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Central banks, debt managers, and specialness in the Bund repo market

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Abstract

Elevated repo rate specialness for German government bonds in 2016–17, and particularly in 2022-23, has often been linked to the absorption of these securities by the ECB's asset purchase programmes. We provide the first evidence on how the debt management office mitigates these effects by jointly analyzing daily secondary-market trades and repo operations of the Deutsche Finanzagentur (DFA) alongside Eurosystem transactions in Bunds from 2015–2024. We find two points: first, that Eurosystem purchases depress repo rates about four times more than DFA purchases (0.4 bp vs 0.1 bp per 1% of free float), while DFA repo lending raises repo rates by roughly 0.2 bp per 1% of outstanding volume. Our evidence suggests that DFA interventions helped mitigate scarcity-induced specialness. Second, with elevated hedge fund demand for bonds, the overall alleviating impact was constrained by segmentation in the repo market and by the design of the facilities themselves, which aimed to prevent collateral shortages and fails-to-deliver rather than to provide price support.

Keywords: Repo specialness; collateral scarcity; repo market; asset purchases; debt management.

JEL classification: E43, E52, E58, G12, G21, H63.

Non-technical Summary

This paper studies how public institutions influence the functioning of the German government bond repo market, with a particular focus on episodes when bonds become scarce and unusually expensive to borrow. Repo markets are a core part of modern financial systems: they allow banks and investors to borrow cash using government bonds as collateral and help transmit monetary policy to short-term funding conditions. When a specific bond is hard to obtain, repo rates for that bond fall well below normal funding rates, a situation known as "specialness." High specialness signals collateral scarcity and can disrupt market functioning.

The paper examines two major periods of stress in the Bund repo market, in 2016–17 and 2022–23, when specialness reached extreme levels. During these episodes, some German government bonds traded at repo rates up to 60 basis points below the ECB's deposit facility rate, indicating severe shortages of high-quality collateral. Previous research has shown that large-scale asset purchases by central banks can contribute to such shortages by removing bonds from the market. What has been largely missing from the literature is the role of national debt management offices, which actively manage government bond supply and can intervene both in bond and repo markets.

Using a unique dataset covering daily transactions from 2015 to 2024, the paper jointly analyzes the actions of two public actors: the Eurosystem (through ECB and Bundesbank bond purchases and securities lending), and the German Debt Management Office (the Deutsche Finanzagentur, DFA). Germany is an especially informative case because Bunds are the benchmark safe asset in the euro area and because the DFA is unusually active in secondary bond trading and repo operations.

The first key finding is that central bank bond purchases have a much stronger effect on repo market conditions than debt-management purchases. When the Eurosystem buys German government bonds, repo rates for those bonds fall significantly, reflecting increased scarcity. Quantitatively, a purchase equal to 1% of a bond's free float lowers its repo rate by about 0.4 basis points. The Eurosystem also acquired securities not readily available in dealers' inventories, requiring dealers to source the securities in the repo market, exerting pressure on repo rates. By contrast, DFA purchases reduce repo rates by only about one-fourth as much. This difference reflects the fact the DFA primarily bought securities actively offered by dealers and available in their inventories, with the DFA often reselling them within the same day to other dealers in

need of these securities. In line with this, DFA sales raise repo rates by a similar magnitude, easing scarcity.

The paper then shows that repo-based interventions are more effective than outright bond transactions to address collateral shortages. When the DFA lends bonds through repo operations, repo rates rise, indicating reduced specialness. A repo operation equal to 1% of a bond's outstanding volume raises repo rates by roughly 0.2 basis points, about twice the effect of DFA outright sales. This stronger impact arises because repo lending directly targets the market segment where scarcity appears, rather than gradually changing overall bond supply.

Importantly, the DFA actively responds to Eurosystem bond purchases. After the Eurosystem buys a specific bond, the DFA increases its lending of that bond in repo markets within days, and later supplements this with outright sales. This sequencing allows the DFA to offset collateral shortages without changing the overall level or maturity structure of public debt, and therefore without interfering with monetary policy objectives.

The paper also shows that debt-management actions can shift not only short-term repo rates but also the overall level of specialness. A large and targeted DFA intervention in October 2022, when the DFA retained sizable issuance amounts for its own portfolio, led to a clear and sustained reduction in specialness for the affected bonds. The DFA first deployed these bonds through repo lending to relieve immediate shortages, and only later sold them into the market once conditions had normalized.

Despite these powerful tools, the paper explains why public-sector interventions could not fully prevent extreme specialness during the 2022-2023 episode. The core reason lies in demand and market structure. Demand for specific Bunds, particularly from hedge funds that use them for hedging and arbitrage, surged sharply. At the same time, the repo market is segmented, which limits arbitrage across counterparties, and public facilities transact at market-clearing rates. As a result, while these facilities are effective in preventing outright shortages and settlement failures, they are not designed to eliminate scarcity premia.

1 Introduction

The repo market plays a central role in the modern financial system. It enables the creation of safe money-like claims, facilitates arbitrage across fixed-income markets, and is a key channel through which monetary policy affects funding conditions. Its importance is likely to increase further in the coming years. As central banks normalize their balance sheets and excess reserves decline, repo markets will play a growing role in redistributing liquidity across banks, while repo rates will become increasingly informative indicators of reserve scarcity and the stance of monetary policy implementation. At the same time, rising sovereign debt issuance has made well-functioning repo markets increasingly important for debt management, as they provide the financing infrastructure that supports both primary issuance and secondary-market liquidity.

Over the past decade, the repo market in German government securities experienced two episodes of stress, in 2016–17 and 2022–23. During these periods stress manifested in unusually expensive repo rates, a phenomenon known as "specialness".[1] These episodes were driven by scarcity of German government securities, i.e. the securities were hard to source in the market when needed as collateral for repo transactions. A growing body of research attributes this scarcity in part to large-scale asset purchases (LSAPs) by central banks, which withdraw high-quality collateral from the market (e.g., Arrata et al., 2020; Baltzer, Schlepper, and Speck, 2025; Carrera de Souza and Hudepohl, 2022; D'Amico, Fan, and Kitsul, 2018). However, existing work has disregarded the role of national debt management offices (DMOs), whose operations can materially influence the supply of high-quality collateral in both bond and repo markets. This omission arises partly because the U.S. Treasury does not intervene in secondary markets and partly because comparable data for euro area DMOs have historically been inaccessible. As a result, empirical assessments of specialness in the euro area have not incorporated potentially important DMO supply-side offsets.

This paper studies how monetary policy and sovereign debt management jointly shape repo market outcomes. We focus on a period during which both authorities intervened simultaneously and at unprecedented scale in secondary markets. Using a unique dataset that covers all daily secondary-market transactions of the Bundesrepublik Deutschland - Finanzagentur (DFA), the German DMO, combined with transaction records from the Deutsche Bundesbank (Bbk) and

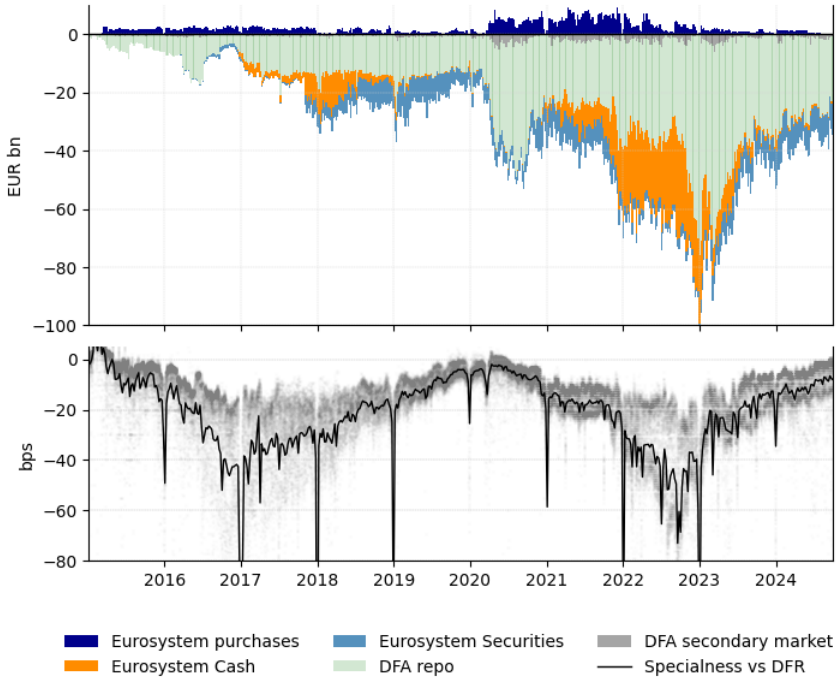
[1] Specialness captures the relative scarcity of a given security in the repo market and can be interpreted as the price of accessing that collateral, expressed as a deviation from funding rates. As such, it is shaped not only by the aggregate availability of collateral, but also by the composition of demand, the segmentation of market access, and the intermediation frictions faced by dealers.

the European Central Bank (ECB) from 2015 to 2024, we analyze the extent to which the DFA's bond market trading and repo operations mitigated the liquidity and scarcity effects induced by the Eurosystem's asset purchase programs, while explicitly accounting for the offsetting role of the Eurosystem's securities-lending facilities.

The German government bond market over the period 2015–2024 provides an especially informative setting for analysing repo specialness. First, the market experienced two extreme episodes of collateral scarcity in 2016–17 and 2022–23, during which the repo rate for "special" Bunds traded up to 60 basis points below the Deposit Facility Rate (DFR). These episodes underline the severity of collateral shortages and were the focus of market talk at the time. Second, the DFA is active both in the bond and repo market and therefore can directly alter the near-term supply of Bund collateral available to market participants. This institutional feature creates a unique environment in which central bank purchases and sovereign collateral-supply operations coexist at economically significant scale. At the peak of the 2022-23 specialness episode, the DFA was lending close to EUR 80 billion of securities daily, substantially larger than the Eurosystem's purchases and securities-lending programmes volumes (see Figure 1). Third, German government bonds constitute the benchmark safe asset for the euro area, implying that scarcity dynamics in this segment have system-wide implications and directly affect monetary policy transmission. Lastly, Germany exhibits a large gap between its share of outstanding sovereign debt and its capital-key-based purchase allocation under the Eurosystem's APP and PEPP programmes resulting in significant absorption of German government bonds for monetary policy purposes.

Our first main contribution is to quantify the security-specific supply and demand effects of DFA secondary-market operations (purchases, sales and repos) and Eurosystem purchases. We show that the impact of Eurosystem purchases on repo rates is roughly four times larger than that of DFA purchases. The Eurosystem also purchased securities that were not readily available in dealers' inventories, forcing dealers to source these securities through the repo market, which put pressure on repo rates. In contrast, the DFA mainly acquired securities actively offered by dealers and held in their inventories, frequently reselling them the same day to other dealers in need. The effect of DFA sales is of the same size but opposite sign to their purchases. The effect of DFA's repo operations, which we identify via an instrumental variable, is approximately twice as large as the corresponding estimate for the outright sales of securities, reflecting the more immediate and targeted nature of repo-based interventions. These results provide evidence on

Figure 1: Eurosystem and DFA secondary bond market operations



Note: In the upper panel, Eurosystem Cash shows the volume of German securities lent against cash via the Eurosystem's securities lending programme, Eurosystem Securities shows the volume of German securities lent against securities via the Eurosystem's securities lending programme, and DFA Repo shows the volume of German securities lent via repo operations by the DFA. In the lower panel, grey dots show the spread versus the DFR for all German government securities repo rates from BrokerTec. The black line represents the daily volume-weighted average across all ISINs.

the role of the DFA in alleviating scarcity.

Our second main contribution is to explain why repo rates became exceptionally expensive again in 2022–23 despite a historically large increase in public-sector collateral supply. Drawing on confidential trading data for members of the Bund Issues Auction Group, we show that demand from hedge funds for specific Bunds rose sharply and was intermediated by a relatively small number of dealers. Because dealer balance-sheet constraints and market segmentation limited arbitrage, the additional collateral supplied by the DFA and the Eurosystem did not fully translate into lower repo rates. This finding illustrates how market structure can dominate aggregate supply in determining repo market outcomes.

Taken together, our findings show that debt management operations can materially influence repo market outcomes but cannot fully offset collateral scarcity when demand surges or market frictions constrain arbitrage. These findings have important implications for both monetary policy and debt management. First, the implementation of monetary policy should account for repo market structure, as limits to dealer intermediation and market segmentation can amplify repo-rate pressures even when collateral supply is abundant. Second, active debt management

can improve bond market liquidity by alleviating specialness, thereby generating a convenience yield for the sovereign issuer in addition to supporting market functioning. More broadly, our results highlight the importance of considering monetary policy and debt management jointly when assessing collateral markets.

Our contribution relates to several strands of literature. First, we inform research on repo market functioning under stress. Early U.S. evidence shows that LSAPs generate local supply effects in cash markets (D'Amico and King, 2013) and scarcity effects in repo markets (D'Amico, Fan, and Kitsul, 2018). Fleming, Hrung, and Keane (2010) demonstrate that the Federal Reserve's Term Securities Lending Facility alleviated collateral scarcity by narrowing spreads between Treasury and less-liquid collateral. For the euro area, Arrata et al. (2020) and Corradin and Maddaloni (2020) document significant specialness effects arising from sovereign bond purchases during periods of market strain. Recent work from Poinelli et al. (2026) highlights the role played by inelastic demand investors such as hedge funds in driving specialness.[2] We complement these studies by quantifying the effect of the actions from the DMO on the repo market. In the particular case of Germany and the Bund repo market, the role played by the DFA is of central importance. Our works also corroborates existing literature on the unintended consequences of the Eurosystem's purchase programmes. Studies focusing on the APP (Baltzer, Schlepper, and Speck, 2025) and including the PEPP (Carrera de Souza and Hudepohl, 2022) find that securities-lending facilities attenuate but do not eliminate scarcity effects. Greppmair and Jank (2023) show that reducing lending fees increases market participation and alleviates rate dispersion. Relatedly, Jank and Moench (2018) document that scarcity is more pronounced for bonds predominantly held by strategic, price-inelastic investors (Breckenfelder and Falco, 2024), while Jank, Moench, and Schneider (2022) show that PSPP-induced scarcity accelerated the turnover of high-priced bonds among banks.

Second, our results contribute to the literature on how changes in the net supply of assets have an effect on prices. Previous studies have confirmed this for stocks (e.g., Shleifer, 1986; Kaul, Mehrotra, and Morck, 2000; Greenwood, 2005) and bonds (e.g., Brandt and Kavajecz, 2004; Lou, Yan, and J. Zhang, 2013; D'Amico and King, 2013), suggesting the presence of a "scarcity premium". D'Amico, Fan, and Kitsul (2018) show it is also present in the US repo market. Our paper confirms the existence of a scarcity premium in the Bund repo market.

[2]Hedge funds are considered inelastic demand investors since their demand in the repo market does not react strongly to prices. We explain their trading behaviour in detail in Section 5.

Third, our findings relate to the post-crisis literature on dealer intermediation and balance-sheet constraints. Recent studies for both the U.S. and the euro area (Huber, 2023; Eisenschmidt, Ma, and A. L. Zhang, 2024) decompose repo spreads into balance-sheet costs and dealer mark-ups, highlighting how constraints interact with collateral scarcity to shape repo pricing. We argue, that, in addition, the segmented nature of the euro area repo market was a further impediment to the overall intermediation capacity of the banking system.

Finally, our analysis draws on current debates concerning the design and effectiveness of public-sector backstop facilities. When facilities are priced at market prices, surges in demand result in price pressures, but the facilities guarantee that bonds can be found (even if at expensive prices). Understanding how DMO activities interact with central bank operations contributes to discussions on optimal collateral management and on mitigating adverse side effects of LSAPs, particularly the amplification of repo specialness and market segmentation. It can also inform on whether central banks or DMOs may be best suited to act as market-maker of last resort.

The remainder of the paper is organized as follows. Section 2 describes the institutional environment, describing the repo market in German government securities and detailing the mechanics of Eurosystem purchase and lending facilities as well as the DFA's bond market and repo operations. Section 3 presents our empirical framework, outlines the identification strategy, and introduces the data. Section 4 reports the main results on transaction effects, scarcity dynamics, and the interaction between central bank and DMO interventions. Section 5 explains why scarcity emerged in the Bund repo market in spite of large supply-side interventions. Section 6 concludes and discusses implications for the design of collateral-management frameworks and the coordination of monetary and debt-management policies.

2 Institutional background

2.1 The repo market

The repo market plays a pivotal role in the functioning of modern financial markets by providing a flexible source of short-term funding and an efficient mechanism for collateral management. A repo consists of the sale of a security coupled with a simultaneous commitment to repurchase it at a specified future date and price. In economic terms, a repo operates as a collateralized loan in which the cash lender acquires securities as collateral, while the cash borrower obtains funding against those securities. The difference between the initial sale price and the repurchase

price defines the repo rate, which represents the cost of secured borrowing. The outstanding volume of repos in the euro area exceeded EUR 12 trillion in June 2025, out of which almost EUR 2 trillion correspond to Bunds[3] (ICMA, 2025).

Repo markets function in two distinct modes, reflecting the underlying motivations of participants. In the *general collateral segment* (GC), transactions are primarily driven by the need to obtain or invest cash, with any sufficiently high-quality collateral deemed acceptable. In contrast, the *specific collateral segment* (SC) is motivated by the desire to access a specific security. The cash lender may accept a lower return in order to obtain the desired securities. The cash borrower can then earn a positive return by placing the cash at, for example, the GC rate. As formalized by Duffie (1996), the spread between the general collateral rate and the special repo rate reflects the market price of scarcity for a given security, capturing its value for settlement, hedging, or arbitrage purposes.[4]

Within the euro area, German government bonds are widely regarded as the safest and most liquid securities in the region. Their extensive use in hedging and arbitrage strategies frequently renders them "special" in the repo market. One prominent example is futures-related hedging activity, whose role in driving repo specialness is well established in the literature (see for example, Carrera de Souza and Hudepohl (2022) and Brand et al. (2019)). More broadly, specialness can be viewed as a manifestation of search frictions and the difficulty of locating willing securities lenders. Periods of elevated demand for specific securities stemming from market stress, settlement needs, or hedging activity can generate pronounced scarcity premia. These pressures are reinforced by regulatory constraints that effectively tighten collateral supply.[5]

Repo market demand–supply dynamics operate across two linked segments: interdealer and dealer–client markets. Interdealer trading occurs mainly on CCP-cleared electronic platforms with short maturities (often overnight), enabling daily funding and generating transparent, security-specific prices that drive repo specialness. In contrast, dealer–client trading is bilateral, less transparent, more flexible, and typically longer-term.

[3]ICMA measures repo market size on a gross basis, aggregating both repo and reverse repo positions. The figure includes all market segments.

[4]When scarcity becomes widespread across a broad set of securities, however, this measurement is less informative. Accordingly, we compute the price of scarcity, or the scarcity premium, using the spread to the rate on the deposit facility (DFR) and not to the GC rate.

[5]Around regulatory reporting dates, particularly quarter-ends, banks frequently scale back repo intermediation to optimise balance-sheet metrics such as the leverage ratio (Cunliffe, 2017). This contraction in repo supply amplifies scarcity and intensifies specialness, creating predictable calendar-driven fluctuations in collateral availability.

Client demand for funding or specific securities is intermediated by dealers and passed into interdealer markets. As a result, interdealer repo specialness reflects collateral scarcity shaped by client demand, dealer activity, and institutional constraints.[6]

These dynamics are directly relevant for understanding the environment in which Eurosystem and DFA operations are conducted. Through their secondary-market purchases and securities-lending activities, both institutions influence the availability of high-quality collateral and thus interact directly with the mechanisms that give rise to collateral scarcity and repo specialness. The next subsection examines these interactions in detail.

2.2 Eurosystem Monetary Policy Operations

As room for further interest-rate cuts diminished after the financial and sovereign-debt crises and amid low inflation, the Eurosystem launched the Asset Purchase Programme (APP) in 2015. In March 2020, in response to the economic and financial disruption triggered by the outbreak of the COVID-19 pandemic, the Eurosystem introduced the Pandemic Emergency Purchase Programme (PEPP). By absorbing a substantial volume of securities, both programmes reduced the supply of bonds available to market participants for secondary-market trading and for use as collateral in repo transactions. This contraction in the stock of available collateral raised concerns about impaired market liquidity and disruptions to efficient price discovery. To mitigate these risks, the Eurosystem established a securities-lending framework aimed at recycling purchased securities back to dealers and alleviating emerging collateral shortages. The next section describes the mechanics of the APP, PEPP and their lending facilities.

2.2.1 Asset Purchases

At its peak in June 2022, the APP absorbed roughly EUR 3.3 trillion in securities, of which about EUR 2.6 trillion were public-sector holdings.[7] Since July 2023, the APP portfolio has no longer been subject to reinvestment. Under the PEPP, the Eurosystem acquired approximately

[6] Client demand is heterogeneous and arises from cash-rich investors using repo as a collateralised investment vehicle, asset managers financing portfolios and managing liquidity, leveraged investors implementing relative-value and hedging strategies, and large buy-and-hold investors, including non-EA central banks. For a detailed description of market structure and market participants in the euro repo market see Brand et al. (2019), and Poinelli et al. (2026)

[7] The Eurosystem's APP comprised four components: the third Covered Bond Purchase Programme (CBPP3), the Asset-Backed Securities Purchase Programme (ABSPP), the Public Sector Purchase Programme (PSPP, launched on 9 March 2015), and the Corporate Sector Purchase Programme (CSPP).

EUR 1.7 trillion in securities by March 2022, of which around EUR 1.6 trillion were public-sector instruments. Since December 2024, the PEPP portfolio has no longer been reinvested.

The Eurosystem aligned the monthly allocation of purchases of public sector securities across jurisdictions with the respective shares in the ECB capital key. Therefore, German central government securities represented a large share of the Eurosystem's early purchases in German securities.[8] Their relative share in total PSPP acquisitions declined over time as the set of eligible German public-sector issuers expanded and purchases were diversified.[9] Under the PEPP, purchases of German public-sector securities also adjusted over time, reflecting both market conditions and the flexible implementation of the programme's envelope.

2.2.2 Securities Lending

The purchases of securities reduced the free float available to market participants, potentially causing tensions in repo markets for highly liquid collateral, such as German government bonds, and impairing the functioning in the bond market. In order to curtail these tensions in repo and bond market liquidity, Eurosystem central banks made their holdings available for securities lending since 2 April 2015. Securities lending was designed in order not to interfere with the monetary policy stance, and took place in a decentralized manner with some variation in the design features of the facilities across national central banks and the ECB.[10]

From April 2015 to December 2016, the Eurosystem lent its securities only against other securities as collateral. As of 15 December 2016, the Eurosystem allowed its holdings to be lent against cash, a measure aimed at alleviating the collateral scarcity present in 2016. The maximum overall limit for securities lending against cash collateral was initially set at EUR 50 billion for the Eurosystem, allocated in proportion to the PSPP holdings of participating central banks. The ECB Governing Council increased the overall limit in several steps to EUR 250 billion until November 2022.

All facilities shared a minimum price designed to ensure that they operated as a backstop

[8] Beginning in March 2015, monthly net purchases of German securities under the PSPP accounted for approximately one-quarter of net purchases of central government securities.

[9] Since 2015, several categories of German public-sector issuers became progressively eligible for purchases under the PSPP and PEPP. Initially, four German public development banks were eligible (e.g. Kreditanstalt für Wiederaufbau). In December 2015, bonds issued by the German federal states ("Länder") were added, and in March 2018 the eligibility list was expanded to include seven additional public development institutions.

[10] Apart from securities lending, collateral easing measures for the Eurosystem's refinancing operations also had a mitigating impact on scarcity in repo markets, in particular during the pandemic and as documented by Greppmair, Paludkiewicz, and Steffen (2025).

rather than as a substitute for private market activity. A minimum lending rate as a spread below DFR was defined for both securities lending against securities and against cash collateral. In episodes where bonds traded at repo rates below this minimum rate, the facilities were pricing in line with prevailing market rates. As a result, the facilities were typically unattractive under normal market conditions.

Additionally, the Eurosystem securities lending facilities were also subject to individual counterparty limits and to ISIN limits, though these design features differed across national central banks and ECB.

2.3 DFA operations

The German Federal Government finances a substantial share of its borrowing requirements through regular issuance of marketable debt securities. Issuance is conducted predominantly via auctions, with an annual issuance plan published at the end of the preceding year.

A distinctive feature of the DFA's issuance process is the retention of a portion of each auction (since 2025 around 25%[11], subject to variation), which is held in the Federal Government's own portfolio. Usually, the retained securities are subsequently sold into the secondary market to fund the Federal budget. However, they also form an operational buffer for liquidity- and market-management activities.[12]

In addition to the funding of the Federal budget, the DFA undertakes interventions in the secondary market to support liquidity. Operations are executed at market-consistent prices to avoid distorting trading behaviour. The DFA deploys retained holdings, as well as securities obtained through secondary-market purchases, to address dislocations at specific maturities and to smooth trading conditions. Furthermore, continuous market engagement provides high-frequency information on order flow, liquidity imbalances, and maturity-specific demand, consistent with microstructure models in which order flow conveys information about underlying supply–demand conditions (e.g., Hasbrouck, 1991; Brandt and Kavajecz, 2004).

Repurchase agreements are a central instrument in these secondary-market operations. While repo activity is primarily used for liquidity management and short-term budget financing, since the introduction of the ECB's large-scale asset purchase programmes the DFA has also increas-

[11] In the years before the retention quota was typically about 20%.

[12] The accumulation of own holdings is constrained by § 2(6) of the Federal Budget Act ("Gesetz über die Feststellung des Bundeshaushaltsplans"). In general, the act limits own holdings to 15% of the outstanding stock of Federal securities.

ingly relied on repos to mitigate scarcity in specific Federal securities, consistent with evidence that official-sector securities lending alleviates liquidity frictions associated with quantitative easing (D'Amico and King, 2013; Christensen and Gillan, 2022). By temporarily lending scarce securities against cash, repo operations reduce specialness, compress scarcity premia, and improve price discovery, in line with established theoretical and empirical findings (Duffie, 1996; Krishnamurthy, 2002; Mancini, Ranaldo, and Wrampelmeyer, 2016).

Moreover, the integration of secondary-market transactions and repo operations enhances the informational basis of DFA decision-making. Repo activity reveals collateral shortages, maturity-specific demand pressure, and segmentation along the sovereign curve. In accordance with the structured issuance approach, these signals are used to calibrate issuance volumes as well as the timing and size of taps, and allocation policies.

3 Data and methodology

3.1 Data

3.1.1 Central bank and debt management office activity

We construct a novel dataset that combines detailed information on Eurosystem secondary market activity, DMO operations, and repo market conditions at the security level. The core of the analysis focuses on German government securities and spans the period from January 2015 to December 2024, at a daily frequency.

We use transaction-level data from the Bundesbank and the European Central Bank covering secondary market transactions conducted under the APP and the PEPP. These data are complemented with information on securities lending operations conducted by both central banks, allowing us to jointly track outright holdings and securities lending supply over time at the ISIN-level. This data enables the construction of both stock- and flow-based measures of central bank presence in individual securities.

A key contribution of the dataset is the inclusion of novel proprietary data from the DFA. These data provide detailed information on DFA secondary market transactions, including outright purchases and sales, as well as repo market operations, where the DFA both provides cash and lends securities. We also have daily-security-level information on the DFA's own holdings of German government bonds.

We supplement these data with public auction-level information from the DFA, including issuance volumes and dates, retention amounts, and other auction characteristics. This information is used to identify primary market events, taps, and retention decisions, and to construct measures of changes in (net) bond supply.

3.1.2 Repo market data and bond characteristics

Repo market conditions are captured using daily ISIN-level repo rates from the *BrokerTec* and *MTS* platforms, which together account for the vast majority of interdealer repo trading in euro-denominated government bonds. We consider overnight, tomorrow-next, and spot-next repo transactions and compute, for each security and trade date, a daily volume-weighted average repo rate. Repo specialness is defined relative to the Eurosystem deposit facility rate (DFR), which serves as the relevant risk-free overnight benchmark. Formally, for each security i on day t, repo specialness is computed as

$$\text{Specialness}_{i,t} = r_{i,t}^{\text{repo}} - \text{DFR}_t, \tag{1}$$

where $r_{i,t}^{\text{repo}}$ denotes the observed repo rate for security i on day t. Under this definition, more negative values of $\text{Specialness}_{i,t}$ correspond to higher specialness, that is, securities that trade at repo rates further below the policy rate.

Bond-level characteristics are obtained from standard reference datasets and include coupon rates, maturity dates, bond type (e.g. nominal, inflation-linked, green bonds), and indicators for on-the-run status, futures delivery dates, and cheapest-to-deliver (CTD) status.

All data sources are merged into a daily ISIN-level panel, indexed by trade date, in which each observation corresponds to a specific German government security on a given business day.

3.1.3 Money Market Statistical Reporting data

In the second part of the analysis, we rely on transaction-level data from the Money Market Statistical Reporting (MMSR) dataset. MMSR covers euro money market transactions reported by a broad set of large euro area banks and provides detailed information on repo contracts, including ISINs, counterparties, rates, maturities, and volumes.

Using counterparty identifiers, we classify trades into dealer-to-dealer and dealer-to-client segments. This classification allows us to measure the rates at which dealers source securities

from clients and the rates at which they lend securities to clients, providing a granular view of intermediation margins in the repo market.

To account for the heterogeneous maturities across the different trades, we measure the specialness of each contract relative to the realised path of the DFR over the life of the contract. Formally, for each repo contract i initiated at time t with maturity T_i, we define contract-level specialness as the difference between the agreed repo rate and the realised average DFR over the contract's term. This approach is particularly relevant during periods of rapidly changing policy rates, when repo traders price contracts based on expectations about future policy rate developments at the time of trade. Using the realised DFR over the contract horizon provides an ex post proxy for these expectations and allows for a consistent comparison of repo rates across contracts with different maturities.

We then construct on-loan balance positions by tracking each contract from its settlement date to its maturity date, treating positions as outstanding for the full duration of the contract. Aggregating across contracts yields time series of dealer-to-client from borrowing and lending perspective at the security-level.

These measures allow us to study the price dynamics per on-loan balance position of client-facing repo activity and to assess the potential intermediation margin of dealers over time, defined as the spread between rates at which securities are sourced from clients and rates at which they are re-lent to other clients. We are also able to compute margins relative to the interdealer market rate over the contract periods.

3.1.4 Additional series

Finally, we incorporate additional time series related to hedge fund activity in the repo market, which are used in supplementary analyses. The data are provided by the DFA. Since 2005, members of the Bund Issues Auction Group ("Bidder Group") submit monthly reports that record their daily secondary-market trading in German government securities. Each record includes the security identifier (ISIN), trade date, trade direction from the reporting bank's perspective, nominal transaction volume, and the counterparty sector. Holdings by sector can be constructed by cumulating net flows over time. This approach is particularly informative for hedge funds because primary issuance is initially allocated to bidder banks and subsequently distributed to investors through the bidder-bank trading network, which intermediates the bulk of Bund secondary-market activity. As a result, the cumulated-flow series provides a reasonable

approximation of hedge fund demand and holdings according to Branger, Muck, and Pütz (2024).

3.2 Methodology

A central econometric concern in the context of estimating the effects of supply-side intervention on repo rates is possible reverse causality: both Eurosystem and DFA interventions may respond to contemporaneous movements in repo rates, biasing OLS estimates. The nature of the endogeneity issue differs for each operation type. For Eurosystem purchases, the main source of reverse causality may come from the fact that, following the market neutrality guideline of the purchase programmes, specialness may be taken into account when selecting the bonds to purchases. That is, on any given day, the Eurosystem would try to avoid buying those bonds which are trading special (Coeuré, 2015). In the case of securities lending/operations the nature of the reverse causality is straightforward: the highly special bonds are precisely those which are borrowed from the facilities. We therefore implement two complementary identification strategies, tailored respectively to bond market operations and repo market operations.

For operations in the cash market, our identification strategy exploits the non-overlapping trading schedules of the repo and cash bond markets, following D'Amico, Fan, and Kitsul (2018) and Carrera de Souza and Hudepohl (2022). The repo market functions primarily as an early-morning market, with the bulk of transactions executed before 9 a.m., at which time the cash market has not yet opened.[13] By contrast, Eurosystem and DFA interventions in the cash bond market only began around 9 a.m. and were executed throughout the morning. Leveraging these non-overlapping trading windows, we regress the change in repo rates from day t–1 to day t on Eurosystem or DFA purchases and sales executed on day t–1. If such day t–1 transactions respond to repo-rate developments on the same day (our reverse-causality concern), their effect would materialize only in the repo rate observed on day t.

Following this logic, our baseline regression is:

$$\begin{aligned}\Delta \text{RR}_{i,t,t-1} = \beta_0 + \beta_1 \text{ES purchase}_{i,t-1} + \beta_2 \text{DFA purchase}_{i,t-1} \\ + \beta_3 \text{DFA sale}_{i,t-1} + \beta_4 X_{i,t} + \gamma_i + \psi_t + \varepsilon_{i,t}\end{aligned} \tag{2}$$

[13] According to data from the Money Market Statistical Reporting, approximately two-thirds of trades are reported to occur before 9 a.m.; Securities Financing Transactions Regulation data exhibit a comparable pattern.

where $\Delta RR_{i,t,t-1}$ stands for the change in the interdealer market repo rate for ISIN i between days $t-1$ and t, ES purchase$_{i,t-1}$ stands for the Eurosystem purchase amount of ISIN i on day $t-1$ expressed as a % of the free float on that ISIN, DFA purchase$_{i,t-1}$ and DFA sale$_{i,t-1}$ stand for the DFA purchase/sale amount of ISIN i on day $t-1$ expressed as a % of the free float on that ISIN.[14] This specification accounts for the fact that buying a particular euro amount of a security should have a larger impact on an ISIN for which the free float is small compared with one for which it is larger. We control for whether bonds are on-the-run and cheapest-to-deliver ($X_{i,t}$), since it is well known that specialness is higher for these type of bonds (e.g, Duffie, 1996; D'Amico, Fan, and Kitsul, 2018). We include ISIN (γ_i) and time (ψ_t) fixed effects. The time-fixed effects absorb broad, time-varying shifts in scarcity, such as year-end, regulation-driven window-dressing (Munyan, 2017), while the bond-fixed effects capture persistent cross-sectional differences in specialness premia, including the characteristically high premia on Bubills and the comparatively low premia on inflation-linked bonds. We look at changes in repo rates, not levels, because these variables exhibit a high degree of serial correlation.

We cannot rely on the same specification scheme for repo market operations since the Eurosystem and the DFA conduct their securities lending and repo operations starting in the early morning, when repo market activity is taking place. We rely instead on an instrumental variable approach for identification. We instrument the DFA repo operations with the DFA securities holdings. The instrument should be relevant, i.e., correlated with the endogenous variable, and exogenous, i.e., not correlated with the error term, so the instrument affects the outcome variable only through its effect on the endogenous variable. The DFA holdings should be correlated with its repo operations, if they do not hold a particular security they cannot lend it, and if they hold a large volume of a security they could lend a large volume of it. The DFA holdings are mainly determined by the retention rate at issuance[15] and the subsequent buys/sells taking place in the secondary market. These two factors are not related to the specialness of a security throughout its life, a large retention might happen due to low market appetite for government debt, but that security could be scarce in the market two years down the road. In Section 4.1 we formally show that the relevance condition holds. There is no formal statistical test that can verify the exogeneity condition directly. Therefore, its validity must be justified primarily

[14] We define free float as the difference between outstanding amount and Eurosystem holdings. The DFA holdings are included in this definition, since they are held only temporarily.

[15] As outlined in Section 2.3, when the DFA issues or taps a security it keeps part of the issuance in its books. The average retained share for auctions taking place during our sample period is around 19%, with a range between 0% and 82%.

through economic reasoning and institutional knowledge.

Formally, we run the following two-stage least squares model:

$$\text{DFA repo}_{i,t} = \beta_0 + \beta_1 \text{DFA holdings}_{i,t-1} + \beta_2 X_{i,t} + \gamma_i + \psi_t + \varepsilon_{i,t} \tag{3}$$

$$\Delta \text{RR}_{i,t,t-1} = \beta_0 + \beta_1 \widehat{\text{DFA repo}}_{i,t} + \beta_4 X_{i,t} + \gamma_i + \psi_t + \varepsilon_{i,t}, \tag{4}$$

where $\text{DFA repo}_{i,t}$ stands for the DFA amount of ISIN i lent on day t expressed as a % of the outstanding amount of that ISIN, $\text{DFA holdings}_{i,t-1}$ denotes the DFA amount of ISIN i held in their books on day $t-1$ expressed as a % of the outstanding amount of that ISIN, $\Delta \text{RR}_{i,t,t-1}$ stands for the change in the interdealer market repo rate for ISIN i between days $t-1$ and t, and $\widehat{\text{DFA repo}}_{i,t}$ is the predicted value for $\text{DFA repo}_{i,t}$ based on the first-stage regression. Note that we normalize the variables with respect to outstanding amounts rather than free float, since outstanding amounts provide a more appropriate benchmark for the amount of collateral that could potentially be lent in the repo market. As in Equation (2) we control whether bonds are on-the-run and cheapest-to-deliver ($X_{i,t}$) and we include ISIN (γ_i) and time (ψ_t) fixed effects.

4 Effects of supply-side interventions on repo rates

4.1 Secondary market interventions

4.1.1 Cash market interventions effect on repo rates

We start by looking at the effects of secondary market purchases and sales of German government securities by the Eurosystem and the DFA on repo rates according to Equation (2). As shown in the first column of Table 1, both purchases from the Eurosystem and the DFA result in repo rates decreasing (i.e. price increasing). But the size of the effect is quite different for each institution; the effect of Eurosystem purchases is around 4 times larger than the effect of DFA purchases. The coefficients, all statistically significant at at least the 5% level, suggest that purchases from the Eurosystem of 1% of the free float of an ISIN decrease repo rates by around 0.4 basis points on average. For DFA purchases, it is around 0.1 basis points. The effect of DFA sales is of the same size but opposite sign to the purchases, which we interpret as providing robustness to our results. Distinguishing ECB and Bundesbank purchases results in coefficients

similar to the Eurosystem aggregate coefficient.

Table 1: Impact of public-sector purchases and sales on repo rates

	Dependent variable: Repo Rate Change			
	(1) Full sample	(2) Full sample	(3) 2015–2019	(4) 2020–2024
Eurosystem Purchases (lagged)	−0.432***		−1.092***	−0.370***
	(0.054)		(0.176)	(0.054)
ECB Purchases (lagged)		−0.501***		
		(0.150)		
Bundesbank Purchases (lagged)		−0.449***		
		(0.059)		
DFA Purchases (lagged)	−0.109**	−0.111**	−0.029	−0.180***
	(0.045)	(0.049)	(0.050)	(0.068)
DFA Sales (lagged)	0.081**	0.104***	0.045*	0.143**
	(0.033)	(0.037)	(0.025)	(0.056)
Control variables	Yes	Yes	Yes	Yes
ISIN fixed effects	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes
Observations	180,466	180,466	86,647	93,819
Adjusted R^2	0.930	0.930	0.893	0.965

Note: The table reports estimates of Equation (2). Column 1 includes all Eurosystem and DFA secondary-market transactions in German government securities between January 2015 and December 2024. Columns 2 distinguishes between ECB and Bundesbank purchases. Columns 3 and 4 are sample splits for January 2015 to December 2019 (column 3) and January 2020 to December 2024 (column 4). The dependent variable is the daily change in the repo rate for each ISIN, constructed as a volume-weighted average of all daily trades recorded on BrokerTec. Control variables include a cheapest-to-deliver dummy and an on-the-run dummy. Standard errors are shown in parenthesis. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

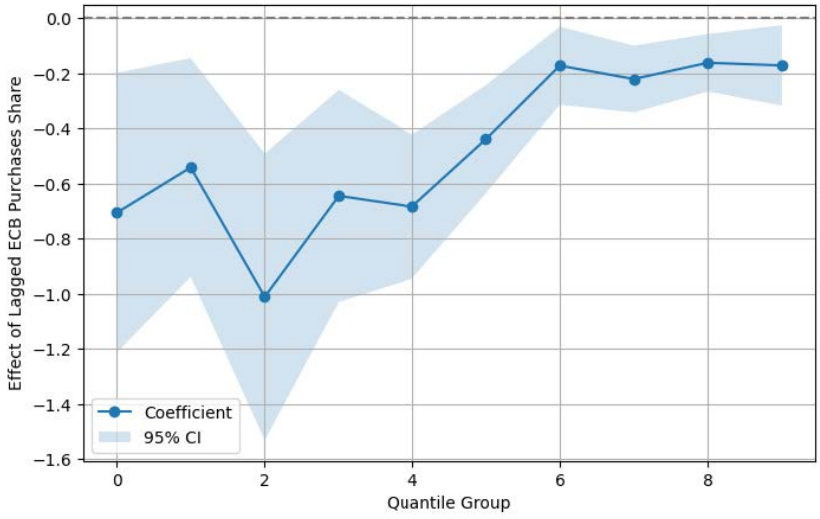
Our estimates for the Eurosystem purchases are broadly in line with the existing literature. For Bunds, Baltzer, Schlepper, and Speck (2025) estimate that a purchase of 0.3% of free float leads to a flow effect of about 0.12 bp. Jank and Moench (2018) estimate a stronger impact of 2 bps for a purchase of 1% of the amount outstanding, but their study ends in 2017, before market conditions eased. Brand et al. (2019) find an increase in specialness of between 0.3 bp and 0.4 bp for a 1% increase in PSPP-holdings relative to the amount outstanding. Looking at German, French, Italian and Spanish bonds together, Arrata et al. (2020) estimate a flow effect of 0.78 bps for purchasing 1% of the amount outstanding. Given that the free float of Bunds is between 30% and 40% of the amount outstanding, their effect is smaller than ours. For the US Treasury market, D'Amico, Fan, and Kitsul (2018) document a rather small effect of 0.2 bp for a purchase of 1 p.p. of the outstanding amount. However, average specialness is lower in the US market compared to the German market.

The greater impact of Eurosystem purchases, relative to those of the DFA, can be attributed to the differences in the types of securities acquired by each and the different time horizon of their operations. The DFA primarily bought securities actively offered by dealers and available in

their inventories, with the DFA often reselling them within the same day to other dealers in need of these securities. The Eurosystem's purchases were larger, more diverse, and not subsequently resold. This distinction meant that, in addition to purchasing securities actively offered by dealers, the Eurosystem also acquired securities not readily available in dealers' inventories. Consequently, dealers were required to source securities purchased by the Eurosystem, frequently through the repo market, which exerted pressure on repo rates and led to the emergence of a scarcity premium. As the supply of specific securities diminished, their repo rates decreased, resulting in investors lending money at lower rates to obtain these securities.

We also studied the effect of security purchases on repo rates depending on the characteristics of the bonds purchased. Table A1 shows that the effects are stronger at both ends of the maturity spectrum, purchases from the Eurosystem of 1% of the free float of one ISIN decrease repo rates by around 0.8 basis points on average for 2- and 30-year maturity bonds. For 10-year bonds, the effect is around 0.5 basis points.[16]

Figure 2: Effect of Eurosystem purchases on repo rates by specialness of bonds bought



Note: The figure plots estimates for β_1 in Equation (2) obtained separately for different quantiles of specialness. The sample includes all Eurosystem and Deutsche Finanzagentur (DFA) secondary-market trades in German government securities from January 2015 to December 2024. The dependent variable is the daily change in the repo rate for each ISIN; daily repo rates are constructed as BrokerTec volume-weighted averages. Regressions control for cheapest-to-deliver and on-the-run dummies.

Figure 2 shows that the effect of security purchases on repo rates increases with the degree of specialness of the bonds purchased. When the Eurosystem buys bonds that are on the lower end of the specialness distribution, the purchases have practically no effect on their repo rate.

[16] Performing the same interactions with DFA purchases does not yield statistically significant differences across maturity buckets, but the regressions also rely on fewer observations

On the other hand, when buying bonds at the higher end of the specialness distribution, the effects are double the average effects shown in Table 1. Bonds at the lower end of the specialness distribution are liquid and available, and thus can withstand supply reductions without much price variation.

Specialness in the Bund market varied significantly during our sample period, as illustrated in Figure 1, with two distinct cycles. The first cycle spanned from late 2015 to 2019, while the second extended from late 2020 to 2024, peaking in mid-2022 and gradually diminishing by the end of 2024. The actions of the DFA and the Eurosystem differed in the two periods. Both the Eurosystem and the DFA were substantially more active in their securities lending/repo operations during the 2020-2024 period. In order to analyze whether we see any differential effect of their cash market operations on repo rates we conduct the same econometric analysis for the two subperiods separately. Columns 2 and 3 in Table 1 show the results. The impact of Euroystem purchases on repo rates was significantly stronger in the 2015-2019 period than in the 2020-2024 period. Conversely, DFA cash market operations had a stronger effect during the 2020-2024 period than in the 2015-2019 period. During the first specialness episode Eurosystem purchases took a more prominent role due to their novelty. As time passed, markets adapted to the new regime, and the DFA became not only more active but also more attuned to addressing specialness. We will further explore the reasons of why these larger and targeted actions of the DFA still did not prevent the rise in specialness during the years 2021-2022 in Section 5.

4.1.2 Securities lending and repo operations

We now turn to the analysis of repo operations. As described in Section 3, we address endogeneity concerns using an instrumental-variables (IV) strategy. The OLS regressions of daily changes in repo rates on the volume of securities supplied via repo operations by the DFA or the Eurosystem yield negative and statistically significant coefficients, implying that greater security provision is associated with richer repo rates (see first column in Table 2). However, this finding reflects reverse causality: on days when repo rates are increasing, both the Eurosystem and the DFA tend to increase their activity as security providers.

Second column of Table 2 presents the IV estimates for DFA repo operations. The coefficient becomes positive and statistically significant at the 5% level, indicating that the lending of securities through DFA repo operations raises repo rates - that is, alleviates scarcity. Quantitatively, a repo operation amounting to 1% of an ISIN's outstanding volume increases repo rates

by approximately 0.2 basis points.

Table 2: IV regression: DFA securities lending and repo rates

	Dependent variable:	
	Repo Rate Change	
Panel 1: OLS and IV	OLS	IV 2S
DFA securities lending	-0.215^{***}	0.226^{**}
	(0.028)	(0.099)
Control variables	Yes	Yes
ISIN fixed effects	Yes	Yes
Day fixed effects	Yes	Yes
Observations	180,626	180,626
Adjusted R^2	0.930	0.929

Panel 2: First stage

	DFA sec. lend.
DFA holdings	0.032^{***}
	(0.008)
F-test (1st stage)	stat = 4,239.7
Wu-Hausman	stat = 21.4
Control variables	Yes
ISIN fixed effects	Yes
Day fixed effects	Yes
Observations	180,626
Adjusted R^2	0.333

Note: The table reports estimates from an instrumental variables (IV) regression of the daily change in the repo rate at the ISIN level on the daily volume of DFA securities lending, expressed as a percentage of the outstanding amount of the corresponding ISIN. DFA securities holdings, scaled by outstanding amount, are used as the instrument. The sample includes transactions in German government securities between January 2015 and December 2019 and between January 2020 and December 2024. Control variables include a cheapest-to-deliver dummy and an on-the-run dummy. Standard errors are shown in parenthesis. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

This effect is roughly twice as large as the corresponding estimate for DFA outright sales of securities, reflecting the more immediate and targeted nature of repo-based interventions. Repo operations inject scarce securities directly into the market segment where shortages materialize, thereby exerting an immediate and focused alleviating effect on scarcity premia. In contrast, outright sales alter the stock of freely circulating securities more gradually and may be partially offset by portfolio-rebalancing behavior among market participants. As a result, repo operations generate a stronger marginal impact on repo rates than outright transactions of comparable size.

The strength of our instrument is confirmed by a high first-stage F-statistic. First-stage results, reported in the lower panel of Table 2, show that the instrument is strongly correlated with the endogenous variable.

As in the case for bond market operations we run our baseline regression for the periods 2015-2019 and 2020-2024 separately. Again, we find that DFA actions had a stronger effect during the 2020-2024 period than in the 2015-2019 period. As reported in Table 3, while during 2020-2024 a repo operation amounting to 1% of an ISIN's outstanding volume increases repo rates by approximately 0.4 basis points, it does so only 0.1 basis points during the 2015-2019 episode (and the coefficient is not statistically significant at any meaningful level). This result confirms the idea that DFA lending became not only more active, but also more developed and more targeted to address specialness. We will further explore the reasons for why these larger and targeted actions of the DFA still did not prevent the rise in specialness during the years 2022-2023 in Section 5.

Table 3: DFA securities lending and repo rates: sample split by period

	Dependent variable: Repo Rate Change	
	(1) 2015–2019	(2) 2020–2024
DFA securities lending	0.099	0.386**
	(0.133)	(0.181)
F-test (first stage)	614.6	3,019.2
Wu–Hausman test	0.86	61.6
Control variables	Yes	Yes
ISIN fixed effects	Yes	Yes
Day fixed effects	Yes	Yes
Observations	86,749	93,877
Adjusted R^2	0.892	0.963

Note: The table reports estimates from an instrumental variables (IV) regression of the daily change in the repo rate at the ISIN level on the daily volume of DFA securities lending, expressed as a percentage of the outstanding amount of the corresponding ISIN. DFA securities holdings, scaled by outstanding amount, are used as the instrument. The sample is split between January 2015 and December 2019 (column 1) and between January 2020 and December 2024 (column 2). Control variables include a cheapest-to-deliver dummy and an on-the-run dummy. Standard errors are shown in parenthesis. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

4.1.3 Interrelation between Eurosystem and DFA operations

Eurosystem purchases of German government bonds are guided by a policy mandate and implemented in accordance with Germany's share in the ECB capital key (Hammermann et al., 2018). They were determined independent of DFA secondary market operations. By contrast, DFA actions reflect active management of its own holdings portfolio and may respond endogenously to developments in market functioning. In particular, DFA operations are partly aimed at mitigating market dislocations and may thus react to the effects of Eurosystem interventions.

In previous sections, we have shown that both Eurosystem and DFA actions have measurable effects on repo rates. Against this background, we investigate whether and how the DFA reacted to Eurosystem market activity. Specifically, we assess whether DFA secondary market and repo operations responded to, and could have then potentially stabilised, the repo market effects induced by Eurosystem interventions documented in the previous section. In order to formally determine whether the DFA actions responded to the Eurosystem, we run the following local projections:

$$\sum_{s=0}^{h} DFA_{i,t+s}^{\text{CashMkt}} = \alpha_i + \delta_t + \beta_h \, ES_{i,t} + \gamma_h \sum_{s=1}^{h} ES_{i,t+s} + u_{i,t+h}, \tag{5}$$

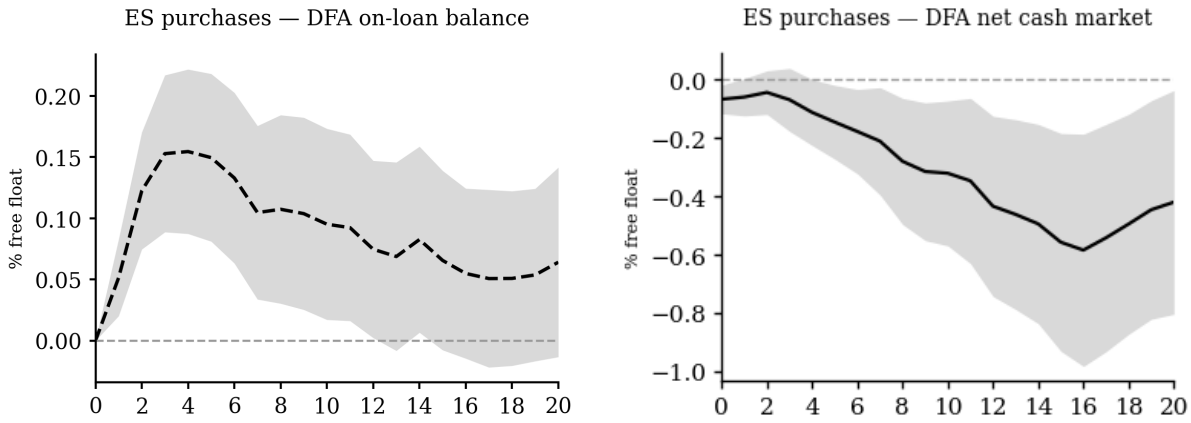
$$DFA_{i,t+h}^{\text{OLB}} - DFA_{i,t}^{\text{OLB}} = \alpha_i + \delta_t + \beta_h \, ES_{i,t} + \gamma_h \sum_{s=1}^{h} ES_{i,t+s} + u_{i,t+h}, \tag{6}$$

where $DFA_{i,t}^{\text{CashMkt}}$ denotes DFA net transactions in the secondary cash market for ISIN i on day t. Positive values indicate net buying by the DFA, while negative values indicate net selling. $ES_{i,t}$ denotes the Eurosystem purchase amount of ISIN i on day t, and $DFA_{i,t}^{\text{OLB}}$ denotes the DFA on-loan balance of ISIN i on day t. All variables are expressed as a percentage of the free float of the respective ISIN i.

In the first specification, we cumulate DFA net secondary market transactions between t and $t+h$, reflecting the fact that both DFA sales and Eurosystem purchases are flow variables. Cumulating net cash market transactions over the horizon therefore allows us to measure the total amount of collateral supplied back to the market in response to an initial Eurosystem purchase. By contrast, DFA repo activity is observed in the form of on-loan balances, which are stock variables. Changes in these balances over the horizon t to $t+h$ capture the cumulative net effect of new lending and maturing positions. Accordingly, in the second specification we focus on the change in the DFA on-loan balance over the horizon, which provides a stock-based measure of the cumulative provision of collateral through repo lending. In both specifications, we control for future Eurosystem purchases through the cumulative term $\sum_{s=1}^{h} ES_{i,t+s}$ and include ISIN and time fixed effects.

Figure 3 reports the estimated coefficients β_h for each horizon h for both specifications.

Figure 3: DFA reaction to Eurosystem securities purchases



Note: The figure shows the dynamic response of DFA operations to Eurosystem securities purchases. The left panel reports the change in the DFA on-loan balance, while the right panel reports cumulative net secondary-market transactions by the DFA. Shaded areas indicate 95% confidence intervals.

The results indicate that the DFA reacts to Eurosystem securities purchases by increasing its repo lending activity in the affected ISINs, starting the day after the purchase. The response in on-loan balances peaks three days after the Eurosystem purchase, with the DFA lending, on average, around 0.15% of the outstanding amount of an ISIN in response to a Eurosystem purchase of 1% of the outstanding amount. The effect then gradually dissipates and becomes statistically insignificant at the 5% level after approximately 15 days. DFA secondary market sales also respond to Eurosystem purchases, as shown in Panel (b) of Figure 3. In this case, the response is more gradual, rising over time and peaking around 15 days after the Eurosystem purchase. Taken together, the results indicate that the DFA actively responds to Eurosystem purchases by supplying collateral as it is withdrawn from the market. This response unfolds sequentially: repo lending adjusts rapidly at first and is subsequently, and progressively, replaced by outright sales in the secondary market. Importantly, these DFA operations do not affect the outstanding stock of public debt or its maturity structure and therefore should not interfere with the monetary policy stance transmitted through the Eurosystem's purchase programmes. By operating instead on the local availability of special collateral, DFA interventions attenuate the impact of Eurosystem purchases on repo market conditions, mitigating potentially distortive effects on repo rates and thereby supporting market functioning.

4.2 Primary market interventions

4.2.1 DFA's issuances into own holdings portfolio

So far, we have focused on flow effects, which explain short-run, day-to-day changes in repo rates. We now turn to the question of whether DFA interventions can also shift the level of repo specialness.

Two exceptional episodes provide a natural setting to study such level effects. In April 2020, the DFA expanded its own holdings across a broad set of approximately 40 securities by a total of EUR 142 billion. In October 2022, the DFA conducted a EUR 54 billion tap of 18 securities by retaining issuance amounts in its own portfolio.

These interventions are exceptional in both scale and nature. In particular, the increase implemented in October 2022 was explicitly intended to alleviate collateral scarcity and to reduce elevated specialness in German Federal securities.

These operations constitute plausibly exogenous shocks to the supply of securities available for lending. Prior to 2020, no interventions of this nature had been undertaken, and subsequent taps have been infrequent and substantially smaller. The October 2022 tap, moreover, was not announced in advance, limiting market participants' ability to anticipate it and thereby strengthening its suitability for identification. The April 2020 expansion, by contrast, was implemented in two separate ad hoc steps, and it is at least partly questionable whether the second step retained the same element of surprise once the first had revealed the DFA's willingness to intervene on this scale.

The April 2020 interventions were also implemented within a short time window and ultimately covered nearly all outstanding ISINs. As a result, they do not permit the construction of a meaningful untreated comparison group, precluding a reliable difference-in-differences analysis for this episode. By contrast, the 2022 tap was concentrated on a subset of 18 ISINs, allowing for a difference-in-differences design that compares tapped and untapped securities around 19 October 2022. Taken together the cleaner single-step implementation, the absence of advance announcement, and the availability of an untreated control group make the October 2022 episode the substantially better-suited quasi-experiment, and we focus our identification on it accordingly.

We treat the tapped ISINs as the treatment group and the remaining untapped ISINs as the control group. The sample comprises all Federal bonds (Bunds, Bobls and Schätze). We

exclude money-market instruments (Bubills) from the control group because bills are a different instrument: they differ in market conventions and, possibly, in their investor base. The two markets are therefore partially segmented and do not form an adequate comparison group for bond-levels specialness dynamics.

To trace out the evolution of the treatment effect rather than imposing a constant post-treatment coefficient, we estimate a dynamic difference-in-difference specification. The dynamic structure allows us to test formally whether pre-treatment trends are parallel by inspecting pre-treatment leads and it reveals how the effect evolves over the post-treatment window. The model is as follows:

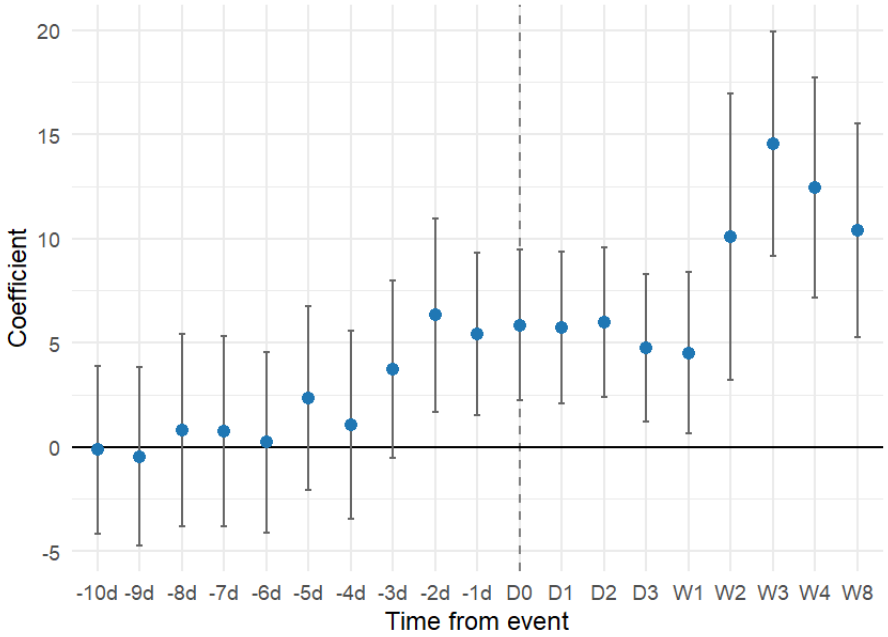
$$\begin{aligned} Y_{i,t} = \alpha_i + \gamma_t &+ \sum_{k=1}^{10} \beta_k^{\text{pre}} \cdot \mathbf{1}[t = T^* - k] \cdot D_i \\ &+ \sum_{d=0}^{2} \beta_d^{\text{post day}} \cdot \mathbf{1}[t = T^* + d] \cdot D_i \\ &+ \sum_{w=1}^{4} \beta_w^{\text{post week}} \cdot \mathbf{1}[t \in W_w] \cdot D_i + \beta^{\text{post tail}} \cdot \mathbf{1}[t \in W_{\text{tail}}] \cdot D_i \\ &+ X_{i,t}'\delta + \varepsilon_{i,t} \end{aligned} \tag{7}$$

where $Y_{i,t}$ is the specialness of bond i on trading day t, T^* denotes the announcement date (19 October 2022), D_i is a treatment indicator equal to one if bond i is tapped, α_i and γ_t are bond and day fixed effects, $X_{i,t}$ is a vector of controls that includes Eurosystem purchases and DFA net purchases expressed as a percentage of the ISIN-level free float, and $\varepsilon_{i,t}$ is an idiosyncratic error. $\mathbf{1}[t = T^* - k]$ is a dummy variable which takes the value 1 on day $T^* - k$ and 0 otherwise. The weekly bins W_w partition the trading days $t \in \{T^* + 3, \ldots, T^* + 22\}$ into four non-overlapping 5-trading-day windows, and W_{tail} collects all subsequent trading days. Standard errors are clustered at the ISIN level.

Figure 4 reports the estimated pre-and post-treatment coefficients together with their 95% confidence intervals. The pre-treatment leads are statistically insignificant with the exception of the coefficient at T^*-1 and T^*-2. We do not attribute this to anticipation of the DFA tap itself, the official announcement and the first Bloomberg coverage both occurred on 19 October 2022. A plausible alternative explanation is an unrelated fiscal event: on Friday 14 October 2022, the Bundestag held a first reading of a supplementary budget authorizing EUR 200 billion in additional federal borrowing to finance energy-crisis relief measures. An announcement signaling

a large prospective expansion of Bund supply is consistent with a modest downward shift in specialness [17].

Figure 4: Counterfactual: Bund own holdings tap 2022



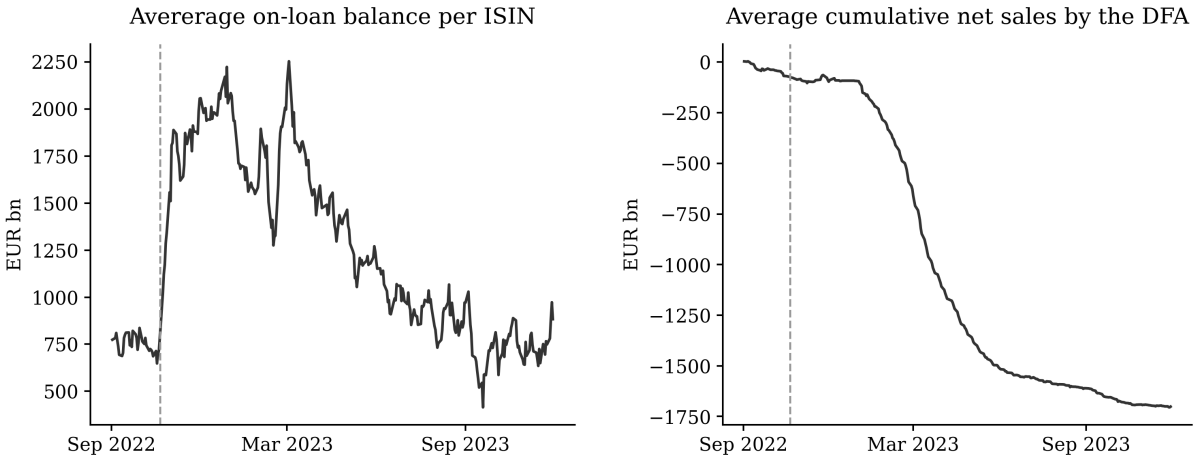
Note: The figure plots the dynamic difference-in-differences coefficients from Equation (7) with 95% confidence intervals. The treatment group comprises the 18 ISINs tapped by the DFA on 19 October 2022 (T^*); the control group consists of all remaining untapped German Federal bonds. Pre-treatment coefficients are reported at daily frequency; post-treatment coefficients at daily frequency for days 0–2, in five-trading-day bins for weeks 1–4, and as a single tail coefficient thereafter.

The post-treatment coefficients trace a clear hump-shaped pattern. The effect is immediate but modest, reaching its maximum magnitude three weeks after the announcement and subsequently subsiding, as indicated by the slightly lower tail coefficient. The profile is consistent with two complementary mechanisms that we document in Figure 5. In the immediate aftermath of the tap, the DFA sharply increased repo lending in the treated ISINs, directly supplying additional collateral and mechanically depressing specialness. This initial response is gradually complemented by a second-channel: the DFA progressively increased outright sales in the secondary market. Such sales permanently expand the free float and thus sustain a portion of the initial reduction in specialness even after the repo-lending channel fades.

Figure 6 plots observed repo specialness for the treated ISINs together with a counterfactual path constructed from the dynamic specification. The counterfactual is obtained by refitting

[17] As a robustness check, we re-estimate the specification shifting T^* to the 14 October 2022; the post-treatment coefficients are shifted the respective days but are unchanged in magnitude and statistical significance, indicating that our inference is not sensitive to this pre-period anomaly.

Figure 5: DFA reaction to Eurosystem securities purchases



Note: The figure illustrates the DFA's response to the 2022 own-holdings taps. The left panel shows the average on-loan balance per treated ISIN, capturing the expansion of lending through repo operations. The right panel shows cumulative net secondary-market sales by the DFA. The dashed vertical line marks the tap announcement date (19 October 2022).

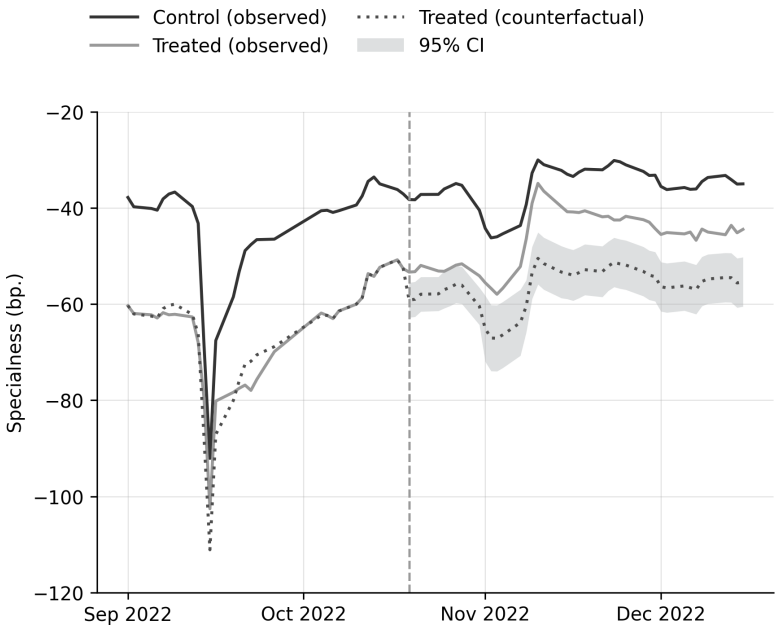
the model with all post treatment coefficients restricted to zero, so that predicted specialness is driven solely by fixed effect and control coefficients. Relative to this counterfactual, specialness declines for tapped securities after 19 October 2022, closing a substantial share of the gap vis-à-vis the control group. Importantly, because the counterfactual is built from the full vector of dynamic coefficients rather than from a single average post-treatment coefficient, the time profile in Figure 6 is internally consistent with the coefficient path in Figure 4: The peak separation between observed and counterfactual specialness coincides with the horizons at which β^{post} is largest.

Taken together, the evidence suggests that the DFA effectively alleviated persistent specialness in the treated ISINs by expanding the effective supply of these securities in the repo market. By making additional bonds available through repo lending, the DFA shifted repo specialness to a lower level through the direct provision of collateral, rather than by altering the outstanding stock. Only at a later stage—once specialness had subsided—did the DFA sell these bonds outright in the secondary market.

4.2.2 The auction cycle

While our analysis primarily focuses on secondary-market interventions, issuance activity in the primary market also has the potential to affect conditions in the repo market. Following the initial issuance of a security, the DFA conducts additional tap auctions that increase the outstanding supply of the same ISIN. To the extent that a bond is relatively scarce early in

Figure 6: Counterfactual: Bund own holdings tap 2022



Note: The figure presents the average specialness for both tapped and non-tapped ISINs (excluding Bills), along with the counterfactual. The shaded red area indicates the 95% CI corresponding to the respective post coefficient. The dashed vertical line marks the announcement day. Month-end excluded for better visualization.The dashed vertical line marks the tap announcement date (19 October 2022).

its life, when free float is limited, such incremental supply may alleviate scarcity pressures and thereby influence repo rates.

To examine the dynamic response of repo specialness to tap auctions, Figure 7 presents event-study impulse responses of repo rates around tap dates. The figure reports average responses for the first, second, and third tap following the initial issuance.

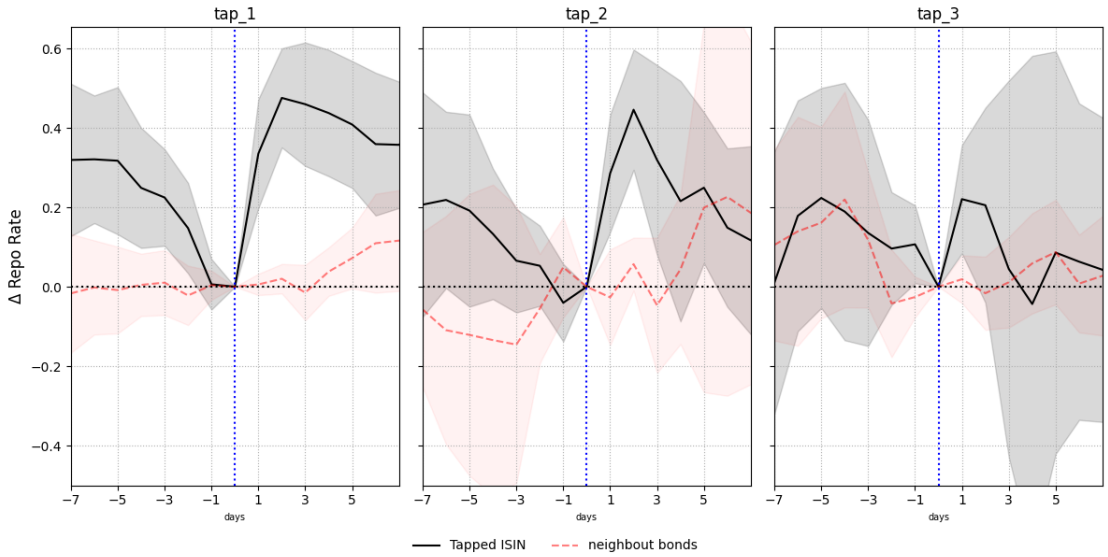
To construct these impulse responses, we measure changes in repo rates relative to the tap date using a local-projection framework. Let $rr_{i,h}$ denote the repo rate of ISIN i at horizon h relative to the tap. For each tap event, we compute the relative change in repo rates as

$$\Delta rr^{\text{rel}}_{i,h} = \frac{rr_{i,h} - rr_{i,0}}{rr_{i,0}} = \alpha_h + \varepsilon_{i,h}, \tag{8}$$

where $rr_{i,0}$ denotes repo the day before the tap. The transformation normalises responses across ISINs. The coefficient α_h is estimated separately for each horizon h and represents the average dynamic response of repo rates to tap-induced supply changes.

Panel (a) shows a pronounced pattern around the first tap. Repo specialness for the tapped ISIN increases in the days leading up to the auction and declines immediately thereafter. Repo

Figure 7: The auction cycle



Note: The figure reports event-study impulse responses. Identification comes from within-ISIN changes around tap dates, benchmarked against bonds with similar maturity characteristics. Responses are normalized relative to the repo rate on the business day preceding the tap, which is set to zero by construction. Day 0 corresponds to the tap date. Solid lines show the response of the tapped ISIN, while dashed lines show the response of neighbouring bonds. Shaded areas denote 95% confidence intervals.

specialness declines sharply following the tap, by around 40% relative to its pre-tap level on average, indicating a rapid alleviation of scarcity following the supply injection. Panels (b) and (c) display qualitatively similar dynamics for the second and third taps, though the magnitude of the post-tap adjustment diminishes across successive auctions.

This attenuation is consistent with the evolving market structure over the bond's life cycle. Early after issuance, when the bond is on-the-run and subject to elevated hedging and trading demand, incremental supply has a relatively large marginal effect on repo specialness. As outstanding supply accumulates over successive taps, the marginal impact of additional issuance declines.

Importantly, the observed adjustment is confined to the specific ISIN being tapped. There is no evidence of spillovers to bonds with similar maturity or issuance. Neighbouring bonds do not exhibit systematic changes in repo rates around the tap dates of the reference security. The absence of spillover effects suggests that the response reflects bond-specific supply conditions rather than broader shifts in demand or market-wide scarcity.

5 What drives specialness in the Bund repo market?

Section 4 documents that interventions by the Eurosystem and the DFA, through outright purchases, sales, and repo operations, have significant effects on repo rates. In particular, the DFA repo interventions are shown to impact repo rates more effectively than outright transactions of comparable size. The same directional effect has been shown in the literature for the Eurosystem securities lending facilities (see Baltzer, Schlepper, and Speck, 2025; Greppmair and Jank, 2023). We further show that the DFA can shift the level of repo specialness when targeting specific ISINs and actively deploying them through repo lending, as during the October 2022 tapping episode.

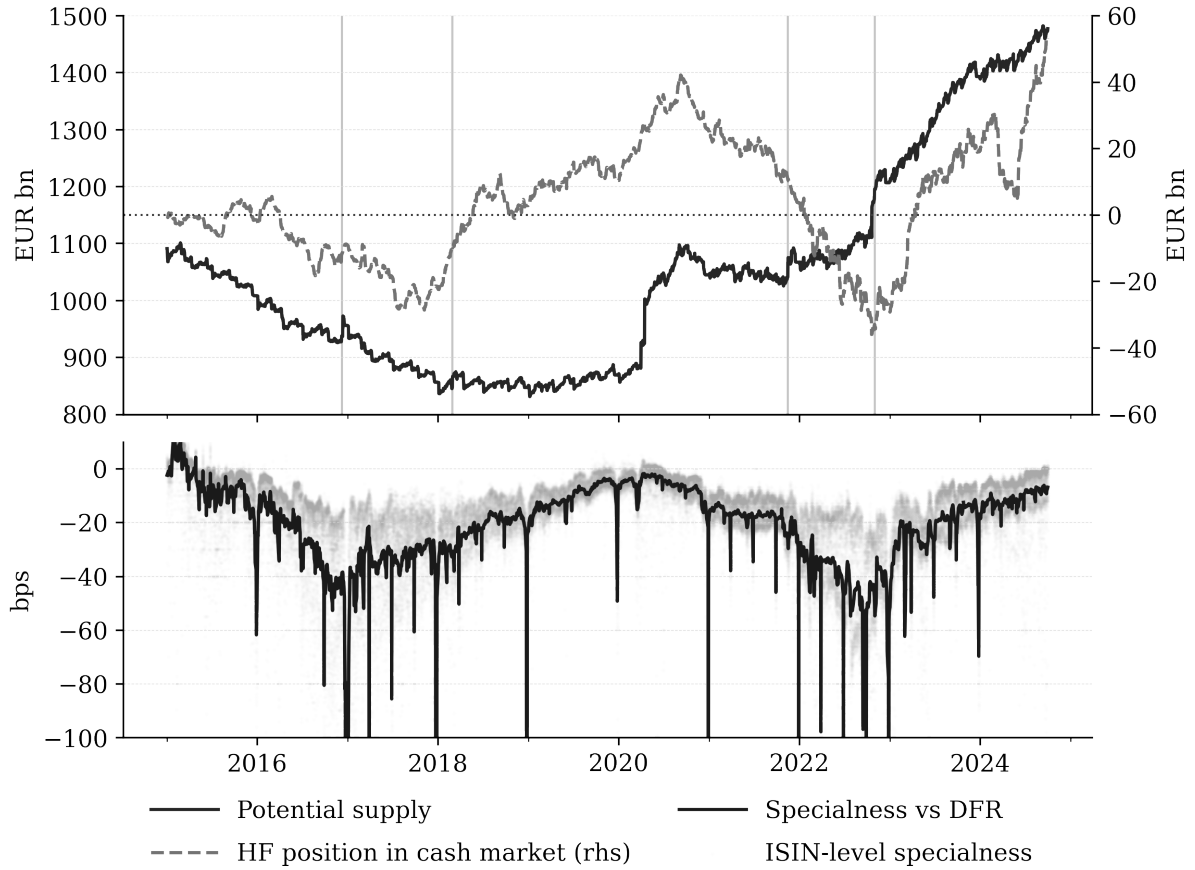
Having established that public-sector interventions can materially influence both short-run repo rates and the level of specialness, the 2022 scarcity episode stands out as a period in which repo specialness reached unprecedented levels despite historically large volumes of securities being made available through public-sector lending facilities. This apparent contradiction raises a central question: why did repo rates remain deeply special even when collateral availability was ample? Addressing this question requires moving beyond a purely aggregate view of supply and also focusing on how collateral is demanded, intermediated, and priced within the structure of the repo market.

In the following section, first, we characterise supply and demand imbalances in the repo market by using proxies that capture time variation in both dimensions. Second, we explain how the segmented nature of the Bund repo market amplifies the restrictive effect of counterparty limits in securities lending operations and why public-sector lending does not provide price insurance, but it prevents collateral shortages and fails-to-deliver. Third, we analyse the pricing of repo transactions to shed light on how dealer intermediation and client demand translate into elevated specialness.

5.1 Supply and demand imbalances in the repo market

Collateral scarcity in repo markets reflects the interaction between security-specific demand pressures and the effective supply of lendable securities. Figure 8 shows proxies for both demand and supply in the Bund repo market. To quantify supply, we use the outstanding volume of German government securities (including DFA own holdings) minus the Eurosystem holdings plus the amount that could be borrowed via the securities lending facilities. The measure can

Figure 8: Supply and demand dynamics



Note: The upper panel illustrates supply and demand conditions for German government securities. The solid line shows potential supply, defined as the outstanding amount of German securities net of Eurosystem holdings and adjusted for borrowing limits from securities lending facilities. The dashed line shows hedge funds' net positions in the cash market, measured as cumulative net purchases by members of the Bund Issues Auction Group. Vertical lines indicate dates when Eurosystem limit for lending against cash collateral was increased. The lower panel shows repo market conditions, with the solid line reporting the volume-weighted average specialness relative to the Deposit Facility Rate (DFR) and the shaded area indicating ISIN-level specialness.

be seen as the maximum amount of collateral that could be mobilized into the repo market. It decreased from around EUR 1100 bn in 2015 to EUR 850 bn in 2019 driven mainly by securities purchases under the APP. The introduction of the cash securities lending facility in December 2016 increased potential supply, but was a relatively small increase in size compared to the main declining trend. In 2019 potential supply started to increase and jumped in 2020 with the large tap of bonds into the DFA own holdings (see Section 4.2.1). In 2022 there is another large tap of bonds driving supply, and the upward trend is accelerated by the winding down of the Eurosystem purchase programmes.

On the demand side, we focus on the positioning of hedge funds in German government securities. This choice is motivated by the structure of repo markets described in Section 2.1.

Leveraged investors, such as hedge funds, generate security-specific collateral demand through a range of strategies, including relative-value, macro, directional, and basis trades, which can give rise to short positions in cash bonds financed via repo.[18] While hedge funds access repo primarily through bilateral dealer–client relationships, dealers intermediate this demand by sourcing the required securities through multiple channels, including other clients, securities lending facilities, and interdealer repo markets. As a result, hedge fund positioning is transmitted, via dealer intermediation, into interdealer collateral flows impacting interdealer pricing.

Given their leverage and sensitivity to funding and collateral conditions, hedge funds can therefore be viewed as marginal investors in the repo market, as discussed by Poinelli et al. (2026). Therefore, their net positioning in the cash bond market provides a proxy for security-specific demand pressures that are transmitted, via dealer intermediation, into interdealer repo specialness.

As shown in Figure 8, hedge funds were net sellers of German government bonds during the two pronounced scarcity episodes of 2016-17 and 2022-23. By the end of 2016, hedge funds had cumulatively net sold around EUR 15 bn of German bonds, with net sales continuing until mid-2017 before being fully reversed by 2019. In early 2022, hedge funds again became net sellers, reaching cumulative net sales of approximately EUR 30 bn by September 2022. The short positioning in the cash market directly translated into increased demand in the repo market. That is, both scarcity episodes were periods in which collateral demand increased substantially.

To formalize the effect of hedge fund cash market operations on repo rates we add the hedge funds' flows as an additional regressor to Equation (2). Consistent with the rest of flow variables, we lag the hedge funds' flows by one day. We introduce the flows as net sales, so we can interpret the coefficient sign as the effect on repo rates when repo demand increases (as explained above, securities sold by hedge funds in the cash market are sourced via the repo market). Table 4 shows the results. The new coefficient, statistically significant at the 1% level, implies that net hedge funds' sales of 1% of the free float of an ISIN decrease repo rates by around 0.2 basis points on average. The size of the effect is meaningful; it is half of the effect of Eurosystem purchases and the same size (but opposite sign) as DFA repo lending operations.

[18]The basis trade involves selling (buying) a government bond futures contract while concurrently buying (selling) the associated cheapest-to-deliver bond and financing the position through term repo until the futures delivery date.

Table 4: Effect of demand pressure on repo rates

	Dependent variable:
	Repo Rate Change
ES purchases (lagged)	−0.404***
	(0.050)
DFA purchases (lagged)	−0.093**
	(0.043)
DFA sales (lagged)	0.067**
	(0.032)
Hedge funds net purchases (lagged)	0.218***
	(0.055)
Control variables	Yes
ISIN fixed effects	Yes
Day fixed effects	Yes
Observations	180,466
R^2	0.932
Adjusted R^2	0.930

Note: The table reports the estimates of Equation (2) plus a term reflecting the net purchases of German securities by hedge funds from members of the Bund Auction bidding group. The sample includes all Eurosystem and DFA transactions on German debt securities in the secondary market conducted between January 2015 and December 2024. The dependent variable is the daily change in the repo rate for each ISIN, with the daily repo rate constructed as a volume-weighted average from all daily trades recorded in BrokerTec. Control variables include cheapest-to-deliver dummy and on-the-run dummy. Standard errors are shown in parenthesis.
* / ** / *** indicate 10% / 5% / 1% significance level.

5.2 Why didn't the Eurosystem facilities and the DFA fully prevent scarcity

Figure 8 highlights a key difference between the 2016 and 2022 scarcity episodes. In the former, the volume of collateral available to the repo market declined persistently, whereas in 2022 aggregate collateral supply was expanding, reflecting large-scale issuance by the DFA, the gradual unwinding of Eurosystem asset purchase programmes and an increase in the overall limit of lending against cash collateral from the Eurosystem securities lending facilites. Despite this expansion, repo specialness reached historically elevated levels in 2022. This situation raises the question of why a high public sector supply of collateral did not translate into lower scarcity premia.

The limited effect of the high public sector supply, both by the DFA and the Eurosystem,

reflects the design of the facilities as well as the market structure of repo intermediation. Both the DFA and the Eurosystem transact at prevailing interdealer market rates.[19] Borrowing from public-sector operations in order to lend through the interdealer market offers limited scope for profitable intermediation and is not a core function of most repo desks, which use these operations mainly to support settlement, mitigate fails, or meet client demand. Because dealers access public-sector repo primarily to meet their own trading or client-driven needs, and not to supply other dealers through the interdealer market, securities sourced from these channels do not generally expand the effective supply of collateral available for interdealer redistribution. Instead, they primarily reduce demand pressure at the level of individual dealers in the interdealer market.

In this environment, dealers facing strong client demand, access the facilities directly to source securities. If scarcity had been driven primarily by aggregate quantity constraints, borrowing limits would have become binding across counterparties. Instead, we observe on the utilisation rates from the Eursystem facilities that there exists a segmented market in terms of client demand across dealers. [20]

Figure 9 documents utilisation of the ECB and Bundesbank securities lending facilities relative to counterparty borrowing limits. Panel (a) shows average utilisation across all counterparties. Borrowing activity increased during periods of elevated scarcity, peaking in September 2022 when Bund specialness reached historical highs. However, even at the peak, average utilisation remained well below available limits (in 2022 it did not go above 40% of the available limit), indicating that the facilities borrowing limits were not binding in aggregate.[21] Panels (b) and (c) reveal substantial heterogeneity across counterparties, with a small group of dealers accounting for the bulk of borrowing. Many of these banks were close to their limits in the amount of securities borrowed, while the remaining eligible counterparties made limited use of the facilities. This heterogeneity persists throughout the period of heightened scarcity and is observed for both the Bundesbank and ECB facilities.

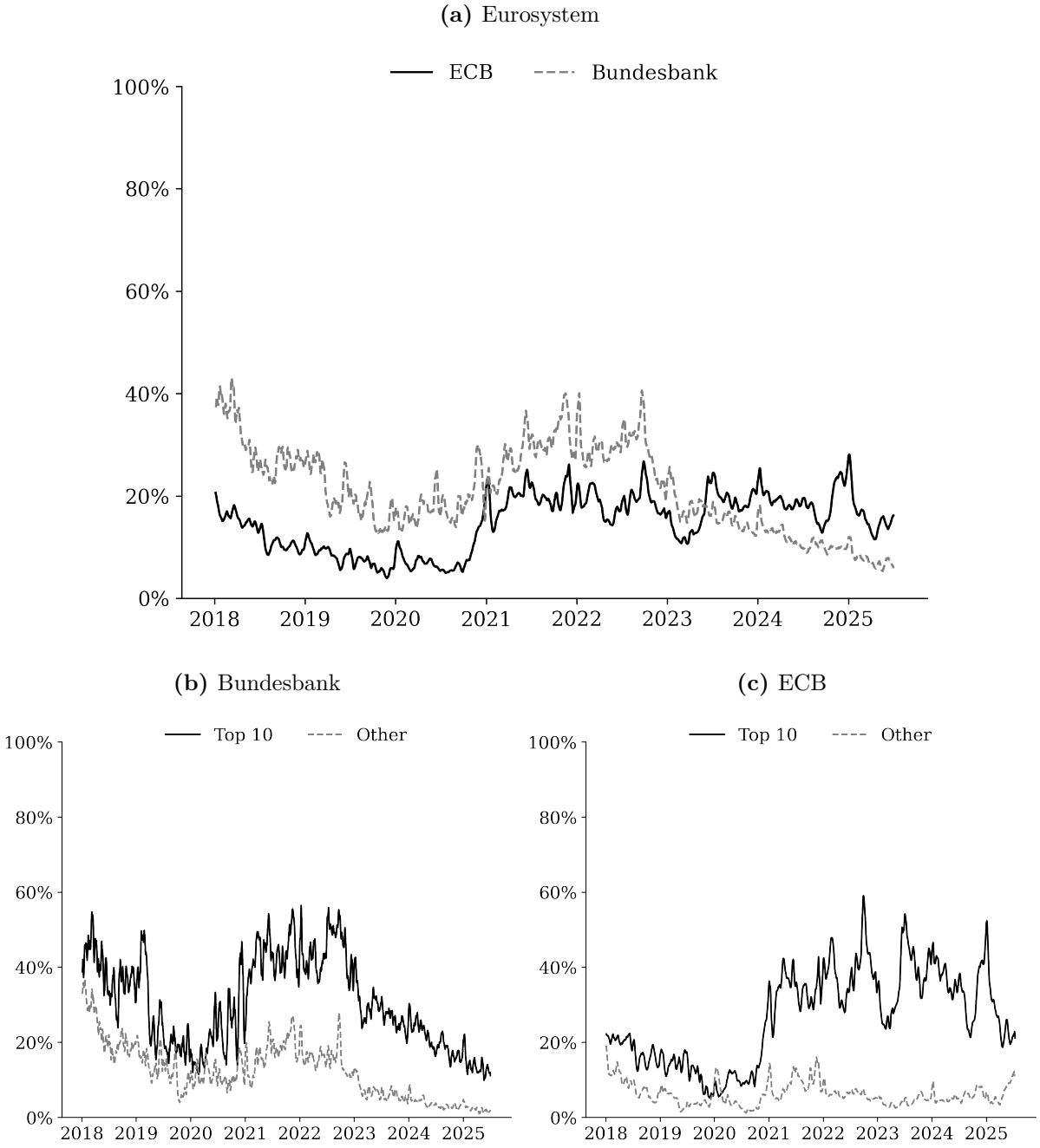
To understand these patterns, we combine quantitative evidence with market intelligence gathered through regular operational discussions with facility users during the 2022 episode.

[19] As explained in Section 2, the Eurosystem securities lending facilities are subject to a minimum rate. Transactions are conducted at this floor when market repo rates stay above it, and otherwise take place at prevailing market rates

[20] See Figure A1 in the Appendix for the DFA's daily net outstanding repo-market position as a percentage of its own holdings.

[21] The utilisation of the DFA portfolio also remained well below its potential maximum as shown in Figure B1.

Figure 9: Securities lending average counterparty utilization



Note: Counterparty utilization is defined as the volume of securities borrowed by a counterparty from the Bundesbank/ECB securities lending facilities relative to its limit to borrow from the respective facility. Chart lines show the daily average of this measure across counterparties. In panels (a) and (b), "Top 10" refers to the ten banks with the highest average utilization over time, while "Other" refers to all remaining eligible counterparties.

These discussions consistently indicate that facility usage was driven primarily by client demand. Dealers with significant hedge fund client activity reported that sourcing securities for clients was the main motivation for accessing the facilities, while dealers without such client relationships relied on the facilities mainly to manage positions in their own trading books. This is consistent with MMSR data, which shows that just five banks were responsible for 86% of German collateral repo and reverse repo transactions with hedge funds between 2019 and 2026. These banks are the dealers in the top users group in Figure 9. Banks without hedge funds relationships accessed the facilities sparsely.

Overall, the evidence is consistent with the market structure described in Section 2.1. Hedge funds generate security-specific collateral demand through leveraged strategies and access repo through bilateral dealer relationships. Dealers facing strong client demand cannot rely simply on the interdealer market to obtain these securities, also because other dealers use the securities lending facilities typically for their own client or trading positions, more than to redistribute them through the interdealer repo market. As a result, collateral sourced from the facilities does not typically circulate across dealers. Instead, scarcity pricing reflects the effective supply available within the interdealer network, while public-sector facilities provide quantity insurance without back-stopping prices. We turn next to the determination of repo pricing to examine how these dynamics translate into observed borrowing rates.

5.3 Repo pricing

In previous sections, we have described three key ingredients in the German repo market. First, a group of market participants (hedge funds) who swiftly modify their demand for securities according to market conditions. Second, a central bank and a DMO who provide securities at market prices. Third, a segmented market, with only a reduced number of dealers with relationships to hedge fund clients.

We use these three ingredients to explain the dynamics underlying increases in repo rates by estimating a Dynamic OLS (DOLS) model (Stock and Watson, 1993). We explain clients' borrowing rates by three key determinants: (i) dealers' own borrowing costs for the same securities, (ii) the borrowing costs associated with the DFA securities lending facilities, and (iii) hedge fund positions in German government securities.

Our specification allows for the ability of dealers' to appropriate a share of the expected profits associated with short-selling activity through exercising market power. Duffie, Garleanuc,

and Pedersen (2002) show that prospective short sellers must search for security lenders and bargain over lending fees with them. Empirical evidence shows that during the 2022 scarcity episode, dealers' own borrowing rates for scarce securities increased only modestly, while the lending rates charged to clients rose substantially more.

The DOLS model incorporates leads and lags that are selected automatically using the Akaike Information Criterion. Statistical inference is based on heteroskedasticity- and autocorrelation-consistent standard errors, with long-run variance estimated using a Newey–West estimator employing a Bartlett kernel and a data-driven bandwidth selection procedure.

We assess the stability of the long-run relationship using the Hansen (1992) parameter instability test. The null hypothesis of cointegration with stable parameters cannot be rejected at the 10% significance level, providing no evidence of structural instability and supporting the existence of a persistent long-run equilibrium relationship among the variables.

The estimation results in Table 5 indicate that dealers' own borrowing costs and their costs of borrowing from the DFA exert quantitatively similarly important effects on clients' borrowing rates from dealers. In addition, hedge fund positioning has a statistically meaningful impact: larger net short positions are associated with higher borrowing costs of securities for clients.

A limitation of this analysis is that it does not permit a formal test of the weak exogeneity of the explanatory variables. Future work employing a Vector Error Correction Model (VECM) would allow for an explicit assessment of weak exogeneity, as well as the identification and economic interpretation of potentially multiple cointegrating relationships.

Table 5: Determinants of clients' borrowing rates from dealers

	Dependent variable:
	Borrowing rate
Lending rate	0.427***
	(0.15)
DFA rate	0.460***
	(0.043)
Hedge funds cash position	0.109**
	(0.020)
Constant	−7.855***
	(0.659)
Day fixed effects	Yes
Observations	2,364
R^2	0.980
Adjusted R^2	0.979

Note: The dependent variable is the weighted-average daily repo rate paid by clients borrowing German government securities from dealers. The lending rate is the weighted-average daily repo rate paid by dealers when sourcing securities in the market, while the DFA rate corresponds to the cost of obtaining securities from the DFA. All interest rate series are expressed as deviations from the Deposit Facility Rate (DFR). The sample comprises daily observations from 6 June 2017 to 31 December 2023. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

6 Conclusion

Over the past decade, the repo market in German government securities experienced two episodes of stress, in 2016-2017 and 2022-23. Repo rates became exceptionally depressed, a phenomenon known as "specialness." Prior research has largely attributed this to the Eurosystem's LSAPs, which reduced the free floating amount of high-quality collateral. Our analysis provides a broader and more complete view. First, it highlights the important role played by the DFA in containing specialness and second, it shows how spikes in demand and segmentation in the repo market were key contributors in exacerbating specialness.

We have shown how the DFA operations reacted to Eurosystem purchases and cheapened repo rates during episodes of collateral scarcity in the German bond market. A repo operation amounting to 1% of an ISIN's outstanding volume increases repo rates by approximately 0.2 basis points. This effect is roughly twice as large as the corresponding estimate for DFA outright

sales of securities, reflecting the more immediate and targeted nature of repo-based interventions. Moreover, we examine a major intervention in October 2022, when the DFA conducted a large tap that shifted repo specialness for the tapped ISINs, thereby easing stress in the repo market while leaving the outstanding amount of debt unchanged.

However, in spite of the DFA efforts, repo rates rose to unprecedented levels in 2022. We argue that this stress in the market for German government securities repos reflected a surge in demand interacting with a supply that, while ample in aggregate, was distributed through a dealer-segmented market and priced at market-clearing rates.

The results of this analysis have implications for monetary policy and debt management policy and leave ample room for future research. The close connection between monetary policy and the repo market provides this segment of the money market with a key role. During the current balance-sheet normalization of the Eurosystem, the repo market takes on a growing importance as a channel for liquidity redistribution among banks. Repo rates thus may serve as an indicator, whether central bank liquidity is becoming scarce (Daskalova et al., 2024). Non-bank financial intermediaries, specifically hedge funds, were arguably key drivers during the two episodes of stress. In 2022–2023, hedge funds may have contributed to downward pressure on repo rates by accepting less favorable pricing from dealers, notwithstanding the higher level of collateral availability from public sector sources relative to 2016–2017. This effect may have been amplified by limits to arbitrage, given that hedge fund demand was intermediated by a restricted set of dealer relationships. These results raise the question of how should central banks take segmented dealer markets and their impact on repo pricing into account in the design of their monetary policy implementation framework.

The repo market plays a central role in the functioning of the government bond market by providing the financing infrastructure that underpins secondary-market trading. At the same time, repo conditions are directly influenced by the issuance and trading decisions of the DMO. Our findings therefore carry implications for public debt management. In particular, they indicate that active participation by the DMO in the repo market can improve market functioning beyond the DMO's immediate financing needs. By alleviating collateral scarcity and stabilizing repo rates, such participation supports liquidity in the underlying bond market, thereby enhancing trading conditions for market participants more broadly. An additional implication is that these effects can translate into a convenience yield for the issuer, as the improved availability and financing conditions raise the non-pecuniary value of owning the securities themselves.

The results also raise questions with regard to coordination of monetary and debt-management policies. Our study suggests that the degree of interaction between central banks and DMOs has been considerable. With regard to their securities lending facilities, both pursued similar goals to support market functioning and mitigate stress in the repo market. With regard to outright transactions the alignment of goals is less clear. The DFA may have successfully mitigated local scarcity effects induced by Eurosystem LSAPs.

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A Appendix tables

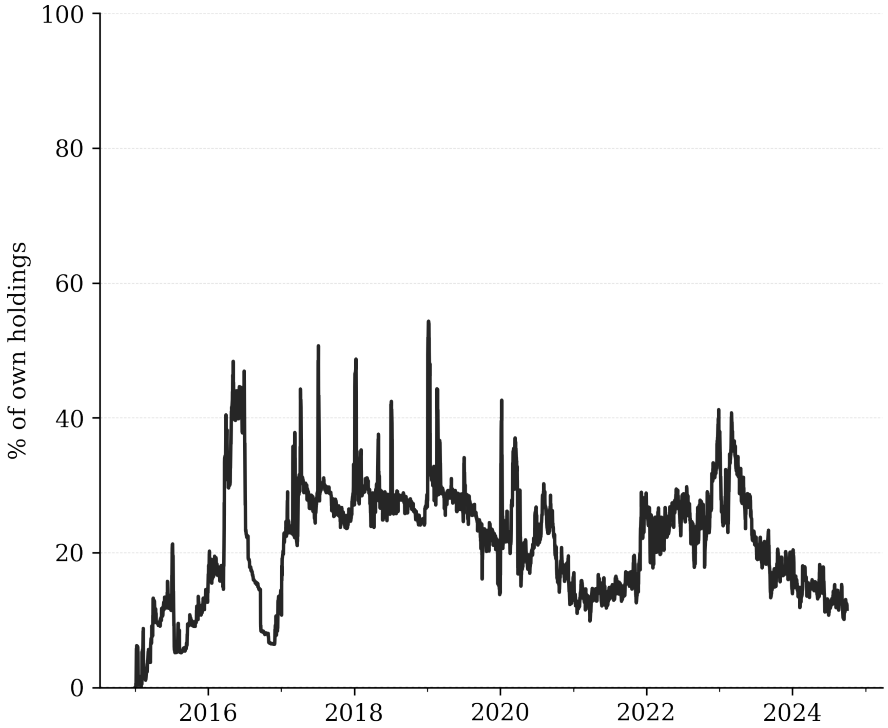
Table A1: Effect of Eurosystem cash market operations on repo rates by maturity buckets

	Dependent variable:
	Repo Rate Change
ES Purchases (Base)	-0.304^{***}
	(0.053)
ES Purchases × Y2	-0.469^{**}
	(0.198)
ES Purchases × Y5	-0.322^{***}
	(0.115)
ES Purchases × Y10	-0.225
	(0.207)
ES Purchases × Y15	-0.226^{**}
	(0.094)
ES Purchases × Y30	-0.468^{**}
	(0.223)
Control variables	Yes
ISIN fixed effects	Yes
Day fixed effects	Yes
Observations	180,466
Adjusted R^2	0.930

Note: The table reports the estimates of Equation (2) plus interaction terms of the Eurosystem purchases variable with dummies for each maturity bucket. The omitted maturity bucket is that of 1 year or less. The sample includes all Eurosystem and DFA transactions on German debt securities in the secondary market conducted between January 2015 and December 2024. The dependent variable is the daily change in the repo rate for each ISIN, with the daily repo rate constructed as a volume-weighted average from all daily trades recorded in BrokerTec. Control variables include cheapest-to-deliver dummy and on-the-run dummy. Standard errors are clustered at the ISIN level.
* / ** / *** indicate 10% / 5% / 1% significance level.

B Appendix figures

Figure B1: DFA repo lending utilization relative to own holdings



Note: DFA's daily net outstanding repo-market position as a percentage of its own holdings. Positive values indicate net lending, while negative values would indicate net borrowing by the DFA. Since the DFA trades via a central counterparty, the counterparty to each transaction is the CCP, meaning that DFA usage cannot be split by individual counterparty.

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The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Eurosystem or the DFA.

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