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EUROSISTEMA

Mercati, infrastrutture, sistemi di pagamento

(Markets, Infrastructures, Payment Systems)

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DEMAND AND SUPPLY OF ITALIAN GOVERNMENT BONDS DURING THE EXIT FROM EXPANSIONARY MONETARY POLICY

by Fabio Capasso,* Francesco Musto,* Michele Pagano,* Onofrio Panzarino, Alfonso Puorro,* Vittorio Siracusa***

Abstract

In response to 2022-23 inflationary pressures, the portfolio of assets held by euro-area central banks for monetary policy purposes has gradually shrunk (quantitative tightening), after years of rapid expansion in the Eurosystem's balance sheet. In these circumstances, the capacity of financial markets to continue to absorb the supply of government bonds in an orderly and efficient manner, without any significant impact on prices, is important. Drawing on granular data from the primary and secondary markets for Italian government bonds, this paper investigates Market Absorption Capacity (MAC), defined as a market's ability to respond to supply and demand shocks with limited price impact. Our analysis shows that when Eurosystem purchases were reduced or suspended, private investment in sovereign securities remained stable or increased, with modest and statistically non-significant impacts on issuance costs. However, during periods of market stress, demand from end investors tends to weaken, and issuance costs at auctions rise accordingly.

JEL Classification: E52, E58, G12, G14.

Keywords: Unconventional monetary policy, Public debt, Supply effects, Dealer intermediation, Market stability.

Sintesi

In risposta alle pressioni inflazionistiche del 2022-2023, dopo anni di forte espansione del bilancio dell'Eurosistema, il portafoglio di attività detenute delle banche centrali dell'area per finalità di politica monetaria è stato gradualmente ridotto (*quantitative tightening*). In tali circostanze, assume rilevanza la capacità dei mercati finanziari di continuare ad assorbire in maniera ordinata ed efficiente l'offerta di titoli pubblici, senza che si verifichino impatti significativi sulle quotazioni. Basandosi su dati granulari relativi ai mercati primario e secondario dei titoli di Stato italiani, questo lavoro analizza la cosiddetta capacità di assorbimento del mercato (*Market Absorption Capacity*, MAC), definita come la capacità di un mercato di fare fronte a shock di offerta e di domanda con un impatto contenuto sui prezzi. L'analisi mostra che, nei periodi in cui gli acquisti dell'Eurosistema sono stati ridotti o sospesi, gli investimenti privati in titoli sovrani sono rimasti stabili o sono aumentati, con impatti modesti e statisticamente non significativi sui costi di emissione. Tuttavia, durante fasi di tensione sui mercati, la domanda da parte degli investitori finali tende a indebolirsi, con conseguente aumento dei costi di emissione nelle aste.

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1. Introduction

The outburst of inflationary pressures in 2022 and 2023 called for a massive monetary tightening in several advanced economies, with rapid and significant increases in policy rates and a shift from quantitative easing to quantitative tightening. Uncertainty about the inflationary outlook and the required pace of monetary restriction generated volatility and hindered liquidity in government bond markets, including US Treasuries and German Bunds. At the same time, the halt in public bond net purchases by central banks radically changed the landscape on the demand side of the market, while supply remained generally sustained. With regard to the Italian government bond market, after several years of negative net supply, the amounts to be absorbed by the market experienced a considerable upward shift.

Managing public debt in this context can be challenging. The capacity of sovereign markets to absorb bond supply (Market absorption capacity, MAC) in such a rapidly changing environment is key. MAC can be defined as the ability of a market to withstand shifts in the supply and demand of a certain asset class with limited price impact, i.e. in an efficient and cost-effective way. In other words, new information is incorporated in an appropriate, prompt and smooth manner into prices, thus allowing them to generate meaningful signals and converge in an orderly manner to new equilibrium levels, so that market participants with diverse trading interests can adjust, share and redistribute financial exposures.

This work contributes to a strand of literature on the topic which is still building up. While many studies focus on the demand for government debt securities in auctions and examine the impact of bond issuance on market yields, few have attempted to shed light on the potential implications for the MAC stemming from central banks' balance sheet normalisation. Our findings are intended to support and complement those of some recent studies analysing how marginal buyers change over time, along with changes in central banks' purchasing regimes (Cordes and Ferris, 2024), as well as the costs associated to the issuance of government securities in primary markets (Albuquerque *et al.*, 2023) and stemming from secondary market dynamics (Ferrara, 2024).

On the back of the above, this paper looks into the MAC of the Italian government bond market, based on primary and secondary market data from the last 10 years. In particular, we focus on the potential effects that may stem from a lighter presence (or a full absence) of the Eurosystem on the market in a context of unchanged or increased supply, as well as from phases of accentuated volatility.

The work is organized as follows. Section 2 reviews the relevant academic literature. Section 3 focuses on the demand for sovereign debt and analyses the trading flows on the secondary market in stylized scenarios characterized by different degrees of Eurosystem presence and different volatility conditions. Section 4 investigates the costs related to market capacity to absorb new issuance on the primary market, by analysing the price-elasticity of demand in a sample of Italian sovereign bond auctions, as well as the issuance costs stemming from secondary market dynamics around the auction time. Section 5 reports the results of some robustness exercises, and Section 6 concludes.

2. Related literature

MAC is related to a rather recent strand of literature, which is becoming increasingly established and mostly consists of empirical studies focused on the dynamics of primary or secondary market demand. Some of them provide valuable insights into investors' behavior in the context of sovereign bonds auctions, central bank policy shifts, or financial stress.

Kandel *et al*. (1999) pioneered this research by analyzing Initial Public Offering (IPO) data to identify key factors influencing the demand for stocks. Duffie (2010) discusses asset price dynamics caused by slow-moving capital, presenting an illustrative model showing that secondary market prices react sharply to supply or demand shocks due to a limited risk-bearing capacity by investors. Lou *et al.* (2013) focus on anticipated and repeated shocks in secondary, liquid markets, using market data to analyze the significant effects of these shocks on prices and liquidity. Beetsma *et al*. (2016) examine the price effects of sovereign debt auctions in the secondary market during the Eurozone crisis, finding that new public debt issuance in Italy turns into stylized yield movements described as an auction cycle, in contrast to the evidence obtained for Germany. Fleming and Liu (2016) examine the intraday effects of US Treasury auctions on prices and liquidity, finding that prices decrease in the hours leading up to the auction and recover in the hours following it, with better liquidity before the auction. Logan and Bindseil (2019) consider the impact of a sizeable central bank balance sheet increase on market functioning, concluding it can significantly influence market liquidity and stability. Building on the understanding of demand shocks in liquid markets, Koijen and Yogo (2019) advance the literature by developing a comprehensive demand system approach to asset pricing. Their framework departs from the representative agent paradigm and explicitly models how asset prices reflect the heterogeneous, partially inelastic demand of different investor sectors. By calibrating this model to detailed flow-of-funds and holdings data, they show that deviations from the representative agent benchmark can meaningfully explain cross-sectional return predictability and amplify the price impact of large balance sheet shifts, including those triggered by central bank interventions or regulatory changes. Their empirical approach is particularly relevant for sovereign bond markets, where the interplay between heterogeneous investor appetites and balance sheet capacity constraints can drive persistent yield dynamics. Bellia (2018) studies how the supply of bonds through primary auctions affects prices and liquidity in the secondary market, finding a general inverted 'V-shaped' effect on yields, quite pronounced for Italian bonds. Bouveret *et al*. (2022) analyze flash crashes in EU sovereign bond markets, finding that liquidity vanishes before crashes, causing a significant and long-lasting price impact. Fleming *et al*. (2022) revise a previous study (Fleming and Rosenberg, 2007) to analyze how US Treasury dealers manage their positions, using a large span of dealer position data and concluding that Treasury issuance is the main driver of weekly changes in dealer inventory. Spronsen and Beetsma (2022) confirm the impact of unconventional monetary policy on auction cycles by using evidence for Eurozone sovereign debt issuance. Albuquerque *et al*. (2023) highlight the price elasticity of demand and risk-bearing capacity in Portuguese sovereign bond auctions, finding that demand elasticity is strongly correlated with yield volatility in the secondary market. Holm-Hadulla *et al*. (2023) examine the balance sheet responses of investors to monetary policy shocks, finding significant variations between banks and non-banks. Panzarino (2023) investigates Italian sovereign bonds investors behavior under market stress, reporting a tendency to reduce exposure during stress periods which negatively affects prices and liquidity. Shida (2023) analyzes the issuance for German government bonds in the primary market, identifying key factors capturing auction-specific, institutional, regulatory and financial market conditions that influence demand. Cordes and Ferris (2024) set up a framework to point out US Treasuries marginal buyer shifts when the Fed reduces its securities holdings, finding that with the post-pandemic balance sheet reduction, dealers, private insurances, and foreign investors increased their purchases, while this was not the case for hedge funds. Finally, Ferrara (2024) investigates the relationship between unconventional monetary policy and auction cycles in the euro area, focusing on the impact of central bank asset purchases on government bond yields in secondary markets around public debt auction dates and finding that Eurosystem asset purchase flows on medium-term maturities help dampen yield cycles around public debt auctions, counteracting the amplification effects of market volatility.

Altogether, these works highlight the presence of several key factors influencing market absorption capacity. Primary dealers' risk-bearing capacity, the timing and frequency of debt issuances and the behavior of investors during periods of market stress all play significant roles in determining how well markets can absorb new supply and ultimately new information. Moreover, the impact of large central bank balance sheets and unconventional monetary policies on market liquidity and stability underscores the importance of coordinated policy measures to enhance market resilience. Understanding these dynamics seems essential for policymakers and market participants to ensure efficient market functioning and mitigate the risks of market disruptions.

However, so far there has been limited exploration into the potential implications for MAC arising from the normalization of central banks' balance sheets. This work is aimed at integrating the existing research by broadening the investigation in this direction. With this purpose, within the scope of Italian government bonds, it examines the evolution over the last ten years of the appetite of multiple investors and the resulting issuance costs in primary and secondary markets, subject to the occurred shifts in the Eurosystem's purchasing programmes.

More specific evidence from the aforementioned studies, concerned with either trading flows, price-elasticity of primary market demand, or secondary market yield patterns around auctions, is recalled in the respective sections of this work dedicated to these matters.

3. The demand for sovereign bonds: an analysis based on trading flows on the secondary market

Italian sovereign bonds are traded on a multitude of trading venues and over-the-counter (OTC). Trading is facilitated by the presence of Primary Dealers, which play a key role in intermediating bond supply and demand. With orders arriving in large lots at irregular times, liquidity in government bond markets is essentially determined by dealers' ability to match buyers and sellers and to temporarily absorb order imbalances.

This section analyzes the net trading flows intermediated by dealers on the secondary market to investigate the buying and selling behavior of bond investors in Italian sovereign securities in two types of periods: (i) periods with 'lighter' Eurosystem presence; (ii) periods characterized by high volatility. We use data reported by primary dealers under the European Market Activity Report (EMAR),[1] which covers trades in Italian sovereign securities negotiated by dealers with bond investors in the secondary market, i.e. within the so-called dealer-to-customer segment. Investors are classified into six categories: non-dealer banks, asset managers, hedge funds, insurance companies and pension funds, non-financials (including corporate and retail investors) and public entities. To investigate changes in investors' purchasing behavior we adopt the following specification:

$$NetBuy_{it} = \sum_{i} \beta_{1,i}\, \mathbb{1}_i \times NoCB_t + \sum_{i} \beta_{2,i}\, \mathbb{1}_i \times HighVol_t + X_{it} + \mu_i + \mu_q + \varepsilon_{it} \qquad (1)$$

where the dependent variable, *NetBuy*, is the difference between the amount of securities bought and sold by sector i from primary dealers on day t (and expressed in euro billions).[2] *NoCB* is a dummy that takes the value of one if it is a period with reduced or no central bank purchases. This variable identifies three sub-periods in which Eurosystem purchases were: (i) completely absent (i.e. before March 2015); (ii) 'virtually', or close to, zero (i.e. the periods January 2019–October 2019 and July 2022–February 2023, when there were no net purchases but only reinvestments of redemptions); (iii) particularly low and negative (i.e. from March 2023 onwards, when there were no net purchases and only partial reinvestments of redemptions). *HighVol* identifies periods characterised by high volatility (i.e. if above the 90th percentile of the sample distribution). X includes the daily series of gross issues of Italian securities on the primary market, as well as lags of the same series, which are added as control variables since secondary market trading flows may be affected by Treasury issuance.[3] We include sector and quarter fixed effects to control for time-invariant sector characteristics and time trends. The sample period spans from January 2014 to January 2024.

[1] The dataset contains all transactions involving the primary dealers in the Italian sovereign bond market, thus providing an extensive, albeit not full, picture of the secondary-market activity. It provides a sector classification for each counterparty in a trade, which enables to disentangle trading activity among different type of investors, regardless of whether it is a resident or a foreign entity. The reporting scheme is consolidated at the European level. See Euro Market Activity Report (EMAR) for more details.

[2] The trading activity is reported at the nominal amount (par value) therefore the net purchases variable does not reflect valuation effects related to changes in bond prices, but only the difference between actual sales and purchases made by market participants.

[3] Bonds maturing in investors' portfolios do not constitute sales transactions and are thus not observed in the primary dealer reporting.

Results are reported in Table 1. Columns (a) and (b) display the coefficients $\beta_{1,i}$ and $\beta_{2,i}$ associated with changes in sectors' net purchases during periods of limited central bank's presence and high volatility, respectively. The coefficients on the *NoCB* dummy (Table 1, column a) are not statistically significant or positive, suggesting that market participants tend not to significantly change, or at most to slightly increase, their (net) purchases of securities in months with limited presence of the Eurosystem. In particular, the types of investors tending to increase net purchases in these months are asset managers and (non-dealer) banks. By contrast, during periods of high volatility private investor trading flows show some marked divergences. As shown in Table 1 (column b), for some sectors the coefficients on the *HighVol* dummy tend to be statistically different from zero and show opposite signs. In times of turmoil, some non-bank investors, such as hedge funds and asset managers, become net sellers, while banks significantly increase net purchases. These findings underscore that, in stressed conditions, government bond markets are not exempt from significant liquidity imbalances and large one-sided flows (FSB, 2022), which could put considerable pressure on dealers' intermediation capacity and adversely affect MAC

Table 1: Net purchases from primary dealers

	Changes in net purchases from dealers, bn	
	(a) periods with limited, or no, central banks' purchases	(b) stressed/high volatility periods (>90th perc.)
(Non-dealer) Banks	0.0768*	0.3434***
	(1.6702)	(5.6779)
Asset managers	0.1165***	-0.1650***
	(2.6701)	(-3.2655)
Hedge funds	0.0337	-0.1829***
	(0.8478)	(-3.8696)
Insurances and pension funds	0.0026	-0.0334
	(0.0721)	(-1.2717)
Non-financials	-0.0122	-0.0159
	(-0.3450)	(-0.6824)
Public entities (inc. foreign CBs)	-0.0535	-0.0393
	(-1.3953)	(-1.1941)
Sector FE	Y	
Quarter FE	Y	
Control variables	Y	
R-squared	0.1682	
Observations	15443	

The table reports the estimates of the coefficients $\beta_{1,i}$ and $\beta_{2,i}$ from specification (1), which are associated with changes in the net purchases of the sectors during periods of limited central bank presence and high volatility, respectively. Newey-West heteroskedasticity consistent standard errors are shown in parentheses. Data begins in January 2014 and ends in January 2024. *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

The findings are robust to different specifications and a number of robustness checks (see Section 5). The use of different percentiles to identify high volatility periods also yields consistent results. Interestingly, when a lower percentile is chosen to identify high volatility periods (i.e. if the threshold is set at the 80th, 70th, 60th percentile, instead of 90th as in the baseline specification) investors' trading flows become less divergent. These findings are in line with related studies showing that the trading behavior of fixed-income investors may differ across sectors and in response to past changes in yields. Sectoral heterogeneity may even increase during crisis periods, also reflecting ' different exposure to liquidity risk across firms (see, e.g., Timmer, 2018, Czech and Robert-Sklar, 2019, Panzarino, 2023).[4]

As anticipated, the sample period of our analysis covers three different monetary policy phases where the Eurosystem net purchases on the secondary market were low or completely absent. In order to capture the differential effect of distinct monetary policy phases, we run an alternative specification where we include three indicator variables to uniquely identify these periods (and account for potential differences in trading activity by market participants). Specifically, we include three dummies to identify the following periods: (i) January 2014 – March 2015 (no central bank purchases), (ii) January 2019–October 2019 and July 2022–February 2023 (zero net purchases, full reinvestment of redemptions), (iii) March 2023–January 2024 (negative net purchases, due to partial reinvestment of redemptions).

Table 2: Net purchases in periods with limited central banks' presence

Changes in net purchases from dealers in periods with limited central banks' purchases, bn				
	(a) all	(b) no CB purchases	(c) zero net purchases	(d) negative net purchases
(Non-dealer) Banks	0.0768*	0.0786	-0.0003	0.2649***
	(1.6702)	(1.0024)	(-0.0053)	(2.7627)
Asset managers	0.1165***	0.0722	0.1267**	0.2264**
	(2.6701)	(1.1217)	(2.1915)	(2.4200)
Hedge funds	0.0337	-0.0454	0.1275**	0.0570
	(0.8478)	(-0.8148)	(2.4095)	(0.6149)
Insurances and pension funds	0.0026	-0.0003	0.0097	0.0642
	(0.0721)	(-0.0064)	(0.2166)	(0.7982)
Non-financials	-0.0122	0.0113	-0.0154	0.0318
	(-0.3450)	(0.2094)	(-0.3462)	(0.3952)
Public entities (inc. foreign CBs)	-0.0535	0.0932	-0.1295***	-0.0525
	(-1.3953)	(1.5376)	(-2.8134)	(-0.6313)
Sector FE	Y			
Quarter FE	Y			
Control variables	Y			
R-squared	0.1742			
Observations	15443			

The table reports, in column (a), the estimated coefficients $\beta_{1,i}$ from specification (1), which are associated to changes in net purchases by the sectors during periods of limited central bank presence. Columns (b), (c) and (d) report results from an alternative specification that incorporates three indicator variables to differentiate among distinct monetary policy phases. Newey-West heteroskedasticity consistent standard errors are shown in parentheses. Data begins in January 2014 and ends in January 2024. *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

The results are presented in Table 2 and show that the main findings are generally confirmed across all sub-periods, with market participants tending, on average, not to change

[4] Recent studies on the trading activity of financial institutions in fixed-income assets shows that the demand for securities is generally elastic to changes in yields and that the response of fixed income investors to past returns may differ across sectors. More generally not all investors have access to the same information, follow the same trading strategy, take the same investment horizon, or have the same balance sheet structure. See also Panzarino (2023) for a review of the relevant studies focusing on the trading behavior of different types of bond investors.

significantly, or at most to increase slightly, their net purchases of securities. The results also show that the participation of bond investors in the secondary market was not the same in all sub-periods. Bond purchases were generally higher in the most recent phase, from March 2023 onwards (column d), suggesting that various types of private investors revived their appetite for securities after the Eurosystem started to shrink its balance sheet. Net purchases were higher for banks and investment funds in particular, although the investor base may be broader than the data suggest. For example, the figure for banks may also reflect purchases made by the sector on behalf of their retail clients,[5] whose demand for government bonds has been particularly strong in the last year (see Bank of Italy, 2024).

The results also provide further evidence of the great diversity and importance of non-bank investors in government bond markets, whose footprint has increased significantly in recent years globally (see, e.g., Eren and Wooldridge, 2021). Asset managers and hedge funds, which are traditionally highly sensitive to changes in yields (Panzarino, 2023), are among the most active investors within the non-bank sector, although net purchases by the latter have been more muted in the latter part of the sample than in earlier periods. Such findings highlight that the role of marginal buyers may change over time, in line with evidence from other markets. Cordes and Ferris (2024), for example, recently showed that during the recent 'balance sheet reduction phase' initiated by the Federal Reserve (FED) in June 2022, households purchased a large share of US Treasury securities no longer held by the FED, while hedge funds did not engage in such purchases to the same extent as observed in the past (e.g., during the balance sheet reduction phase in 2017-19). Moreover, our findings corroborate the procyclical behavior exhibited by certain market participants, notably hedge funds, whose flows can shift, also abruptly, in response to prevailing market conditions.[6] Monitoring hedge funds flows holds particular significance from a central banking perspective, given the increasingly prominent role hedge funds play in the liquidity and overall functioning of global sovereign bond markets.[7]

[5] One feature of our dataset is captures who is executing the trade, while not necessarily who the beneficial owner is. For example, a bank might execute a trade on behalf of a retail client. For this reason, we cannot rule out the possibility that the large purchases of Italian government bonds by the retail sector in recent months may have been reflected in the figure for banks in our database.
[6] See, e.g., Brandt *et al*. (2017).
[7] See Kolokolova *et al*. (2018).

4. Market absorption capacity, measurement and costs

In this section we look into the costs associated to the MAC of Italian government securities, by focusing on the placement of securities on the primary market and their impact on market prices. We first follow a price–elasticity approach to study primary dealers' demand in auctions of Italian sovereign bonds. The analysis exploits granular data related to the bids submitted by dealer banks in auctions and studies their demand curves under different market scenarios. We then focus on the secondary market and examine the impact of the Italian Treasury auctions on bond yields. Consistently with previous studies, we find that prices decrease in the hours preceding auction and recover afterwards, suggesting that supply shocks generate price pressures, which might put a strain on the MAC.

4.1 The price-elasticity of demand in auctions of Italian sovereign securities

Issuing bonds via auctions is by far the most important financing method for the governments of advanced economies (Shida, 2023). We focus on the primary market demand for Italian government bonds and study the behavior of primary dealers in auctions, by analyzing the elasticity of their bids in accommodating a supply shock (in the short run). Following an approach similar to Albuquerque *et al*. (2023), our elasticity measure is based on the slope of the empirical demand curves. With a particular focus on the market absorption capacity, the elasticity measure is computed as the marginal decrease in the bond's price demanded by investors due to a marginal increase in the demanded quantity[8]. A common theoretical assumption is that the price elasticity of demand for an asset is infinite in a perfectly competitive market, which indicates that investors can absorb any supply shock at the equilibrium price (Albuquerque *et al.,* 2023). Existing research based on the reaction of market prices to supply and demand shocks has however questioned this assumption and documented that the demand for financial assets is not perfectly elastic (Duffie, 2010; Albuquerque *et al.,* 2023). According to these studies, the evidence suggests the existence of an implicit cost that primary dealers charge to the issuer to absorb the bond supply, which is connected to their limited risk-bearing capacity. The price–elasticity of demand in auctions could therefore provide an indication of the additional issuance costs borne by the government for the placement of securities on the primary market and, more broadly, of the markets' capacity to absorb new issuances. Italian government medium and long-term bonds are mainly placed via public, marginal price auctions, in which all allocated bids are awarded at the same price (the marginal one). Auctions are carried out by the Bank of Italy – on behalf of the Italian Ministry of Economy and Finance – and are restricted to market makers (primary dealers). In marginal price auctions, the amount placed is determined discretionally by the Italian Treasury, within a minimum and maximum amount announced in a press release some days before the auction. The lowest price among the awarded bids is the auction (marginal) price, which is then applied to all the allotted bids[9].

In the context of bond auctions, low elasticity (as defined below) implies that primary dealers are able to absorb an increase in the quantity of the bond supplied by asking only a slight

[8] The choice in computing the elasticity as shown above is to emphasize the price effects produced by an additional quantity. Applying the common definition of elasticity to the context of government bond auctions, elasticity is usually computed as the marginal increase in the quantity demanded by investors for a marginal decrease in the bond's price, as in Albuquerque *et al.* (2023).

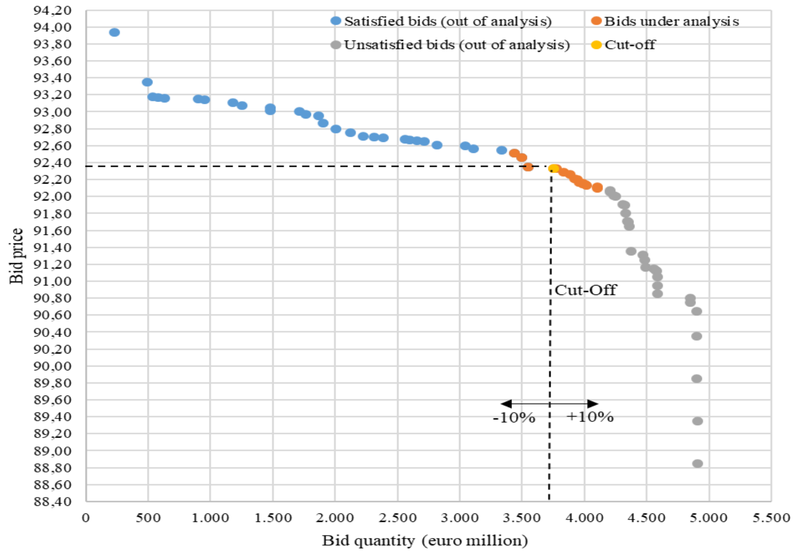
[9] The framework ruling Italian bond auctions execution is described in detail in the Appendix.

decrease in the price at issuance. This makes low elasticity a desirable feature for the bond issuer. Indeed, a low (absolute) value of the elasticity means that only small price decreases are associated with (relatively) large increases in offered quantities; in other words, a supply shock is absorbed by demand without much of a price decrease. The use of the indicator of price elasticity to study primary dealers' behavior in government bond auctions follows an approach similar to Albuquerque *et al.* (2023), who studied the primary market for Portuguese government bonds. More specifically, the elasticity measure is defined as the percentage decrease in the cut-off price that one would observe for a marginal increase in quantity[10]:

$$Elast. = \frac{\Delta Price\ offered\ by\ Primary\ Dealers\ (as\ \%\ of\ the\ cut-off\ price)}{\Delta Quantity\ demanded\ by\ Primary\ Dealers\ (as\ \%\ of\ the\ allotted\ quantity)} \quad (2)$$

In marginal price auctions, as is the case for Italy, elasticity is mostly relevant when it is measured near the so-called 'cut-off price', since the latter is the only price determining the cost at issuance for the whole quantity supplied. Therefore, for each auction of interest, we compute this measure of elasticity using the auction demand curve and focusing, in particular, on the primary dealers' bids placed around the allotted quantity. Specifically we consider the bids corresponding to a cumulative demand positioned in the range between –10% (satisfied bids) and +10% (unsatisfied bids) of the quantity allotted by the Treasury (Figure 1). An alternative section of the demand curve for calculating the demand elasticity has also been taken into account for robustness check purposes, since the choice of one methodology over another might provide different information (see Section 5).

Figure 1: Illustrative auction demand curve



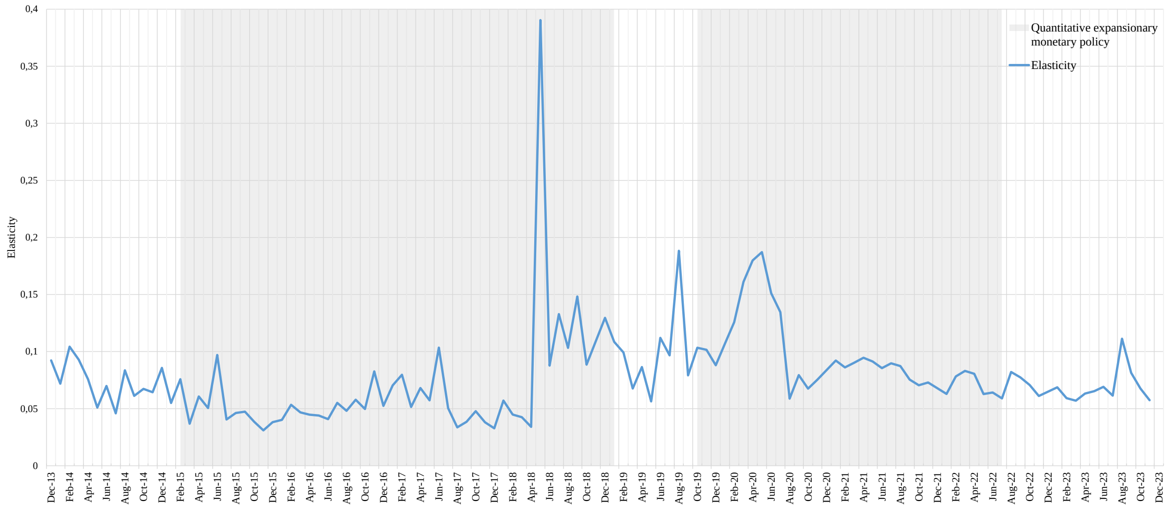
The figure reports an illustrative empirical auction demand curve, obtained by sorting the auction bids in decreasing order of price and plotting them in a chart with the price on the vertical axis and the cumulative quantities requested for each price on the horizontal axis. Source: authors' calculations on Bank of Italy data.

[10] We rescaled the value by multiplying by 10, to facilitate the presentation of results

For each auction, we obtain elasticity by multiplying the slope of the selected section of the curve – derived from a linear regression model of Price (P) on Quantity (Q) – by the ratio of the quantity determined in auction to the cut-off and the cut-off price. In this way we obtain an a-dimensional measure of elasticity that can be compared across time and across securities.

We analyse the elasticity of demand for Italian 5- and 10-year benchmark government bonds using data derived from 228 auctions conducted between December 2013 and November 2023. We focus on these specific maturities, as they exhibit the highest number of auctions and the lowest volatility of elasticity over the sample period. To obtain a monthly elasticity value, the simple average of the elasticity of the 5-year and 10-year bonds auctions was calculated. The dataset includes all the bids submitted by each primary dealer in each auction.

Figure 2: Elasticity over time



The values in the figure are obtained as a tenfold increase in the monthly elasticity computed according to equation (2). The time series thus proxies the percentage decrease in the cut-off price that would have been observed if the allotted quantity increased by 10% in each auction. Source: authors' calculations on Bank of Italy data.

Figure 2 illustrates the evolution of the price elasticity measure over the sample period. Given the focus of our analysis, the chart also reports the periods characterized by the expansionary interventions of the Eurosystem. Between 2015 and 2017, the elasticity stabilized around subdued levels. This period coincides with the onset of the Eurosystem's Public Sector Purchase Programme, which signalled an extraordinary accommodative monetary policy along with a gradual improvement of the Italian macroeconomic outlook. The descriptive analysis seems also to reveal few spikes coinciding with specific exogenous events. The highest elasticity value (around 0.4) in the series is observed in May 2018. This outlier[11] can be attributed to the rise in the political uncertainty in Italy, which was associated to heightened volatility and a sharp increase in the sovereign bonds' risk premia.[12] The period between

[11] The evidence that the observation relating to May 2018 qualifies as a structural breakpoint of the series is provided by the test reported in the Table A.3 of the Annex.

[12] Between the end of May and the start of June 2018, coinciding with uncertainty around the formation of a new government in Italy, tensions on the Italian government securities market heightened, driving up yields and following a material deterioration in market liquidity conditions (Bouveret *et al.*, 2022).

January and October 2019 witnessed a reduction in central banks' interventions. The second spike in the series occurs in July 2019, when elasticity reaches a value equalling 1.5 times the series average, coinciding with an exogenous shock (government crisis) that led to an increase in volatility and risk premia for Italian bonds. Then, in February-April 2020, a quick upsurge in elasticity coincided with the first wave of the COVID-19 pandemic, after which a return to the mean has been observed. Remarkably, the first talks and the final allocation of Next Generation EU funds, occurred respectively in July 2020 and July 2021. Starting from July 2022, the cycle of ECB rate hikes did not exert a substantial influence on the trajectory of elasticity. A qualitative analysis of the elasticity values suggests that the metric has been particularly sensitive to exogenous shocks over the sample period, while remaining almost invariant overall following monetary policy tightening, when large–scale asset purchase programs have been scaled back or suspended.

On the back of the variability shown by elasticity across time, we also conduct a regression analysis to check whether changes of the estimated elasticity indicator are associated to periods with: (i) limited central bank purchases and (ii) higher volatility. As outlined in previous studies, price elasticity is strictly connected to primary dealers' capacity to absorb new issuance. This ability is likely influenced by several factors, like the composition of their existing inventory as well as the capability (and willingness) to warehouse the issued securities in their portfolios before they are absorbed by the broader financial system (Lou *et al*., 2013, Fleming *et al.*, 2022) (see Section 3.2). These components are dealer-specific and difficult to be captured without access to individual trading books, which are generally unobservable. However, previous research suggests that the ability of dealers to absorb supply shocks tends to be driven to some extent by common factors affecting their risk appetite. In particular, when volatility is low, dealers tend to have a greater capacity to warehouse securities (Logan and Bindseil, 2019, Holm-Hadulla *et al.*, 2023).

To investigate whether the exit from monetary policy purchase programs could be associated with a higher cost in the placement of government bonds on the primary market, we adopt the following specification:

$$E_t = \alpha + (\beta * NoCB_t) + (\gamma * HighVol_t) + \varepsilon_t \qquad (3)$$

Where the dependent variable, E_t, is our elasticity measure, $NoCB_t$ is a dummy variable which is equal to one in months of reduced or no central bank purchases under PSPP and PEPP programs (and zero otherwise), and $HighVol_t$ is a dummy variable which identifies periods of high volatility. Data are expressed on a monthly basis and the sample period runs from December 2013 to November 2023. The aim of the analysis is to identify changes in the price elasticity of demand, by distinguishing phases with reduced central bank purchases of government bonds on the secondary market and heightened volatility.

The reduction or absence of central banks' purchases on the secondary market tends to have a negligible effect on the price elasticity of demand in auctions. [13] As represented in Table 3, during the periods of reduced or absent Eurosystem's purchases, independently of the percentile chosen to capture the level of market volatility, there are no (statistically) significant changes to the elasticity. This pattern is overall consistent with the governance of central bank

[13] As represented in Table 3 by the low value of the estimate for the coefficient β.

purchase programs, aimed at preserving market neutrality, in particular during public auction events.

Table 3. Regression results.

Volatility > 50th perc.		Volatility > 70th perc.		Volatility > 90th perc.	
α	0.0705256***				
NoCB	-0.00531236				
HighVol (50th)	0.0202565**				
		α	0.0731517***		
		NoCB	-0.00768974		
		HighVol (70th)	0.0275815***		
				α	0.0763848***
				NoCB	-0.00520625
				HighVol (90th)	0.0446337***
R-squared:	0.053673	**R-squared:**	0.081815	**R-squared:**	0.090609

The table provides the results of the regression model $E_t = \alpha + (\beta * NoCB_t) + (\gamma * HighVol_t) + \varepsilon_t$. E_t is the elasticity series. $NoCB_t$ is a dummy variable which is equal to one in months of reduced or no central bank purchases under PSPP and PEPP programs (and zero otherwise). $HighVol_t$ is a dummy variable which is equal to one when volatility on the secondary market, measured as the standard deviation of the yields of the ten-year Italian benchmark bond, exceeds the 50th, 70th or 90th percentile of its daily volatility distribution (and zero otherwise). Data are expressed on a monthly basis. The sample period runs from January 2014 to November 2023. *, **, *** denote significance at 1%, 5%, and 10% confidence level, respectively.

By contrast, periods of higher volatility are associated to an appreciable increase in the elasticity, consistently with previous studies (Albuquerque *et al.*, 2023). Table 3 shows the regression using alternative volatility measures as regressors, based on different percentiles of the volatility distribution. The impact of volatility on our estimates magnifies as volatility increases, with higher levels of significance of the coefficient associated with volatility. The results are robust to different specifications (See Section 5).

4.2 An analysis based on yield patterns around auctions

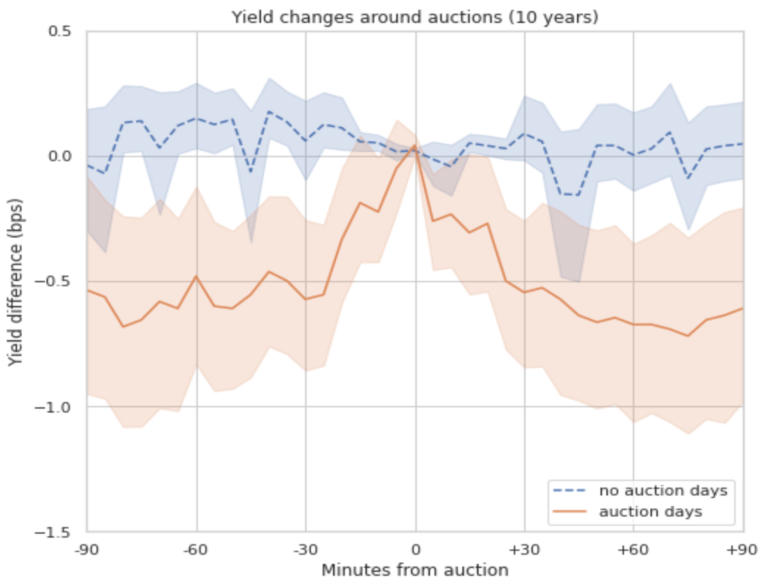
Another strand of the literature focusing on debt issuance costs examines how the bond supply, via auctions on the primary market, impacts prices on the secondary market. A number of empirical works[14] shows that supply shocks in government securities, even when fully anticipated,[15] have temporary effects on price dynamics in the secondary market. These studies document the existence of a so-called 'auction cycle', where bond yields tend to increase before auctions and to decline afterwards, following an inverted 'V-shaped' pattern. A pattern of the kind has been demonstrated for several advanced economies, including the United States (Lou *et al.*, 2013, Fleming and Liu, 2016) and the euro area countries (Beetsma *et al.*, 2016).

Previous research suggests that these patterns are mainly attributable to two factors: the limited risk-bearing capacity of dealers and the 'imperfect' capital mobility of final investors. Primary dealers are expected to actively participate in all Treasury auctions, by submitting competitive

[14] See, for example, van Spronsen and Beetsma (2022), Fleming and Rosenberg (2007), Lou *et al.* (2013), Beetsma *et al.* (2016), Fleming and Liu (2016).
[15] Auctions' timing and issuances' size are typically known days in advance; in an efficient market one would expect no predictable bond price or yield movements around auctions (Beetsma *et al.*, 2016).

bids. In turn dealers require to be compensated for the risks associated to the auction-driven inventory changes (affecting their trading portfolio), given that they are risk adverse and that their capital is costly.[16]Additionally, the magnitude of auction cycles might be linked to the demand of end-investors. Beetsma *et al*. (2016) suggest that auction cycles would be smaller if it is easier for primary dealers to unload their inventory of the newly issued security. Issuers do indeed rely on the capability (and willingness) of primary banks to warehouse bonds before they are 'absorbed' by the broader financial system. The investor base is therefore a factor that influence the behavior of dealers in government bond auctions, with implications for yield dynamics on the secondary market.[17] The magnitude of the auction cycle is then indicative of the markets' capacity to absorb new issuances, which is the focus of this analysis.

Figure 3: Yield movements before and after auction



The figure reports the average of $y_t - y_0$, where y_t is the yield of the ten-year BTP (on-the-run) t minutes away from the auction, and $y_0$is the yield at the time of the auction (11:00 a.m.). Yield differences are measured in the three-hour window surrounding the auction time, for both auction (orange) and non-auction (blue) days, and expressed in basis points. Shaded areas are 90% confidence intervals. The sample period runs from January 1, 2014 to January 31, 2024 and includes 110 auctions.

To assess the impact of Treasury auctions on secondary market yields, we present the results of an event study analysis.[18] Figure 3 reports intraday yield movements of the 10 year BTP (on-the-run) in the three-hour[19] window surrounding the auction, for both auction and non-auction days. Specifically, the figure reports yield differences calculated as the simple difference between the yield of the bond *t* minutes away from the auction, and the yield

[16] To hedge the risk they are about to acquire, dealers (short) sell securities in advance in the secondary market (i.e. before auctions), exerting downward pressure on bond prices. The compensation comes in the form of higher auction yields from which the dealers generate trading profits (see, for instance, Fleming and Rosenberg, 2007).
[17] According to Lou *et al*. (2016), for instance, a large fraction of potential end-investors in U.S. public debt are passive investors that do not stand ready to absorb new debt issues.
[18] In the vein of Fleming and Liu (2016).
[19] Fleming and Liu (2016) use a larger time window, that goes from minus four hours to plus four hours of the auction time. In line with Bellia (2018) we focus on a smaller window for two reasons: the first is related to the auction time in Italy (11 a.m.); the second is related to the high price volatility and bid-ask spread at the beginning of the day. This effect is since not all the dealers' quotes are present immediately after market opening.

observed on the same bond at the time of the auction (11:00); t ranges from -90 (one hour and half before auction) to +90 (one hour and half after auction). Yield differences are expressed in basis points and computed for each five-minute interval within the time window. Shaded areas are 90% confidence intervals. Data are from the MTS market, which is the most liquid trading venue in the interdealer segment for the Italian sovereign securities. The sample period runs from January 1, 2014 to January 31, 2024.

The results show the presence of an intraday yield pattern around the auction time. On auction days, bond yields tend to rise in the run-up to the auction and to fall back around their original level after the auction. By contrast, on non-auction days, no clear patterns seem to emerge: yield differences are miniscule over the same window (and not significantly different from zero). The pricing patterns we observe are thus unique to auction days and centred around the auction time.

We complement our event study analysis by conducting regressions to better control for the potential presence of confounding factors occurring during the event window. We adopt the following specification:

$$\Delta y_{dt} = \beta_1 AUC_d \times Before_t + \beta_2 AUC_d \times After_t + \mu_t + \mu_q + \varepsilon_{dt} \quad (4)$$

where the dependent variable (Δy) is the difference between on-the-run yields quoted t minutes from auction and at the time of auction (11 am) on day d; *Before* (*After*) is a dummy variable equal to 1 in the one-hour time window before (after) the auction, i.e. from 10:00 am (11:00 am) to 11:00 am (12:00 am); AUC is a dummy variable indicating auction days. In order to investigate whether auction cycles change during phases of reduced Eurosystem presence and/or in periods of higher volatility, we expand our baseline specification by adding two dummy variables, *NoCB* and $HighVol$, which take the value of 1 if it is a period of limited presence of central banks' purchases or higher volatility, respectively. We also add hour and year-quarter fixed effects to control for intraday dynamics as well as other time-varying factors that may affect debt issuance costs. The sample period runs from January 1, 2014 to January 31, 2024. The results are reported in Table 4.

Regression estimates corroborate the results of the event study analysis and document the existence of an auction cycle in the Italian sovereign bond market. There is a clear and statistically significant downward price pressure around auction time: ten-year yields tend to be half a basis point lower before and after the auction.[20] The effect is temporary and slightly asymmetric: after the auction, yields revert to levels that are slightly higher than their original ones. The results also imply a 'hidden' issuance cost for the Italian Treasury, estimated to be around 130 million euros for the issuance size in 2023.[21] As outlined in previous studies,

[20] Results are robust to the choice of different time interval before and after auction time (e.g., 10:30-11:00, 10:15-10:45; see Section 5).

[21] We compute the auction-induced additional issuance cost for the Italian Treasury as in Beetsma *et al*. (2016). Based on the findings of our analysis, the estimated average price pressure effect (around auctions time) for the 10-year securities is approximately 0.5 basis points. Hence, referring to the total amount issued in 2023 for these securities (around 45 billion), we compute an additional annual interest payment of around 2.26 million (i.e. total amount allotted, 45 billion, times 0.5 basis points). We then multiply this number by the modified duration of a 10-year benchmark bond at the end date of our sample period. The additional debt issuance component that arise purely because of the auction cycle is than equal to 18 million euros. Assuming that all the debt issued in 2023 by

although not being the major components of the total financing cost borne by governments, issuance costs associated with auction cycles are not (economically) negligible and may provide insights on the market capacity to ‘absorb’ new issuances.

Table 4. Auction effects on yields.

Yield differences around auction time, bps	(1)	(2)	(3)	(4)	(5)
AUC × Before	-0.5374***	-0.5521***	-0.3762***	-0.4075***	-0.3838***
	(-9.3720)	(-9.8383)	(-7.1335)	(-7.5940)	(-7.0090)
AUC × After	-0.4463***	-0.3989***	-0.4722***	-0.4396***	-0.4159***
	(-7.4564)	(-6.1025)	(-9.9133)	(-8.2438)	(-7.8412)
NoCB					0.0567
					(1.4787)
AUC × Before × NoCB		0.0445		0.1721	0.2165
		(0.3286)		(1.2192)	(1.5671)
AUC × After × NoCB		-0.1433		-0.1792	-0.1349
		(-1.1096)		(-1.3113)	(-1.0169)
HighVol					0.0493
					(1.3173)
AUC × Before × HighVol			-0.3255***	-0.3771***	-0.4115***
			(-2.9503)	(-3.3080)	(-3.7440)
AUC × After × HighVol			0.0522	0.1059	0.0715
			(0.4699)	(0.9006)	(0.6485)
Hours FE	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	
R-squared	0.0003	0.0003	0.0003	0.0003	0.0003
Observations	95599	95599	95599	95599	95599

The table report the results of regression (4). The dependent variable is the difference between on-the-run yields quoted *t* minutes from auction and at the time of auction (11 am) on day *d*; *t* ranges from -90, or one hour and half before auction, to 90, or one hour and half after the auction; yield differences are from the interdealer market MTS Italy and are expressed in basis points. Before (After) is a dummy variable equal to 1 in the 1-hour time window from 10:00 a.m. (11:00 a.m.) to 11:00 a.m. (12:00 a.m.); AUC is a dummy variable indicating auction days; NoCB (HighVol) is a dummy that takes the value of one if it is a month of ‘reduced’, or no, central banks’ purchases (period of high volatility, i.e. if above the 90th percentile). Data begins in January 2014 and ends in January 2024. Newey-West heteroskedasticity consistent standard errors are shown in parentheses. *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

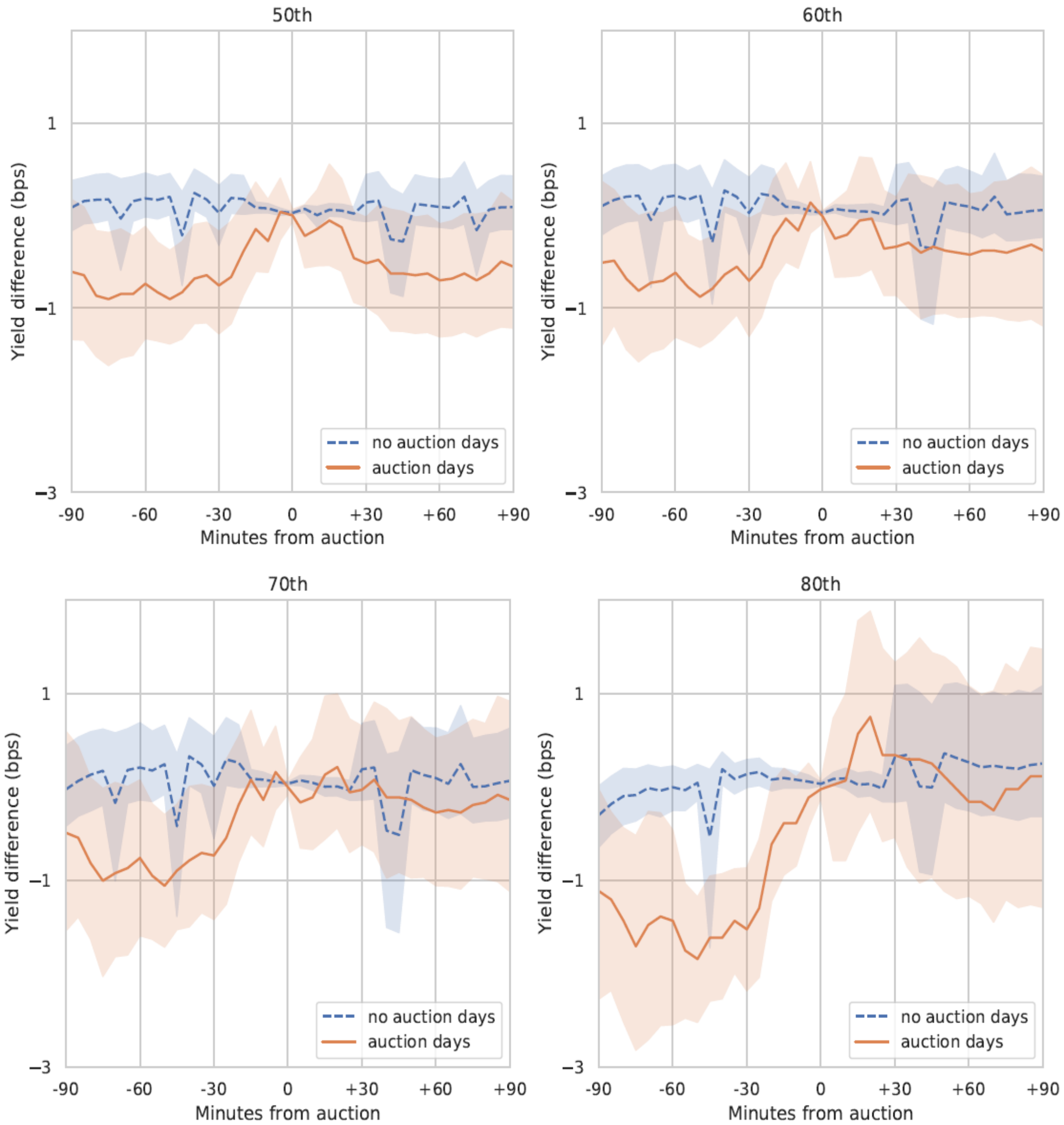
Such evidence aligns with the existing literature and is common to other government bond markets. The impact of government security supply shock on secondary market yields has been demonstrated both in the US (Fleming and Liu, 2016, Lou, Yan, and Zhang, 2013) and in the euro area (Shida, 2023, Spronsen and Beetsma, 2022, Beetsma *et al*., 2016, Lou *et al.*, 2013). In most cases previous research is based on lower frequency (i.e. daily) data, which make the magnitude of the cycles not directly comparable with our study (because of differing time intervals of the analysis). To the best of our knowledge, the only empirical contributions that use intraday[22] data are the works of Fleming and Liu (2016) and Bellia (2018), which are

the Italian Treasury has been subject to the same additional issuance cost (of 0.5 basis points), the total cost borne by the Italian Treasury would have been equal to around 130 million euros (500 billion times 0.5 basis points times the average modified duration of the government securities).

[22] Using intraday data substantially reduces the potential for confounding effects arising from unrelated events during the day. For instance, by focusing on intervals immediately before and after the auction, our approach avoids other timeframes that are usually linked to significant information releases, such as macroeconomic

focused, respectively, on the US treasury market and on the Italian and German sovereign bond markets. Consistent with our findings, the authors provide evidence of a price pressure effect around auctions, which is not present in non-auction days, with a maximum intraday yield movement of about 0.5–1 basis points. Notably, despite differing markets and sample periods, the results are consistent with our findings (and estimates are broadly comparable in terms of magnitude).

Figure 4: Yield movements before and after auctions in high volatility periods (>perc.)



Yields reported as difference between on-the-run mid-quotes *t* minutes from/after auction and at the time of auction (11 am); *t* ranges from -90 to 90 (minutes). Yield quotes are from the interdealer MTS market and are expressed in basis points. Shaded areas are 90% confidence intervals. The sample period runs from January 1, 2014 to January 31, 2024 and includes 110 auctions.

announcements. However, previous studies have suggested that price pressure effects may unfold over longer timeframes, often spanning several days, implying that our intraday framework may only capture a portion of the total effect.

As shown in Table 4, the absence (or reduced presence) of central bank purchases is not associated to significant changes in yield patterns around auctions (the coefficients are not statistically different from zero). By contrast, yield patterns exhibit a different behavior during periods of heightened uncertainty: bond yields tend to increase slightly more on average before the auction, and they have a tendency to remain elevated for a longer period after the auction (see Figure 4). Dealers are likely demanding higher premia when volatility is higher and the impact of treasury auctions on bond yields is more persistent within the examined time window.

5. Robustness

This section investigates the robustness of our findings. We conduct a series of robustness checks, with results summarized in Tables A.1–A.6. Our key conclusions remain stable across alternative model specifications, different thresholds used to define high-volatility periods, and various measures of elasticity. In the following subsections, we explore two aspects in greater detail: (i) the potential interaction between central bank purchases and market volatility, and (ii) the robustness of our estimates on auction elasticity across different maturities.

5.1 Central bank purchases and market volatility

This study analyses issuance costs under two distinct market conditions: (i) periods with limited or no central bank purchases, and (ii) episodes of heightened market volatility. A potential concern is that these two regimes may not be fully independent. For example, reduced central bank interventions might coincide with calmer market conditions, such as declining volatility or restored market functioning, potentially biasing our estimates.

To address this potential issue, we test for multicollinearity between the variables that identify high-volatility periods and phases of reduced central bank purchases in our setting. The results (see Table A.4 in the Appendix) indicate no significant correlation, suggesting that reduced ECB activity does not systematically align with any volatility regime.

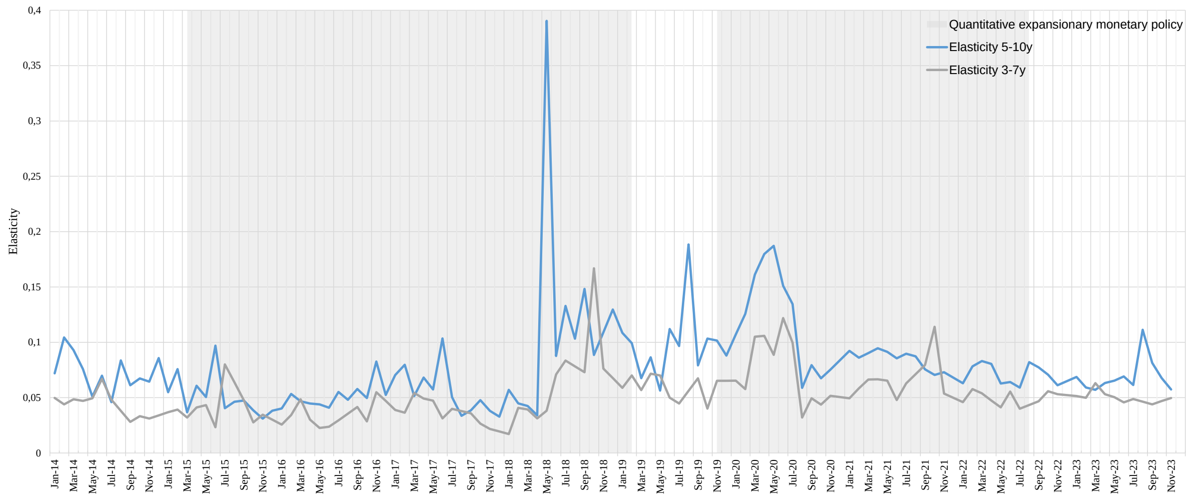
The institutional framework of asset purchase programs during our sample period corroborates this finding. Monetary policy programmes, particularly the Asset Purchase Programme (APP), were designed to meet broader monetary policy objectives, rather than to stabilise the market in the short-term. Although instruments explicitly linked to market functioning - such as the Transmission Protection Instrument (TPI) or the flexibility embedded in the Pandemic Emergency Purchase Programme (PEPPflex), were announced during the sample period (June 2022) -, they had no material interference with purchase flows (excluding the "*announcement effect*"). These factors reduce the likelihood of a structural link between asset purchases intensity and prevailing market conditions during the period under study. Furthermore, our analysis employs binary regime indicators (i.e. dummies) rather than continuous measures of purchase flows or volatility, which helps to further reduce the risk of multicollinearity. As a result, any component of central bank purchase activity potentially linked to volatility would not be captured by a framework based on binary indicators since the regime describing central bank purchases would not shift. It is also important to note that our analysis specifically focuses on periods of non-intervention.

As an additional robustness check, we regress our measure of issuance costs (i.e. auction demand elasticity) on both central bank net purchases and the orthogonal component of market volatility, with the latter defined as the residual from a regression of volatility on ECB purchases. This exogenous volatility measure retains significant explanatory power in the model (see Table A.5), which supports the conclusion that market volatility influences issuance costs beyond central bank activity.

5.2 Measure of price-elasticity (across different tenors)

One of the key challenges in estimating price elasticity is selecting which segment of the demand curve to focus on. In fact, the slope of the curve can be measured in multiple stretches, for instance considering a neighbourhood of the allocated quantity (chosen measure), as illustrated above, or rather using: (i) all the demand price points, or (ii) only the allotted demand price points, or (iii) the right tail of the curve, made up of the unallotted bids. The first two alternative measures would misrepresent the quantity increase that would have been observed if the cut-off price dropped. The third measure, instead, could potentially capture consistently how much the price would have to decline if the Treasury were to increase the quantity sold into the untapped liquidity. Nevertheless, since it focuses on a right-skewed neighbourhood of the allocated quantity, the measurement may lack robustness. This is especially the case when auctions exhibit slope clustering, e.g. when the slope (in absolute value) is quite low in the allotted portion of demand and very high in the unallotted portion, due to particularly opportunistic tail-bids. However, due to the popularity of this alternative measure, used by Albuquerque *et al*. (2023) – who used a representative portion of this part of the curve – and similar to that used by Kandel *et al*. (1999), as a further control, we have also computed elasticity over the whole of the demand curve that lies at the right of the cut-off price. The results are summarized in Table A.1 and A.2. They show the same pattern, albeit with different coefficients, as those obtained with the chosen measure and, thus, do not deserve any discussion.

Figure 5: Elasticity measures for different tenors



The figure presents auction elasticity measures, as defined in equation (2), for the 3- and 7-year tenors, along with the same indicator for 5- and 10-year BTP auctions. The series show the percentage decline in the cut-off price that would have resulted from a 10% increase in the allotted quantity in each auction. Source: authors' calculations based on Bank of Italy data.

As a further analysis, the data at our disposal allow us to determine the elasticity series for other maturities as well. In this study, we have focused on the 5- and 10-year BTP auctions, also considering the indicative value of the 10-year maturity: both securities are continuously offered by the Treasury (end-of-month auctions) and on the same auction day. Elasticity has also been calculated for other tenors. Similar to the 5- and 10-year BTPs, the 3- and 7-year BTP auctions are conducted on a continuous basis (mid-month auctions), whereas the Treasury offers securities with maturities longer than 10 years by alternating maturities at its discretion (15, 20, 30, and 50 years), which in this latter case makes the study of elasticity less straightforward. The elasticity series determined as the average elasticity of the 3- and 7-year BTP auctions shows a trend similar to that obtained for the 5- and 10-year BTP auctions (Figure 5), albeit with some differences due to the time gap between mid-month and end-of-month auctions.

6. Conclusions

The analysis unveils that, at least so far, the issuance of Italian sovereign debt has been smoothly absorbed by the market, despite reduced asset purchases by the Eurosystem as a result of quantitative tightening.

An analysis of investors' trading flows on the secondary market shows that the periods (although limited in our sample) of 'lighter' Eurosystem presence did not come along with significant changes in investors' purchasing behaviors. During these periods, market participants have on average kept stable or increased their bonds purchases, maintaining their appetite for debt securities. The findings remain valid also in the latter part of our sample, from March 2023 onwards, when the Eurosystem started to shrink its balance sheet and private investors stepped in. By contrast, we observe significant and "asymmetric" changes in investors' purchasing behaviors in times of stress, when asset managers and hedge funds quickly shy away and positive flows only stem from banks' demand. In such context trading imbalances are pronounced, generating high pressure on liquidity providers and potentially hampering market absorption capacity.

Consistently with these results, the investigation of the costs associated with the market's capacity to absorb bond supply confirms that the lack of Eurosystem purchases has not significantly affected issuance costs so far. The reduction or absence of central bank purchases in the secondary market tends to have a negligible effect on the price elasticity of demand in auctions. Primary dealers can absorb increased net issuance of securities without demanding significantly higher yields. However, a statistically significant impact is observed during periods of heightened volatility, when primary dealers' activity in auctions may become less supportive, and demand from final investors weakens. This conclusion is further supported by evidence from an analysis of secondary market movements around auctions (auction cycles). The absence or reduction of central bank purchases is not associated with significant changes in yield patterns around auctions. In contrast, yield patterns exhibit a distinct behavior during periods of heightened uncertainty; not only bond yields tend to increase slightly more on average before the auction, but they have a tendency to remain elevated for a longer period afterward. When volatility is elevated, dealers are likely demanding higher premia and the impact of treasury auctions on bond yields is more visible and persistent.

The analysis also underscores the key role of primary dealers in intermediating supply and demand for bonds in the market, thereby supporting absorption capacity by end-investors, and ultimately market stability and liquidity. Uncertainty and volatility are factors that can trigger material trading imbalances from end investors and threaten the capacity of market makers to provide immediacy services.

The gradualism and predictability that have so far characterised the Eurosystem's approach in the current tightening cycle have been crucial, as they have helped to avoid sudden spikes in volatility that prove detrimental to market absorption capacity.

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ANNEX

Background on Italian auctions

The information relating to the rules governing government bond auctions and the related issuance procedures are detailed by the Ministry of Economy and Finance (MEF, 2024).

Italian government medium and long-term bonds are mostly placed via public auction to guarantee access by an extensive group of investors and maintain a high level of competition and transparency. At the end of every calendar year, the Italian Treasury publishes the annual auction calendar for the next year, along with its public debt management guidelines. These documents inform dealers well beforehand about the frequency of auction placements and the quality profile that will guide the issuance policy during the year. In particular, the Calendar contains all the dates of the issue press releases, of the auctions and their settlements, grouped by bond category. Moreover, an "issue programme" is published quarterly to disclose all the information regarding new bonds to be placed via auction and re-proposed regularly during the quarter, together with the information regarding the offer of outstanding bonds. Prominently, a press release is made before each auction: aside from announcing the bonds to be issued and their characteristics, it indicates the precise minimum and maximum quantities offered in the auction as well as all relevant dates, including the bond settlement date. The settlement date for all government bonds is typically two business days following the auction date (t + 2). When the settlement date of medium/long-term bonds does not coincide with the date in which the bond's interest begins to accrue (the interest commencement date), subscribers pay the Treasury the corresponding accrued interest.

Government bond auctions are carried out by the Bank of Italy. Authorized dealers that are market makers (primary dealers) have obligations, as to subscriptions in government bond auctions and trading volumes on the secondary market, that give rise to some privileges in a variety of other operations. Primary dealers' bids to participate in the auctions are sent online. Dealers can place bids for each bond offered until 11 am of the auction day. The system automatically rejects bids beyond the deadline. Dealers can repeatedly adjust their bids, substituting the previous ones, since the system only considers the final bid made within the deadline as valid. In order to maintain data privacy, bids sent online are encrypted on the receiving monitor at the Bank of Italy. They can be decrypted with a digital key only after 11 am by the officials of the Bank of Italy in charge of the auction. A series of automatic operations thus begins. These produce a printout in which bids are listed in decreasing price order or increasing yield order. Immediately after the auction's end, each dealer is privately informed about the outcome of its bids; subsequently the aggregate information on the auction result is broadcasted via press release, both by the Bank of Italy and the Treasury as well as by Bloomberg and Refinitiv. The Bank of Italy also releases twice a month a rich dataset with all the aggregate features of the auctions concluded since 2002.

Auctions for medium and long-term bonds are *marginal price* placements: allotted bids are all satisfied at the same price, the marginal one. The quantity issued is not set beforehand, but it is contained in a minimum and maximum amount range announced in the press release published some days before the auction. The amount placed is determined by discretionally excluding bids made at prices that are not suitable with respect to market conditions, based on a ranking in which dealers' bids are listed anonymously. The lowest price among those bid by awarded dealers is the auction (marginal) price, which is applied to all awarded dealers. If bids at the marginal price cannot be completely satisfied, they will be divided proportionally, rounding off when needed.

Dealers can place up to five bids, each at different prices, for a minimum amount of at least EUR 500,000 of nominal capital and less than the amount being issued. Bids beyond the latter limit are accepted up to the amount on offer. The minimum denomination for investors is EUR 1,000. Prices must vary by at least one hundredth.

The Bank of Italy therefore possesses a unique, granular dataset on behalf of the Italian Ministry of Economics and Finance including all the bids submitted by each primary dealer in all the bond auctions conducted in the last thirty years.

Table A.1

Volatility > 50th perc.		Volatility > 70th perc.		Volatility > 90th perc.	
α	0.155905***	**α**	0.15886***	**α**	0.165349***
NoCB	0.00550559	**NoCB**	-0.00150192	**NoCB**	0.00291215
HighVol (50th)	0.0402243	**HighVol (70th)**	0.0648734**	**HighVol (90th)**	0.12193***
R-squared:	0.024586	**R-squared:**	0.050106	**R-squared:**	0.07377

Table A.2

	Coefficient	*P-value*
α	0.175159	<0.0001 ***
NetPurchases	4.65278e-07	0.7902
Residuals	0.129582	0.0039 ***
R-squared	0.071908	

Table A.3

Structural break in the elasticity trend

Quandt Likelihood Ratio (QLR) Test
Maximum F = 33.5414, at the observation May 2018
P-value = 8.71278e-014

Table A.4

Multicollinearity test between variables $NoCB_t$ and $HighVol_t$

Variance Inflation Factor (VIF) Test					
NoCB	1.034				
HighVol (50th)	1.034				
		NoCB	1.058		
		HighVol (70th)	1.058		
				NoCB	1.019
				HighVol (90th)	1.019

Possible collinearity issues for values > 10

This table reports the results of a multicollinearity test (variance inflation factor – VIF – test) between variables $\mathrm{NoCB_t}$ and $\mathrm{HighVol_t}$ at different percentiles. $\mathrm{NoCB_t}$ is a dummy variable which is equal to one in months of low presence or absence of central banks (and zero otherwise). $\mathrm{HighVol_t}$ is a dummy variable which is equal to one when volatility on the secondary market, measured as the standard deviation of the yields of the ten-year Italian benchmark bond, exceeds the 50^{th}, 70^{th} and 90^{th} percentile of its daily volatility distribution (and zero otherwise). Data are expressed on a monthly basis. The test does not provide evidence of excessive collinearity between the two variables.

Table A.5

Relations between volatility, central bank net purchases and elasticity on the primary market

	Coefficient	*P-value*
α	0.0763203	9.62e-029 ***
NetPurchases	4.22269e-07	0.4517
Residuals	0.0491818	0.0007 ***
R-squared	0.101391	

Regression of the elasticity on (i) NetPurchases defined as the monthly series of central bank net purchases of Italian government bonds, and (ii) Residuals, the series of residuals from the regression model between the monthly volatility of the ten-year Italian government bond (expressed in percentage terms), as dependent variable, and the monthly series of central bank net purchases of Italian government bonds, as independent variables. Data are expressed on a monthly basis. *, **, *** denote significance at 1%, 5%, and 10% confidence level, respectively.

Table A.6. Net purchases from primary dealers (robustness tests). The dependent variable is the difference between the amount of securities bought and sold by sector *i* from primary dealers on day *t* (expressed in euro billions). *NoCB* is a dummy that takes the value of one if it is one of the following sub-periods, in which Eurosystem purchases were: (i) completely absent (i.e. before March 2015); (ii) 'virtually', or close to, zero (i.e. the periods January 2019–October 2019 and July 2022–February 2023); (iii) particularly low and negative (i.e. from March 2023 onwards). *HighVol* identifies periods characterised by high volatility (i.e. if above the 90th percentile of the sample distribution). *X* includes the daily series of gross issues of Italian securities on the primary market, and lags of the same series, as control variables. The specification includes sector and quarter fixed effects. The sample period is from January 2014 to January 2024. Significance levels: ***: 1% level; **: 5% level; *: 10% level.

Changes in net purchases from primary dealers, bn	(1)	(2)	(3)	(4)	(5)
NoCB × (Non-dealer) Banks	0.1059***	0.0978*	0.1006**		0.0768*
	(2.9719)	(1.9334)	(2.1987)		(1.6702)
NoCB × Asset managers	0.1494***	0.1412***	0.1068**		0.1165***
	(4.5185)	(2.8664)	(2.4500)		(2.6701)
NoCB × Hedge funds	0.0650**	0.0569	0.0227		0.0337
	(2.4417)	(1.2810)	(0.5708)		(0.8478)
NoCB × ICPFs	0.0340***	0.0260	0.0015		0.0026
	(5.5223)	(0.6921)	(0.0429)		(0.0721)
NoCB × Non-financials	0.0192**	0.0111	-0.0121		-0.0122
	(2.5621)	(0.2939)	(-0.3407)		(-0.3450)
NoCB × Public entities	-0.0217	-0.0298	-0.0550		-0.0535
	(-1.4534)	(-0.7234)	(-1.4333)		(-1.3953)
HighVol × (Non-dealer) Banks	0.3471***	0.3427***		0.3517***	0.3434***
	(5.6604)	(5.2291)		(5.9308)	(5.6779)
HighVol × Asset managers	-0.1640***	-0.1683***		-0.1502***	-0.1650***
	(-2.9358)	(-2.8731)		(-2.9714)	(-3.2655)
HighVol × Hedge funds	-0.1814***	-0.1857***		-0.1818***	-0.1829***
	(-3.6882)	(-3.4881)		(-3.8757)	(-3.8696)
HighVol × ICPFs	-0.0321**	-0.0369		-0.0375	-0.0334
	(-2.5633)	(-1.5806)		(-1.4405)	(-1.2717)
HighVol × Non-financials	-0.0145*	-0.0187		-0.0225	-0.0159
	(-1.8102)	(-0.9313)		(-0.9663)	(-0.6824)
HighVol × Public entities	-0.0377	-0.0419		-0.0528	-0.0393
	(-1.4737)	(-1.3157)		(-1.6041)	(-1.1941)
Sector FE	Y	Y	Y	Y	Y
Quarter FE		Y	Y	Y	Y
Control variables			Y	Y	Y
R-squared	0.0136	0.0114	0.1610	0.1674	0.1697
Observations	15455	15455	15443	15443	15443
High volatility periods (>perc.)	90th	90th		90th	90th

Changes in net purchases from primary dealers, bn	(5)	(6)	(7)	(8)	(9)
NoCB × (Non-dealer) Banks	0.0768*	0.0682	0.0412	0.0480	0.0618
	(1.6702)	(1.4730)	(0.8850)	(1.0405)	(1.3305)
NoCB × Asset managers	0.1165***	0.1201***	0.1164***	0.1203***	0.1196***
	(2.6701)	(2.7336)	(2.6270)	(2.7412)	(2.6884)
NoCB × Hedge funds	0.0337	0.0369	0.0414	0.0386	0.0445
	(0.8478)	(0.9204)	(1.0289)	(0.9670)	(1.1043)
NoCB × ICPFs	0.0026	0.0019	0.0089	0.0067	0.0106
	(0.0721)	(0.0535)	(0.2497)	(0.1883)	(0.2897)
NoCB × Non-financials	-0.0122	-0.0121	-0.0117	-0.0099	-0.0044
	(-0.3450)	(-0.3420)	(-0.3300)	(-0.2806)	(-0.1204)
NoCB × Public entities	-0.0535	-0.0559	-0.0527	-0.0455	-0.0420
	(-1.3953)	(-1.4651)	(-1.3751)	(-1.1937)	(-1.0737)
HighVol × (Non-dealer) Banks	0.3434***	0.2481***	0.2234***	0.2058***	0.1955***
	(5.6779)	(5.0773)	(5.7464)	(5.9456)	(5.9196)
HighVol × Asset managers	-0.1650***	-0.1083***	-0.0367	-0.0549*	-0.0195
	(-3.2655)	(-2.6109)	(-1.0626)	(-1.8234)	(-0.6812)
HighVol × Hedge funds	-0.1829***	-0.1138***	-0.0702**	-0.0632**	-0.0555**
	(-3.8696)	(-3.0300)	(-2.3613)	(-2.4909)	(-2.4007)
HighVol × ICPFs	-0.0334	-0.0072	-0.0281	-0.0217	-0.0036
	(-1.2717)	(-0.3005)	(-1.5471)	(-1.3773)	(-0.2451)
HighVol × Non-financials	-0.0159	-0.0041	-0.0019	-0.0102	0.0016
	(-0.6824)	(-0.1819)	(-0.1078)	(-0.6836)	(0.1094)
HighVol × Public entities	-0.0393	0.0032	-0.0086	-0.0382**	-0.0198
	(-1.1941)	(0.1130)	(-0.3889)	(-1.9908)	(-1.0611)
Sector FE	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y
Control variables	Y	Y	Y	Y	Y
R-squared	0.1697	0.1682	0.1668	0.1672	0.1662
Observations	15443	15443	15443	15443	15443
High volatility periods (>perc.)	90th	80th	70th	60th	50th

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