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Elastic in Cash, Inelastic in Repo: Hedge Funds in the Treasury and Repo Markets

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Elastic in Cash, Inelastic in Repo: Hedge Funds in the Treasury and Repo Markets *

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Abstract

Sovereign bond markets are a cornerstone of the financial system, and their functioning is tightly linked to repo markets, where investors finance long positions and source bonds for short sales. We show, theoretically and empirically, that repo prices are set in the cash bond market: when demand for cash bonds exceeds available supply, arbitrageurs accommodate the excess by shorting bonds and borrowing them in the repo market, opening a wedge between the policy and repo rates, i.e., generating specialness. An elastic supply of collateral, in turn, limits how much of the excess demand is capitalized into bond prices. Using regulatory data covering the universe of repos backed by German sovereign bonds, we identify the final borrowers and lenders of securities and estimate the first demand and supply elasticities for a repo market. Supply, dominated by the public sector, accounts for 87% of the aggregate elasticity. Demand, driven by hedge funds, is strongly inelastic: a 10% increase in borrowing costs reduces their borrowing by only 1%. Despite being among the most price-elastic investors in cash bond markets, hedge funds are inelastic in repo, as their borrowing sustains relative-value positions whose size is pinned by the preferred-habitat demand they intermediate: their elasticity is inherited from their cash-market counterparties rather than being a primitive. Specialness thus emerges as the equilibrium price of cash-market demand pressure—of which collateral scarcity from central bank purchases is a special case—tying safe-asset pricing and the transmission of monetary policy to the same imbalances in the cash bond market.

JEL Classification Codes: E51, E52, E58, G21.

Keywords: Monetary Policy, Repo Market, Bond Market, Safe Assets.

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1 Introduction

Sovereign bonds are a cornerstone of the financial system, and their prices are shaped by the interaction of cash and repo markets: intermediaries and arbitrageurs finance bond holdings and source bonds for short sales in the repo market, so sovereign bond and repo markets clear jointly. The price of borrowing a specific bond—repo specialness, the wedge between the policy rate and the bond's repo rate—is capitalized into the bond's price and yield curve (Duffie, 1996; DAmico and Pancost, 2022; Jappelli, Subrahmanyam, and Pelizzon, 2023), and the divergence of repo rates from the policy rate impairs the transmission of monetary policy to short-term rates (Duffie and Krishnamurthy, 2016; Nguyen, Tomio, and Vari, 2023; Ballensiefen, Ranaldo, and Winterberg, 2023).

The nexus between the two markets has moved to the center of policy debates as hedge funds have become dominant borrowers in government-bond repo, funding the basis trades whose rapid unwinding is a leading concern for Treasury market stability (Barth and Kahn, 2025). Yet the bond and repo markets are typically studied in isolation, and remarkably little is known about who sets the price in the repo market or what determines its level. We provide the first answer with a model in which repo prices are set by demand pressure originating from the cash bond market, testing it with the first estimation of demand and supply elasticities for the repo market.

The existing literature treats specialness as a crisis phenomenon, owing to dealer balance-sheet constraints (Andersen, Duffie, and Song, 2019; Brunnermeier and Pedersen, 2009); as a byproduct of unconventional monetary policy, driven by the collateral scarcity that central bank purchases induce (Arrata, Nguyen, Rahmouni-Rousseau, and Vari, 2020; Corradin and Maddaloni, 2020; Pelizzon, Subrahmanyam, and Tomio, 2025); or as a result of trading frictions, with search costs and dealer market power generating dispersion in funding rates (Infante, 2020; Eisenschmidt, Ma, and Zhang, 2020). Specialness, however, prevails even when balance sheets are unconstrained and collateral supply is stable. We show that specialness arises in a repo market that clears competitively at a single price, with unconstrained arbitrageurs, as the equilibrium response to demand pressure from the cash bond market—of which central bank purchases are a special case.

Our analysis is organized around the model's central prediction: hedge funds—among the most price-elastic investors in cash bond markets (Chaudhary, Fu, and Zhou, 2024; Jansen, Li, and Schmid, 2024)—are price-inelastic in the repo market. Unlike the decision to enter the basis trade, repo borrowing is not discretionary (Duffie, 1996): it is an input required to sustain relative-value positions whose size is set elsewhere, namely, by the preferred-habitat investors' demand that hedge funds satisfy by short selling the bond in the cash bond market.

The economic mechanism is simple. Preferred-habitat investors—pension funds, insurance companies, bond mutual funds—value physical bonds for regulatory and institutional reasons that make synthetic substitutes imperfect. When their demand exceeds available supply, the cash bond becomes more expensive than the synthetic substitute: bases, such as the cash-futures basis or the asset-swap spread, open up.[1] Hedge funds exploit the wedge by shorting the bond against an offsetting synthetic position, borrowing the bond in the repo market to deliver it, effectively expanding the supply of bonds available to preferred-habitat investors. The cash-market imbalance thus translates one-for-one into repo borrowing demand. On the other side of the repo market, dealers and the public sector lend securities, with supply that is upward-sloping in specialness due to intermediation costs and institutional design. Specialness is the price at which the repo market supports hedge funds' intermediation of cash-market demand.

This mechanism delivers a theoretical insight that applies beyond the repo market. In demand-system asset pricing, estimated elasticities are commonly interpreted as preference or technology parameters of the estimated sector. Our model shows that for an intermediary whose position in one market is mechanically tied to its position in another, the elasticity is instead an equilibrium object: the arbitrageur's elasticity in one market is determined, through market clearing, by the elasticity of its counterparties in the *other* market.

In our setting, the linkage works as follows. Because hedge funds arbitrage the spread between the basis and specialness, their willingness to adjust repo borrowing is not limited by their own price sensitivity, but by how much quantity their cash-market counterparties release when prices move. The slope of hedge funds' demand for borrowing bonds on the repo market: the price sensitivity of preferred-habitat investors.[2] Symmetrically, the slope of their cash-market supply schedule is governed by the repo-market friction. The repo market is the cleanest laboratory for this cross-market determination: hedge funds trade there only to fund relative-value positions, never as an independent strategy, so their demand in the repo market is just as inelastic as preferred-habitat investors' demand is in the cash market.

[1] The cash-futures basis compares the price of the cash bond with the price implied by the corresponding futures contract; the asset-swap spread compares the bond's yield with the fixed rate of a maturity-matched interest-rate swap.

[2] Hedge funds' own frictions—transaction costs, price impact, balance-sheet charges—would enter as well, but Appendix A.4 shows that the equilibrium elasticity never exceeds the cash-market depth, and approaches it as those frictions become small relative to the rigidity of preferred-habitat demand.

Equilibrium prices follow from this intermediation structure. Specialness reflects the intersection of hedge funds' inelastic derived demand with imperfectly elastic securities-lending supply. Any shift in cash-market conditions—in preferred-habitat demand or bond supply—moves specialness through hedge funds' derived demand, and thereby moves bond prices through the specialness premium embedded in yields. The model predicts that time variation in market-wide specialness is driven by the size of cash-market imbalances, not by changes in price sensitivities.

Testing these predictions requires observing who ultimately borrows and lends each bond for every transaction—a level of detail that, to our knowledge, no available dataset provides for the U.S. Treasury market. We obtain such visibility for the European repo market from the Securities Financing Transactions Data Store (SFTDS), a regulatory dataset that records who-to-whom transactions for the universe of European repos. Ours is the first paper to use it to study repo pricing and its link to investor positions, and to estimate a demand system for a repo market, which we do using the Optimal Granular Instrumental Variables (O-GIV) framework of Chaudhary et al. (2024). Identification exploits the granularity of the market: the idiosyncratic changes in the positions of large sectors are, under the model's factor structure, uncorrelated with aggregate demand shifts and thus serve as instruments for price changes.

We focus on the repo market for German government bonds: the euro area's safe asset and the world's second-largest safe-asset repo market, with approximately EUR 200 billion in outstanding transactions. Its structure—preferred-habitat demand, hedge fund basis trades, and repo-financed positions—mirrors that of the U.S. Treasury market.[3] We combine SFTDS with confidential data on the ECB's securities lending operations and identify ultimate borrowers and lenders, looking through intermediaries and central counterparties.

The market topology matches the model. Repo participation is effectively decoupled from bond ownership: insurance companies and pension funds hold over EUR 120 billion in German government bonds yet are virtually absent from the repo market, while hedge funds—predominantly domiciled in the Cayman Islands and Bermuda, the same jurisdictions that dominate U.S. Treasury basis-trade activity (Barth and Kahn, 2025)—hold few bonds yet absorb 50% of net securities borrowing directly, and 80% once their positions through foreign dealers are included. The public sector, through the ECB's securities lending program and the German debt management office's retained holdings, provides approximately 60%

[3]In recent years, U.S. basis trades have typically involved buying the cash bond and selling futures, whereas Bund richness implies the opposite legs. The mechanism—repo-financed arbitrage linking the cash and derivative markets, with the repo leg pinned by the cash position—is analogous across geographies.

of net securities lending, while euro-area banks and dealers run matched books. Preferred-habitat investors generate the demand pressure in the cash market but do not appear in the repo market; the hedge funds that accommodate their demand in the cash bond market do so by borrowing the securities in the repo market.

The elasticity estimates confirm the model's central prediction. Hedge funds exhibit a repo elasticity of 0.11: a 10% increase in borrowing costs reduces their demand by only 1%. The estimate is economically small but statistically different from zero—precisely what the model predicts when preferred-habitat investors retain some, albeit limited, price sensitivity—and consistent with the cash-market evidence in Koijen, Koulischer, Nguyen, and Yogo (2021). The market as a whole shows an aggregate repo-market elasticity of 1.2, only 13% of which originates on the demand side and 87% on the supply side. Among suppliers, the public sector is elastic, with an institutional nuance the model helps interpret: the German debt management office supplies bonds broadly, while the ECB's facility is more responsive, consistent with its role as a backstop.

Comparing our repo-market estimates with cash-market elasticities for the same sectors shows the cross-market inversion at the heart of the framework. Hedge funds are among the most elastic investors in the cash bond market (Jansen et al., 2024; Chaudhary et al., 2024) but the least elastic in the repo market; the public sector displays the opposite pattern, purchasing bonds according to policy mandates regardless of price while lending them elastically in repo. The inversion is what the mechanism predicts for an intermediary that exercises discretion in one market and covers positions in the other. The determination, moreover, runs in both directions: just as hedge funds' repo elasticity reflects preferred-habitat investors' price sensitivity, their high cash-market elasticity rests on the elastic securities-lending supply of dealers and the public sector in the repo market. Neither elasticity is a hedge-fund primitive.

The time series supports the model's remaining prediction that specialness moves with quantities, not as a result of changing price sensitivities.[4] During the ECB's rapid tightening in 2022, every measure of cash-market imbalance (cash-futures bases, asset-swap spreads, and pricing errors from fitted yield curves) widened, consistent with intensifying preferred-habitat demand. Hedge funds expanded their short positions, bond borrowing on the repo market surged, and specialness reached historically unprecedented levels. As imbalances receded in late 2022 and 2023—with increased issuance, moderating excess demand, and expanded securities lending by the German debt management office—borrowing and specialness normalized. Sub-sample estimates show hedge fund elasticities virtually unchanged

[4] Quarter-end spikes in specialness are the exception: they reflect dealers' balance-sheet constraints around reporting dates rather than cash-market demand pressure.

across the quantitative easing and tightening regimes. The dynamics ran through positions rather than price sensitivity, as the model implies when repo elasticity is anchored by the structural rigidity of preferred-habitat demand.

Our results yield three policy implications. First, aggregate repo specialness is a timely, observable signal of cash-market demand pressure, and it co-moves with the bases and pricing errors that central banks monitor for transmission. Second, the design and pricing of securities lending facilities have first-order effects on both repo pricing—our sectoral decomposition indicates that public-sector facilities reduced specialness by approximately 15 basis points at the peak of the 2022 episode—and cash bond pricing. Third, because repo demand inelasticity originates in the cash market, specialness exists as long as profitable basis-trade opportunities persist. It can be contained only by satisfying preferred-habitat demand in the cash market or by lending securities at the policy rate.

The topology and the elasticities together carry a final financial-stability message that extends well beyond our setting: the marginal price-setters in the repo market for a major safe asset are offshore, non-bank entities outside the domestic regulatory perimeter. The transmission of monetary policy through repo rates thus increasingly depends on actors whom domestic regulators cannot directly supervise—and through whom shocks originating far from euro-area fundamentals can propagate into the market that anchors the euro-area risk-free rate. The same hedge funds, running the same basis trades from the same jurisdictions, are the dominant (cash) borrowers in U.S. Treasury repo. Our estimates provide the first evidence on how price-sensitive that borrowing is—evidence not yet available for the U.S. market. To the extent that the same derived-demand logic operates there, hedge funds' financing demand is similarly inelastic to repo rates, and shifts in their basis-trade positions would transmit directly into the rates from which SOFR—the benchmark that anchors U.S. dollar pricing—is constructed.

The remainder of the paper is organized as follows. Section 2 develops the theoretical framework. Section 3 describes the data and documents the structure of the repo market. Section 4 presents the empirical methodology, and Section 5 reports the elasticity estimates. Section 6 analyzes hedge fund behavior and the link between cash and repo markets. Section 7 concludes.

Literature Review

Our paper contributes to several strands of the literature. We contribute to the literature on repo pricing and its linkage to bond pricing, pioneered by Duffie (1996), who models repo demand as a byproduct of bond short-selling, and later by DAmico and Pancost (2022). Subsequent work on repo pricing emphasized dealer balance-sheet constraints (Andersen et al., 2019; D'Avernas, Petersen, and Vandeweyer, 2025), liquidity spirals (Brunnermeier and Pedersen, 2009), and collateral scarcity from central bank asset purchases (Arrata et al., 2020; Corradin and Maddaloni, 2020; Jappelli et al., 2023; Pelizzon et al., 2025). We complement this work by showing that specialness arises as a normal-times equilibrium outcome of cash-market demand pressures, of which collateral scarcity from asset purchases is a special case. Our paper provides the first market-wide empirical test of the mechanism proposed at the security-level by Duffie (1996), using comprehensive transaction data to estimate a demand system for the repo market.

We contribute to the demand-system approach to asset pricing, pioneered by Koijen and Yogo (2019) and extended to sovereign bond markets by Koijen et al. (2021), Jansen et al. (2024), and Chaudhary et al. (2024). Most relevant to our work, Jansen et al. (2024) estimate sector-level demand functions for the U.S. Treasury market and document that hedge funds and primary dealers accommodate demand imbalances from preferred-habitat investors by holding short positions. We show that this cash-market role has an exact repo-market counterpart, and that neither elasticity is a primitive: hedge funds' cash-market elasticity is governed by the frictions of the repo market where they source the bonds they short, while their repo-market elasticity is inherited from the preferred-habitat investors they accommodate in the cash market. Chaudhary et al. (2024) develop the O-GIV framework we apply, finding hedge funds to be the most elastic investors in the U.S. Treasury cash market; our paper documents their mirror image in the repo market.

On the empirical side, we provide new evidence on the structure of the euro-area repo market and hedge funds' prominent role in it. Our work complements Mancini, Ranaldo, and Wrampelmeyer (2015), who provide the first in-depth analysis of the euro-area repo market, Hermes, Schmeling, and Schrimpf (2025), who use SFTDS to study U.S.-dollar repo positions of European banks, and Ampudia, Formoso da Silva, Hesse, Putz, Schobert, von Landesberger, and Wohlert (2025), who study interactions between the Eurosystem and the Finanzagentur in cash and repo markets for German collateral. A nascent literature highlights the importance of hedge funds in the repo market. Barth and Kahn (2025) document that basis trades account for the large majority of hedge fund positions in the U.S. Treasury repo market, while Li, Ma, Mendicino, and Supera (2026) show that bank lending to non-bank financial institutions such as hedge funds affects credit supply to the real economy. We are the first to use transaction-level SFTDS data to map the full topology of the European safe-asset repo market, link investor positions to prices, and estimate sector-level elasticities.

2 Theoretical Framework

This section develops a simple one-period model designed to capture the mechanism underlying the elasticities estimated in our empirical analysis. The model features three markets: cash bonds, futures, and repo. The central agents are hedge funds, which link the cash bond and repo markets: they allow the former to clear by borrowing bonds in the latter, thereby increasing supply. Hedge funds are motivated by profiting from the wedge in price between the physical bond and a synthetically equivalent futures position. The wedge originates from preferred habitat investors' preference for holding the cash bond, which makes it "rich" relative to the futures.[5] Because shorting the bond requires borrowing it in the repo market, cash-market imbalances translate into hedge funds' repo bond borrowing demand. This demand, combined with the securities-lending supply from dealers and the central bank, determines the level of specialness at which the repo market clears.

The model is characterized by three traded assets: a cash bond, a futures contract on the same underlying bond, and a risk-free asset available in perfectly elastic supply at rate r_s, which can be interpreted as the policy rate. We derive demand and supply functions for the three markets from the agents' objective functions. The net supply of futures is zero, while the physical supply of the bond is exogenous. There are four types of agents: preferred habitat investors (PH), hedge funds (H), dealers (D), and the central bank (CB). Preferred habitat investors and hedge funds interact in the cash bond market. Hedge funds, dealers, and the central bank interact in the repo market. We present the objective functions of the four agents, then solve for cash- and repo-market equilibria.

2.1 The Hedge Fund

Hedge funds have mean-variance preferences and implement a range of strategies, including relative-value arbitrage. They trade in both the cash bond and futures markets and obtain bonds in the repo market to support short positions in the cash market. The relative-value strategy exploits the cash-futures wedge, or basis, defined as $x = r_F - r_T > 0$, where r_F is the futures bond- and r_T is the cash bond-yield. The basis represents the per-unit return advantage of a long futures position relative to a long cash-bond position.

Hedge funds implement this trade by shorting the bond and taking an offsetting long futures position, earning gross arbitrage profits equal to x before repo and margin costs. A positive

[5] While we refer to this synthetic asset as a futures contract, it may equally be thought of as an asset or interest-rate swap, and the richness can be in line with the definition of a bond's convenience yield.

basis, therefore, reflects a situation in which the cash bond is rich relative to futures: obtaining exposure through the physical bond is more expensive (lower yield) than replicating it synthetically, consistent with a premium paid by preferred habitat investors for holding the underlying security.

To short the bond, the hedge fund must borrow it in the repo market. Let $\chi > 0$ denote the specialness spread, i.e., the spread between the policy rate and the repo rate received from lending cash against the borrowed bond. Specialness is the per-unit cost of borrowing the scarce bond in the repo market to short-sell it in the cash market.

The representative hedge fund chooses a short position in the cash bond, $D_H < 0$, and a futures position with two components. The first is a hedging leg, denoted $D_F^H > 0$, which supports the basis trade and satisfies

$$D_F^H = -D_H. \tag{1}$$

The second is an additional directional futures position, N_F^H, which can be long or short.

The cash bond and the futures contract reference the same underlying bond, so their returns are perfectly correlated: $\text{corr}(r_T, r_F) = 1$. Since the basis-trade legs satisfy $D_F^H = -D_H$, the variance of the basis-trade component is zero. The directional trade exposes the fund to the common variance in bond and futures returns, σ^2, which, for simplicity, we normalize to 1.

Both the basis-trade futures leg and the directional futures position require margin. Let $m > 0$ denote the margin requirement per unit of futures exposure, and let $k > 0$ denote the opportunity cost of one unit of posted margin. Total margin usage must not exceed the fund's equity capital $E_H > 0$:

$$m\left(|D_F^H| + |N_F^H|\right) \leq E_H. \tag{2}$$

A hedge fund that shorts the bond and borrows it on the repo market pays χ per unit of the bond demanded, $|D_H|$. Once specialness and funding costs are accounted for, the basis trade earns per-unit profits of $x - \chi - mk$, and the directional futures position earns $N_F^H(r_F - r_s) - m|N_F^H|$. The basis trade is profitable if $x > \chi + mk$. We set up the model assuming that hedge funds are price-takers in both the cash and repo markets, and relax this assumption in Section 2.7.

The hedge fund's objective function is therefore:

$$\max_{D_F^H, N_F^H} \quad D_F^H(x - \chi - mk) + N_F^H(r_F - r_s) - km|N_F^H| - \frac{1}{2B}(N_F^H)^2 \tag{3}$$

subject to (1) and (2), where $B > 0$ is hedge fund risk tolerance. The directional futures position is standard and is characterized by a no-trade region induced by the margin friction.

Lemma 1 (Optimal basis trade)**.** *Two cases arise:*

(i) Basis trade profitable *($x > \chi + mk$): the hedge fund optimally sets $D_F^H = -D_H$, earning a riskless profit of $D_F^H(x - \chi - mk)$. Since this profit is linear and increasing in D_F^H, the hedge fund is willing to take as large a short bond position as possible.*

(ii) Basis trade unprofitable *($x \leq \chi + mk$): the hedge fund does not engage in the basis trade. $D_F^H = 0$ and $D_H = 0$.*

Lemma 2 (HF directional positions)**.** *The optimal directional futures position is*

$$N_F^{H*} = \begin{cases} 0, & \text{if } |r_F - r_s| \leq km, \\ B(r_F - r_s - km), & \text{if } r_F - r_s > km, \\ B(r_F - r_s + km), & \text{if } r_F - r_s < -km. \end{cases}$$

2.2 The Preferred Habitat Investors

Preferred habitat investors—pension funds, insurance companies, bond mutual funds—hold the physical bond both for structural reasons (regulatory mandates, liability matching, benchmark tracking, Holm-Hadulla, Leombroni, Mota, Papoutsi, and Corell, 2024) and in response to the term premium (Vayanos and Vila, 2021). The representative preferred habitat investor chooses $D_{PH} \geq 0$ to maximize:

$$\max_{D_{PH} \geq 0} \quad D_{PH}\big(r_T - r_s\big) - \frac{1}{2\eta}\big(D_{PH} - \bar{D}\big)^2, \tag{4}$$

where $\bar{D} > 0$ is the target allocation, capturing mandate-driven demand, and $\eta > 0$ is the price sensitivity, governing willingness to deviate from the target in response to the term premium. The quadratic penalty $\frac{1}{2\eta}(D_{PH} - \bar{D})^2$ captures the costs of deviating from the mandate. We define structural excess demand as $\Delta_S \equiv \bar{D} - S_T$, the gap between target allocation and physical bond supply.

The first-order condition yields:

$$D_{PH}^{*} = \bar{D} + \eta\big(r_T - r_s\big). \tag{5}$$

Demand has two components: a structural component $\bar{D}$, independent of returns, and a price-sensitive component $\eta(r_T - r_s)$. A small η corresponds to a setting in which preferred habitat investors are unwilling to deviate from their target allocation. A zero $\bar{D}$, instead, recovers a standard mean-variance investor with no target and risk tolerance η.

2.3 The Repo Dealer

The representative dealer is active only in the repo market, where it chooses the quantity $D_R^D \geq 0$ of bonds to lend. For each unit lent, the dealer earns the specialness spread χ, but incurs a convex cost of sourcing securities. This reduced-form cost captures balance-sheet charges, search frictions, and operational costs associated with locating and delivering scarce collateral.[6] The dealer solves

$$\max_{D_R^D \geq 0} \quad D_R^D \chi - \frac{\gamma}{2}(D_R^D)^2,$$

where $\gamma > 0$ governs the marginal cost of supplying bonds. The first-order condition yields the dealer's optimal supply, which is upward-sloping in specialness:

$$D_R^{D*} = \frac{\chi}{\gamma}. \tag{6}$$

2.4 The Central Bank

The central bank lends securities through a facility associated with a legacy portfolio of asset purchases $\bar{Q} > 0$. We model central-bank lending as a reduced-form tradeoff between alleviating repo-market distortions and limiting balance-sheet usage to avoid crowding out private intermediation, consistent with the ECB's stance that "the aim of securities lending is to support bond and repo market liquidity without unduly curtailing normal repo market activity."[7]

[6] These dealers can be thought of as custodian banks that lend the holdings of preferred habitat investors, retaining any profit from securities lending.

[7] See https://www.ecb.europa.eu/mopo/implement/app/lending/html/index.en.html.

Specifically, the central bank chooses D_R^{CB} to solve

$$\min_{D_R^{CB}\in[0,\bar{Q}]} \frac{\mu}{2}\chi^2 + \frac{\lambda}{2}(D_R^{CB})^2, \tag{7}$$

where μ is the specialness-aversion parameter, governing how much the central bank dislikes repo rates diverging from the policy rate, and $\lambda > 0$ is the footprint-cost parameter, capturing operational, institutional, or political costs of lending and crowding out private securities lenders. We solve this problem explicitly after deriving the equilibrium condition.

While the model features the central bank as the sole public-sector lender of securities, empirically we estimate separate elasticities for the two entities that constitute the public sector: the central bank and debt management office (DMO). Like the central bank, DMOs operate securities lending facilities—to manage liquidity, finance short-term budget needs, and mitigate scarcity in their bonds (Ampudia et al., 2025). The two entities may weigh the costs—crowding out private lenders—and the benefit—limiting specialness—differently, and the DMOs may additionally value the financing costs saved by collecting lending fees. Any such objective, however, that combines a quadratic footprint cost with specialness aversion or fee revenue implies lending supply that is linear in specialness. Aggregate public sector lending is therefore equivalent to that of a single lender with composite parameters (μ, λ), and we model the public sector as a single entity.

2.5 The Cash Market Equilibrium

We next characterize cash-market clearing. We first build intuition by assuming that r_T is exogenous, then present the equilibrium with endogenous r_T in Section 2.7. Let S_T denote the exogenous physical supply of the bond available to the private sector, net of any central-bank holdings. The cash market clears when preferred-habitat investor holdings plus hedge-fund holdings equal net supply. When the basis trade is profitable, hedge funds accommodate the excess demand of preferred habitat investors by shorting the bond. In that case, their equilibrium position is pinned down by cash-market clearing: $D_H^* = S_T - D_{PH}^*$.

In the empirically relevant case in which preferred habitat investors demand more bonds than are physically available, $D_{PH}^* > S_T$ and hence $D_H^* < 0$: hedge funds supply bonds to the cash market through short sales. By contrast, if the basis trade is not profitable, hedge funds are absent from the cash market and preferred habitat investors hold the available supply.

Lemma 3 (Cash-market equilibrium)**.** *Suppose the hedge fund's equity constraint does not bind.*

(i) Profitable basis trade: *If $x > \chi + mk$, the basis trade is profitable and the hedge fund's supply of bonds to the cash market is perfectly elastic. The hedge fund earns the same per-unit riskless profit $x - \chi - mk$ on every bond, so its supply curve in the cash market is horizontal. The hedge fund's equilibrium bond supply is determined entirely by preferred habitat investors' excess demand relative to the physical supply S_T:*

$$|D_H^*| = D_{PH}^* - S_T = \Delta_S + \eta(r_T - r_s) > 0.$$

(ii) Unprofitable basis trade: *If $x \leq \chi + mk$, the hedge fund does not supply bonds to the cash market: $D_H = 0$, regardless of the prevailing price. Preferred habitat investors can only hold the physical supply: $D_{PH} = S_T$.*

Lemma 3 highlights the first step of the narrative the model is designed to capture. Conditional on a profitable basis trade and no capital limits, the hedge fund's cash-market position is pinned down by the imbalance created by preferred habitat investors' demand for the physical bond, which the hedge fund accommodates in full.

2.6 The Repo Market Equilibrium

On the repo market, hedge funds borrow bonds to support their short cash positions. Dealers and the central bank supply those bonds through securities lending. Repo-market clearing requires that hedge fund bond borrowing equal total securities-lending supply:

$$|D_H^*| = D_R^D + D_R^{CB}. \tag{8}$$

Substituting (6) into (8) and assuming that $|D_H^*| > D_R^{D*}$ yields equilibrium specialness as a function of hedge fund borrowing, central-bank lending and repo dealer's marginal costs:

$$\chi = \gamma \left(|D_H^*| - D_R^{CB} \right). \tag{9}$$

Specialness equals the dealer's marginal cost evaluated at the residual demand that the central bank does not absorb. The central bank internalizes this relationship when choosing how much to lend. Substituting (9) into (7), the interior solution is

$$D_R^{CB*} = \frac{\mu\gamma^2}{\mu\gamma^2 + \lambda} |D_H^*|. \tag{10}$$

The central bank absorbs a share $\mu\gamma^2/(\mu\gamma^2+\lambda)$ of hedge fund borrowing. This share is increasing in μ (CB cares more about specialness), increasing in γ (dealers' intermediation is costly, so the CB compensates), and decreasing in λ (securities lending affects CB footprint). The interior solution is valid whenever $D_R^{CB*} \leq \bar{Q}$; otherwise the portfolio constraint binds and $D_R^{CB} = \bar{Q}$.

Substituting (10) into (9), specialness can be expressed as a function of hedge fund demand:

$$\chi = \gamma\,|D_H| \left(1 - \frac{\mu\gamma^2}{\mu\gamma^2+\lambda}\right) = \frac{\gamma\lambda}{\mu\gamma^2+\lambda}\,|D_H| = \phi\,|D_H|, \tag{11}$$

where

$$\phi \equiv \frac{\gamma\lambda}{\mu\gamma^2+\lambda} \tag{12}$$

is the repo-market friction parameter. It summarizes the marginal specialness cost per unit of hedge fund borrowing, given the equilibrium responses of the dealer and central bank.

We can now state the central implication of the model. When the basis trade is profitable, hedge fund repo bond borrowing is determined by equilibrium in the cash market, as the hedge fund must borrow exactly the quantity of bonds that it shorts. Hedge fund bond borrowing on the repo market is therefore pinned down by the cash-market imbalance and is insensitive to repo specialness—that is, inelastic. Hedge fund demand elasticity in the repo market is thus bimodal, as the following proposition describes.

Proposition 1 (Repo borrowing demand)**.** *Suppose the hedge fund's equity constraint does not bind.*

- *(i)* Profitable basis trade: *If $x > \chi + mk$, the short position D_H is determined entirely by cash-market clearing. Hedge fund repo borrowing, $|D_H|$, is therefore inelastic to specialness.*
- *(ii)* Unprofitable basis trade: *If $x \leq \chi + mk$, the hedge fund does not trade the basis or borrow bonds in the repo market: $|D_H| = 0$.*

Proposition 1 characterizes the fund's demand conditional on cash-market clearing; it does not say that the fund is insensitive to prices. On the contrary: holding the cash price fixed, the fund's demand is perfectly elastic with respect to the arbitrage spread—its partial price elasticities are unbounded. The zero elasticity of Proposition 1 is what remains of that unbounded willingness to trade once the quantity is pinned by cash-market clearing. Section 2.7 develops this distinction between partial and total elasticities with endogenous bond prices, and Appendix A.4 formalizes it.

Finally, we characterize repo supply. Combining the dealer and central-bank problems yields simple upward-sloping supply schedules.

Proposition 2 (Repo-market supply)**.** *In the repo market, securities-lending supply is upward-sloping in specialness.*

(i) Dealer supply is $D_R^D = \frac{1}{\gamma}\chi$. A lower dealer cost parameter γ makes private supply more elastic.

(ii) Central-bank supply is $D_R^{CB} = \frac{\mu\gamma}{\lambda}\chi$ at the interior solution. Higher specialness aversion μ, lower footprint cost λ, or higher dealer cost γ makes public supply more elastic.

(iii) Aggregate repo supply is

$$D_R^D + D_R^{CB} = \left(\frac{1}{\gamma} + \frac{\mu\gamma}{\lambda}\right)\chi = \frac{\mu\gamma^2 + \lambda}{\gamma\lambda}\,\chi. \tag{13}$$

Aggregate supply is upward-sloping in specialness. Its slope is decreasing in λ (costlier central-bank lending reduces supply elasticity) and increasing in μ (a more specialness-averse central bank lends more at every level of χ).

Equilibrium specialness is determined by the intersection of hedge fund demand (Proposition 1) at $|D_H|$ with the aggregate upward-sloping supply schedule (13).

Taken together, Propositions 1 and 2 deliver the mechanism that underlies our empirical analysis. Preferred habitat investors' demand makes the cash bond rich relative to futures. Hedge funds respond by shorting the bond and going long futures whenever the basis exceeds repo and margin costs, and their supply in the cash bond market is perfectly elastic. Because maintaining the arbitrage position requires borrowing the bond in repo, the cash-market imbalance translates directly into repo borrowing demand that is independent of specialness—i.e., inelastic. Since the supply of securities lending from dealers and the central bank is not perfectly elastic, equilibrium specialness is positive.

In this sense, specialness does not reflect collateral scarcity in a mechanical sense; it arises from the interaction between cash-market demand for the physical bond and the elasticity of repo-market supply. Any shift in cash-bond demand—through preferred habitat investors' price sensitivity η, target allocation $\bar{D}$, or the term premium $r_T - r_s$—or in bond supply S_T translates into changes in specialness. Naturally, specialness also depends on frictions arising from dealers' balance-sheet charges, search frictions, and operational costs, as well as on the design of the central bank's securities lending facilities.

2.7 Endogenous Basis

The benchmark results are derived under the assumptions that the basis x and bond return r_T are exogenous and that the hedge fund does not internalize its own price impact on the bond and repo markets. We relax these assumptions, and show that the inelasticity of hedge funds in the repo market arises as a limiting case of the baseline model when preferred-habitat demand is sufficiently rigid. In this section, we model hedge funds to be perfectly competitive—thus behaving as price takers, yet having a price impact as a group.

The cash-market clearing condition $D_H = S_T - D_{PH}$ allows us to solve for the endogenous return, $r_T(|D_H|) = r_s + \frac{|D_H|-\Delta_S}{\eta}$, or equivalently for the endogenous basis:

$$x\big(|D_H|\big) = r_F - r_T\big(|D_H|\big) = \underbrace{r_F - r_s + \frac{\Delta_S}{\eta}}_{\equiv\ \bar{x}} - \frac{|D_H|}{\eta}. \tag{14}$$

We denote by $\bar{x}$ the natural basis, i.e., the basis that would prevail if hedge funds were absent:

$$\bar{x} \equiv r_F - r_s + \frac{\Delta_S}{\eta}. \tag{15}$$

It decomposes into the futures premium $r_F - r_s$ and the demand premium Δ_S/η. The latter captures the price distortion from preferred habitat demand: it is large when structural excess demand is high (Δ_S large) and preferred habitat investors are inflexible (η small).

Because the hedge fund's cash-market short position and repo borrowing are the same quantity $|D_H|$, its behavior in one market depends on conditions in the other. To understand how the fund's behavior in one market depends on the other, we derive conditional schedules: the fund's position as a function of one market's price, taking the other market's clearing condition as given. Substituting either the endogenous basis (14) or specialness (11) into the zero profit condition $x = \chi + mk$ allows us to characterize these conditional schedules.

Substituting the cash-market clearing condition (14) into the zero-profit function yields the fund's repo-market schedule as a function of χ:

$$|D_H|^{Repo}(\chi) = \eta\big(\bar{x} - \chi - mk\big).$$

Repeating this procedure with the repo-market condition (11) yields the cash-market schedule as a function of r_T:

$$|D_H|^{Cash}(x) = \frac{x - mk}{\phi} = \frac{r_F - r_T - mk}{\phi}.$$

The slopes of the two schedules are

$$\text{for the repo market: } \frac{\partial |D_H|^{Repo}}{\partial \chi} = -\eta, \qquad \text{for the cash market: } \frac{\partial |D_H|^{Cash}}{\partial x} = \frac{1}{\phi}$$

and represent total elasticities, the result of collapsing a multi-asset system into a single-asset system.

A total elasticity embeds the general-equilibrium feedback from cross-asset substitution, measuring the equilibrium effect of a change in repo prices, after all other prices have adjusted (Chaudhary et al., 2024). The distinction matters here because the two objects behave very differently: with zero profits, the fund's partial elasticities—its responses to either price holding the other fixed—are unbounded, yet the total elasticities in each market are finite, bounded by the friction of the other market. An increase in specialness is capitalized into the bond price, the spread re-widens, and what survives of the fund's unbounded willingness to trade is exactly the quantity its cash-market counterparties release: η. The total elasticity is what our empirical framework recovers. Section 5 uses the mapping between the estimated elasticities and the model's conditional schedules to interpret hedge funds' behavior across the two markets. Appendix A.4 provides a formal derivation, embedding the model in a multi-asset demand system.

These schedules reveal a cross-market pattern that follows from the model's structure. Because a single quantity $|D_H|$ links two markets, the fund's conditional schedule slope in each market is determined by the friction it internalizes from the *other* market. The intuition is that when the funds expand in one market, the cost of doing so is governed by how much the other market tightens. Higher η (more flexible preferred habitat investors) makes funds more responsive to repo conditions, because the cash-market price impact is smaller and the fund can adjust more freely. A less frictional repo market (lower ϕ) makes the fund more responsive to cash-market price changes, because the cost of adjusting repo borrowing is smaller.

Equilibrium quantities follow from the zero profit condition, where $\beta \equiv \frac{1}{\eta} + \phi$ captures the two equilibrium price responses that pin the competitive quantity: $\frac{1}{\eta}$ on the cash market and ϕ on the repo market. The following propositions summarize the model when the basis is endogenous.

Proposition 3 (Equilibrium quantities)**.** *The basis trade is profitable if and only if* $\bar{x} > mk$*, where* $\bar{x} = r_F - r_s + \Delta_S/\eta$*. Conditional on profitability and under perfect competition,* $|D_H| = (\bar{x} - mk)/\beta$*, the basis is* $x = \bar{x} - \frac{\bar{x}-mk}{\eta\beta}$*, specialness is* $\chi = \phi \cdot \frac{\bar{x}-mk}{\beta}$*, and profits are zero:* $x - \chi - mk = 0$*.*

Proposition 4 (Cash-market conditional schedule)**.** *Conditional on the repo market clearing, the hedge fund's intermediation is increasing in the basis x with slope $1/\phi$, or equivalently decreasing in the bond return r_T with slope $-1/\phi$, where $\phi = \gamma\lambda/(\mu\gamma^2 + \lambda)$ is the repo-market friction parameter. The slope is governed by the repo-market parameters: a less frictional repo market (lower ϕ) makes the hedge fund more responsive to the basis.*

Proposition 5 (Repo-market conditional schedule)**.** *Conditional on the cash market clearing, the hedge fund's repo borrowing is decreasing in specialness with slope $-\eta$, where η is the cash-market depth parameter. The slope is governed by the cash-market friction: more flexible preferred habitat investors (higher η) make the hedge fund more responsive to repo conditions. Since the hedge fund's cash-market short position and repo borrowing are the same quantity, the cross-market structure follows: in each market, the hedge fund's conditional schedule slope is determined by the friction in the other market.*

The baseline result of hedge funds' inelasticity on the repo market is effectively recovered as $\eta \to 0$, when preferred habitat investors' demand becomes perfectly inelastic at $\bar{D}$. The price impact $1/\eta \to \infty$ dominates β and $|D_H| \to \Delta_S$. The cost of obtaining a bond on the repo market becomes irrelevant, as the quantity $|D_H|$ is pinned on the cash side. The hedge fund's conditional schedule slope on the repo market $\eta \to 0$: the fund becomes perfectly inelastic, borrowing a fixed quantity of bonds regardless of χ. On the cash market, the fund's conditional schedule slope $1/\phi$ is unchanged—it is governed by repo friction, not by η. However, the equilibrium quantity is now pinned down by the preferred habitat investors' excess demand, so repo-market frictions are irrelevant for the cash-market clearing.

3 The Repo Market: Data and Topology

We analyze the repo market for German central government collateral from March 2021 to June 2024. This section presents the main datasets used in our analysis—with a specific focus on the most novel source, the Securities Financing Transactions Data Store (SFTDS)—and a first look at the data's descriptive statistics.

3.1 Data

The Securities Financing Transactions Regulation (SFTR), introduced in 2016 following Financial Stability Board recommendations, mandates reporting of securities financing transactions—including repos, buy–sell backs, securities lending, and margin lending—to authorized trade repositories.[8] As a result, SFTDS provides a near-exhaustive view of repo activity involving euro-area counterparties, substantially improving upon earlier datasets such as MMSR, which covered only selected dealers and did not allow for CCP look-through.

Because each transaction is reported multiple times by different counterparties, deduplication is required. A single CCP-cleared transaction typically generates four reports when all parties are euro-area domiciled. We describe our deduplication algorithm in Appendix A.1. In brief, it links ultimate securities lenders and borrowers, tracks any CCP intermediation, and consolidates all reports corresponding to the same economic transaction. Central banks and government debt management offices are exempt from reporting, although their counterparties must still report transactions conducted with them.

From the cleaned transactions, we construct daily stock positions that account for repo maturities. The methodology is detailed in Appendix A.1. Counterparties are identified by Legal Entity Identifier (LEI), country of domiciliation, and ESA 2010 sector classification. Because this classification does not distinguish dealers from other deposit-taking monetary (MFIs) or other financial institutions (OFIs), we supplement it with Bloomberg data to identify dealers explicitly. We refer to non-dealer banks as MFIs throughout.

We thus group counterparties into eight sectors: banks (MFIs excluding central banks), hedge funds (investment funds excluding MMFs), government (primarily euro-area debt management offices), other financial institutions (OFIs), dealers, central banks, insurance corporations and pension funds (ICPFs), and money market funds (MMFs). Non-financial corporations and residual sectors are excluded, as their presence on this market is minimal. Details are provided in Appendix A.2.

To address missing reporting by central banks and government entities, we supplement SFTDS with two additional sources. For the eurosystem, we use confidential data on securities lending operations from the ECBs Market Operations Database (MOPDB). For government activity, we rely on public institutional information. In the case of the Deutsche Finanzagentur, securities lending is primarily conducted via Eurex on a limited set of retained-issuance bonds. Because neither Eurex nor the Deutsche Finanzagentur reports these transactions, but final borrowers report trades with Eurex, we attribute such lending activity to the Deutsche Finanzagentur.[9]

[8] See Financial Stability Board, *Policy Framework for Addressing Shadow Banking Risks in Securities Lending and Repo*, and EU Regulation 2015/2365.

[9] While the unreported sector may include limited CCP proprietary lending, market participants indicate that these volumes are negligible. Figure A-1 shows that the unreported sector is consistently a net lender and lends more when specialness is high.

SFTDS reporting is restricted to transactions involving at least one EU-domiciled counterparty. This limits visibility into repo positions of non-euro area dealers. As illustrated in Figure A-2, when a euro-area dealer intermediates between a euro-area bank and a non-euro area hedge fund, both legs of the transaction are observed. By contrast, when the dealer itself is non-euro area domiciled, only the initial sourcing of the bond is reported. This asymmetry mechanically inflates the net borrowing positions of non-euro area dealers, which largely mirror the positions of their hedge fund counterparties. Consequently, non-euro area dealers appear as net borrowers rather than operating matched books.

We include all repo transactions collateralized by German Bunds. We complement the repo data with bond-level characteristics from the Centralised Securities Database (CSDB) and sectoral bond holdings from the eurosystems Securities Holdings Statistics (SHS). We compute asset swap (ASW) spreads for each bond as the difference between its yield (from MTS) and the interpolated Overnight Index Swap (OIS) rate at the same remaining maturity, with STR as the floating leg. ASWs capture cash-market expensiveness beyond interest rate and default risk and are closely related to repo-market expensiveness.

Overall, through transaction-level cleaning, harmonization, and reconstruction of stock positions, this paper provides the first comprehensive and granular view of investor participation in the repo market for German collateral.

3.2 The Topology of the Repo Market for German Collateral

Figure 1 shows daily flows and stocks of repos collateralized by German government bonds. Between 2021 and 2024, outstanding repo stocks ranged from EUR 200 to EUR 500 billion per day, equivalent to roughly one-fifth of total Bund supply. These quantities hide a significant heterogeneous participation rate to the repo market. Figure 2 decomposes repo stocks into borrowing and lending positions by sector, while Table 1 reports yearly average repo positions alongside cash bond holdings. On the borrowing side, dealers, banks, and hedge funds dominate. On the lending side, the primary providers are public sector entities—central banks and debt management offices—followed by dealers and banks.

Insurance corporations and pension funds (ICPFs) exhibit almost no direct repo activity, despite holding EUR 121–144 billion in German government bonds (around 8% of total outstanding supply). This reflects the fact that ICPFs typically delegate securities lending to agent intermediaries, whose activity is recorded under banks and dealers repo positions. In contrast to the U.S. Treasury repo market, money market funds play only a negligible role for

German collateral. Banks, OFIs, and dealers hold relatively small bond inventories—EUR 3–11 billion—but repo out more than EUR 100 billion per day, consistent with delegated and proprietary lending. Overall, repo market activity is largely decoupled from bond ownership across sectors.

To assess net positions, we compute net repo stocks separately for euro-area (EA) and non-euro area (non-EA) entities, reflecting reporting constraints. Figure 3 shows that the public sector, the eurosystem and the Deutsche Finanzagentur, is the largest net lender of securities, providing around 60% of all securities, while non-euro area hedge funds are the largest net borrowers, taking in nearly 50% of securities. These hedge funds are predominantly domiciled in the Cayman Islands and Bermuda (Figure A-3).

Banks and dealers primarily act as intermediaries. Euro-area banks are marginal net lenders, consistent with agent lending, while euro-area dealers operate matched books. Non-euro area dealers appear as net borrowers (37% of total demand), reflecting reporting limitations rather than true balance sheet exposure. Their net positions closely track those of non-euro area hedge funds, indicating that hedge funds are the ultimate borrowers. With full reporting coverage, we suspect that non-euro area dealers would likely also appear as matched-book intermediaries.

Finally, Figure 4 illustrates securities flows in 2022. The euro-area public sector emerges as the de facto securities lender, with foreign dealers and hedge funds as the ultimate borrowers. Banks and dealers mainly intermediate flows from euro-area entities to non-euro area investors, while euro-area banks lend more securities than they borrow, underscoring their role as agent lenders.

4 Equilibrium Model of the Repo Market: Econometric Framework

This paper estimates an equilibrium model of repo specialness that jointly incorporates investor demand across sectors and allows for heterogeneous responses to repo specialness and macroeconomic conditions. We conduct the empirical analysis using the methodological contribution of Chaudhary et al. (2024), the Optimal Granular Instrumental Variable (O-GIV). O-GIV extends the standard GIV framework introduced by Gabaix and Koijen (2024). The GIV framework constructs instruments by extracting idiosyncratic demand shocks from large investors and uses these shocks to estimate supply and demand elasticities.

GIV, like any other instrumental variable setup, relies on two assumptions, relevance and exclusion restriction. Relevance is satisfied if the idiosyncratic shocks are economically meaningful and originate from a small number of large institutions: When investors are sufficiently large, their idiosyncratic shocks to quantities can move aggregate prices. The exclusion restriction is satisfied if the shocks used as instruments are truly idiosyncratic. In particular, the variation captured by the instrument must be orthogonal to shocks that affect all investors, i.e., common factors. Under these two conditions, Chaudhary et al. (2024) provide a framework for estimating *sector-specific* elasticities. While their application focuses on the cash Treasury market, we apply O-GIV to the repo market.

Their setting is as follows. Assume sector i's demand for borrowing securities, $\Delta q_{i,t}$, can be expressed as a log-linear function of repo specialness, Δp_t—i.e., the repo price, defined as the eurosystem deposit facility rate minus the average repo rate for German government collateral—and other demand shifters $\upsilon_{i,t}$:

$$\Delta q_{i,t} = \overline{\Delta q}_i - \zeta_i \Delta p_t + \upsilon_{i,t}. \tag{16}$$

Here, $\overline{\Delta q}_i$ denotes sector fixed effects. Equation 16 represents sector i's net demand in the repo market, and ζ_i captures the response of sector i's net securities borrowing to changes in repo prices. A large ζ_i indicates a very elastic sector, which aggressively adjusts its supplied or demanded quantity in response to price changes. By contrast, a near-zero ζ_i characterizes a sector composed of price-inelastic investors, whose security-borrowing decisions are largely insensitive to repo pricing.

We decompose demand shifters into common factors η_t and sector-specific idiosyncratic shocks $u_{i,t}$. For example, an increase in uncertainty may induce hedge funds to expand cash-market positions in an attempt to profit from price discrepancies. To increase the profitability of these positions, hedge funds rely on leverage obtained by borrowing cash or securities in the repo market. Banks may also respond to heightened uncertainty by relying more on short-term funding, potentially taking positions that mirror those of hedge funds with varying intensity, or even adopting opposite strategies. In this setting, uncertainty is a common factor: it affects repo market activity across sectors while eliciting heterogeneous sectoral responses, captured by the sector-specific coefficient λ_i. Beyond uncertainty and other common factors η_t, sector-specific "bets" are captured by the idiosyncratic component $u_{i,t}$. This yields:

$$\Delta q_{i,t} = \overline{\Delta q}_i - \zeta_i \Delta p_t + \lambda_i \eta_t + u_{i,t}. \tag{17}$$

We relate prices and quantities through market clearing: in equilibrium, net securities borrowed must equal net securities lent. Equivalently, the market-share-weighted sum of sector flows satisfies $\sum_i S_i \Delta q_{i,t} = 0$. Imposing market clearing in Equation 17 and solving for equilibrium repo specialness gives, with S denoting size-weighted aggregation across sectors,

$$\Delta p_t = \frac{1}{\zeta_S} \left(\overline{\Delta q}_S + \lambda_S \eta_t + u_{S,t} \right), \tag{18}$$

where

$$\zeta_S = \sum_i S_i \zeta_i \tag{19}$$

is the aggregate elasticity. Equation 18 links changes in repo specialness to changes in aggregate net demand for securities in the repo market, scaled by the inverse of the aggregate elasticity.

Because prices and quantities are jointly determined in equilibrium, we use an instrumental variable approach to address simultaneity. Under the relevance and exclusion restriction conditions, the (O-)GIV framework constructs instruments by extracting investors' idiosyncratic demand shocks and using them as instruments for repo specialness faced by other sectors.

The endogenous variable is sector i's net repo position, $Q_{i,t}$. Net positions are daily outstanding stocks, computed as securities borrowed minus securities lent (EUR bn). We detrend net positions using a three-month moving average $\bar{Q}_{i,t}$, following Kubitza, Sigaux, and Vandeweyer (2025). The resulting variable, $\Delta q_{i,t}$, is expressed as a percentage deviation from the moving average:

$$\Delta q_{i,t} = \frac{Q_{i,t} - \bar{Q}_{i,t}}{|\bar{Q}_{i,t}|}, \tag{20}$$

a transformation we apply to all other quantities, including price, as well. The sample is partitioned into euro-area and non–euro area sectors, for a total of 15 sectors.[10]

We compute sector i's daily market share as its three-month moving average net position relative to the corresponding aggregate across sectors, and use the time-series average market share S_i over the sample:

$$S_i = \frac{1}{T} \sum_{t=1}^{T} \frac{|\bar{Q}_{i,t}|}{\sum_j |\bar{Q}_{j,t}|}. \tag{21}$$

Figure 5 compares value weights to equal weights by sector. Equal weights (the inverse of the number of sectors) provide a benchmark in which all sectors participate with equal footprint, while value weights S_i capture actual market shares in terms of net borrowing positions. The figure shows that the repo market for German collateral is highly concentrated in a

[10] Owing to their limited (direct) participation to the repo market, non-financial corporations, households, and non–euro area money market funds are excluded.

small number of large sectors. This granularity strengthens the relevance of O-GIV, as idiosyncratic shocks from large sectors can meaningfully affect repo prices.

Common factors are central to identification because they allow us to separate idiosyncratic shocks from aggregate shocks shared across sectors, supporting the exclusion restriction. We group controls into four macro-categories: Monetary policy quantities, repo demand quantities, repo supply quantities, and bond supply quantities. We detail which measures fall in each of these categories in the next section. We apply the same transformation as in Equation 20 to all common factors.

We extract idiosyncratic shocks to sector positions by residualizing each sector's net position $\Delta q_{i,t}$ with respect to sector fixed effects and common factors. This step is central to identification: conditioning on common factors isolates sector-specific shocks that can be used as instruments. The first-stage regression is:

$$\Delta q_{i,t} = \alpha_i + \lambda_i \eta_t + u_{i,t}, \tag{22}$$

where α_i denotes sector fixed effects, η_t is the vector of common factors (expressed as percentage deviations from three-month moving averages), and $u_{i,t}$ captures idiosyncratic shocks. We use Newey–West standard errors to account for serial correlation.

Because prices and quantities are jointly determined, we use an instrumental variable approach to identify the effect of quantities on repo specialness and address simultaneity. Under the relevance and exclusion restriction conditions, O-GIV constructs instruments by using estimated idiosyncratic shocks from other sectors as instruments for changes in repo prices.

Formally, Chaudhary et al. (2024) introduce a generalized method of moments (GMM) estimator—the Optimal-GIV estimator—to recover sector-specific elasticities $\hat{\zeta}_i$. Identification is based on the exclusion restriction and on weighting moment conditions by sector market shares to increase instrument relevance. The exclusion restriction implies:

$$\mathbb{E}[u_{i,t} u_{-i,t}] = 0 \qquad \text{for any } i \neq -i, \tag{23}$$

i.e., idiosyncratic shocks from sector i are orthogonal to idiosyncratic shocks from any other sector $-i$. The Optimal-GIV estimator $\hat{\zeta}$ solves the moment condition:

$$\widehat{\mathbb{E}}\Big[\hat{u}_{i,t}(\hat{\zeta}_i)\, \hat{u}_{S(-i),t}(\hat{\zeta})\Big] = 0, \tag{24}$$

where $\hat{u}_{S(-i),t}(\hat{\zeta}) = \sum_{j \neq i} S_j \hat{u}_{j,t}(\hat{\zeta}_j)$ denotes the size-weighted idiosyncratic shocks of all sectors other than i. The weights S_j give more influence to sectors with larger market shares, reflecting that their shocks move prices more strongly. Accordingly, for each sector i, the estimator selects $\hat{\zeta}_i$ so that the sample covariance between $\hat{u}_{i,t}(\hat{\zeta}_i)$ and $\hat{u}_{S(-i),t}(\hat{\zeta})$ is zero.

Substituting $\hat{u}_{i,t}(\hat{\zeta}_i) = \Delta q_{i,t} + \hat{\zeta}_i \Delta p_t$ into Equation 24 yields:[11]

$$\hat{\zeta}_i = -\frac{\widehat{\mathbb{E}}\Big[\,\Delta q_{i,t}\,\hat{u}_{S(-i),t}(\hat{\zeta})\,\Big]}{\widehat{\mathbb{E}}\Big[\,\Delta p_t\,\hat{u}_{S(-i),t}(\hat{\zeta})\,\Big]}, \tag{25}$$

which can be resolved recursively (Appendix A.3). This expression corresponds to the inverse of the canonical IV estimator: the numerator is the covariance between the endogenous variable and the instrument (constructed from first-stage residuals), and the denominator is the covariance between the price change and the same instrument.

5 The Repo Market Elasticity

In this section, we present our main results from the O-GIV estimation detailed in the previous section. We include several robustness checks and conclude with the quantification of how much each sector and factor contribute to the evolution of specialness.

5.1 Loadings on Common Factors Across Sectors

We begin by estimating the relationship between sector-level net securities borrowing positions and a broad set of common factors, controlling for sector fixed effects, as specified in Equation 22. The dependent variable is the percentage deviation of sector is net securities borrowing from its three-month moving average. The same transformation is applied to the common factors, which we group into four macro-categories, monetary policy quantities, repo demand quantities, repo supply quantities, and bond supply quantities:

- *Monetary policy quantities:* These variables capture interest rate expectations, surprises, and duration extraction. They include: The 1-month OIS 1M; the 10Y-1Y,1Y-3M, and 3M–1M OIS spread; and the 1M OIS–deposit facility rate spread.

[11] For simplicity, we abstract from common factors in this derivation.

- *Repo supply quantities:* These varaibles proxy for capital provision by repo-dealers. We include the three-month cross-currency basis swap, which links repo supply to FX markets, and Duffie (2023)'s measure of liquidity-versus-volatility deviations for the euro-area bond market (see Besugo, Cinquin, Nguyen, Paoli, and Szydlo, 2025) as a proxy for intermediation constraints.

- *Repo demand quantities:* These measures capture repo-demand driven by arbitrage opportunities. We include the skewness of Euribor futures options-implied density; the Merrill Lynch Swaption Option Volatility Estimate (MOVE); the 3M Bund volatility premium; deviations of cash Bund prices from a Nelson-Siegel curve; and generic 10-year Bund futures open interest. We also include the Bund–KfW spread, a measure of European bank's illiquidity, and the Bund–French spread.

- *Bond supply quantities:* the eurosystem balance sheet, Deutsche Finanzagentur holdings, and the free float of German government bonds, computed as issued amounts minus holdings by the Deutsche Finanzagentur and the eurosystem.[12]

Results for the largest sectors are reported in Table 2. These sectors—euro-area government, banks, and central bank; non-euro area hedge funds, dealers, and other financial institutions (OFIs)—each account for more than 5% of average outstanding repo positions. Together, they represent 83% (91%) of aggregate repo supply (demand). Results for the remaining sectors are reported in Table A-2.

We classify a sector as a supplier (demander) of repo market liquidity if it is, on average over the sample period, a net lender (borrower) of securities. Several patterns emerge. Non-euro area hedge funds load positively on all proxies for investment opportunities and pricing dislocations, including MOVE, the Bund volatility premium, and deviations from the Nelson-Siegel yield curve. Monetary policy variables, such as the yield curve slope, also strongly explain hedge fund borrowing behavior: hedge funds increase net securities borrowing when these measures rise. Bond supply variables are likewise important. Hedge fund borrowing increases with expansions in the public sector balance sheet and declines when free float rises.

Non-euro area dealers borrowing positions are more strongly correlated with monetary policy variables such as OIS 1M. They lend more when collateral availability—proxied by free float—is higher. The public sector, comprising the euro-area central bank and government,

[12] We obtain data for the common factors from Bloomberg, MTS, LSEG, and the ECB Statistical Data Warehouse. We compute a proxy for the Deutsche Finanzagentur's holdings from public information by projecting retained-at-issuance amounts to maturity, implicitly assuming no secondary-market sales.

supplies more securities when repo market conditions deteriorate, as indicated by larger pricing deviations from the Nelson-Siegel model or elevated interest rate volatility. Higher bond holdings by these institutions are associated with greater net lending in the repo market, generating a negative correlation between their bond holdings and repo positions. Free float loads positively for both the government and the central bank, indicating that public sector lending declines when collateral becomes more readily available. Hedge funds, by contrast, display the opposite pattern.

Euro-area banks load significantly on the cross-currency basis swap and the Kreditanstalt für Wiederaufbau (KfW)-Bund yield spread, which proxy for overall euro-area banking liquidity. Overall, common factors explain a substantial share of the variation in sectoral net borrowing positions, with peak R^2 values reaching 45% for hedge funds and 42% for government.

Figure A-4 plots the daily sum of residuals across sectors from the first-stage regressions. These residuals represent idiosyncratic demand and supply shocks, which form the basis for the estimation of sector-specific elasticities in the next subsection. At this stage, net securities borrowing positions have been purged of common influences and sector fixed effects, yielding the inputs for the second-stage elasticity estimation.

5.2 Specialness Elasticity

We now turn to estimates of repo market specialness elasticities. We first present the elasticity of aggregate repo demand and then examine sector-specific elasticities. The bottow row of Table 3 reports the aggregate Bund repo market elasticity, ζ_S. We estimate an aggregate elasticity of 1.2, implying that a 1% demand shock increases repo specialness by approximately 0.83%, the inverse of the aggregate elasticity. In our sample, this corresponds to a 0.21 basis point increase in specialness for a EUR 110 million increase in net repo borrowing. This estimate is comparable in magnitude to elasticity estimates for the U.S. Treasury market (close to 1; see Kaminska and Zinna, 2020; Jansen et al., 2024; Chaudhary et al., 2024) but substantially smaller than those found for the U.S. equity market (around 5; Gabaix and Koijen, 2021), as illustrated in Figure 6. These comparisons are indicative rather than exact: our elasticity is defined over a rate spread and over positions that net to zero across the market, so its units differ from those of holdings-based estimates for cash markets.[13] Importantly, the sector and factor decompositions of Sections 5.3–5.4 are

[13]Existing estimates for Treasury, corporate-bond, and equity markets relate quantities to percentage changes in asset prices and scale holdings by assets in positive net supply. Repo positions net to zero, so no direct analogue of shares outstanding exists, and the unavailability of investor-level bond holdings prevents scaling repo positions by holdings of the underlying collateral.

invariant to this scaling, so the paper's central results do not depend on it.

The remainder of Table 3 reports sector-level elasticities ζ_i and corresponding market multipliers $M = 1/\zeta_i$, along with average market shares S_i. As before, sectors are classified as suppliers or demanders based on average net lending or borrowing over the sample period. The table shows the stark contrast between demand and supply elasticity.

Non-euro area hedge funds and dealers (the demand side) are by far the most price-inelastic participants, with elasticities of 0.11 and 0.05, respectively. As discussed earlier, dealers plausibly act on behalf of hedge funds. A 1% increase in net securities borrowing by non-euro area hedge funds (dealers) increases repo specialness by approximately 9% (20%). In economic terms, an additional EUR 380 million (EUR 330 million) in repo borrowing by hedge funds (dealers) raises specialness by about 2.34 (5.2) basis points.[14] Alternatively, a 1% rise in specialness cuts hedge funds' and dealers' repo borrowing by only a tenth or a twentieth of a percent.

The estimated elasticity of 0.11 is economically small but statistically different from zero, consistent with the model with endogenous basis in Section 2.7 rather than with the baseline's knife-edge prediction of exactly zero elasticity. When the basis is determined in equilibrium, the hedge fund's repo-market elasticity is proportional to the cash-market depth parameter η; through the lens of the model, a small but positive repo elasticity thus indicates that preferred-habitat investors retain some, albeit limited, price sensitivity—in line with the cash-market demand-system literature (Koijen et al., 2021).

The estimate of 0.11 is the hedge funds' *total* elasticity with respect to the repo price: it measures the equilibrium response of their repo quantities to a change in specialness, after all other prices have adjusted (Chaudhary et al., 2024). A low total elasticity, however, does not imply that hedge funds' repo positions are insensitive to cash prices. In the model, in fact, the opposite holds, as Appendix A.4 formalizes. Because hedge funds arbitrage the spread between the basis and specialness, their repo borrowing responds to the repo price and to the cash bond price with partial elasticities of equal magnitude: the two prices enter the fund's problem only through the arbitrage spread $x - \chi - mk$ (equation (3) and Lemma 1), so, holding one price fixed, a change in the other moves the spread, and thus repo borrowing, one-for-one.

As Section 2.7 anticipates, an increase in specialness triggers two large, opposing responses in hedge funds' repo borrowing. Holding the bond price fixed, the arbitrage spread compresses

[14] In our sample, average specialness is 26 basis points, while average net positions are EUR 38 billion for non-euro area hedge funds and EUR 33 billion for non-euro area dealers.

and funds cut their borrowing sharply—the direct, own-price response. In equilibrium, however, the rise in specialness is fully reflected in an increase in the bond price through the zero-profit condition (Proposition 3; cf. also Duffie, 1996), and the spread, re-widened by the price increase, pulls borrowing back up through the equally large cross-price response—the indirect response (for this decomposition of total elasticities into partial responses and price passthrough, see Chaudhary, Fu, and Li, 2023). The direct and indirect responses offset almost fully: on net, a rise in specialness lowers hedge funds' repo borrowing only at rate η, the cash-market depth parameter of Proposition 5. The residual is exactly η because repo borrowing must equal preferred-habitat investors' excess demand (Lemma 3): when the bond price rises one-for-one with specialness, preferred-habitat investors release bonds at rate η per unit of price increase, and the short position—and with it repo borrowing—contracts by exactly η. Hedge funds' measured total repo elasticity is thus not their own price sensitivity, which is effectively unbounded, but that of their counterparties in the cash market. This resolves the apparent tension: precisely because hedge funds are perfectly elastic in the cash market—absorbing whatever imbalance preferred-habitat investors leave—their demand in the repo market is just as inelastic as preferred-habitat investors' demand is in the cash market.

On the supply side, the public sector—the German debt management office and the Eurosystem—provides highly elastic securities lending, but the two institutions do so in markedly different ways, by institutional design. The debt management office, with an elasticity of 0.64, lends at every level of specialness: its facility grants broad access, requiring only clearing membership, and is pried at terms competitive with the market, so investors tap it routinely and its supply responds more moderately to price. The Eurosystem, with an elasticity of 1.28, is the more responsive lender—by design rather than by appetite. Its facility charges the higher of 20 basis points and the prevailing market rate, so at low specialness the facility is dominated by the market: at a specialness of 10 basis points, borrowing from the Eurosystem costs twice the market rate. The facility becomes competitive only once specialness exceeds the 20 basis point threshold, and its lending is therefore concentrated precisely where specialness is high. The backstop pricing generates the high measured elasticity: the Eurosystem effectively supplies securities when specialness rises, and only then.

Intermediaries such as euro-area banks and dealers are highly elastic, implying limited price impact. In aggregate, the public sector and euro-area intermediaries account for 88% of repo supply, while non-euro area hedge funds and dealers account for 82% of repo demand. These six sectors alone contribute more than 85% of the aggregate elasticity. Of the overall elasticity of 1.2, approximately 13% originates from demanders and 87% from suppliers, indicating that repo demand is highly inelastic, while supply is highly elastic.

Figure 7 visualizes these findings by comparing market multipliers across sectors. Demand-side participants—non-euro area hedge funds and dealers—exhibit the largest multipliers, whereas supply-side participants—the public sector and euro-area banks—exhibit small multipliers.

Table 4 compares sector-level elasticities in the repo and cash bond markets. Cash market elasticities are taken from Koijen et al. (2021), which provides the most recent sector-level estimates for the euro area.[15] We uncover a clear negative relationship between elasticities in the two markets, illustrated in Figure 13.

In the cash market, the euro-area central bank exhibits zero price elasticity, reflecting bond purchases that are independent of prices and driven solely by monetary policy objectives. In contrast, the central bank is elastic in the repo market, limiting its ability to mitigate specialness during stress episodes. While securities lending facilities are designed not to interfere with the monetary policy stance, they could nevertheless play a stabilizing role by easing access to scarce collateral during systemic specialness episodes. The government is inelastic in the cash market and only weakly elastic in the repo market, reflecting interventions that are largely insensitive to prices and aimed at minimizing funding costs.

Finally, the foreign sector—dominated by non-euro area hedge funds and their dealer intermediaries—displays the most striking asymmetry: hedge funds are highly elastic in the cash market but extremely inelastic in the repo market. This behavior is economically rational. Profits from cash market strategies dominate repo funding costs, leading hedge funds to maintain repo borrowing even when specialness rises sharply. Repo borrowing thus serves primarily to finance cash market strategies, reinforcing and amplifying specialness episodes.

This asymmetry is a direct prediction of the model in Section 2.7. Proposition 5 shows that the hedge fund's conditional repo-market schedule slope is $-\eta$, governed by the cash-market depth parameter, while Proposition 4 shows that the cash-market schedule slope is ϕ, governed by the repo-market friction parameter. When hedge funds are intermediating, they face an elastic supply on the repo market and inelastic demand on the cash market, and they, in turn, provide elastic supply on the cash market and inelastic demand on the repo market. The empirical cross-market elasticity pattern in Figure 13 aligns with our proposed economic mechanism.

[15] The sectoral mapping is imperfect because Koijen et al. (2021) relies on ESA 2010 classifications and treats the foreign sector as a residual. Our sectoral breakdown is more granular and focuses explicitly on German government bonds. Sample periods also differ, although both cover periods of eurosystem balance sheet expansion.

With these elasticity estimates in hand, Section 5.3 assesses the contribution of different sectors to repo specialness between 2021 and 2024. Before doing so, we present robustness checks for our baseline estimates.

5.3 Sector Decomposition

Using sector-specific elasticities, we decompose deviations in repo specialness into contributions from individual sectors. Formally, the contribution of sector i to specialness is given by:

$$\Delta\hat{p}_{i,t} = \frac{1}{\hat{\zeta}_S} S_i \left(\hat{\overline{\Delta q}}_i + \hat{\lambda}_i \eta_t + \hat{u}_{i,t} \right). \tag{26}$$

We compute average daily contributions at the quarterly frequency and group sectors into four categories: (i) non-euro area hedge funds and dealers, (ii) the public sector (euro-area governments and central banks), (iii) intermediaries (euro-area banks and dealers), and (iv) remaining sectors. Results are shown in Panel A of Figure 8.

Natural securities borrowers—non-euro area hedge funds and dealers—are the primary drivers of repo specialness dynamics. In the first part of the sample, their net borrowing contributes almost exclusively to positive deviations in specialness. In the second part, their contribution turns negative as they sharply reduce net borrowing and move toward balanced positions (Figure 3). By contrast, the public sector adopts the opposite stance, acting as a net lender over most of the sample. Through its securities lending facilities, it mitigates the impact of hedge fund borrowing on specialness, particularly in the first half of the sample. This offsetting role is illustrated in Panel B of Figure 8, which cumulates sectoral contributions to specialness over time, expressed in basis points.[16]

At the peak of specialness in 2022Q3, the government (central bank) reduced specialness by approximately 5 (10) basis points relative to its three-month average. Absent public sector lending facilities, specialness would have been roughly 15 basis points higher. At the same time, non-euro area hedge funds and their dealer intermediaries cumulatively increased specialness by more than 30 basis points relative to its three-month average. While this exercise does not constitute a formal counterfactual,[17] it provides intuition for how sectoral

[16]We back out basis point contributions from the three-month percentage deviation transformation in Equation 20, applied to prices. Specifically, we scale $\Delta\hat{p}_{i,t}$ by the observed three-month average $\overline{p_t}$, divide by the number of sectors, and cumulate over time. Figure A-5 shows the strong positive correlation between predicted specialness $\Delta\hat{p}_t$ and observed deviations Δp_t, indicating good model fit.

[17]A full counterfactual would require recursively recomputing three-month average specialness in the absence of specific sectors.

borrowing and lending translate into cumulative changes in the *level*, rather than the *change*, of specialness.

Overall, market multipliers indicate that changes in hedge fund participation exert the largest price impact. Consistent with this, the sector decomposition shows that hedge funds were the primary drivers of the 2022 specialness episode. This naturally raises the question of whether the subsequent easing reflects changes in hedge fund elasticities or instead changes in their repo positions.

The sample period spans two distinct monetary policy regimes. From January 2021 to November 2022, the euro area experienced prolonged balance sheet expansion, with elevated excess liquidity reflecting pandemic-era interventions such as the PEPP, PSPP, and large-scale TLTROs. This regime shifted in mid-2022, when the ECB initiated a tightening cycle, raised policy rates in July, and returned to positive rates in September. In October 2022, the Governing Council recalibrated TLTRO pricing to better align central bank operations with tighter monetary conditions. This triggered substantial early repayments, with nearly EUR 300 billion—about 14% of the outstanding EUR 2 trillion—repaid in November 2022, marking the effective start of balance sheet contraction.

While our baseline specification controls for common factors such as the central bank balance sheet and the monetary policy stance, elasticities are estimated as averages over the full sample and evaluated at period-average sector sizes. Consequently, declining specialness in the second half of the sample could reflect either changes in hedge fund elasticities or changes in their net repo positions. To distinguish between these mechanisms, we re-estimate the O-GIV separately for the balance sheet expansion period (January 2021–November 2022) and the contraction period (December 2022–June 2024).

Results, shown in Figure 10, indicate that hedge fund elasticities remain virtually unchanged across regimes. This robust finding implies that the decline in specialness is driven primarily by reduced hedge fund borrowing—or increased lending—rather than by changes in price sensitivity. With the exception of the central bank, repo supply becomes slightly more elastic during quantitative tightening, while demand becomes more inelastic. The market-wide elasticity increases modestly from 1.2 to 1.4. The broad stability in estimates is consistent with the model. Because the hedge fund's repo-market elasticity is governed by the structural parameter η—the price sensitivity of preferred-habitat investors—rather than by the level of specialness or the monetary policy regime, it should remain approximately constant across subsamples, as we observe.

5.4 Factor Decomposition

Equation 26 also allows us to disentangle the contributions of common factors and sector-specific shocks to repo specialness. The contribution of the k-th common factor is:

$$\Delta \hat{p}_{\eta(k),t} = \frac{1}{\hat{\zeta}_S} S_i \hat{\lambda}_i(k) \eta_t(k). \tag{27}$$

Importantly, this decomposition does not measure the direct effect of common factors on specialness. Instead, it captures how common factors affect sector-level repo borrowing and how these quantity responses transmit to prices. Contributions are computed as the product of sector-level first-stage coefficients $\hat{\lambda}_i(k)$ (Tables 2 and A-2), factor realizations $\eta_t(k)$, and sector market shares.

Figure 9 presents the factor decomposition aggregated to the quarterly frequency, grouping factors into five categories: bond supply quantities, window-dressing dummies, repo supply quantities, monetary policy variables, and repo demand variables. Figure A-6 reports contributions of individual factors.

Bond supply quantities. Bond supply is decomposed into eurosystem holdings, Deutsche Finanzagentur holdings, and free float. Up to June 2022, these factors jointly contributed to a decline in specialness (Figure 9), driven primarily by central bank holdings (Figure A-6). While balance sheet expansion is often associated with higher specialness, our decomposition captures an alternative channel: larger central bank holdings are associated with increased securities lending through central bank facilities, mitigating specialness. As balance sheet expansion ended in mid-2022 and contraction began, this mechanism reversed, and bond supply factors contributed positively to specialness. Overall, bond supply effects tended to reduce specialness over the sample, consistent with increased collateral circulation via public sector facilities.

Window-dressing. Month-end and quarter-end effects are captured using countdown dummies for the final 18 days of each month. Aggregated to the quarterly frequency, window-dressing contributes positively to specialness (Figure 9). Figure 11 examines sector-specific contributions during the three weeks preceding quarter-end, distinguishing periods before and after March 2022. Prior to March 2022, euro-area intermediaries benefited from leverage ratio exemptions that reduced balance sheet costs. After the exemption expired, intermediaries contributions to specialness became more pronounced, a pattern confirmed in Figure

11. Figure A-6 further shows that euro-area banks and dealers are the primary drivers of specialness during post-exemption quarter-ends. Overall, these results highlight the role of balance sheet constraints and demonstrate that quarter-end effects reflect both common and sector-specific dynamics.

Repo supply quantities. Among repo supply variables, the one-year EUR/USD cross-currency basis swap accounts for the largest contribution (Figure A-6). The basis turned from negative to positive in late 2023, possibly reflecting the end of the euro-area tightening cycle. This shift indicates strong demand for euro funding and translated into a large negative contribution to specialness between 2023Q4 and 2024Q1. As shown in Table 2, these effects are driven by increased securities lending (or reduced borrowing) by non-euro area hedge funds and dealers, as well as by the euro-area government.

Monetary policy quantities. Contributions in this category are dominated by the spread between the one-year and three-month OIS rates, which proxies short-term interest rate expectations. The spread widened early in the sample, remained elevated through early 2023, and then narrowed as expectations shifted toward the end of the tightening cycle. In late 2023, the spread turned negative, consistent with anticipated rate cuts in 2024. Table A-2 shows that this factor loads significantly on non-euro area banks lending activity. Correspondingly, Figure A-6 shows negative contributions to specialness in the first half of the sample and positive contributions in the second half.

Repo demand quantities. This group proxies broader financial conditions affecting repo borrowing across sectors, including volatility (MOVE), hedging activity (Bund futures open interest), and flight-to-quality and flight-to-safety episodes. While common demand factors explain only a limited share of specialness at the quarterly frequency (Figure 9), this reflects offsetting effects across individual factors. The French-German government bond spread, capturing flight to safety, contributes positively to specialness and loads strongly on hedge fund borrowing. By contrast, flight-to-quality effects load on central bank lending, contributing negatively to specialness. Volatility measures load negatively on euro-area public sector and intermediaries, as these sectors increase lending during volatile periods. Finally, pricing errors from the Nelson-Siegel model correlate negatively with securities borrowing by both the public sector and non-euro area hedge funds, implying that higher pricing errors are associated with increased lending and lower specialness.

5.5 Robustness

To assess the robustness of our price elasticity estimates, we report in this section how our main results vary as we alter sample definitions, first-stage controls, and the transformation of the main variables of interest. Our results are mostly unchanged, pointing to a stable ranking of elastic and inelastic investors.

To account for unobserved common drivers of investors' quantities, we augment the first stage with latent common factors extracted from the residuals of the baseline regression. The O-GIV identification requires idiosyncratic shocks to be orthogonal across sectors, so any remaining common variation would violate the exclusion restriction. We proceed in three steps: we estimate the baseline first-stage regression in Equation 22, including sector fixed effects and observed common factors; we extract the first three principal components of the sector-level residuals; and we re-estimate the first stage including the three principal components alongside the original controls and sector fixed effects. First-stage results for the largest sectors are reported in Table 5. Relative to the baseline estimates in Table 2, the principal components increase explanatory power on both the supply and demand sides, especially for euro-area banks. We report the second-stage results in Table 6 and Figure 14, together with the baseline elasticities. Sector-level elasticity estimates are broadly unchanged, with the only notable difference being euro-area banks, whose elasticity falls closer to that of the other suppliers. The resulting aggregate elasticity declines from 1.20 to 0.97.

For our estimates to qualify as total—rather than partial—elasticities for the repo market, the explanatory variables in the first stage should account for the general-equilibrium clearing of all other markets, including that for cash bonds (Chaudhary et al., 2024). While our baseline includes a wide set of interest-rate controls, it omits measures of the German yield curve. We repeat the analysis including changes in the 10-year point of the German yield curve in the first stage. The resulting elasticity estimates, reported in Figure A-8 of the Appendix, are nearly identical to the baseline.[18]

Our elasticity estimates should be interpreted as applying to the aggregate market for repo positions, even though repo contracts are collateralized by heterogeneous Bunds. We estimate the model separately for sample splits based on a bond's time to maturity and scarcity. In both cases, we rank each day's transactions by the relevant bond characteristic, form the top and bottom halves by volume, compute average quantities and prices within

[18] Bund yields are nearly spanned by the explanatory variables we included in the baseline's first-stage: The correlation between actual and predicted yields is 64%.

each half, and apply our baseline transformations. We report the results in Figure A-9 of the Appendix. Hedge funds' elasticity for longer time-to-maturity bonds is significantly lower than for shorter ones, consistent with hedge funds' activity concentrating in futures–bond basis trades on the 10-year contract—by far the most liquid European bond future—which lock in their repo demand for the underlying long-term bonds. Repos backed by short-term bonds, by contrast, are rarely tied to basis positions, leaving hedge funds freer to respond to repo costs. As for scarcity, central-bank securities lending is more elastic for high-scarcity bonds, consistent with the central bank stepping in more aggressively to tamp down high specialness.

The variables in our main specifications are transformed into deviations from their three-month moving average, following Kubitza et al. (2025). This transformation represents a middle ground between the two extremes of estimating the model in daily changes—deviations from a one-day moving average—and in levels—deviations from an infinitely long moving average. The choice trades off statistical well-behavedness against noise. To confirm that our results are robust to this choice, we replicate the analysis using deviations from one- and six-month moving averages, reporting the results in Figure A-10 of the Appendix. The spread between demand and supply elasticities widens with the length of the look-back window; even with a one-month window, however, demand is significantly more inelastic than supply. All estimates remain close to the baseline.

Finally, scaling by realized trading positions may not be fully exogenous to prices—unlike scaling by an asset's amount outstanding—since investors can adjust positions more readily. We repeat the analysis with the scaling variable lagged by four months and obtain elasticities generally in line with the baseline, reported in Figure A-11 of the Appendix.

6 The Role of Hedge Funds

Previous sections estimate an equilibrium model of demand and supply in the repo market. We show that the repo market for German government collateral features an elastic supply—largely provided by the public sector—and a highly inelastic demand. This demand inelasticity is driven by non-euro area hedge funds. In the sectoral decomposition in Section 5.3, we show that these investors were responsible for the sharp increase in repo specialness in 2022. During this period, hedge funds became the largest net borrowers of securities and thus the marginal investors shaping specialness. This role of hedge funds in 2022 is consistent with evidence based on confidential Bund auction group data presented by Ampudia et al. (2025) suggesting that hedge funds were net sellers during this period in the cash Bund market.

To understand why hedge funds borrowed so aggressively, Panel A of Figure 12 documents a concurrent increase in several measures of mispricing across markets, including the cash–futures bond basis, asset swap spreads, and pricing errors from the Nelson-Siegel model.[19] The widening of these measures indicates the emergence of profitable arbitrage opportunities.

In what follows, we use the cash–futures bond basis as an illustrative example.[20] A widening of the positive cash–futures basis—shown in Panel B of Figure 12—implies that the cash price of a deliverable bond exceeds the implied bond price embedded in the corresponding futures contract. A hedge fund seeking to exploit this mispricing would sell the bond in the cash market and buy the corresponding futures contract, a strategy commonly referred to as the *basis trade*. The short cash position is financed by borrowing the bond in the repo market. Large short positions in the cash market are therefore consistent with large net borrowing positions in the repo market.

Crucially, hedge funds access the repo market as price-inelastic investors, sustaining elevated borrowing even as funding costs rise. As long as arbitrage profits exceed repo specialness—i.e., the cost of funding the trade—this behavior is economically rational. Basis-trade positions are maintained as long as cash-market profits dominate repo-market costs.[21] As discussed in Section 5.2, while hedge funds are inelastic in the repo market, the existing literature finds them to be elastic in the cash market: when arbitrage opportunities narrow, both cash and repo positions unwind.

Consistent with this mechanism, by the end of 2022 mispricing measures had declined, hedge fund borrowing in the repo market had fallen, and repo specialness had receded. More generally, elevated repo borrowing by hedge funds reflects equilibrium demand for cash-market positions that require securities borrowing, i.e., hedge funds short-selling bonds to accommodate strong cash-market demand. Repo specialness therefore emerges as a by-product

[19]The observed mispricing likely reflects the interaction of several concomitant factors. The rapid pace of monetary policy tightening following the inflation surge induced abrupt repricing across the yield curve and elevated interest rate volatility, which may have limited arbitrageurs ability to enforce price parity between cash and derivatives markets. At the same time, pressures on dealers balance sheets were increasing during this period (Besugo, Nguyen, Poinelli, and Scheicher, 2025), potentially impairing their intermediation capacity, which is central to the implementation of arbitrage trades.

[20]This relative-value trade is only illustrative. We acknowledge that other trading strategies that require securities borrowing may also have contributed to hedge funds elevated repo demand.

[21]When repo specialness increases, the funding leg of the trade becomes more expensive, limiting arbitrage capacity and allowing the basis to persist; see, e.g., Pelizzon et al. (2025).

of securities borrowing associated with cash-market clearing and should be interpreted as a macroeconomic outcome rather than an idiosyncratic feature of individual securities.

7 Conclusion

This paper provides a unified theoretical and empirical framework for understanding repo specialness as an equilibrium outcome of cross-market positioning, rather than as a purely mechanical consequence of collateral scarcity. Our model shows that the preferred habitat investors' preference for physical bonds generates excess cash-market demand, which hedge funds accommodate by shorting bonds and hedging with futures. Because shorting requires borrowing in the repo market, the cash-market imbalance pins down hedge fund repo demand independently of specialness—making them inelastic borrowers despite being the most elastic participants in the cash market. Allowing for endogenous bond yields shows that hedge funds' repo-market elasticity is inherited from preferred-habitat investors: it equals the price sensitivity of the investors whose demand they accommodate in the cash market.

We take these predictions to the data using the first demand-system estimation for a repo market, applying the O-GIV framework to novel SFTDS transaction-level data for German government collateral. The estimated aggregate elasticity of 1.2 masks a stark asymmetry: non-euro area hedge funds exhibit an elasticity of just 0.11, while public sector supply—provided nearly monopolistically by the German debt management office and the Eurosystem—is highly elastic. Hedge funds are the primary drivers of specialness, with their elevated borrowing closely tracking the widening of the cash-futures basis and other mispricing measures. Their retrenchment from the market, rather than a change in price sensitivity, explains the normalization of specialness.

The joint analysis of the topology of the repo market and sector-level elasticities reveals a previously unappreciated feature of the collateralized funding market: the marginal price-setters in the European sovereign repo market are offshore, non-bank entities outside the euro-area regulatory perimeter. Financial stability in the European sovereign bond market and the effectiveness of monetary policy transmission through repo rates increasingly depend on actors whom euro-area regulators cannot directly supervise.

These findings carry implications for monetary policy. As sovereign bond markets have taken center stage in unconventional monetary and fiscal interventions, our results show that the impact of such operations depends critically on how bond investors—hedge funds in particular—accommodate purchases and sales through the repo market. Repo specialness thus serves as an observable signal of cash-market demand pressure: widening bases coincide with specialness episodes, giving central banks an indicator for monitoring monetary policy transmission. Securities lending, in turn, becomes a policy lever: the design and pricing of lending facilities have first-order effects on specialness and, through it, on cash bond prices. The lever has limits, however: because repo demand inelasticity originates in the cash market, specialness cannot be eliminated as long as profitable basis-trade opportunities persist, unless bond supply satisfies preferred-habitat demand or securities are lent at the policy rate. Cash-market interventions should therefore be accompanied by monitoring of repo-market conditions: in the repo market, as our framework shows, prices are set by demand pressures that originate elsewhere.

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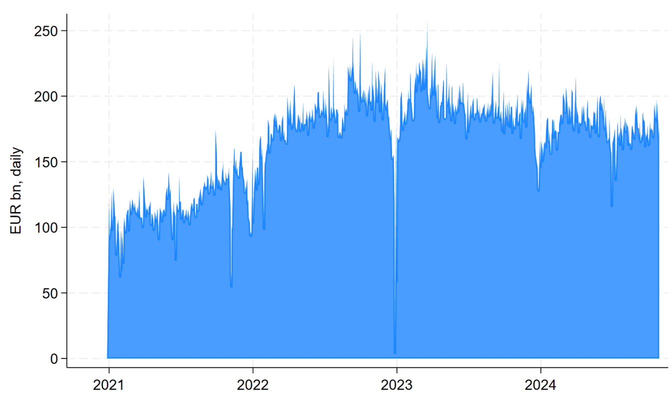
Figures

Figure 1. Flows and stock quantities in the repo market

In this figure, we show the size of the repo market for German government collateral, using two different metrics, a flow measure and a stock measure. In Panel A we show the flow of repo transactions, which quantifies the size of new trades happening on a given day, regardless of the term of the cotract. In Panel B, we report the stock measure, which captures the quantity of securities currently on loan on any given day. For example, a three-day transaction will be counted three times in the measure shown in Panel B, but only once, on the day the trade was initiated, in Panel A. Repo volumes date are from SFTDS, and eurosystem repo lending data are from MOPDB. Data are limited to repo transactions that use German central government bonds as collateral. The sample period is from January 2021 to June 2024.

A: Flows



B: Stocks

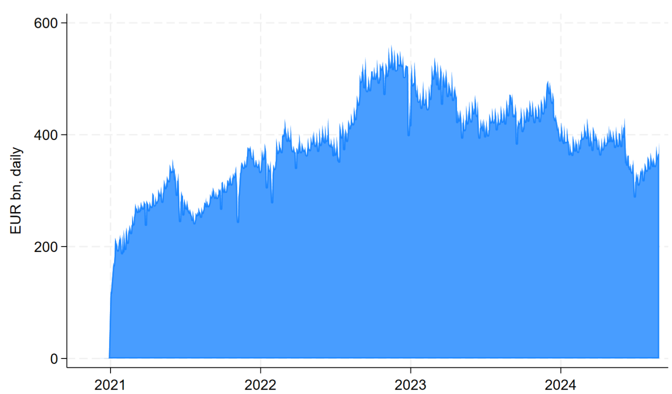
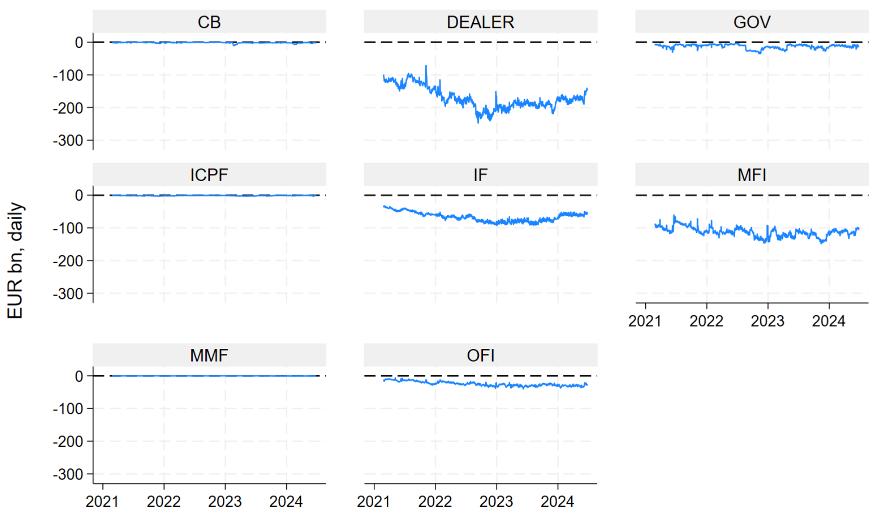


Figure 2. Gross outstanding amounts of securities lent and borrowed by sector

In this figure, we show the repo gross positions of different sectors on the repo market, measured as the stock of securites borrowed (Panel A) or lent (Panel B), in billions of euro. We net out intra-sector transactions, so that we can interpret the quantities as measuring the obligation of a sector toward the rest of the world. We do not report volumes of money-market funds, as they are minimal. Repo transactions data are from SFTDS, while data for the position by the euro area's central banks are from MOPDB and capture the eurosystem securities lending facility's outstanding volume. For the latter, we only consider securities lent against cash, to better approximate repo the economic exposure of a repo transaction. We focus on transactions collaterlized by German government bonds, and the subsample covers the period from March 2021 to June 2024.

A: Borrowed stocks of securities



B: Lent stocks of securities

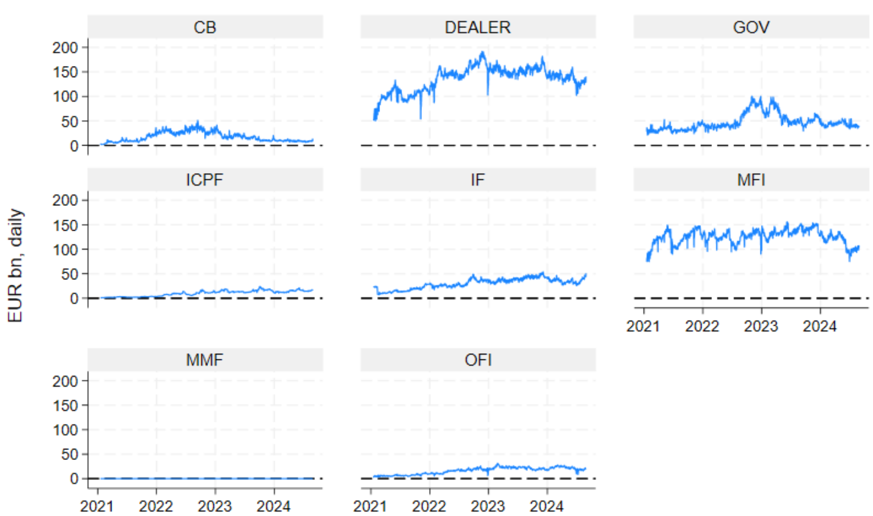


Figure 3. Securities lending positions by sector and geography

In this figure, we show the net position on the repo market, by sector, calculated as the amount of securities lent minus securities borrowed. A positive (negative) amount means a sector is a net-security lender (borrower) on the repo market. The measure captures the stock positions on the repo market, i.e., the outstanding amount of repo transactions taking into account the term of each repo contract. We show the quantity for euro-area and non-euro Area sectors, separately. We exclude positions of money market funds, insurance companies, and pension funds, as they are minimal. Repo data are sourced from SFTDS. Data for the securities lending by the central bank are obtained from MOPDB and are limited to cash-collateralized securities-lending transactions. All transactions in the sample are collateralized with German government bonds. The sample covers March 2021 to June 2024.

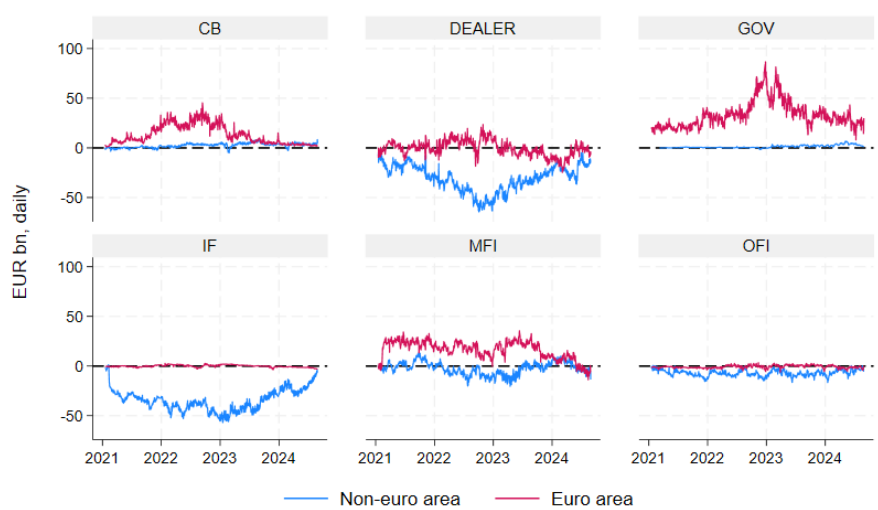


Figure 4. The structure of the repo market

In this figure, we show the structure of the repo market. For each couple of investors, we show the average end-of-day oustanding amount of securities on loan, in billions of euro, for 2022. Sectors on the left are net securities lenders, sectors on the right are net securiites borrowers. The "Other" includes the smaller players, i.e., money market funds, non-euro area banks, euro-area hedge funds, insurance companies and pension funds, and foreing government and central banks. We consider repo transactions that have German government bond as collateral, and source repo data from SFTDS, while the eurosystem's cash-against-collateral securities lending data are from MOPDB.

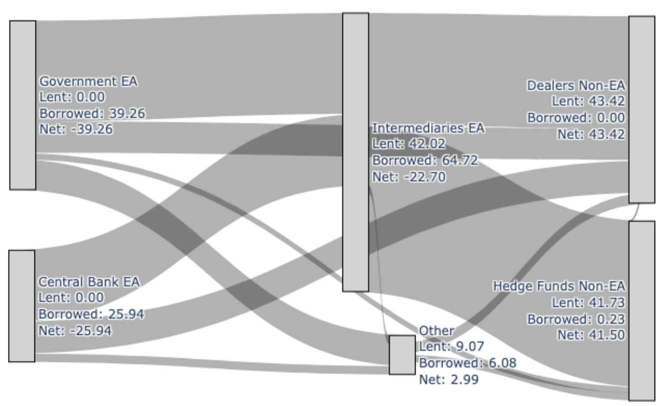


Figure 5. The concentration of the repo market for German government collateral

In this figure, we compare the equal weights versus the value weights - the repo market participation shares - by sector. Equal weights are computed as the inverse of the number of sectors and represent a theoretical benchmark where all sectors participate in the repo market for German collateral with equal footprint. The value weights are the actual participation shares of the different sectors in terms of net securities borrowing positions, see Equation 21. We consider repo transactions that have German government bond as collateral, and source repo data from SFTDS, while the eurosystem's cash-against-collateral securities lending data are from MOPDB.

Figure 6. Market multipliers in the literature

In this figure, we compare our estimated market multiplier—i.e., the inverse of the price-elasticity ζ from Eq. 19—for the repo market to existing estimates in the literature for several asset classes. Jansen et al. (2024), Chaudhary et al. (2024), and Kaminska and Zinna (2020) estimate the elasticity for the US Treasury market, Kubitza et al. (2025) for the FX derivatives market and Gabaix and Koijen (2021) for the U.S. stock market.

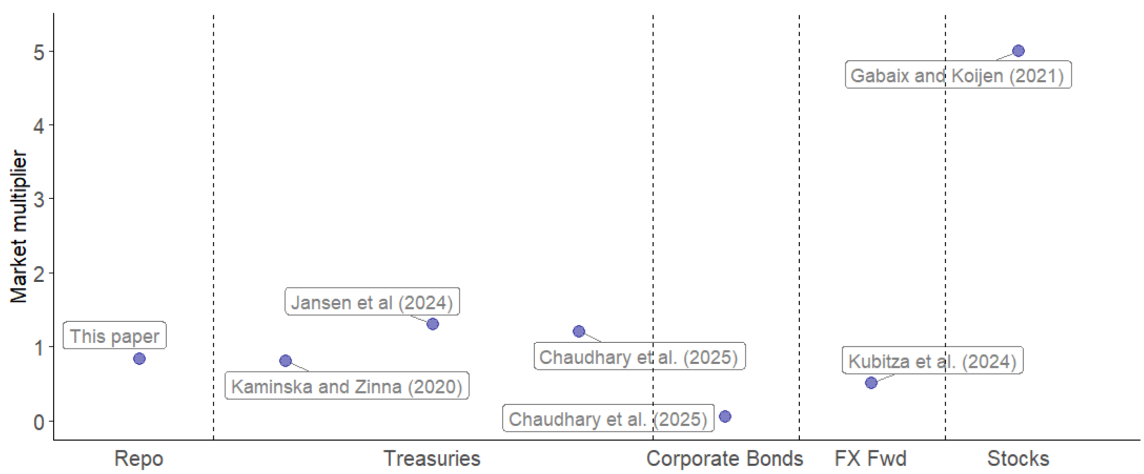


Figure 7. Market multiplier by sector

In this figure we compare the market multipliers, the inverse of the price-elasticity ζ_i, for the largest participants to the repo market. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period. The market multipliers are estimates of $1/\zeta_i$ from Eq. 16. Our data includes repo transactions that use German government bonds as collateral for the March 2021–June 2024 period. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB

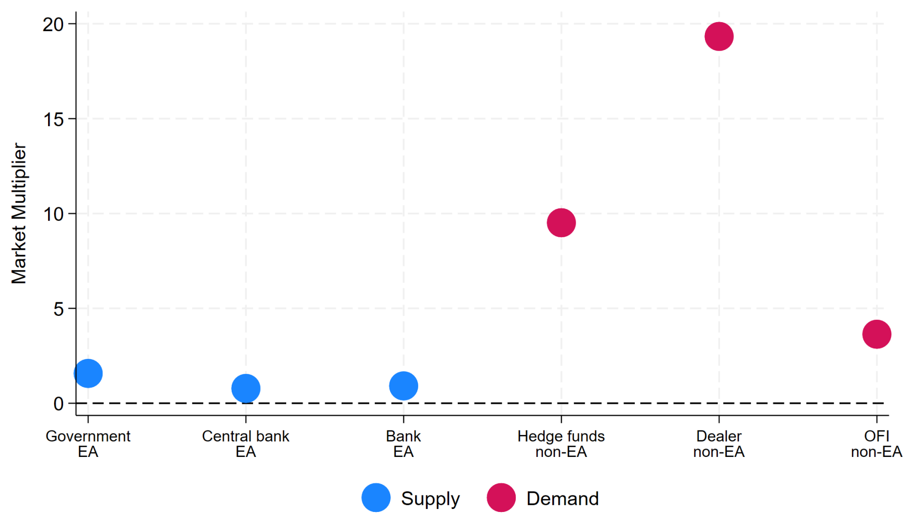
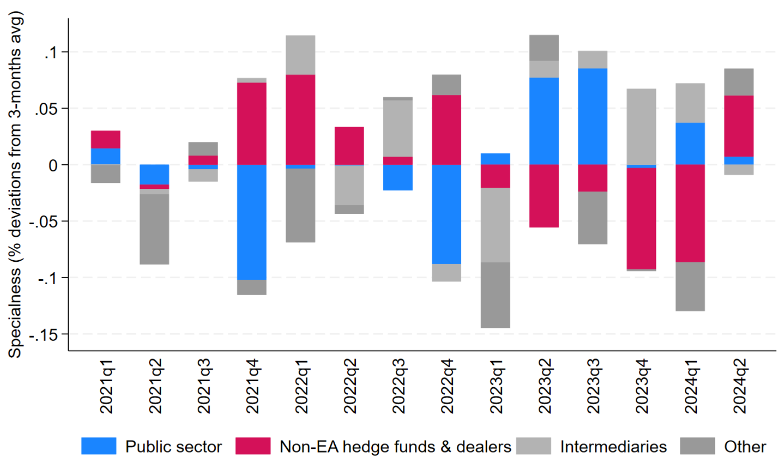


Figure 8. Contribution to repo specialness changes by sector

This figure shows the decomposition of the changes in the specialness spread among the contributions of different sectors. We define changes in specialness as the relative deviation from the three-month moving average, and changes in quantities accordingly. In Panel A, we average the daily contributions at the quarter level, and classify the sectors into the public sector, the euro-area government and central bank; intermediaries, euro-area banks and dealers; and non-euro Area hedge funds and their dealers. The "Other" sector aggregates the contributions of non-euro Area central bank, governments, and banks, and insuarance companies, pension funds, and money market funds. The sector decomposition is calculated as $\Delta\hat{p}_{i,t} = \frac{1}{\hat{\zeta}_S} S_i(\hat{\Delta q}_i + \hat{\lambda}_i \eta_t + \hat{u}_{i,t})$, for sector-$i$ and day-t, where $\hat{\zeta}_S$ is reported in Table 3. In Panel B, we report the cumulated contribution of each sector. To obtain this, we scale $\Delta\hat{p}_{i,t}$ by the observed three-month average $\overline{p_t}$, divide it by the number of sectors, and cumulate it across time. In the same panel, we also show the 3-month moving average of specialness. We estimate the demand-system using outstanding positions in repo contracts collaterlized by German government bonds, for the period betwee from March 2021 to June 2024. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB.

A: Specialness change by quarter



B: Cumulative specialness innovations

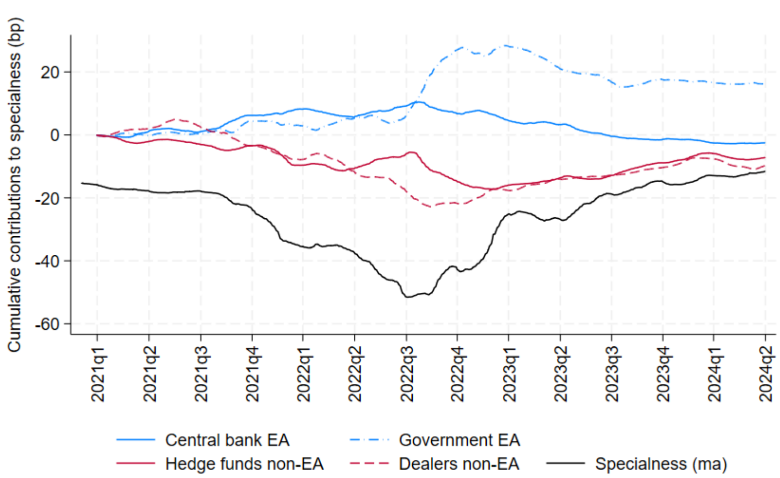


Figure 9. Decomposition of repo specialness contributions by common factors

This figure shows the decomposition of the changes in the specialness spread among common factors. We define changes in specialness as the relative deviation from the three-month moving average, and changes in quantities accordingly. We average the daily contributions at the quarter level, and classify the factors into monetary policy, repo demand, repo supply, and bond supply factors. The factor decomposition for factor $\eta(k)$ is calculated as $\Delta \hat{p}_{\eta(k),t} = \frac{1}{\hat{\zeta}_S} S_i \hat{\lambda}_i(k) \eta_t(k)$, for and day-$t$, where $\hat{\zeta}_S$ is reported in Table 3. The sample period goes from March 2021 to June 2024 and the sample consists of repos with underlying collateral a German government bond. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB.

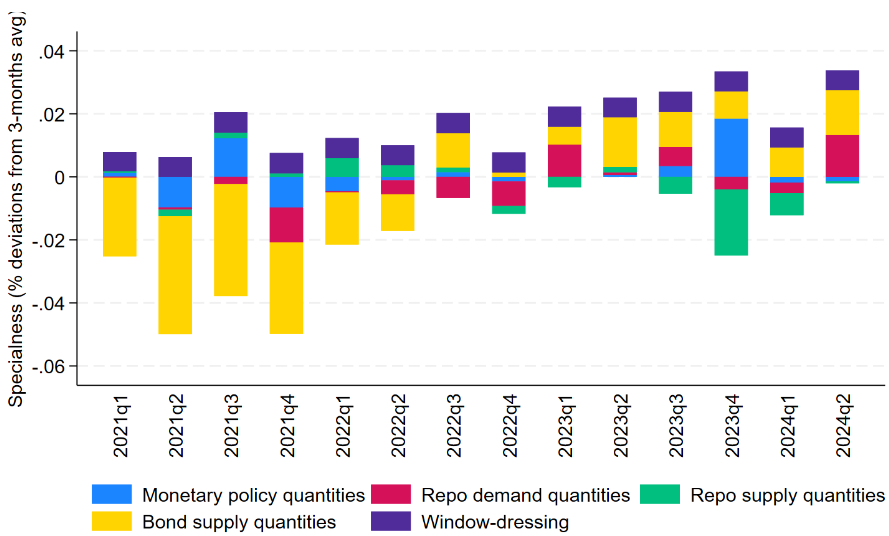


Figure 10. Repo market elasticities during QE and QT

In this figure, we compare the price-elasticity ζ_i of the largest sectors in the repo market across periods of varying monetary policy. The first sub-sample covers the eurosystem' balance sheet expansion, which terminated with the large repayment of targeted long-term refinancing operations, March 2021–November 2022, while in the second period the ECB's balance sheet is reducing, December 2022–June 2024. We include sectors whose positions account for at least 5% of the total repo outstanding, which cumulatively represent 83% (91%) of the supply (demand). The price elasticities ζ_i in Eq. 16 are estimated using the optimal GIV method shown in Section 4. The estimation weights S_i are sample-specific. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB. We estimate the model on repo transactions collateralized by German government bonds.

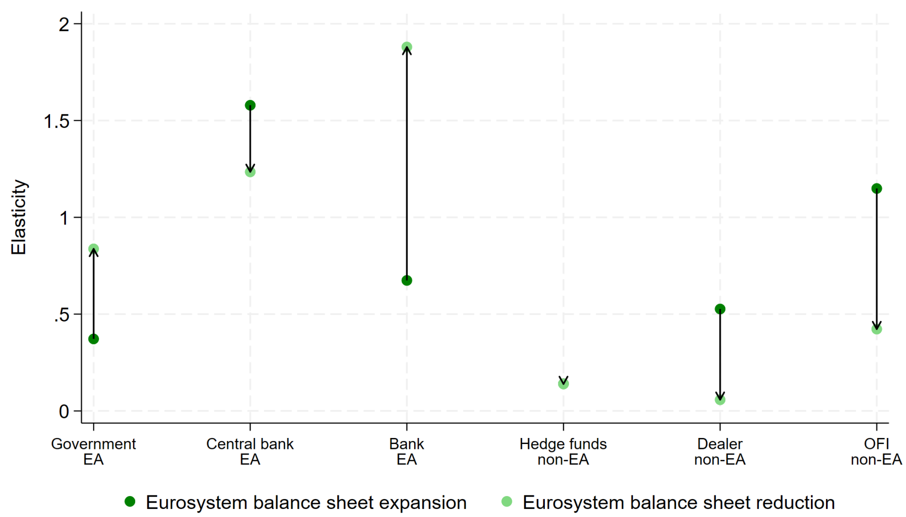


Figure 11. Decomposition of repo specialness contributions of EA intermediaries at quarter-end

In this figure, we show the cyclicality of sectoral contribution to specialness within a quarter. That is, we calculate the contribution $\Delta\hat{p}_{i,t} = \frac{1}{\hat{\zeta}_S} S_i(\hat{\Delta q_i} + \hat{\lambda}_i \eta_t + \hat{u}_{i,t})$, for sector-$i$ and day-t, where $\hat{\zeta}_S$ is reported in Table 3, aggregate it by sector type, and average it by the number of days to the end of the quarter. We group investors in euro-Area intermediaries (banks and dealers) and the rest. We show the results separately for two sub-samples, before and after March 2022. In the earlier part of the sample, euro-area intermediaries benefitted from a leverage ratio exemption, which allowed them to exclude sizeable central bank exposures, contributing to lower balance sheet costs. The sample consists of repos with underlying collateral a German government bond. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB.

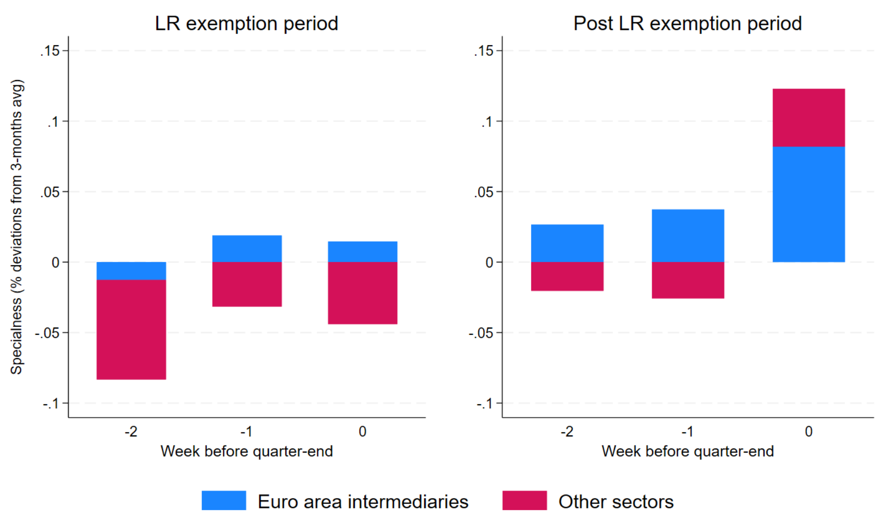
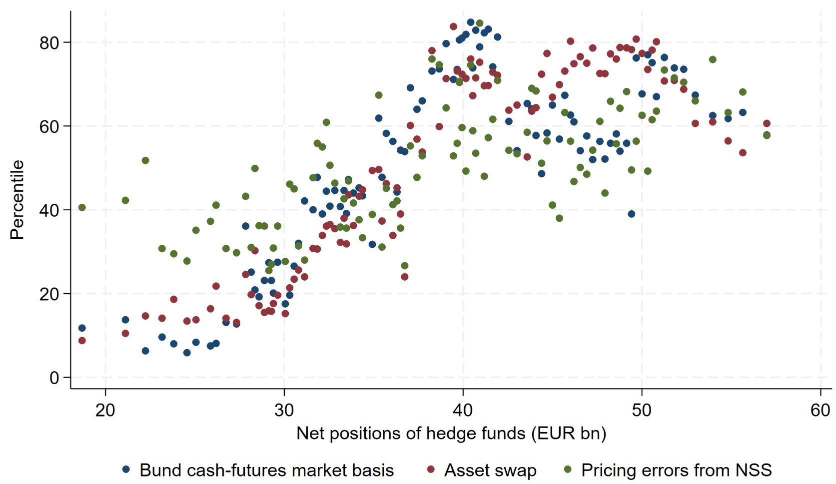


Figure 12. Mispricing measures and hedge funds positions

In Panel A, we show three measures of asset mispricing against the net aggregate securities borrowing positions by non-euro Area hedge funds. The three measures consist of the cash-futures bond basis, the average government-OIS spread (asset swap), and the pricing errors of a Nelson-Siegel curve. The future-bond basis is calculated for the next-next-delivery 10-year contract, while the other two measures are based on the universe of traded German government bonds. The mispricing measures are expressed as percentiles over the sample period, to allow for a comparison across measures. The hedge fund net-borrowing positions are in billion of euros of German governmnet bonds borrowed on the repo market. In Panel B, we show the development of repo specialness and the cash-futures bond basis. The former is measured in basis points, while the latter is annualized and shown as percentage difference between futures and cash bond price. Repo volumes and prices are from SFTDS, pricing errors and asset swaps are calculated using MTS pricing data, and the Bund cash-futures basis is sourced from Bloomberg and uses the euro short-term rate (ESTR) as funding rate.

A: Mispricing measures against hedge fund repo positions



B: Cash-future bond basis and specialness

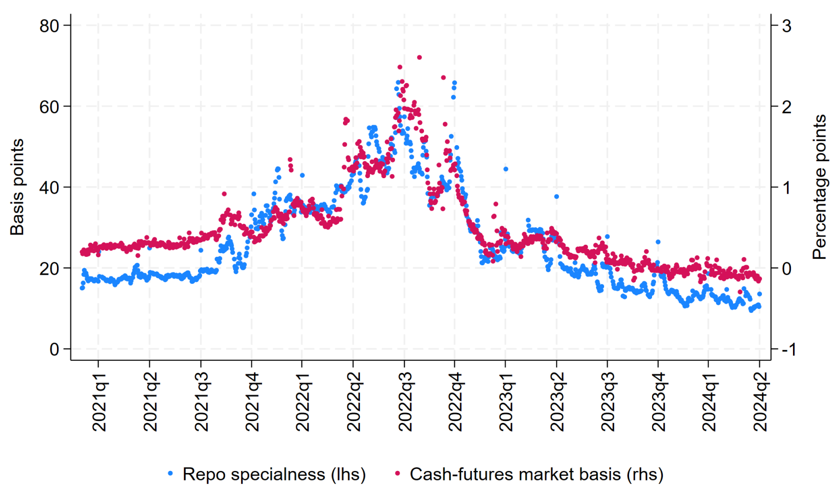


Figure 13. The inverse relation between cash- and repo-market elasticity

In this figure, we plot a sector's price elasticity in the cash market from Koijen et al. (2021) against its price elasticity of the repo market from Table 3. We impute an elasticity of zero for the eurosystem in the cash market and for a sector when its elasticity in either the cash or repo market is negative. The foreign sector' elasticity in the repo marker is the average of the repo market elasticity of non-EA dealers and hedge funds.

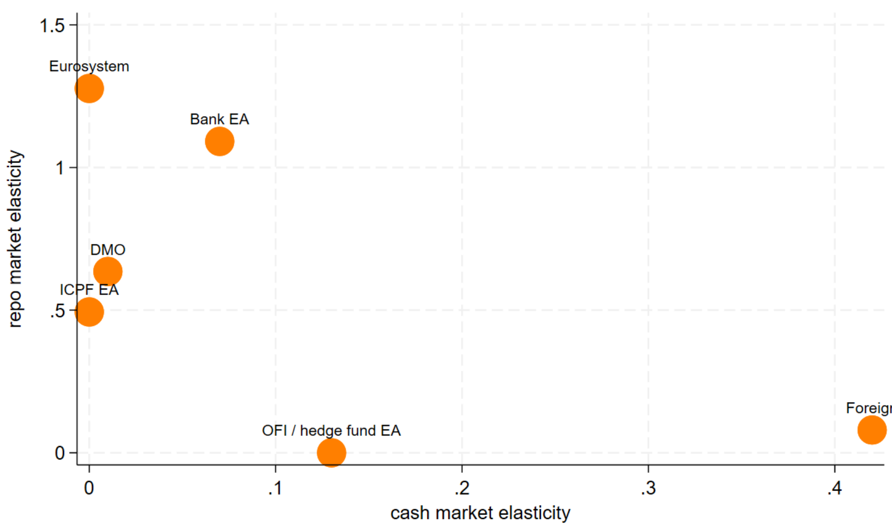
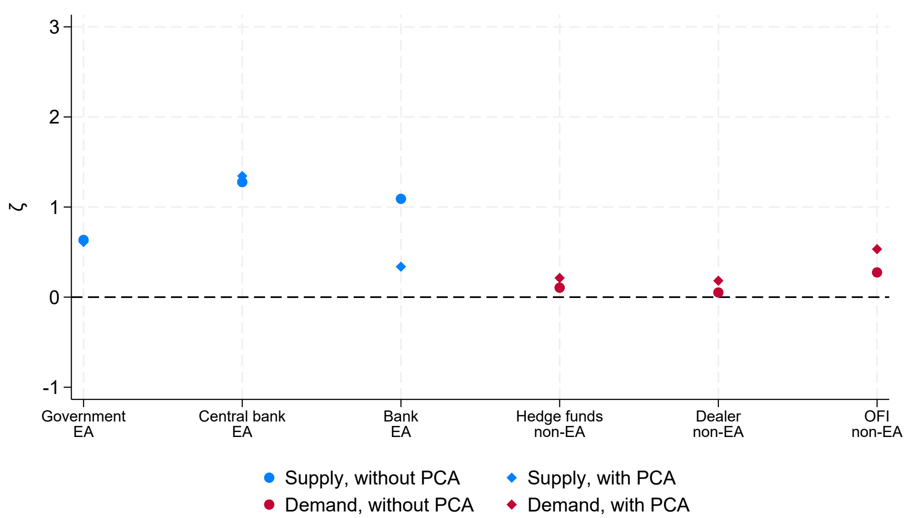


Figure 14. Elasticity by sector: estimation with PCA

In this figure we compare the price-elasticity ζ_i for the largest participants to the repo market when three principal components are added to the common factors. The pricipal components are calculated on the residuals from the first stage, see Eq. 22. We first estimate the first stage equation with common factors and sector fixed effects, we extract sector's residuals, we apply the PCA on these residuals and we re-estimate the first stage using common factors, sector fixed effects and the three principal components. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period. The elasticities are computed from Eq. 25. Our data includes repo transactions that use German government bonds as collateral for the March 2021–June 2024 period. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB



Tables

Table 1
Securities holdings and amounts borrowed and lent on the repo market, by sector

In this table, we show the amount of securities held, and the amounts of securities lent and borrowed on the repo market. We report the average by sector at the yearly level, and restrict the sample to German government bonds and repo transactions that use them as collateral. The amounts borrowed and lent on the repo market represents averages of end-of-day stocks against all counterparties. All quantities are expresse in billion of euros. eurosystem borrowing and lending figures are limited to cash-collateralized transactions. Holdings of dealers, banks (monetary financial institutions, MFI), and other financial institutions (OFI) are reported as one, as the holding dataset does not distinguish between them. Non-euro area holdings are computed as a residual of the nomial value oustanding of German bonds. We exclude money market funds, households and non-financial corporations from the euro area, as their participation to the repo market is negligible. Our sample extends from January 2021 to June 2024. Holdings data are from SHSS, repo volumes from SFTDS, and eurosystem repo lending data are from MOPDB.

Year	Area	Sector	Holdings	Borrowed	Lent
	euro Area	ICPF	121	0.2	0.2
		Bank		61.5	83.0
		OFI	11	3.5	2.1
2021		Dealer		65.7	65.1
		Hedge funds	117	1.9	1.6
		Government	172	10.0	32.0
		Central Bank	554	0.0	9.1
	Non-euro Area		554	142.0	92.0
	euro Area	ICPF	121	0.1	3.9
		Bank		67.0	83.9
		OFI	3	6.3	5.7
2022		Dealer		108.1	113.9
		Hedge funds	148	1.8	2.3
		Government	169	13.6	53.0
		Central Bank	655	0.0	25.9
	Non-euro Area		534	215.9	124.3
	euro Area	ICPF	141	0.1	7.1
		Bank		80.0	99.4
		OFI	3	6.9	7.2
2023		Dealer		122.4	119.2
		Hedge funds	178	2.2	2.7
		Government	203	14.2	56.2
		Central Bank	621	0.0	10.6
	Non-euro Area		616	215.4	139.3
	Euro Area	ICPF	144	0.3	6.5
		Bank		81.8	88.3
		OFI	3	7.1	6.0
2024		Dealer		111.9	103.0
		Hedge funds	178	2.2	1.2
		Government	208	11.0	40.3
		Central Bank	577	0.0	3.7
	Non-euro Area		700	172.4	137.8

Table 2
First stage of Optimal-GIV - large sectors

In this table, we show the coefficients resulting from the first stage of the O-GIV where sector i net securities borrowing volumes in the repo market are residualised against a broad set of common factors and sector fixed effects, see equation 22. The dependent variable is the percentage deviation of sector i ' net securities borrowing volumes from its 3-months moving average. The same transformation is applied to common factos, which are listed in Section 3. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period. *, **, and *** indicate that parameters are significantly different from zero at the 10%, 5%, or 1% level, respectively. Significance is based on autoregression and heteroskedasticity-robust Newey-West standard errors.

	Government EA	Central Bank EA	Banks EA	Dealers non-EA	OFI non-EA	Hedge funds non-EA
OIS 1M	-0.021^{*}	-0.054^{***}	-0.018	0.039^{***}	0.022	-0.012
OIS1M DFR spread	-0.001	-0.008	0.000	0.003	0.002	-0.002
3M1M OIS spread	-0.019^{**}	0.001	0.004	0.008	0.005	-0.018^{**}
1Y3M OIS spread	-0.002	-0.021^{***}	-0.005	0.011^{**}	0.009	0.011^{***}
Slope YC	-0.085^{***}	0.004	-0.053	-0.006	0.120^{*}	0.056^{***}
Cross-ccy basis	-0.047^{**}	-0.002	0.077^{**}	-0.043^{*}	-0.066	-0.019^{*}
Duffie	0.002	0.003	0.002	0.004	-0.011	0.000
KFW vs DE spread	0.023	-0.207^{***}	0.164^{**}	-0.069^{*}	-0.172^{*}	-0.020
OID skew	-0.019	0.113^{*}	0.005	-0.009	0.197^{**}	-0.067^{**}
SMOVE	-0.168	-0.038	-0.345	0.492^{**}	-0.042	0.233^{**}
Bund vol prem	0.030	-0.094^{**}	0.053	-0.043^{*}	0.026	-0.052^{***}
NSS dev	-0.103	-0.414^{**}	0.088	0.088	0.607^{***}	-0.237^{***}
Bund OpenInt	-0.034	0.552^{*}	-0.344	-0.120	1.421^{**}	0.243
DE vs FR spread	0.052	0.130	0.685	-0.337	-0.075	0.187^{*}
Free float	3.700^{***}	3.080^{**}	-1.913	-2.155^{**}	-3.363	-1.773^{***}
ECB holdings	1.508^{**}	-2.506^{*}	-3.714^{*}	-1.655	-1.912	1.135^{*}
DFA holdings	-3.127^{***}	2.324^{**}	2.901^{**}	0.921^{*}	1.312	2.018^{***}
Constant	-0.005	0.036	0.007	0.063	0.107	0.004
R-squared	0.43	0.42	0.14	0.30	0.17	0.48
Observations	823	823	823	823	823	823
Day-of-the-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Weights	42%	18%	23%	37%	9%	45%
Side	Supply	Supply	Supply	Demand	Demand	Demand

Table 3
Sector Elasticities ζ_i

In this Table, we show the sector-level elasticities ζ_i. The table reports the market share of the sector calculated as in Eq. 21, the sector price-elasticity ζ_i calculated from Eq. 25, the market multiplier or the inverse of the price-elasticity and the contribution to the aggregate elasticity. We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period.

Sector	**Share**	ζ	**M**	$\zeta\times$**Share**
Supply				
Euro area				
Government	42%	0.64	1.56	21%
Central bank	18%	1.28	0.78	18%
Bank	23%	1.09	0.91	20%
Dealer	5%	5.38	0.18	21%
ICPF	5%	0.49	2.04	2%
Hedge funds	1%	−0.85	−1.17	−1%
Non-euro area				
Government	1%	−1.41	−0.70	−1%
Central bank	3%	2.50	0.40	6%
ICPF	5%	0.48	2.08	2%
Demand				
Euro area				
OFI	1%	−0.89	−1.12	−1%
MMF	0%	0.11	9.10	0%
Non-euro area				
Bank	5%	1.60	0.62	7%
Dealer	37%	0.05	20.00	1%
OFI	9%	0.27	3.70	2%
Hedge funds	45%	0.11	9.10	4%
Aggregate	200%	1.20	0.83	100%

Table 4
Repo vs. Cash Market Elasticities

In this table, we compare a sector's price elasticity in the cash market from Koijen et al. (2021) against its price elasticity of the repo market from Table 3.

<table>
<tr><th></th><th>Linzert et al. (2025)
Repo market elasticity</th><th>Koijen et al. (2021)
Cash market elasticity</th></tr>
<tr><td>***Non-euro area***</td><td></td><td></td></tr>
<tr><td>Government</td><td>−1.41</td><td rowspan="7">0.42</td></tr>
<tr><td>Central bank</td><td>2.50</td></tr>
<tr><td>Bank</td><td>1.60</td></tr>
<tr><td>Dealer</td><td>0.05</td></tr>
<tr><td>OFI</td><td>0.27</td></tr>
<tr><td>Hedge funds</td><td>0.11</td></tr>
<tr><td>ICPF</td><td>0.48</td></tr>
<tr><td>***Euro area***</td><td></td><td></td></tr>
<tr><td>Government</td><td>0.64</td><td>0.01</td></tr>
<tr><td>Central bank</td><td>1.28</td><td>–</td></tr>
<tr><td>Bank</td><td>1.09</td><td>0.07</td></tr>
<tr><td>Dealer</td><td>5.38</td><td>–</td></tr>
<tr><td>OFI</td><td>−0.89</td><td rowspan="2">0.13</td></tr>
<tr><td>Hedge funds</td><td>−0.85</td></tr>
<tr><td>ICPF</td><td>0.49</td><td>−0.34</td></tr>
<tr><td>MMF</td><td>0.11</td><td>–</td></tr>
<tr><td>Households</td><td>–</td><td>0.01</td></tr>
</table>

Table 5
First stage of Optimal-GIV with PCs - large sectors

In this table, we show the coefficients resulting from the first stage of the O-GIV where sector i net securities borrowing volumes in the repo market are residualised against a broad set of common factors and sector fixed effects, see equation 22. The dependent variable is the percentage deviation of sector i ' net securities borrowing volumes from its 3-months moving average. The same transformation is applied to common factos, which are listed in Section 3. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period. *, **, and *** indicate that parameters are significantly different from zero at the 10%, 5%, or 1% level, respectively. Significance is based on autoregression and heteroskedasticity-robust Newey-West standard errors.

	Government EA	Central Bank EA	Banks EA	Dealers non-EA	OFI non-EA	Hedge funds non-EA
OIS1M DFR spread	−0.001	−0.008*	0.000	0.003	0.002	−0.002
3M1M OIS spread	−0.019**	0.001	0.004	0.008	0.005	−0.018***
1Y3M OIS spread	−0.002	−0.021***	−0.005	0.011***	0.009*	0.011***
KFW vs DE spread	0.023	−0.207***	0.164***	−0.069**	−0.172**	−0.020
DE vs FR spread	0.052	0.130	0.685**	−0.337***	−0.075	0.187***
OIS 1M	−0.021**	−0.054***	−0.018	0.039***	0.022	−0.012
Slope YC	−0.085***	0.004	−0.053	−0.006	0.120***	0.056***
OID skew	−0.019	0.113*	0.005	−0.009	0.197***	−0.067***
SMOVE	−0.168	−0.038	−0.345	0.492***	−0.042	0.233***
Bund vol prem	0.030*	−0.094***	0.053*	−0.043**	0.026	−0.052***
NSS dev	−0.103*	−0.414***	0.088	0.088	0.607***	−0.237***
Bund OpenInt	−0.034	0.552*	−0.344	−0.120	1.421***	0.243**
Cross-ccy basis	−0.047**	−0.002	0.077***	−0.043**	−0.066*	−0.019**
Duffie	0.002	0.003	0.002	0.004	−0.011	0.000
Free float	3.700***	3.080***	−1.913	−2.155***	−3.363*	−1.773***
ECB holdings	1.508**	−2.506**	−3.714**	−1.655*	−1.912	1.135***
DFA holdings	−3.127***	2.324***	2.901***	0.921***	1.312	2.018***
PC 1	−0.003	0.047***	0.121***	−0.081***	0.008	−0.049***
PC 2	−0.007	0.075***	0.016	−0.012	−0.046***	0.012***
PC 3	−0.048***	0.013	0.108***	0.017*	0.191***	0.003
Constant	−0.005	0.036	0.007	0.063**	0.107	0.004
R-squared	0.56	0.59	0.56	0.63	0.55	0.79
Observations	823	823	823	823	823	823
Day-of-the-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Weights	42%	18%	23%	37%	9%	45%
Side	Supply	Supply	Supply	Demand	Demand	Demand

Table 6
Sector Elasticities ζ_i with PCs

In this Table, we show the sector-level elasticities ζ_i for the baseline estimation of the first stage (Table 2) and for the estimation of the first stage with three pricipal components (Table 5). The table reports the market share of the sector calculated as in Eq. 21, the sector price-elasticity ζ_i calculated from Eq. 25, and an alternative estimate of ζ_i using principal component analysis (PCA). We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period.

Sector	**Share**	ζ	ζ with PCA
Supply			
Euro area			
Government	42%	0.64	0.61
Central bank	18%	1.28	1.34
Bank	23%	1.09	0.34
Dealer	5%	5.38	1.17
ICPF	5%	0.49	−0.32
Hedge funds	1%	−0.85	−1.99
Non-euro area			
Government	1%	−1.41	−0.47
Central bank	3%	2.50	1.65
ICPF	5%	0.48	−0.12
Demand			
Euro area			
OFI	1%	−0.89	0.02
MMF	0%	0.11	−0.67
Non-euro area			
Bank	5%	1.60	2.44
Dealer	37%	0.05	0.18
OFI	9%	0.27	0.53
Hedge funds	45%	0.11	0.21
Aggregate	200%	1.20	0.97

Appendix

A.1 SFTDS De-duplication Algorithm

This appendix is intended to provide a detailed overview of the de-duplication algorithm employed for the analysis of SFTDS transaction data and report the external validity cross-checks conducted to ensure the data quality of this deduplication.

A.1.1 Regrouping observations belonging to the same economical transaction

The first step consists of a light cleaning of the raw SFTDS data, namely the exclusion of transactions above EUR 50 bn and below EUR 1000 and the exclusion of trades which do not report at least volumes, counterparties, collateral and rates. We focus on new repo transactions (`report_type = 'New'` and `trade_type='RpTrad'`). SFTDS identifies transactions based on Unique Transaction Identifiers ('UTI') that are usually not directly exploitable. For instance, UTIs keep information about the direction of trade ('B' or 'S'), or use sometimes incremental numbering depending on the reporting counterparty. We first clean the UTI by identifying these patterns, namely removing leading and trailing '0','X','B','S','BO' and 'SO' from the UTI strings, and removing the numbering in the last 5^{th} and 6^{th} digits for the UTI strings registered by LCH. To further ensure that we indeed regroup observations related to the same transaction, we check the exact matching of the trade characteristics, using a MD5 hash function (from the R package `openssl`) that recreates a unique identifier from the following variables:

Variable Name	Description
`exctndt`	Execution date
`valdt`	Value date
`term_fxd_mtrtydt`	Maturity date
`trunc_prncplamt_valdtamt_eur`	Truncated principal amount
`round_intrst_rate_derived_sdw`	Repo rate, rounded at the second decimal
`assttp_scty_id`	ISIN of the collateral

The creation of the hash allows us to detect double-counting that even cleaned UTI cannot flag. This is the case, for instance, for interoperability, which trades. Interoperability refers to arrangements between two CCPs to intermediate a single repo transaction. They allow clearing members of one CCP to centrally clear trades carried out with members of another CCP, without needing to be a member of the second CCP. LCH and CC&G, both members of LSE Group have an interoperability agreement for Italian government bonds collateral. In SFTDS, an interoperability transaction involving LCH and CC&G and two final non-CCP counterparties in EEA would feature 6 observations, but with different UTIs. Observable patterns in the UTI would not allow to match the observations for a given transaction. We then proceed by creating the hash as explained above, check whether both LCH and CC&G appear as reporting agents or counterparties, override the UTI with the hash when it is the case.

A.1.2 Building repo positions from transaction flows

After cleaning all transactions, we compute the outstanding amounts of repos for each investor. For each unique transaction identifier (UTI), we calculate the number of days between the settlement date and the maturity date, and expand the dataset accordingly by adding one row for each business day during which the repo remains outstanding. Since accurate information on the maturity dates of open repos is unavailable, we exclude these transactions from the analysis.

A.2 Bloomberg Sector Classification

Our sector classification uses a mix of Bloomberg sector classifications (Sector 4 and Fund type) and ESA 2010 classification. Investors (LEIs) are allocated to hedge funds when fund type is "Hedge Fund", "FCP", "OEIC", "SICAV","Open-End Fund", "Closed-End Fund", "ETF", "Fund of Funds", "Private Equity Fund", "Unit Trust", "Variable Annuity", "Investment Trust" or sector level 4 is "Private Equity".

Investors are allocated to ICPF using ESA classification "S129" and "S128" we also add investors with Bloomberg sector 2 classification "Insurance" or fund type "Open-End Pension".

We use ESA sector S123 for MMFs. For NFC we use Bloomberg sector 2 "Utilities", "Consumer Discretionary Products", "Consumer Discretionary Services", "Health Care", "Industrial Services", "Materials", "Media", "Oil & Gas", "Real Estate", "Retail & Wholesale - Staples", "Retail & Whsle - Discretionary", "Software & Tech Services", "Telecommunications", "Consumer Staple Products".

For Central Bank we use the Bloomberg industry subgroup "Central Bank". For Government we use sector 2 "National", "Regional & Local" and ESA sector classification S1311 and

S1312. We also allocate to Government all the transactions where the counterparty is unreported, see Section 3.

For OFI, we use Bloomberg sector 4 “Consumer Finance”, “Instl Trust, Fiduciary & Custody”, “Commercial Finance”, “Diversified Banks”, “Institutional Brokerage”, “Investment Companies”, “Investment Management”, “Other Financial Services”, “Unknown”, “Wealth Management”, “Mortgage Finance”, “Security & Cmdty Exchanges”.

MFI are investors belonging to Bloomberg sector 4 “Banks”. The remaining non-allocated investors are hedge funds. Some LEIs of international institutions and banks are re-allocated manually, we refer to our online code for details.

A.3 Estimation of the demand elasticities

The elasticities ζ_i are estimated by granular IV (OGIV). For each sector i, the estimator takes the canonical IV form

$$\hat{\zeta}_i \;=\; -\frac{\hat{\mathbb{E}}\Big[\Delta q_{i,t}\,\hat{u}_{S(-i),t}(\hat{\zeta})\Big]}{\hat{\mathbb{E}}\Big[\Delta p_t\,\hat{u}_{S(-i),t}(\hat{\zeta})\Big]}, \qquad \hat{u}_{S(-i),t} = \sum_{j\neq i} S_j\,\hat{u}_{j,t}, \tag{A-28}$$

where the instrument $\hat{u}_{S(-i),t}$ is the size-weighted aggregate of the *other* sectors' idiosyncratic demand shocks. Because these shocks are themselves functions of the elasticities, the estimator is solved by iteration. Starting from an initial guess for $(\hat{\zeta}_1,\ldots,\hat{\zeta}_N)$ (e.g., the OLS coefficients), we recover each sector's residual by re-arranging Eq. 17,

$$\hat{u}_{i,t}(\hat{\zeta}_i) \;=\; \Delta q_{i,t} - \widehat{\overline{\Delta q_i}} - \hat{\lambda}_i\eta_t + \hat{\zeta}_{ii}\Delta p_t, \tag{A-29}$$

form the instrument $\hat{u}_{S(-i),t}$ for each sector i, and update the elasticities via Eq. (A-28). We repeat until the estimates converge. The iteration is necessary because the first-stage residual $\hat{\varepsilon}_{i,t} = u_{i,t} - \zeta_j\Delta p_t$, which removes macro factors and fixed effects, is still affected by the endogenous price response $-\zeta_i\Delta p_t$; adding back the current guess $\hat{\zeta}_i\Delta p_t$ removes this contamination exactly at the fixed point $\hat{\zeta}_i \to \zeta_i$.

A.4 Partial and Total Elasticities: Mapping the Model to a Multi-Asset Demand System

This appendix maps the model of Section 2 into the multi-asset demand system of Chaudhary et al. (2024) and shows that the conditional schedules of Propositions 4 and 5 are the *total* elasticities implied by that mapping. The exercise formalizes the discussion of the empirical estimates in Section 5: the hedge fund's partial own- and cross-price elasticities in the repo market are of equal magnitude, specialness passes through fully into cash bond prices in equilibrium, and the total repo elasticity that survives the offset of these two forces is the cash-market depth parameter η.

Consider two assets: asset 1 is the repo contract, whose price is specialness χ, and asset 2 is the cash bond. Because the futures rate r_F is exogenous, the basis $x = r_F - r_T$ moves one-for-one with the bond's price, and we use x as the price of asset 2. Following Chaudhary et al. (2024), a sector's demand for asset 1 is

$$q_1 = -\zeta_{11}\,\chi + \zeta_{12}\,x + u_1, \tag{A-30}$$

where ζ_{11} is the partial own-price elasticity (the response to specialness holding the bond price fixed), ζ_{12} is the partial cross-price elasticity (the response to the bond price holding specialness fixed), and u_1 is a demand shifter. Imposing market clearing for asset 2 expresses its price as a function of χ, with slope given by the passthrough coefficient $P_{1\to 2} \equiv \partial x/\partial\chi$, and collapses the system to a single-asset demand curve with *total* elasticity

$$\tilde{\zeta}_1 \;=\; \zeta_{11} - \zeta_{12}\,P_{1\to 2}, \tag{A-31}$$

which measures the equilibrium response of q_1 to a change in specialness after the bond price has adjusted.

Under perfect competition, the hedge fund's demand taking both prices as given is zero when $x < \chi + mk$ and unbounded when $x > \chi + mk$. Its partial elasticities are therefore not finite objects. To characterize them, we allow for the fund to have finite arbitrage slope κ,

$$|D_H| = \kappa\,(x - \chi - mk)\,, \tag{A-32}$$

which arises when funds bear convex holding costs or internalize their price impact, as would be the case in a model with imperfect competition. The competitive benchmark of

Section 2.7 is the limit $\kappa \to \infty$. Demand (A-32) delivers the partial elasticities:

$$\zeta_{11}^H = \zeta_{12}^H = \kappa. \tag{A-33}$$

The two partial elasticities are the same because the trade is an arbitrage: only the spread $x - \chi$ enters the fund's profit, so a change in either price (holding the other fixed) moves demand by the same amount. If $\kappa \to \infty$, both partial elasticities diverge together: a large cross-price elasticity necessarily comes with an equally large own-price elasticity.

Cash-market clearing, equation (14), gives $x = \bar{x} - |D_H|/\eta$. Differentiating (A-32) and (14) with respect to χ and solving the two equations,

$$\frac{\partial |D_H|}{\partial \chi} = -\frac{\kappa\eta}{\kappa+\eta}, \qquad P_{1\to 2} = \frac{\partial x}{\partial \chi} = \frac{\kappa}{\kappa+\eta} \xrightarrow{\kappa\to\infty} 1. \tag{A-34}$$

Equivalently, in the notation of Chaudhary et al. (2024), $P_{1\to 2} = \zeta_{S,21}/\zeta_{S,22}$, where $\zeta_{S,21}$ is the aggregate cross-price response of cash-market demand to specialness and $\zeta_{S,22}$ the aggregate own-price response of the cash market. In our model, $\zeta_{S,21} = \kappa$: the hedge fund is the only investor active in both markets, so it alone carries the cross term. Similarly, $\zeta_{S,22} = \eta + \kappa$ sums preferred-habitat depth and the fund's own response. In the competitive limit, passthrough is complete: the zero-profit condition of Proposition 3 implies $dx = d\chi$, so a change in the cost of borrowing the bond is capitalized fully into its price, as in Duffie (1996). The passthrough is an equilibrium object that obtains from market clearing.

Combining (A-31), (A-33), and (A-34),

$$\tilde{\zeta}_1 = \zeta_{11}^H - \zeta_{12}^H\, P_{1\to 2} = \kappa - \frac{\kappa^2}{\kappa+\eta} = \frac{\kappa\eta}{\kappa+\eta} \xrightarrow{\kappa\to\infty} \eta. \tag{A-35}$$

Under perfect competition, both terms of the total elasticity grow without bound. Their difference, however—the response of the fund's repo quantity to a change in specialness after the bond price has adjusted—remains finite and equals the cash-market depth η: the fund's equilibrium response is limited not by its own price sensitivity but by the price impact its trading exerts through cash-market clearing. Equation (A-35) is exactly the slope of the conditional repo schedule in Proposition 5: the conditional schedule, obtained by substituting cash-market clearing into the fund's problem, is the model's counterpart of the total elasticity obtained by collapsing the two-asset system.

Three implications follow. First, since $\kappa\eta/(\kappa+\eta) \leq \min\{\kappa, \eta\}$, the fund's total repo elasticity can never exceed the depth of the cash market, no matter how aggressively it trades. Second, the baseline knife-edge of Proposition 1 is nested as the degenerate limit $\eta \to 0$, in which the total elasticity vanishes even though both partial elasticities remain unbounded: a measured elasticity near zero does not mean that the fund ignores prices. Third, the same derivation with the two markets interchanged—substituting repo-market clearing (11) into (A-32)—yields a total cash-market elasticity of $\kappa/(1+\kappa\phi) \to 1/\phi$, reproducing Proposition 4 and the cross-market asymmetry documented in Section 6.

Collapsing the system also transforms cash-market demand shocks into repo-market demand shifters. Substituting cash-market clearing into (A-32) gives, for finite κ,

$$|D_H| = \frac{\kappa\eta}{\kappa+\eta}\left(\bar{x} - \chi - mk\right), \qquad \frac{\partial |D_H|}{\partial \Delta_S} = \frac{\kappa}{\kappa+\eta} \xrightarrow{\kappa\to\infty} 1, \tag{A-36}$$

since the natural basis $\bar{x}$ carries the demand premium Δ_S/η. A cash-market imbalance therefore shifts the fund's repo demand one-for-one while leaving its price sensitivity unchanged. The coefficient $\kappa/(\kappa+\eta)$ is precisely the loading $\zeta_{12}/\zeta_{S,22}$ on the aggregate demand shifter that arises in Chaudhary et al. (2024) when a multi-asset system is collapsed to a single asset. This result provides the formal basis for the interpretation of the empirical findings in Section 5: time variation in specialness reflects shifts in the quantity of cash-market imbalance that hedge funds intermediate, not changes in their price elasticity.

Table A-1
Securities holdings and borrowing and lending flows on the repo market, by sector

In this table, we show the amount of securities held, and the amounts of securities lent and borrowed on the repo market. We report the average by sector at the yearly level, and restrict the sample to German government bonds and repo transactions that use them as collateral. The amounts borrowed and lent on the repo market represents daily flows. All quantities are expresse in billion of euros. eurosystem borrowing and lending figures are limited to cash-collateralized transactions. Holdings of dealers, banks (monetary financial institutions, MFI), and other financial institutions (OFI) are reported as one, as the holding dataset does not distinguish between them. Non-euro area holdings are computed as a residual of Bund. We exclude money market funds, households and non-financial corporations, as their participation to the repo market is minimal. Our sample extends from January 2021 to June 2024. Holdings data are from SHSS, repo volumes from SFTDS, and eurosystem repo lending data are from MOPDB. The repo contract sample includes only fixed-rate, single-collateral–backed repos.

Year	Area	Sector	Holdings	Borrowed	Lent
2021	**euro Area**	ICPF	121	0.1	0.1
		Bank	11	26.5	30.4
		OFI		1.8	0.7
		Dealer		35.0	33.3
		Hedge funds	117	0.5	0.1
		Government	172	3.9	11.6
		Central bank	554	0.0	3.0
	Non-euro Area		554	55.0	43.3
2022	**euro Area**	ICPF	121	0.1	0.4
		Bank	3	32.0	33.0
		OFI		3.6	3.9
		Dealer		53.4	62.5
		Hedge funds	148	0.7	1.2
		Government	169	3.7	19.1
		Central bank	655	0.0	9.0
	Non-euro Area		534	95.6	60.0
2023	**euro Area**	ICPF	141	0.0	0.6
		Bank	3	35.9	39.3
		OFI		4.4	5.7
		Dealer		57.3	57.8
		Hedge funds	178	1.7	2.0
		Government	203	6.3	19.1
		Central bank	621	0.0	4.0
	Non-euro Area		616	91.0	67.8
2024	**euro Area**	ICPF	144	0.2	0.4
		Bank	3	23.3	34.1
		OFI		3.7	3.4
		Dealer		48.6	45.1
		Hedge funds	178	1.4	0.8
		Government	208	6.6	11.6
		Central bank	577	0.0	0.9
	Non-euro Area		700	66.0	53.9

Table A-2
First stage of Optimal-GIV - other sectors

In this table, we show the coefficients resulting from the first stage of the O-GIV where sector i net securities borrowing volumes in the repo market are residualised against a broad set of common factors and sector fixed effects, see equation 22. The dependent variable is the percentage deviation of sector i ' net securities borrowing volumes from its 3-months moving average. The same transformation is applied to common factos, which are listed in Section 3. We include sectors whose outstanding positions make up more than 5% of the total. These sectors cumulatively represent 17% (9%) of the supply (demand) in the market. We allocate a sector to supply (demand) if the sector is a net lender (borrower) of securities, on average, over our sample period. *, **, and *** indicate that parameters are significantly different from zero at the 10%, 5%, or 1% level, respectively. Significance is based on autoregression and heteroskedasticity-robust Newey-West standard errors.

	ICPF EA	Hedge funds EA	MMF EA	OFI EA	Dealer EA	Central bank non-EA	Government non-EA	Bank non-EA	ICPF non-EA
OIS1M DFR spread	−0.005	−0.014	0.048*	0.020	0.001	−0.004	0.003	0.016	0.000
3M1M OIS spread	−0.037	0.042	0.050	−0.083	0.186***	0.107**	0.064*	0.043	−0.006
1Y3M OIS spread	−0.072*	−0.052	−0.060**	0.065***	0.042	0.002	0.009	−0.172***	−0.044**
KFW vs DE spread	0.357*	0.531*	0.011	0.490*	0.299	−0.149	−0.319	−0.050	0.031
DE vs FR spread	−1.092	−0.554	1.673*	0.013	−1.324	−2.183***	0.781	2.526***	−0.658**
OIS 1M	−0.015	0.003	−0.203**	−0.013	0.388***	0.040	0.078	−0.142**	−0.020
Slope YC	0.213*	−0.197	−0.596***	0.360	−0.283*	0.037	0.025	0.205	0.022
OID skew	0.478**	−0.368*	0.084	−0.309	0.513*	−0.147	−0.157	−0.388	−0.172
SMOVE	−2.602**	−1.466	−1.586*	−0.751	−2.482**	1.947**	1.387*	0.967	−0.475
Bund vol prem	−0.027	0.315**	−0.014	0.029	0.075	0.069	0.233	0.061	−0.019
NSS dev	−0.537	0.781	−0.324	−0.427	2.024***	0.566	0.402	−1.512***	0.694***
Bund OpenInt	0.054	−1.060	−0.266	−4.607***	1.559	−1.143	1.455	−3.741**	−0.939**
Cross-ccy basis	0.108	−0.009	0.090	0.471***	0.452***	0.082	0.007	−0.434***	−0.054
Duffie	−0.032	−0.001	0.031	−0.002	−0.014	−0.019	0.013	0.046	−0.009
Free float	0.441	16.224***	9.916*	−10.341*	14.309**	8.811**	−8.325	−13.369***	4.426***
ECB holdings	3.822	1.689	7.096	−0.009	8.229	−7.646	−16.932***	−11.275	3.404
DFA holdings	0.529	−13.165***	−6.940***	−7.235	−24.268***	−0.797	5.959	7.686***	−3.684***
Constant	−0.311	−0.021	0.085	0.224	−0.196	−0.349*	−0.134	−0.232	−0.145*
R-squared	0.26	0.23	0.23	0.20	0.29	0.22	0.19	0.34	0.39
Observations	823	823	823	823	823	823	823	823	823
Weights	5%	1%	0%	1%	5%	3%	1%	5%	5%
Side	Supply	Demand	Demand	Demand	Supply	Supply	Supply	Demand	Supply

Figure A-1. The Unreported Sector

In this figure, we show the characteristics of cleared trades for which one of the two counterparties is missing (the “missing” sector). In Panel A, we show the net securities lending of the unreported sector as a function of the asset’s specialness. The binscatter is based on bond-day level observations. Panel B shows the aggregate net securities lending (securities lent minus securities borrowed) by the missing sector at the daily level. Data are sourced from SFTDS and are limited to fixed-rate single-collateral–backed repo transactions for German central government bonds, for the 2021–2024 sample.

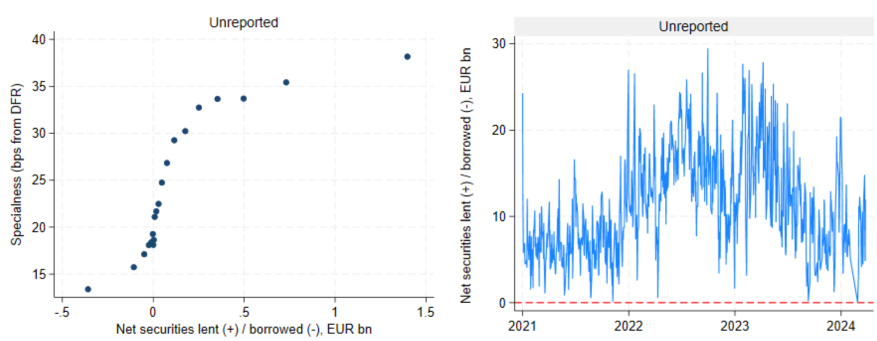


Figure A-2. Implications of SFTDS reporting rules

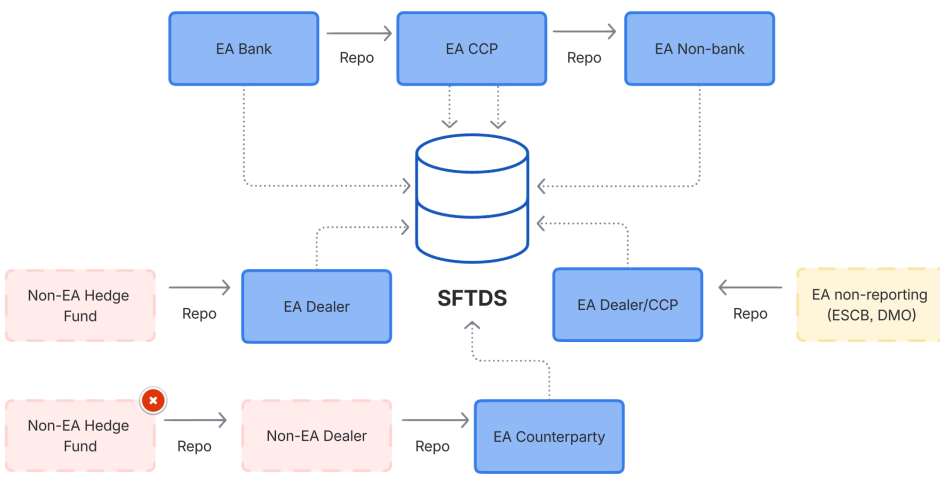


Figure A-3. Volumes of securities borrowed by location of hedge funds (IF)

In this figure, we show the distribution of securities borrowed by hedge fund based on the country of incorporation of the fund. Data are sourced from SFTDS and are limited to fixed-rate single-collateral–backed repo transactions for German central government bonds, for the 2023 sample.

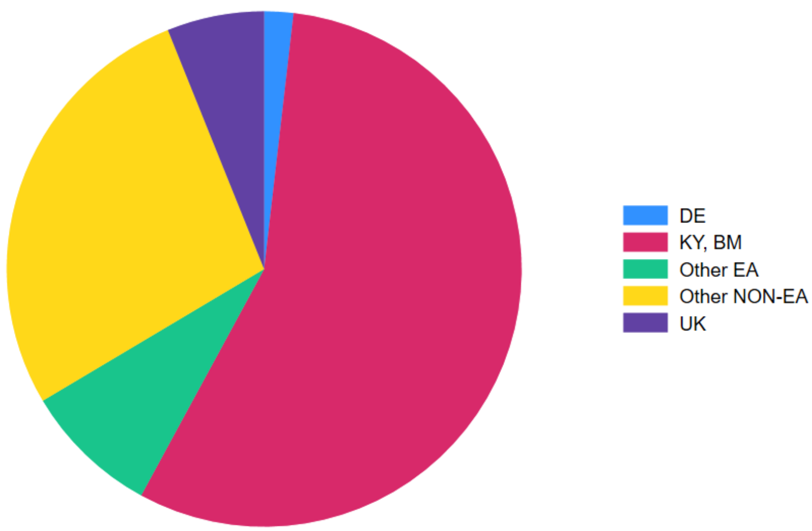


Figure A-4. Idiosyncratic shocks

In this figure, we show the daily time series of the residuals (i.e. idiosyncratic shocks) from the first stage of the O-GIV where sector i net securities borrowing volumes in the repo market are residualised against a broad set of common factors and sector fixed effects, see equation 22 and Table 2 and Table A-2. The dependent variable is the percentage deviation of sector i ' net securities borrowing volumes from its 3-months moving average. The same transformation is applied to common factos, which are listed in Section 3. We aggregate the shocks from all sectors by taking the daily sum.

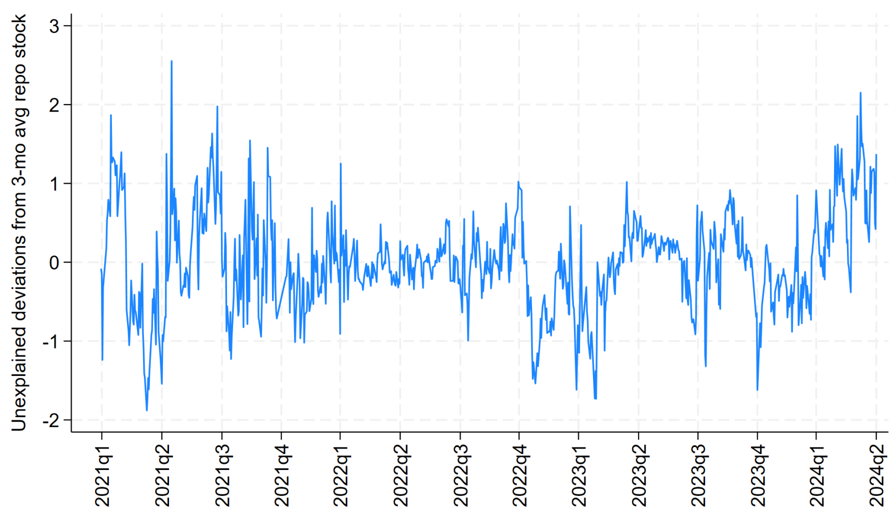


Figure A-5. Actual and predicted specialness deviations from 3-months moving average

In this figure, we show the strong positive correlation between the predicted values from our model $\Delta\hat{p}_t$ - calculated from Eq. 26 - and observed deviations Δp_t as evidence of the good fit of our empirical specification.

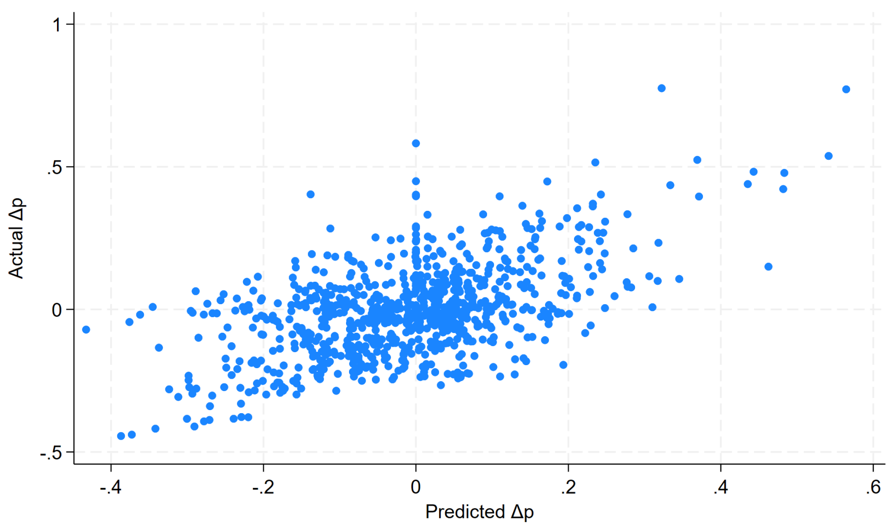


Figure A-6. Decomposition of repo specialness contributions by common factors

This figure shows the decomposition of the changes in the specialness spread among common factors. We define changes in specialness as the relative deviation from the three-month moving average, and changes in quantities accordingly. We average the daily contributions at the quarter level, and classify the factors into monetary policy, repo demand, repo supply, and bond supply factors. The factor decomposition for factor $\eta(k)$ is calculated as $\Delta\hat{p}_{\eta(k),t} = \frac{1}{\hat{\zeta}_S} S_i \hat{\lambda}_i(k)\eta_t(k)$, for and day-$t$, where $\hat{\zeta}_S$ is reported in Table 3. The sample period goes from March 2021 to June 2024 and the sample consists of repos with underlying collateral a German government bond. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB

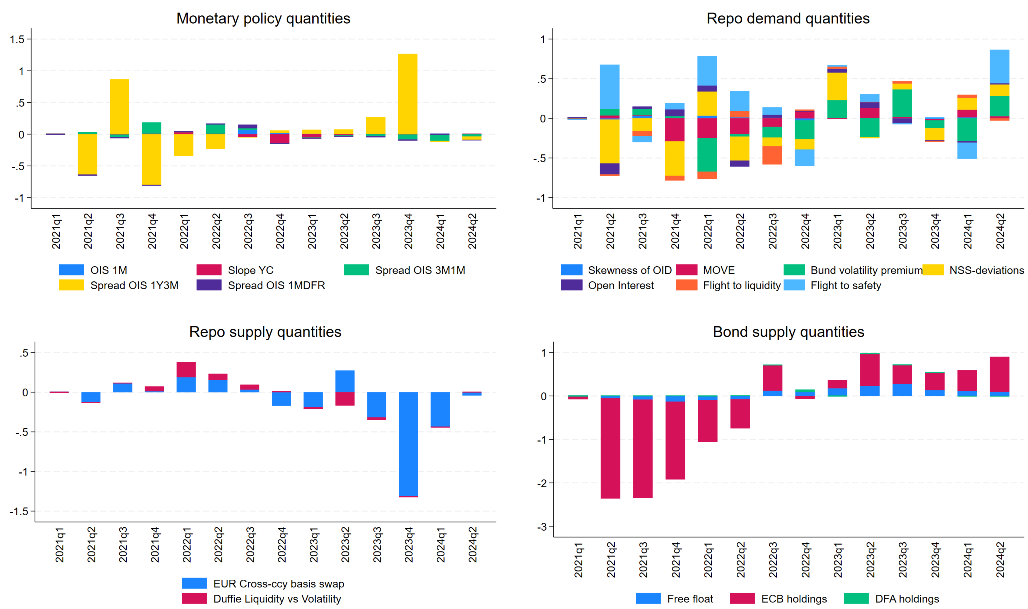


Figure A-7. Decomposition of repo specialness contributions of EA intermediaries at quarter-end

In this figure, we show the cyclicality of sectoral contribution to specialness within a quarter. That is, we calculate the contribution $\Delta\hat{p}_{i,t} = \frac{1}{\hat{\zeta}_S} S_i(\hat{\Delta q_i} + \hat{\lambda}_i \eta_t + \hat{u}_{i,t})$, for sector-$i$ and day-t, where $\hat{\zeta}_S$ is reported in Table 3, aggregate it by sector type, and average it by the number of days to the end of the quarter. We group investors in euro-Area intermediaries (banks and dealers) and the rest. We show the results for the period from March 2022 to June 2024. In this sample, euro-area intermediaries exited from special exemption period, which allowed them to exclude sizeable central bank exposures from the calculation of the leverage ratio, contributing to lower balance sheet costs. The sample consists of repos with underlying collateral a German government bond. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB.

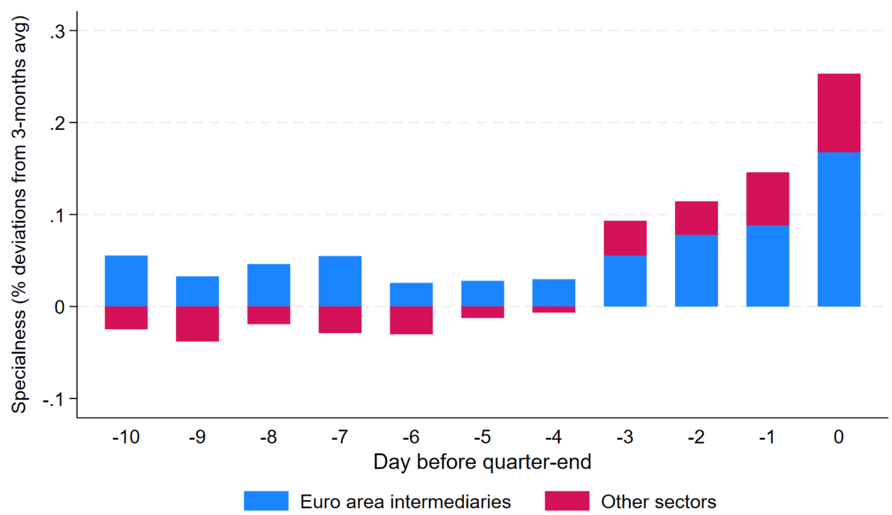


Figure A-8. Elasticity by sector: estimation with Bund yield

In this figure we compare the price-elasticity ζ_i for the largest participants to the repo market when the yield of the 10 year benchmark yield for the Bund is added to the macro-controls in the first stage to account for cash market clearing. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. The elasticities are computed from Eq. 25. Our data includes repo transactions that use German government bonds as collateral for the March 2021–June 2024 period. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB

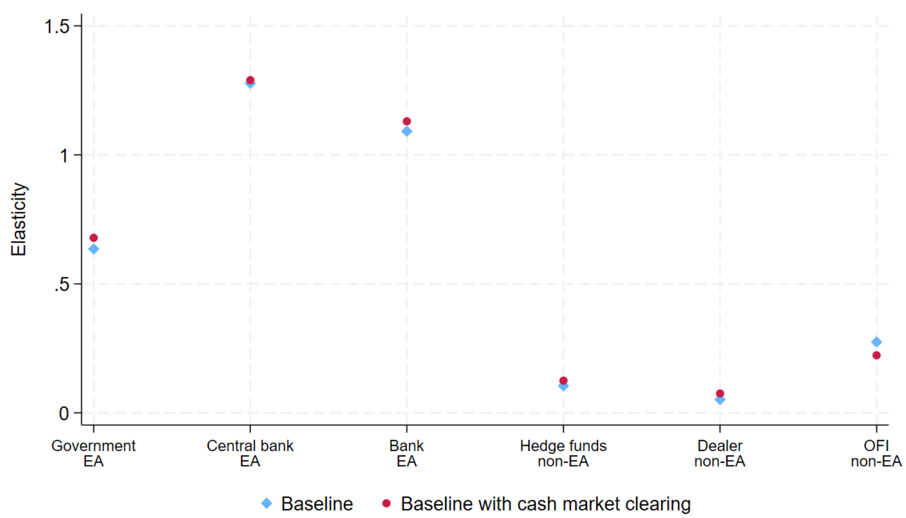
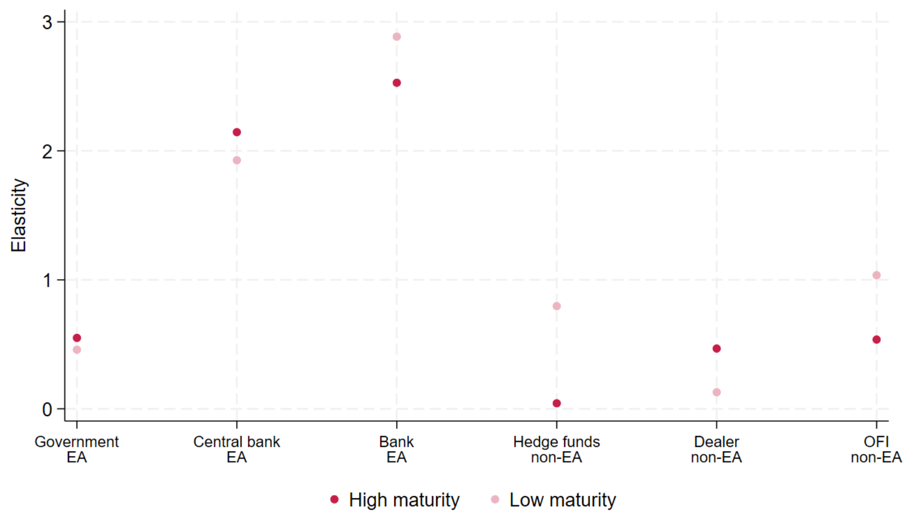


Figure A-9. Elasticity by sector: sample splits

In this figure we compare the price-elasticity ζ_i for the largest participants to the repo market using two sub-samples. The maturity split is based on the remaining maturity of the undelying Bund (i.e. above and below 5 year remaining maturity) and the specialness split is based on the share of the outstanding amount of the underlying bond held at the Eurosystem (i.e. above and below daily median holdings). We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. The elasticities are computed from Eq. 25. Our data includes repo transactions that use German government bonds as collateral for the March 2021–June 2024 period. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB



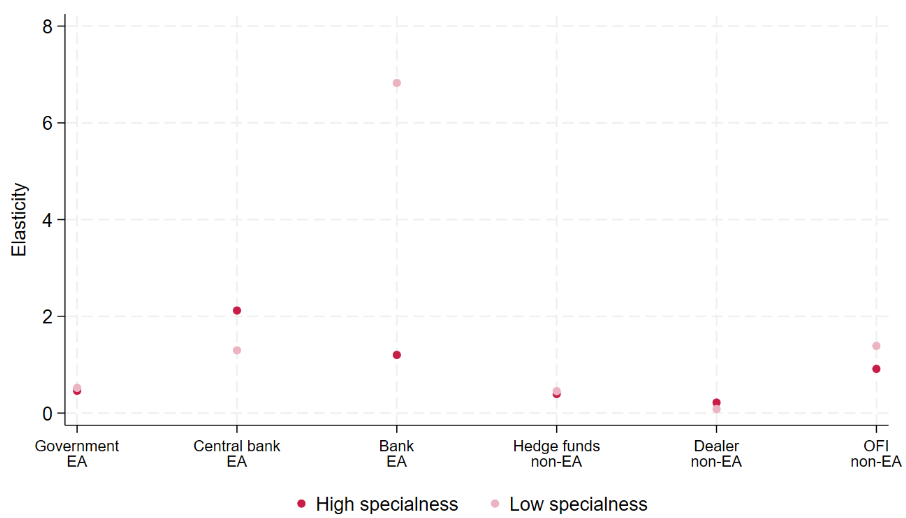


Figure A-10. Elasticity by sector: alternative transformation of quantities and prices

In this figure we compare the price-elasticity ζ_i for the largest participants to the repo market using two alternative transformation of prices (quantities).The baseline model' prices (quantities) are expressed as the percentage deviation from the 3-months moving average, see Eq. 20. We conduct two robustness tests by using the 1-month and 6-months percentage deviation. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. The elasticities are computed from Eq. 25. Our data includes repo transactions that use German government bonds as collateral for the March 2021–June 2024 period. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB

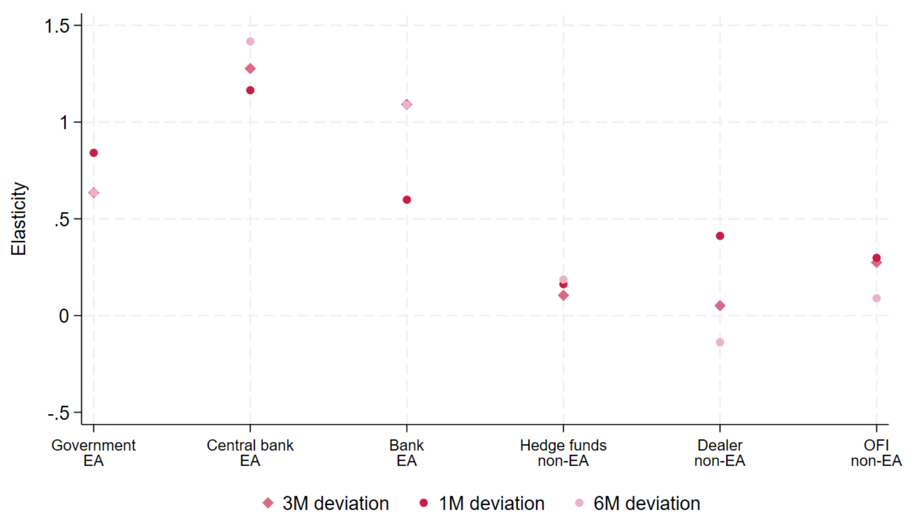
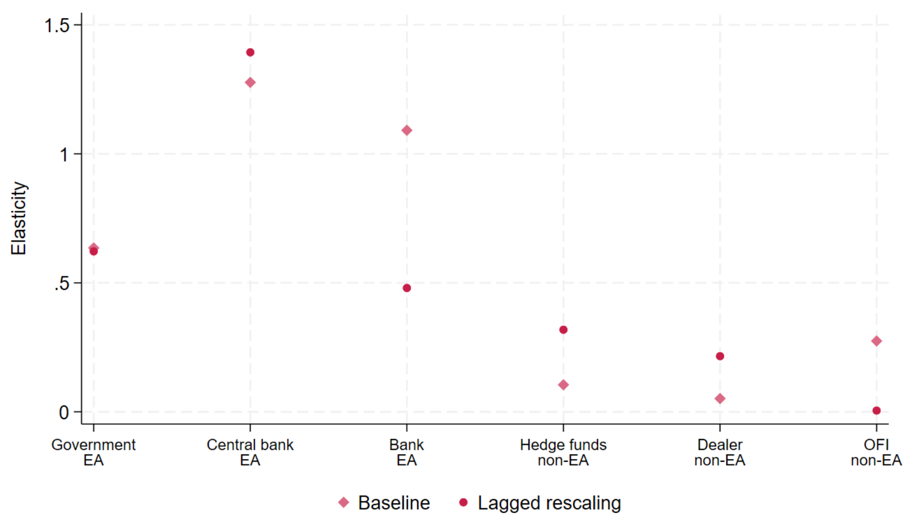


Figure A-11. Elasticity by sector: endogeneity of trading volumes

In this figure we compare the price-elasticity ζ_i of the baseline model and a model where we lag the moving average of prices (quantities) variables by 4 months, see Eq. 20. We exclude sectors whose outstanding positions make up less than 5% of the total. These sectors cumulatively represent 83% (91%) of the supply (demand) in the market. The elasticities are computed from Eq. 25. Our data includes repo transactions that use German government bonds as collateral for the March 2021–June 2024 period. Repo data are from SFTDS, and eurosystem repo lending data are from MOPDB



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