that are not CCP members are able to access CCP services indirectly (FSB, 2022). In fact, access to central clearing can take place either directly, by becoming participant of a CCP (i.e. clearing member), or indirectly, by entering into a contractual relationship with a participant that clears trades not only on his behalf, but also on behalf of his clients.

‘Client clearing’ refers to the service offered by a clearing member (hereinafter ‘client clearing service provider’, CCSP) to enable his clients to get access to central clearing.⁵⁵ Clients are typically entities that do not meet CCP participation requirements (e.g. because of their dimension or legal nature) albeit falling within the subjective scope of the clearing obligation⁵⁶ and/or being willing to resort to central clearing on a voluntary basis, or else entities that choose not to become clearing members in light of the significant costs associated with direct participation in a CCP. There are also some entities that are prevented from acquiring the clearing member status due to regulatory constraints (e.g. legal prohibitions on loss mutualization). In the end, CCSPs carry out a central clearing function themselves shielding the CCP from the default of their clients. Clients can also act as clearing providers to their own clients by offering so-called ‘indirect clearing’ services. The result is a multi-tiered participation structure possibly involving several intermediaries up to the end investor (Pliquett, 2016).

As of today, client clearing allows a wide range of both financial and non-financial counterparties to access CCP services through CCSPs, often representing the only way to fulfill the clearing obligation and, more generally, to enjoy the benefits of central clearing. According to Duffie *et al.* (2015), client clearing can have another important benefit, namely to reduce system-wide collateral demand provided that CCSPs are able to re-use a large enough share of the collateral that they receive from their clients. At the same time, international standard setting bodies and regulators are increasingly aware of the risks associated with client clearing chains, notably including a potential increase in exposure to counterparty risk and risks affecting the portability of clients’ positions and collateral in case of a CCSP’s default (CPMI-IOSCO, 2022). In the European Union, Commission Delegated Regulation (EU) No 2017/2154, supplementing MiFIR, set out specific requirements for the provision of indirect clearing services, distinguishing between four layers of clients (clients, indirect clients, second indirect clients, and third indirect clients). Moreover, the latest proposal to amend EMIR, published by the European Commission in December 2022, includes plans to establish a Joint Monitoring Mechanism within the Union charged with monitoring, amongst others, client clearing relationships (including with respect to portability issues and clearing members and clients’ interdependencies and interactions with other financial market infrastructures) and identifying any related concentration risks.

Available data⁵⁷ shows that client clearing has become a key structural feature of the post-reforms derivatives markets, particularly for asset classes with products subject to the clearing obligation. Looking at the share of initial margins posted by clients at some major internationally

⁵⁵ Client clearing is typically offered to clients within a wider bundle of services including secured lending and custody arrangements.

⁵⁶ According to EMIR, for instance, the clearing obligation applies both to financial counterparties (such as investment firms, credit institutions, insurance and reinsurance companies) and to non-financial counterparties with positions in over-the-counter (OTC) derivatives contracts above certain clearing thresholds.

⁵⁷ We refer to data retrieved from the public disclosures made by CCPs in accordance with the CPMI-IOSCO *Public quantitative disclosure standards for central counterparties*.

active CCPs established in Europe⁵⁸, it turns out that in 2021 client clearing accounted for around 62% and 21% of clearing activity respectively in Interest Rate Swaps (IRSs) and Credit Default Swaps (CDSs) (the lower share for the latter can be linked to the high concentration of this market among few counterparties, typically having clearing member status). Things are different, however, for the repo market, where the share of transactions that are centrally cleared on behalf of clients remains limited – on average lower than 1% at CC&G and LCH SA in 2021 – and the benefits of central clearing do not encompass a significant part of the financial system. As further explained in 4.2.2, new models may facilitate greater access to central clearing by clients, with a positive impact on market functioning and allowing to reap the full benefits of central clearing in terms of financial stability.

4.2.1 The economics of client clearing

In Europe, traditional client clearing relationships are consistent with the ‘principal model’, whereby the client has no contractual relationship with the CCP, but rather there are bilateral contracts between the client and the CCSP and, separately, between the CCSP and the CCP. Under this model, the CCSP has an interest in avoiding any mismatches between the contractual obligations assumed against the CCP and those imposed on his clients in order to minimize possible “asymmetry costs”, especially for what concerns margin requirements. For example, CCSPs have an interest in scheduling margin calls to their clients in accordance with the timing of margin calls set by CCPs, so as to mitigate the liquidity risk related to uncovered margin calls. Similarly, CCSPs typically define the scope of assets accepted as collateral from their clients in accordance with the collateral eligibility criteria adopted by CCPs. This was confirmed by the analysis conducted by the Derivatives Assessment Team – DAT (BCBS-CPMI-FSB-IOSCO, 2018), according to which clauses on the “timeliness of margin/collateral posting requirements” and “types of acceptable collateral” were the most frequent in client clearing contracts. Of course, the very amount of margins that a CCSP charges to his clients shall be at least equal to the amount that the CCSP must post to the CCP. Under net margining, CCSPs can net together the long and short positions of different clients and post margin on aggregate net positions. Under gross margining, margins must be sufficient to cover the gross positions of clients. As noted by Pliquett (2016), in either case the CCSP collects the same minimum amount of margin from his clients, the main difference lying in the proportion of client margin that CCSPs are required to pass through to the CCP. Similarly, fees are typically calculated as the sum between a CCP pass-through fee and other components, such as registration and maintenance fees and/or fees related to the cost of capital.

From the perspective of a CCSP, passing a CCP’s request for prefunded financial resources and fees onto clients is not sufficient to ensure a satisfactory profit margin. This is even more the case considering that CCSPs incur higher costs compared to other clearing members, stemming from different regulatory requirements aimed at tackling the risks associated with client clearing chains (see Section 4.2). Reference is made to EMIR, which requires CCSPs to have “*the necessary additional financial resources and operational capacity*” to clear transactions on behalf of their clients (Article 37(3)), Commission Delegated Regulation (EU) No 2017/2154, which requires clearing members to specify the minimum financial resources and operational capacity requirements for clients that provide indirect clearing services (Article 4), as well as the Basel framework, which requires CCSPs to always capitalize their exposures to clients irrespective of whether the CCSP is acting as an intermediary between the client and the CCP.⁵⁹ Additionally, it ought to be considered

⁵⁸ LCH Ltd (UK) and Eurex Clearing (DE) were considered for IRSs; LCH SA (FR) and ICE Clear Europe (UK) for CDSs.

⁵⁹ However, initial margin posted by clients to their CCSP (and passed on to the CCP) mitigates the exposure the CCSP has against these clients. The same treatment applies, in an analogous fashion, to multi-level client structures (between a higher-level client and a lower-level client).

that banking capital requirements are generally heavier for repos than for derivatives,⁶⁰ which proportionally increases the cost of providing client clearing services in the case of repo clearing.

The limited profitability of client clearing services has turned out to be an issue. In the first place, it has resulted in the imposition of restrictions on some clients' trading and/or hedging activities (e.g. in the form of minimum fees and/or caps on initial margins and notional outstanding)⁶¹ with the aim to limit the amount of risk or the balance sheet exposure that a client can negotiate. CCSPs can place restrictions either at the time of concluding the client clearing contract or after that, with a view to optimizing their risk-adjusted profit targets as they actively manage client relationships. Restrictions can turn out to be particularly impactful for smaller clients or for clients with more directional portfolios, and eventually translate into off-boarding if clients do not have sufficient transaction flow to cover the cost of providing clearing services.

Moreover, the low profitability of the client clearing business helps explain the limited offer of traditional client clearing services in markets that are not subject to the clearing obligation, the repo market being at the forefront, and more generally the very significant concentration characterizing their provision. In this respect, the analysis performed by the DAT in 2018 showed that the amount of centrally cleared client trading activity passing through the top five clearing members across the US, the UK and Japan exceeded 80% for IRSs in terms of notional value. Concentration may exacerbate access related issues, such as difficulties in finding a CCSP with sufficient client clearing capacity and/or a back-up CCSP that is willing to on-board clients in the event of default of the primary CCSP.

4.2.2 Towards new access models

With the aim to address the shortcomings of traditional client clearing, over recent years CCPs have designed new access models shifting certain typical responsibilities of CCSPs to clients, thus lowering the costs of CCSP intermediation (or avoiding it at all) and opening new access opportunities for clients, without asking them to bear the full costs of direct membership.

CPMI-IOSCO (2022) distinguished between 'sponsored access models' and 'direct access models' (Figure 8). Under sponsored access,⁶² the 'sponsor' remains usually responsible for paying the default fund contributions related to the positions of his clients, which in turn discharge typical CCSP responsibilities (e.g. providing initial margin). Under direct access, clients can access CCP services without any intermediation, but with a waiver from (at minimum) the default fund contribution requirement.⁶³ In fact, sponsored access models can be easily thought of as an evolution of traditional client clearing models, whereas direct access models are rather close to access models available to clearing members.

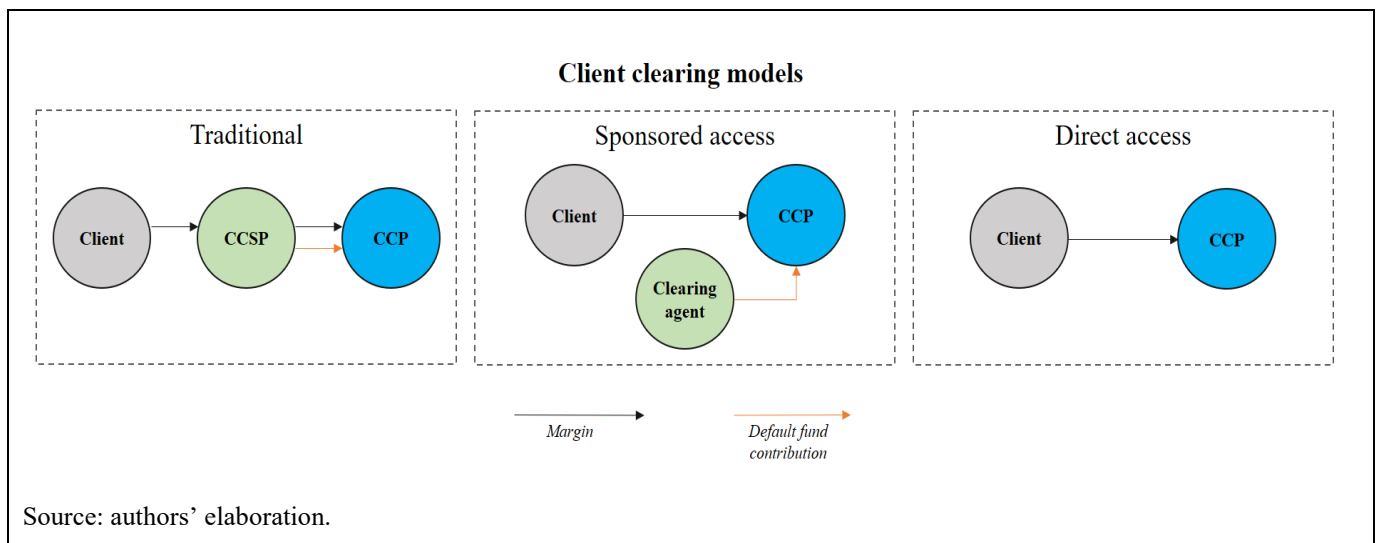
⁶⁰ Especially so after 2019, when the Basel Committee on Banking Supervision agreed to revise the LR treatment of client cleared derivatives so as to permit both cash and non-cash forms of initial margin and variation margin received from a client to offset the replacement cost and potential future exposure for client cleared derivatives only. To be eligible for offset, the initial margin that a bank has received from a client must be subject to appropriate segregation by the bank as defined in the relevant jurisdiction. The revision became applicable on 1 January 2022. On the other hand, the current LR framework does not consider the mitigation of risk given by the collateral of repo operations and CCSPs are not allowed to net the bilateral exposures across their clients, involving the recording of the gross repo exposure on their balance sheet.

⁶¹ Caps expressed in terms of notional outstanding, rather than through the margin proxy, can turn out to be more binding for clients' trading and/or hedging activity, especially in the case of less risky transactions.

⁶² Emerging 'sponsored guaranteed' models – whereby the sponsor is fully responsible for covering losses associated with the default of its clients, even beyond the default fund contribution – fall within this category.

⁶³ The direct access model typically applies to entities with low credit risk, such as public pension funds.

Figure 8: Client clearing models: traditional vs new access models



At the macro-level, new access models, as opposed to more complex indirect compensation structures, may help mitigate the concentration risk characterizing the client clearing industry. This could eventually improve market liquidity, because of the reduced clearing costs that could in turn lead to lower trading costs. On the other hand, as highlighted by Baranova *et al.* (2023), it is still possible that only a small number of banks may continue to offer sponsored clearing services or otherwise account for a large volume of activity.

Table 2 provides additional insight into the main (perceived) costs, risks and benefits of new access models for different categories of actors, distinguishing between CCPs, CCSPs and clients. From a CCP perspective, new access models bring in new categories of direct clearing participants, possibly with different risk profiles to be managed, and introduce additional mutualization risk, due to the potential need to cover losses resulting from the default of new participants which would otherwise have been shielded by CCSPs. Related to this, for sponsored access models in particular, risks may arise from the lack of legal certainty regarding how the sponsorship contract assigns roles and obligations in the event of default (especially in the case of a simultaneous default of the sponsor and the sponsored member), which may ultimately impair the effectiveness of a CCP's default management rules.⁶⁴ Turning to CCSPs, they can benefit from increased capital efficiencies and are less exposed to liquidity risk (as clients are directly exposed to CCPs and responsible for posting initial and variation margins); still, under sponsored access models they need to guarantee the exposure of their clients in case of default.⁶⁵ Finally, there are multiple expected benefits for clients, especially linked to increased netting possibilities, although the costs of getting access to CCPs remain significant, making access by smaller clients difficult,⁶⁶ and there are risks related to the possibility of a sponsor default – especially the risk that clients may be declared in technical default and off-boarded if they fail to establish a contractual relationship with a new sponsor within a compressed timeframe and/or if the waterfall contributions related to their positions remain uncovered.

⁶⁴ On the other hand, in the case of direct access models, the risk of a direct participant's default should be relatively low, given that clients benefitting from these models are typically public entities or entities backed by public support. CCPs still need to cover stressed losses of direct members, and typically do so through multiplied margin requirements. Therefore, the CCPs' ability to correctly calibrate margins acquires special significance.

⁶⁵ Either limited to the default fund contribution or, under 'sponsored guaranteed' models, fully.

⁶⁶ According to ISDA (2022), this is not necessarily an issue as the move of larger clients to new access models can free up capacity at CCSPs for other (smaller) clients.

Eventually, the business case for new access models varies across asset classes. When it comes to the distinction between derivatives clearing and repo clearing, the possibility to benefit from balance sheet offsets and a reduction in capital charges when compared to similar activity carried out through traditional client clearing or bilaterally makes new access models particularly attractive for the latter.⁶⁷ This is consistent with the finding that the market is more mature for repos than for derivatives (CPMI-IOSCO, 2022).

Table 2: Main costs, risks and benefits of new access models

	CCPs	CCSPs	Clients
Costs/Risks	<ul style="list-style-type: none"> • Exposure to counterparty risk of new categories of participants (with different risk profiles) • Additional mutualization risk • Legal certainty issues related to sponsored clearing contracts 	<ul style="list-style-type: none"> • Under sponsored access models, payment to the default fund or unlimited guarantee in case of sponsored client’s default 	<ul style="list-style-type: none"> • High costs (especially operational and in terms of liquidity needed to meet margin calls) • Risks in case of sponsor default
Benefits	<ul style="list-style-type: none"> • Broadening of membership base 	<ul style="list-style-type: none"> • Increased capital efficiencies • Reduced liquidity risks • Reduced balance sheet constraints 	<ul style="list-style-type: none"> • Larger liquidity pool • Wider netting opportunities • Increased balance sheet capacity • Reduced bilateral credit risk and intra-day liquidity requirements thanks to settlement netting • Enhanced segregation and portability

Source: authors’ elaboration.

Sponsored models have a meaningful take up in the US, although some clients are unwilling to become sponsored members because the dealers (sponsors) may impose certain restrictions on client trading strategies (FSB, 2022). In the EU, there are currently two CCPs offering non-traditional access models for repo clearing: Eurex Clearing AG (Germany) with its Individual Segregated Account (ISA) Direct model⁶⁸ and LCH SA (France) with its Sponsored Clearing model, respectively since 2016 and 2021. Notwithstanding the use of the word ‘direct’ by Eurex Clearing, both are in fact sponsored access models, based on a new principal client relationship between clients and the CCP, with the traditional CCSP acting as clearing agent and still performing several functions. In particular, under the ISA Direct model offered by Eurex Clearing, the clearing agent is primarily responsible for the default management obligation and default fund contribution. Moreover, he can provide other

⁶⁷ See above on the higher costs of traditional client clearing, stemming from banking capital requirements, in the case of repos as opposed to derivatives.

⁶⁸ The same model is offered also for OTC interest rate swaps clearing.

optional services such as transaction management, cash management and collateral management. Under LCH SA's Sponsored Clearing model, in addition to providing the default fund contribution, the clearing agent is responsible for margin management and must post additional pre-funded resources to his sponsored member's default waterfall and a buffer for margin cover. For what concerns sponsored entities, ISA Direct membership is open to (re)insurance undertakings, pension funds, mutual funds and investment funds,⁶⁹ whereas sponsored membership at LCH SA is currently available to pension funds, insurance companies and credit institutions.

As for the Italian CCP, demand for new access models has so far been lacking, and only the traditional client clearing model is currently available to clients. However, things could change in the near future following the expected expansion of CC&G clearing services to all Euronext markets,⁷⁰ which, in the plan, will bring about an enlargement of the CCP's membership base. Although the expansion programme relates to the cash equity, listed derivatives and commodities markets, it cannot be excluded that new clearing members and their clients have an interest also in repo clearing at CC&G and possibly in the development of new models to access that section.

Unfortunately, the limited uptake of new access models (CPMI-IOSCO, 2022) makes at present difficult to gauge their actual merits. This is valid also for the assessment of the potential implications of opening new access opportunities for repo clearing at the Italian CCP. Further analysis on the factors contributing to this limited uptake⁷¹ would be needed to assess whether the design of existing solutions can be improved to effectively allow a wider scope of entities to enter the centrally cleared repo market. In principle, this should translate into greater market efficiency, helping mitigate unexpected dysfunction in the repo market, provided that the risks to CCP's resilience are duly contained, particularly those arising from the expansion of CCPs' membership base to new categories of market participants from the NBFIs sector.

5. Conclusions

The money market has undergone profound transformations in the last 15 years. The loss of trust triggered by the GFC fuelled an increase in activity in the repo market, which gradually substituted the unsecured segment. At the same time, CCPs have become fundamental players in the financial system, both for repos and derivatives. In this work, we tried to identify the main features of the repo market backed by government securities, and described the key characteristics of central clearing as well as the new challenges of the sector.

Repo markets fulfil several economic functions. Market participants use repos to manage their short-term funding and collateral needs. Dealers use repos to fund their bids on the primary market and quotes on the secondary market; moreover, they create offsetting positions through repos to hedge interest rate risk. For this reason, the greater is the liquidity and efficiency of a repo market, the better are the price discovery process and the liquidity of the primary and secondary government bond markets. The repo market represents also a pivotal tool for central banks operations: first, it enables central banks to implement monetary policy more efficiently by allowing for a smooth redistribution of liquidity across banks and non-banks, and secondly, it allows implementing securities lending

⁶⁹ In 2021 Eurex Clearing launched an ISA Direct Indemnified model for repo clearing, broadening the availability of ISA Direct to a greater range of market participants including hedge funds. In the "indemnified" variant, the clearing agent also provides an indemnity ensuring the fulfilment of the sponsored member's contractual obligations towards the CCP in a default scenario.

⁷⁰ CC&G is part of the Euronext group since April 2021. In November 2021 Euronext N.V. announced its intention to make CC&G (the only CCP belonging to the group) the CCP of choice for the clearing of Euronext markets.

⁷¹ Possible candidates are stringent access requirements, increased efficiency of individually segregated accounts offered to clients under traditional client clearing, and possibly loss of confidence into the benefits of direct membership after the default of Einar Aas at the Swedish CCP Nasdaq Clearing in 2018, as an occurrence of loss mutualization.

programmes. Lastly, an efficient repo market contributes to preventing settlement failures. Repo activity is also associated with risks impacting both the parties involved in the repo transaction and the broader financial system, and therefore this market is carefully monitored by central banks.

In recent years, also in connection with the rapid increase in issuances of government securities and the extraordinary programmes by central banks, the size of the repo market has grown significantly worldwide. Although repos can have longer and tailored maturities, they are largely concentrated in the one-day maturity bucket, implying that they need to be rolled on a (almost) daily frequency. This reason contributes to explain the very large daily turnover of repo markets in several advanced economies. Repo market structures worldwide can be classified along three significant dimensions: access criteria (interdealer vs dealer-to-customer), trading modalities (electronic vs OTC) and post-trading arrangements (bilaterally cleared, CCP cleared or tri-party). Market structures across core advanced economies tend to be rather homogenous, especially for interdealer, government securities-backed markets: they are largely electronic and centrally cleared, with transactions mostly executed on a CLOB or through RFQ protocols. On the contrary, the dealer-to-client segment is more heterogeneous and mostly based on bilateral agreements.

We identified three main forces that have been driving repo market dynamics in recent years: (i) collateral quality, (ii) excess liquidity and collateral scarcity, and (iii) the regulatory framework. These forces have a material impact on the market activity (i.e. traded repos), the level of interest rates applied (i.e. repo rates) as well as on market liquidity conditions (i.e. bid-ask spread, depth). In Europe, they unfold their effects more markedly at quarter-ends when banks are due to calculate the regulatory ratios and other charges based on their financial statements. Firstly, the higher the quality of the underlying collateral, the greater is the downward pressure on repo rates, as market participants are willing to lend their liquidity at a cheaper rate in order to borrow a safer security. Secondly, the unconventional monetary policy has had a critical role in shaping both activity and repo rates: excess liquidity and collateral scarcity induced by the easing tools implemented by the ECB implied a shift of the activity from the GC to the SR segment; furthermore, repo rates turned negative as they followed strictly the DFR. Lastly, the regulatory reforms process called by the Basel Committee on Banking Supervision (BCBS), and in particular the introduction of the LR, have been related to a window dressing activity by banks that amplified repo rates volatility and lowered market liquidity at quarter-end.

We also provided details on the microstructure of the Italian interdealer repo market, whose transactions are largely concentrated on MTS Repo, a fully electronic and largely centrally cleared platform. The existence of an interoperability link between the Italian and the French CCPs for the clearing of transactions on MTS Repo facilitates the smooth exchange of collateral between market participants of different jurisdictions and makes it easier for Italian intermediaries to access financing from abroad even during acute phases of market volatility.

More generally, we noted that the recent evolution of repo markets has been marked by a significant increase in the use of CCP services by market participants, even in the absence of a central clearing mandate. Amongst other factors, this can be linked to the significance of the netting benefits stemming from central clearing, which allow to free balance sheet space providing relief from certain regulatory constraints like the LR. However, we emphasized that only a subset of repo market participants, in Italy as well as in other jurisdictions, can enjoy the benefits of central clearing. A non-negligible portion of entities, mostly from the NBFIs sector, lacks direct access to CCP services for their repo operations and faces limitations in accessing client clearing services. In fact, the provision of traditional client clearing services is not profitable and is therefore concentrated in a few large CCSPs.

In recent years, to meet the demand for central clearing services from entities that have historically participated as clients, some CCPs have implemented new access models, like sponsored and direct access models. These models shift certain typical responsibilities of CCSPs to clients,

thereby lowering the costs of CCSP intermediation (or eliminating it at altogether) and opening up new access opportunities for clients, while posing specific risks, the majority of which are supposed to materialize in case of a sponsor's or client's default. In conclusion, we argued that the introduction of these models may favour market efficiency and help mitigate unexpected dysfunctions in the repo market by encouraging greater recourse to repo clearing by NBFIs, provided that the risks to CCP's resilience are duly contained. To this end, it is crucial for CCPs to recognize that NBFIs have different profiles compared to traditional bank clearing members (being subject to different legal, liquidity and solvency restrictions), and to be capable of identifying, monitor and manage the associated risks. Further research would be needed to understand the reasons for the limited uptake of existing models and, more generally, to ensure that the benefits for market liquidity and resilience largely outweigh the costs.

References

- Adrian, T., Kiff, J., & Shin, H. S. (2018). Liquidity, leverage, and regulation 10 years after the global financial crisis. *Annual Review of Financial Economics*, 10, 1-24.
- Allahrakha, M., Cetina, J., & Munyan, B. (2018). Do higher capital standards always reduce bank risk? The impact of the Basel leverage ratio on the US triparty repo market. *Journal of Financial Intermediation*, 34, 3-16.
- Anbil, S., & Senyuz, Z. (2018). The regulatory and monetary policy nexus in the repo market. FEDS Working Paper No. 2018-27.
- Anderson, S., Dion, J. P., & Pérez Saiz, H. (2013). To link or not to link? Netting and exposures between central counterparties. Bank of Canada Working Paper No. 2013-6.
- Arrata, W., Nguyen, B., Rahmouni-Rousseau, I., & Vari, M. (2020). The scarcity effect of QE on repo rates: Evidence from the euro area. *Journal of Financial Economics*, 137(3), 837-856.
- Baklanova, V., Dalton, O., & Tompaidis, S. (2017). Benefits and risks of central clearing in the repo market. OFR Brief Series, No. 17-04.
- Baldo, L., Pasqualone, F., & Scalia, A. (2020). Repo market and leverage ratio in the euro area. Bank of Italy Occasional Paper No. 551.
- Baranova, Y., Holbrook, E., MacDonald, D., Rawstorne, W., Vause, N., & Waddington, G. (2023). The potential impact of broader central clearing on dealer balance sheet capacity: a case study of UK gilt and gilt repo markets. Bank of England Staff Working Paper No. 1026.
- Barth, D. & Kahn, R. (2023). Hedge Funds and the Treasury Cash-Futures Disconnect. Working Papers 21-01, Office of Financial Research, US Department of the Treasury.
- Bassi, C., Behn, M., Grill, M., & Waibel, M. (2023). Window dressing of regulatory metrics: evidence from repo markets. ECB Working Paper No. 2023/2771.
- BCBS-CPMI-FSB-IOSCO (2018). Incentives to centrally clear over-the-counter (OTC) derivatives. A post-implementation evaluation of the effects of the G20 financial regulatory reforms. Retrieved from [Incentives to centrally clear over-the-counter \(OTC\) derivatives \(bis.org\)](https://www.bis.org/publ/otc2018.htm).
- Benos, E., Ferrara, G., & Ranaldo, A. (2023). Collateral cycles. Bank of England Staff Working Paper No. 966.
- Bicu-Lieb, A., Chen, L., & Elliott, D. (2020). The leverage ratio and liquidity in the gilt and gilt repo markets. *Journal of Financial Markets*, 48, 100510.
- Billio, M., Costola, M., Mazzari, F., & Pelizzon, L. (2020). The European Repo Market, ECB Intervention and the COVID-19 Crisis. In Billio, M. & Varotto, S. (eds.). *A New World Post COVID-19. Lessons for Business, the Finance Industry and Policy Makers*, 58-67.

- Brand, C., Ferrante, L., & Hubert de Fraisse, A. (2019). From cash-to securities-driven euro area repo markets: the role of financial stress and safe asset scarcity. ECB Working Paper No. 2232.
- Bucalossi, A., & Scalia, A. (2016). Leverage ratio, central bank operations and repo market. Bank of Italy Occasional Paper No. 347.
- CGFS (2017). Repo Market functioning. CGFS Papers No. 59.
- Cœuré, B. (2019). A tale of two money markets: fragmentation or concentration. Speech at the ECB workshop on money markets, monetary policy implementation and central bank balance sheets (Vol. 12).
- Cont, R. (2017). Central clearing and risk transformation. Norges Bank Research Working Paper No 3/2017.
- Cont, R., & Kokholm, T. (2014). Central clearing of OTC derivatives: bilateral vs multilateral netting. *Statistics & Risk Modeling*, 31(1), 3-22.
- Copeland, A., Martin, A., & Walker, M. (2014). Repo runs: Evidence from the tri-party repo market. *The Journal of Finance*, 69(6), 2343-2380.
- Corradin, S., Eisenschmidt, J., Hoerova, M., Linzert, T., Schepens, G., & Sigaux, J. D. (2020). Money markets, central bank balance sheet and regulation. ECB Working Paper No. 20202483.
- Corradin, S., & Maddaloni, A. (2020). The importance of being special: repo markets during the crisis. *Journal of Financial Economics*, 137(2), 392-429.
- CPMI-IOSCO (2022). Client clearing: access and portability. Retrieved from <https://www.bis.org/cpmi/publ/d210.htm>
- CPSS (2010). Strengthening repo clearing and settlement arrangements. Retrieved from <https://www.bis.org/cpmi/publ/d91.htm>
- Della Gatta, D. (2022). What's ahead for euro money market benchmarks?. Bank of Italy Markets, Infrastructures, Payment Systems Working Paper No. 17.
- DTCC (2021). More clearing, less risk: increasing centrally cleared activity in the U.S. Treasury cash market. A white paper to the industry. Retrieved from [Increasing Centrally Cleared Activity in the U.S. Market | DTCC](#)
- Duffie, D. (1996). Special repo rates. *The Journal of Finance*, 51(2), 493-526.
- Duffie, D. (2020). Still the World's Safe Haven? Redesigning the US Treasury market after the COVID-19 crisis. Hutchins Center Working Paper No 62.
- Duffie, D. (2022). Fragmenting Markets: Post-crisis Bank Regulations and Financial Market Liquidity. Walter de Gruyter GmbH & Co KG.
- Duffie, D., Scheicher, M., & Vuillemeys, G. (2015). Central clearing and collateral demand. *Journal of Financial Economics*, 116(2), 237-256.

ECB (2021). Euro money market study 2020. Retrieved from https://www.ecb.europa.eu/pub/euromoneymarket/pdf/ecb.euromoneymarket202104_study.en.pdf

ECB (2023). Euro money market study 2022. Retrieved from <https://www.ecb.europa.eu/pub/euromoneymarket/pdf/ecb.euromoneymarket202204.en.pdf>

Faruqui, U., Huang, W., & Takats, E. (2018). Clearing risks in OTC derivatives markets: the CCP-bank nexus. BIS Quarterly Review. Retrieved from [Clearing risks in OTC derivatives markets:the CCP-bank nexus \(bis.org\)](https://www.bis.org/quarterlyreview/201803/clearing_risks_in_otc_derivatives_markets_the_ccp-bank_nexus.htm)

Fisher, M. (2002). Special repo rates: An introduction. Economic Review-Federal Reserve Bank of Atlanta, 87(2), 27-44.

Fleming, M. J., & Keane, F. M. (2021). The netting efficiencies of marketwide central clearing. Federal Reserve Bank of New York Staff Report No 964.

FSB (2011). Shadow Banking: Strengthening Oversight and Regulation. Recommendations of the Financial Stability Board. Retrieved from https://www.fsb.org/2011/10/r_111027a/

FSB (2013). Strengthening Oversight and Regulation of Shadow Banking. Policy Framework for Addressing Shadow Banking Risks in Securities Lending and Repos. Retrieved from https://www.fsb.org/2013/08/r_130829b/

FSB (2022). Liquidity in Core Government Bond Markets. Retrieved from <https://www.fsb.org/2022/10/liquidity-in-core-government-bond-markets/>

Gorton, G., & Metrick, A. (2012). Securitized banking and the run on repo. Journal of Financial Economics, 104(3), 425-451.

Hempel, S. J., Kahn, R. J., Mann, R., & Paddrik, M. E. (2023). Why Is So Much Repo Not Centrally Cleared?. OFR Brief Series 23-01.

ICMA (2019). Frequently asked questions on Repo. Retrieved from <https://www.icmagroup.org/market-practice-and-regulatory-policy/repo-and-collateral-markets/icma-ercc-publications/frequently-asked-questions-on-repo/>

ICMA (2023). European Repo Market Survey (conducted June 2023). Retrieved from <https://www.icmagroup.org/market-practice-and-regulatory-policy/repo-and-collateral-markets/market-data/icma-repo-survey/>

ISDA (2022). Response to the CPMI/IOSCO discussion paper on Client clearing: access and portability. Retrieved from [ISDA-CPMI-IOCSO-Client-Clearing.pdf](https://www.isda.org/2022/07/15/ISDA-CPMI-IOCSO-Client-Clearing.pdf)

Koijen, R. S., Koulischer, F., Nguyen, B., & Yogo, M. (2017). Euro-area quantitative easing and portfolio rebalancing. American Economic Review, 107(5), 621-627.

Kotidis, A., & Van Horen, N. (2018). Repo market functioning: The role of capital regulation. CEPR Discussion Paper No. DP13090.

- Krishnamurthy, A., Nagel, S., & Orlov, D. (2014). Sizing up repo. *The Journal of Finance*, 69(6), 2381-2417.
- Mancini, L., Ranaldo, A., & Wrampelmeyer, J. (2016). The euro interbank repo market. *The Review of Financial Studies*, 29(7), 1747-1779.
- Market Committee (MC, 2019). Large central bank balance sheets and market functioning. MC paper No. 11.
- McCormick, M., Paddrik, M. E., & Ramirez, C. (2021). The Dynamics of the US Overnight Triparty Repo Market. FEDS Notes No. 2021-08-02.
- Menkveld, A. J., & Vuillemeij, G. (2021). The economics of central clearing. *Annual Review of Financial Economics*, 13, 153-178.
- Miglietta, A., Picillo, C., & Pietrunti, M. (2019). The impact of margin policies on the Italian repo market. *The North American Journal of Economics and Finance*, 50, 100998.
- Munyan, B. (2015). Regulatory arbitrage in repo markets. Office of Financial Research Working Paper No. 15-22.
- Núñez, S., & Valdeolivas, E. (2019). Central clearing counterparties: benefits, costs and risks. *Financial Stability Review*, Spring, Bank of Spain.
- Paddrik, M. E., Young, H. P., Kahn, R. J., McCormick, M. J., & Nguyen, V. (2023). Anatomy of the Repo Rate Spikes in September 2019. OEFR Working Paper 23-04.
- Panetta, F. (2023). Central clearing in turbulent times: frontiers in regulation and oversight. Keynote speech at the Fifth Joint Deutsche Bundesbank, European Central Bank and Federal Reserve Bank of Chicago Conference on CCP Risk Management. Retrieved from [Central clearing in turbulent times: frontiers in regulation and oversight \(europa.eu\)](https://www.europa.eu/central-clearing-in-turbulent-times)
- Pliquett, A. (2016). CCPs: A Challenge for Practical Oversight. In Diehl, M.; Alexandrova-Kabadjova, B.; Heuver, R.; Martinez-Jaramillo, S. (eds.). *Analyzing the Economics of Financial Market Infrastructures*. IGI Global.
- Ranaldo, A., Schaffner, P., & Vasios, M. (2021). Regulatory effects on short-term interest rates. *Journal of Financial Economics*, 141(2), 750-770.
- Schaffner, P., Ranaldo, A., & Tsatsaronis, K. (2019). Euro repo market functioning: collateral is king. *BIS Quarterly Review*, December.
- Schrimpf, A., Shin, H.S., and Sushko, V. (2020). Leverage and Margin Spirals in Fixed Income Markets during the Covid-19 Crisis. *BIS Bulletin*, 2.
- SIFMA (2022). US Repo Markets: A Chart Book. Retrieved from <https://www.sifma.org/resources/research/us-repo-market-chart-book/>
- Wendt, F. (2015). Central Counterparties: Addressing their Too Important to Fail Nature. IMF Working Paper WP/15/21.

PAPERS PUBLISHED IN THE 'MARKETS, INFRASTRUCTURES, PAYMENT SYSTEMS' SERIES

- n. 1 TIPS - TARGET Instant Payment Settlement – The Pan-European Infrastructure for the Settlement of Instant Payments, *by Massimiliano Renzetti, Serena Bernardini, Giuseppe Marino, Luca Mibelli, Laura Ricciardi and Giovanni M. Sabelli* (INSTITUTIONAL ISSUES)
- n. 2 Real-Time Gross Settlement systems: breaking the wall of scalability and high availability, *by Mauro Arcese, Domenico Di Giulio and Vitangelo Lasorella* (RESEARCH PAPERS)
- n. 3 Green Bonds: the Sovereign Issuers' Perspective, *by Raffaele Doronzo, Vittorio Siracusa and Stefano Antonelli* (RESEARCH PAPERS)
- n. 4 T2S - TARGET2-Securities – The pan-European platform for the settlement of securities in central bank money, *by Cristina Mastropasqua, Alessandro Intonti, Michael Jennings, Clara Mandolini, Massimo Maniero, Stefano Vespucci and Diego Toma* (INSTITUTIONAL ISSUES)
- n. 5 The carbon footprint of the Target Instant Payment Settlement (TIPS) system: a comparative analysis with Bitcoin and other infrastructures, *by Pietro Tiberi* (RESEARCH PAPERS)
- n. 6 Proposal for a common categorisation of IT incidents, *by Autorité de Contrôle Prudentiel et de Résolution, Banca d'Italia, Commissione Nazionale per le Società e la Borsa, Deutsche Bundesbank, European Central Bank, Federal Reserve Board, Financial Conduct Authority, Ministero dell'Economia e delle Finanze, Prudential Regulation Authority, U.S. Treasury* (INSTITUTIONAL ISSUES)
- n. 7 Inside the black box: tools for understanding cash circulation, *by Luca Baldo, Elisa Bonifacio, Marco Brandi, Michelina Lo Russo, Gianluca Maddaloni, Andrea Nobili, Giorgia Rocco, Gabriele Sene and Massimo Valentini* (RESEARCH PAPERS)
- n. 8 The impact of the pandemic on the use of payment instruments in Italy, *by Guerino Ardizzi, Alessandro Gambini, Andrea Nobili, Emanuele Pimpini and Giorgia Rocco* (RESEARCH PAPERS) (in Italian)
- n. 9 TARGET2 – The European system for large-value payments settlement, *by Paolo Bramini, Matteo Coletti, Francesco Di Stasio, Pierfrancesco Molina, Vittorio Schina and Massimo Valentini* (INSTITUTIONAL ISSUES) (in Italian)
- n. 10 A digital euro: a contribution to the discussion on technical design choices, *by Emanuele Urbinati, Alessia Belsito, Daniele Cani, Angela Caporini, Marco Capotosto, Simone Folino, Giuseppe Galano, Giancarlo Goretti, Gabriele Marcelli, Pietro Tiberi and Alessia Vita* (INSTITUTIONAL ISSUES)
- n. 11 From SMP to PEPP: a further look at the risk endogeneity of the Central Bank, *by Marco Fruzzetti, Giulio Gariano, Gerardo Palazzo and Antonio Scalia* (RESEARCH PAPERS)
- n. 12 TLTROs and collateral availability in Italy, *by Annino Agnes, Paola Antilici and Gianluca Mosconi* (RESEARCH PAPERS) (in Italian)
- n. 13 Overview of central banks' in-house credit assessment systems in the euro area, *by Laura Auria, Markus Bingmer, Carlos Mateo Caicedo Graciano, Clémence Charavel, Sergio Gavilá, Alessandra Iannamorelli, Aviram Levy, Alfredo Maldonado, Florian Resch, Anna Maria Rossi and Stephan Sauer* (INSTITUTIONAL ISSUES)
- n. 14 The strategic allocation and sustainability of central banks' investment, *by Davide Di Zio, Marco Fanari, Simone Letta, Tommaso Perez and Giovanni Secondin* (RESEARCH PAPERS) (in Italian)

- n. 15 Climate and environmental risks: measuring the exposure of investments, *by Ivan Faiella, Enrico Bernardini, Johnny Di Giampaolo, Marco Fruzzetti, Simone Letta, Raffaele Loffredo and Davide Nasti* (RESEARCH PAPERS)
- n. 16 Cross-Currency Settlement of Instant Payments in a Multi-Currency Clearing and Settlement Mechanism, *by Massimiliano Renzetti, Fabrizio Dinacci and Ann Börestam* (RESEARCH PAPERS)
- n. 17 What's ahead for euro money market benchmarks?, *by Daniela Della Gatta* (INSTITUTIONAL ISSUES) (in Italian)
- n. 18 Cyber resilience per la continuità di servizio del sistema finanziario, *by Boris Giannetto and Antonino Fazio* (INSTITUTIONAL ISSUES) (in Italian)
- n. 19 Cross-Currency Settlement of Instant Payments in a Cross-Platform Context: a Proof of Concept, *by Massimiliano Renzetti, Andrea Dimartina, Riccardo Mancini, Giovanni Sabelli, Francesco Di Stasio, Carlo Palmers, Faisal Alhijawi, Erol Kaya, Christophe Piccarelle, Stuart Butler, Jwallant Vasani, Giancarlo Esposito, Alberto Tiberino and Manfredi Caracausi* (RESEARCH PAPERS)
- n. 20 Flash crashes on sovereign bond markets – EU evidence, *by Antoine Bouveret, Martin Haferkorn, Gaetano Marseglia and Onofrio Panzarino* (RESEARCH PAPERS)
- n. 21 Report on the payment attitudes of consumers in Italy: results from ECB surveys, *by Gabriele Coletti, Alberto Di Iorio, Emanuele Pimpini and Giorgia Rocco* (INSTITUTIONAL ISSUES)
- n. 22 When financial innovation and sustainable finance meet: Sustainability-Linked Bonds, *by Paola Antilici, Gianluca Mosconi and Luigi Russo* (INSTITUTIONAL ISSUES) (in Italian)
- n. 23 Business models and pricing strategies in the market for ATM withdrawals, *by Guerino Ardizzi and Massimiliano Cologgi* (RESEARCH PAPERS)
- n. 24 Press news and social media in credit risk assessment: the experience of Banca d'Italia's In-house Credit Assessment System, *by Giulio Gariano and Gianluca Viggiano* (RESEARCH PAPERS)
- n. 25 The bonfire of banknotes, *by Michele Manna* (RESEARCH PAPERS)
- n. 26 Integrating DLTs with market infrastructures: analysis and proof-of-concept for secure DvP between TIPS and DLT platforms, *by Rosario La Rocca, Riccardo Mancini, Marco Benedetti, Matteo Caruso, Stefano Cossu, Giuseppe Galano, Simone Mancini, Gabriele Marcelli, Piero Martella, Matteo Nardelli and Ciro Oliviero* (RESEARCH PAPERS)
- n. 27 Statistical and forecasting use of electronic payment transactions: collaboration between Bank of Italy and Istat, *by Guerino Ardizzi and Alessandra Righi* (INSTITUTIONAL ISSUES) (in Italian)
- n. 28 TIPS: a zero-downtime platform powered by automation, *by Gianluca Caricato, Marco Capotosto, Silvio Orsini and Pietro Tiberi* (RESEARCH PAPERS)
- n. 29 TARGET2 analytical tools for regulatory compliance, *by Marc Glowka, Alexander Müller, Livia Polo Friz, Sara Testi, Massimo Valentini and Stefano Vespucci* (INSTITUTIONAL ISSUES)
- n. 30 The security of retail payment instruments: evidence from supervisory data, *by Massimiliano Cologgi* (RESEARCH PAPERS)
- n. 31 Open Banking in the payment system: infrastructural evolution, innovation and security, supervisory and oversight practices, *by Roberto Pellitteri, Ravenio Parrini, Carlo Cafarotti and Benedetto Andrea De Vendictis* (INSTITUTIONAL ISSUES) (in Italian)

- n. 32 Banks' liquidity transformation rate: determinants and impact on lending, *by Raffaele Lenzi, Stefano Nobili, Filippo Perazzoli and Rosario Romeo* (RESEARCH PAPERS)
- n. 33 Investor behavior under market stress: evidence from the Italian sovereign bond market, *by Onofrio Panzarino* (RESEARCH PAPERS)
- n. 34 Siamese neural networks for detecting banknote printing defects, *by Katia Boria, Andrea Luciani, Sabina Marchetti and Marco Viticoli* (RESEARCH PAPERS) (in Italian)
- n. 35 Quantum safe payment systems, *by Elena Buccioli and Pietro Tiberi*
- n. 36 Investigating the determinants of corporate bond credit spreads in the euro area, *by Simone Letta and Pasquale Mirante*
- n. 37 Smart Derivative Contracts in DatalogMTL, *by Andrea Colombo, Luigi Bellomarini, Stefano Ceri and Eleonora Laurenza*
- n. 38 Making it through the (crypto) winter: facts, figures and policy issues, *by Guerino Ardizzi, Marco Bevilacqua, Emanuela Cerrato and Alberto Di Iorio*
- n. 39 The Emissions Trading System of the European Union (EU ETS), *by Mauro Bufano, Fabio Capasso, Johnny Di Giampaolo and Nicola Pellegrini* (in Italian)
- n. 40 Banknote migration and the estimation of circulation in euro area countries: the Italian case, *by Claudio Doria, Gianluca Maddaloni, Giuseppina Marocchi, Ferdinando Sasso, Luca Serrai and Simonetta Zappa* (in Italian)
- n. 41 Assessing credit risk sensitivity to climate and energy shocks, *by Stefano Di Virgilio, Ivan Faiella, Alessandro Mistretta and Simone Narizzano*
- n. 42 Report on the payment attitudes of consumers in Italy: results from the ECB SPACE 2022 survey, *by Gabriele Coletti, Alberto Di Iorio, Emanuele Pimpini and Giorgia Rocco*
- n. 43 A service architecture for an enhanced Cyber Threat Intelligence capability and its value for the cyber resilience of Financial Market Infrastructures, *by Giuseppe Amato, Simone Ciccarone, Pasquale Digregorio and Giuseppe Natalucci*
- n. 44 Fine-tuning large language models for financial markets via ontological reasoning, *by Teodoro Baldazzi, Luigi Bellomarini, Stefano Ceri, Andrea Colombo, Andrea Gentili and Emanuel Sallinger*
- n. 45 Sustainability at shareholder meetings in France, Germany and Italy, *by Tiziana De Stefano, Giuseppe Buscemi and Marco Fanari* (in Italian)
- n. 46 Money market rate stabilization systems over the last 20 years: the role of the minimum reserve requirement, *by Patrizia Ceccacci, Barbara Mazzetta, Stefano Nobili, Filippo Perazzoli and Mattia Persico*
- n. 47 Technology providers in the payment sector: market and regulatory developments, *by Emanuela Cerrato, Enrica Detto, Daniele Natalizi, Federico Semorile, Fabio Zuffranieri*

