Overpriced Treasury Auctions*

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Abstract

We document pervasive overpricing in euro area Treasury auctions, challenging the conventional underpricing paradigm. Using a comprehensive 25-year panel covering 22 advanced economies, we show that overpricing is systematically higher in countries that rely more heavily on syndicated issuance. Leveraging a unique dataset of Portuguese auctions from 2004 to 2024 that tracks bidders, we demonstrate that overpricing reflects rational, incentive-compatible behavior driven by remuneration through syndication fees and post-auction non-competitive allocations. Dealers bid more aggressively when future issuance opportunities are most valuable. Our findings connect short-run auction losses to long-run cumulative profits, linking micro-level bidding behavior to macro-level institutional design.

JEL: G12

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Governments around the world finance their borrowing needs primarily through the issuance of sovereign debt securities in competitive auctions, commonly referred to as Treasury auctions. In the United States and other advanced markets, a well-documented empirical regularity is auction underpricing—securities are awarded at prices below contemporaneous secondary-market levels, providing bidders an ex post profit margin that encourages participation. We collect a comprehensive dataset of all Treasury bond auctions for 22 advanced economies between 1999 and 2024 and document that, in contrast, several European sovereign debt markets exhibit persistent overpricing: dealers pay *higher* prices (lower yields) than prevailing secondary-market levels at issuance. The coexistence of such systematic overpricing and repeated primary dealer participation poses a central puzzle: why would rational intermediaries compete aggressively in auctions that appear loss-making ex ante?

We show that auction overpricing reflects the broader institutional design of primary dealer systems, which embed multiple remuneration channels beyond the auction itself. While most of the Treasury auction literature focuses on auction format—uniform versus discriminatory pricing—it largely overlooks the broader institutional design of the overall primary market, particularly the incentive structures faced by primary dealers. To address this gap, we first systematically examine market designs and auction pricing in our cross-country panel of Treasury bond auctions, uncovering a striking pattern: auction overpricing is concentrated in countries that rely heavily on syndicated offerings. From our estimation, a 10-percentage-point increase in the share of debt issued via syndications is associated with approximately 1.6 basis points (bps) more overpricing. In contrast, countries with little or no syndication issuance continue to display the conventional underpricing pattern. This finding suggests that auction pricing reflects not only auction design, but also the broader institutional framework governing primary dealer remuneration.

This cross-country evidence motivates a closer examination of the underlying issuance mechanisms. We focus on the Portuguese Treasury market, where (i) auction overpricing is persistent with an average of 13 bps and 73% of the auctions overpriced, (ii) syndicated offerings represent an important issuance channel (40% of total issuance), and (iii) unusually granular micro-level data are available. The Portuguese Treasury and Debt Management Agency (IGCP) provides us access to a 21-year dataset spanning from 2004 to 2024, containing the complete bidding history of every primary dealer for both T-bond and T-bill auctions. In particular, this unique dataset enables us to track dealers' full demand schedules over a long period of time and link auction behavior to other primary market activities.

In Portugal, as in several other euro area countries, the lead managers of syndicated deals receive substantial syndication fees. Their selection as syndication lead managers is based on a "scorecard" that ranks dealers' performance, in which Treasury auction allocations in the prior year play a major role. In addition, post-auction non-competitive offerings carry implicit option value, allowing dealers to purchase additional issuance amounts after the competitive phase at the auction-determined award price. Access to these non-competitive offerings is determined by each dealer's latest auction allocations. These institutional features enable us to calibrate dealers' total profitability and to analyze how the incentive structure of the Portuguese primary dealership model shapes bidding behavior. We show that the gains obtained from post-auction non-competitive offerings and especially from syndication fees more than offset the losses incurred in competitive auctions, resulting in an average total net profit (i.e., underpricing) of 3 bps of the face value purchased in competitive auctions. This measure of total profit is broadly in line with the underpricing observed in countries without such bundled issuance arrangements. Importantly, these gains accrue disproportionately to dealers that strategically pursue access to syndications and non-competitive offerings. We further show that this remuneration structure prompts more aggressive bidding, reducing auction-stage profits while increasing expected revenues through complementary issuance channels.

Our paper makes four contributions. First, we provide the most comprehensive cross-country evidence to date on auction pricing, showing that overpricing is systematically linked to the prevalence of syndications. Second, using the Portuguese microdata, we develop the first empirical decomposition of primary-market remuneration into auction profits, non-competitive profits, and syndication fees. Despite substantial variation across dealers, syndication fees broadly offset losses from competitive auctions for recurrent primary dealers. Third, we document that aggressive bidding is rewarded: cumulative auction allocations strongly predict future non-competitive access and selection into syndicated offerings, generating an endogenous overpricing equilibrium. Fourth, we show that dealers bid more aggressively when remuneration opportunities from complementary issuance are most salient. In particular, dealers submit larger quantities and smaller discounts (more aggressive) when syndication selection is imminent or when a higher auction allocation has a greater impact on the scorecard ranking. Overall, our findings suggest that overpricing in sovereign debt auctions should not be interpreted as an anomaly but rather as an equilibrium response to incentive-compatible primary dealer systems. These findings have implications for how debt management offices design issuance programs and structure market-making obligations.

The traditional literature on Treasury auctions focuses on the auction format, informational asymmetry, and the winner's curse (e.g., Wilson 1977; Milgrom and Weber 1982; Gordy 1999; Nyborg et al. 2002; Hortaçsu and McAdams 2010; Kastl 2011; Hortaçsu and Kastl 2012). Underpricing has been documented across numerous markets, including the U.S. (Cammack 1991; Spindt and Stolz 1992; Simon 1994; Nyborg and Sundaresan 1996; Goldreich 2007; Herb 2025), Mexico (Umlauf 1993), Japan (Hamao and Jegadeesh 1993), Sweden and Finland (Nyborg et al. 2002; Keloharju et al. 2005), and Canada (Rydqvist and Wu 2016). More recent studies explore dynamics around auction dates and dealer positioning. Lou et al. (2013), Beetsma et al. (2016), Amin and Tédongap (2023), and Sigaux (2024) document a V-shaped price pattern: investors establish short forward positions ahead of auctions, depressing prices that rebound afterward. Rydqvist and Wu (2016) show that dealers often enter auctions with negative inventory positions and expect to cover the short positions from the auctions. Albuquerque et al. (2024) document that this V-shaped secondary market price pattern is related to demand elasticity in the primary market, a proxy for dealers' risk-bearing capacity. These papers examine the short-term effects of inventory management but do not address the longer-term institutional incentives that govern repeated auction participation.

Only a handful of studies highlight the role of explicit dealer remuneration and incentive design. Eisl et al. (2022) find that Denmark's 2017 introduction of an explicit compensation scheme for primary dealers reduces bond yields, demonstrating that dealer remuneration can directly affect market prices. Noël and Wu (2025) document that the emergence of auction overpricing in Iceland coincides with the introduction of commission payments to primary dealers. With similar logic, although in a different market, Ding et al. (2022) show that overpricing in Chinese corporate bond issuance disappears after regulators banned underwriter rebates. Song and Zhu (2018) document comparable patterns in U.S. Quantitative Easing auctions, where a small number of dealers captured most profits by supplying the quantities preferred by the Federal Reserve. Collectively, these studies suggest that the full institutional architecture of debt issuance—not just auction format—shapes bidding behavior and pricing outcomes.

The remainder of the paper proceeds as follows. In Section 1, we provide a cross-country survey of institutional design and auction underpricing. In the next sections, we delve into the Portuguese case. Section 2 describes the institutional framework. Section 3 details the data and key variables. Section 4 analyzes dealers' total profits across remuneration components. Section 5 examines how these incentives affect competitive bidding behavior. Section 6 concludes.

1. Cross-Country Evidence

While the Treasury auction literature predominantly focuses on a single institutional feature – the choice of auction methods – the rich content of sovereign debt managers' other institutional arrangements is often overlooked. In this section, we analyze the institutional differences between countries and their implications on auction pricing. This sets the stage for the rest of our paper.

The existing literature on overpriced euro area Treasury auctions is scattered across short samples, various methodologies, and country-specific studies, see Elsinger and Zulehner (2007), Pacini (2009), Coluzzi (2011), and Alvarez and Mazon (2019). To provide a unified picture, we hand-collect auction results directly from the debt management offices (DMOs) of eleven euro area countries and eleven other advanced economies. Our sample spans from 1999 to 2024, with minor variations due to data availability. The collection includes all Treasury bond auctions for which we are able to obtain comparable secondary market data in Austria, Belgium, France, Finland, Germany, Ireland, Italy, the Netherlands, Portugal, Slovakia, and Spain for the euro area, as well as Australia, Canada, Denmark, Iceland, Israel, Japan, New Zealand, Norway, Sweden, the U.K., and the U.S. For each country, we compute auction underpricing as the difference between the secondary market mid-price (from Bloomberg) and the auction award price (weighted-average for discriminatory-price auctions; cut-off for uniform-price auctions).[1] We also compile information on debt issuance practices, focusing on two critical institutional features: (i) the share of issuance through syndications, in which PDs are selected to form syndicates to underwrite the debt securities and help distribute them to investors, and (ii) whether bidders are given the right to purchase more securities after an auction at the auction-determined price (post-auction non-competitive offerings).

The results are summarized in Table I, which is organized with euro area countries using syndications frequently in Panel A, euro area countries that rarely do so in Panel B, and other advanced economies outside of the euro area in Panel C. There are seven countries in Panel A and the percentage of syndication issuance ranges from an average of 21% in Spain to 55% in Ireland. In Panel B, the Netherlands does not use syndications at all, and the other three countries rarely do so (average of 2-11% in syndicated amount). For countries outside the euro area, Panel C features a mix of countries with syndicated offerings (approximately

[1] We eliminate all the observations with auction underpricing absolute value greater than either 250 bps of face value for prices or 50 bps for yields, to exclude significant outliers and potential data errors.

an average of 20% in issuance amount) and without syndicated offerings.

We observe a striking pattern: countries that use syndication offerings more regularly are associated with statistically significant *overpricing* (auction award price *above* the secondary market price). The statistically significant overpricing ranges from 6 bps for Finland to 16 bps for Austria. The cross-section of countries, long sample periods, and consistent methodology suggest that auction overpricing is prevalent in this group. We also compute the proportion of auctions with overpricing, and it is clear that a majority of auctions in this group of countries is overpriced, not due to outliers. In unreported results, we go one step further and compute overpricing above an ad-hoc value of 5 basis points. The proportions are also high with this threshold. On the other hand, the four countries in Panel B that rarely use syndications tend to have the conventional underpricing established in the prior literature. The average underpricing is a positive number, and the proportion of auctions with overpricing is close to 50%, and the ones above a value of 5 bps for overpricing make up only about one-third of the sample. We thus conjecture that the observed auction overpricing is primarily driven by bidders' desire to perform well in auctions to gain/maintain lead syndication rights.[2] We further confirm this conjecture by looking at other advanced economies in Panel C. All countries, with the exception of Israel, present underpricing. For example, the U.S., with no syndicated offerings, reports a statistically significant average underpricing of 6 bps for 1,219 auctions, and just 39% of the auctions report overpricing. The conclusions are independent of the auction method, as illustrated by the variation of auction formats across groups and over time.

Next, we provide a cross-country panel regression analysis to test whether the use of syndications is systematically associated with auction overpricing, aggregating observations at the yearly level. This setting allows us to understand country and time-series differences between the variables of interest. The dependent variable is auction underpricing, and the

[2]Meanwhile, the impact of the post-auction non-competitive on auction underpricing is less clear, although syndication-reliant countries seem to be associated with allowing post-auction non-competitive subscriptions.

main explanatory variable of interest, *Share of Syndication*, is the fraction of a country's total Treasury bonds issuance conducted via syndicated deals in a given year. Higher values indicate greater reliance on syndications as part of the issuance strategy. We also include a set of macroeconomic and market controls. *GDP* (in mil USD) captures the scale of a country's economy. *Debt-to-GDP* ratio measures a country's sovereign fiscal conditions and market depth. *MOVE*, an implied bond market volatility index, proxies for global risk conditions in debt markets, while *MSCI Vol* represents the realized volatility of the MSCI World equity index, capturing global risk sentiment in equity markets. These regressions include year-fixed effects, and standard errors are clustered at the country level.

Across all specifications, reported in Table II, *Share of Syndication* is negative and statistically significant, with coefficients around –0.16, even after controlling for country size, sovereign risk, and global volatility. The results suggest that for a one percentage point increase in a country's sovereign debt issuance through syndication, underpricing in auctions decreases by approximately 0.16 basis points. We can compare this number to the average auction underpricing of our global sample, which is 0.77 basis points. The effect is both statistically and economically meaningful. This result confirms that countries relying more heavily on syndication issuance are associated with greater auction overpricing. These regressions strengthen our central argument: institutional design, specifically, the reliance on syndications, is a key driver of auction overpricing. While causality remains a challenge, the evidence is consistent with our hypothesis that bundling syndication rights with auction allocations creates incentives for aggressive bidding, leading to systematically overpriced auctions.

Building on these cross-country findings, we next turn to a detailed examination of Portugal—a representative case from Panel A of Table I and a market for which we have access to uniquely comprehensive data on debt issuance. Portugal exhibits many of the institutional features associated with auction overpricing: 40% of total issuance occurs through syndications, complemented by post-auction non-competitive offerings and both single- and multi-price auction formats. The Portuguese Treasury market also shows a statistically significant average auction overpricing of 13 bps, with 73% of the auctions overpriced. This institutional and empirical profile makes Portugal an ideal laboratory for investigating how primary dealer incentives translate into bidding behavior and profitability at the dealer level.[3]

2. Institutional Setting in Portugal

This section provides a brief overview of the issuance of sovereign debt securities and the roles of primary dealers in Portugal, as well as the implementation of post-auction non-competitive offerings and the assignment of lead managers and syndication fees.

Portugal's sovereign debt is issued by the Portuguese Treasury and Debt Management Agency (IGCP), primarily through auctions for Treasury bills (BT) and via auctions and syndications for Treasury bonds (OT). During the euro sovereign debt crisis (2011–2013), Portugal suspended T-bond issuance and relied exclusively on T-bills and official loans until it regained access to the auction market in 2014. Treasury bills are issued at a discount of par and have maturities of up to twelve months.[4] All T-bill auctions in our sample are multi-price auctions. Treasury bonds are fixed-rate securities with maturities ranging from two to thirty years. T-bond auctions underwent a format change as a result of the euro sovereign debt crisis. From 2004 to 2011, T-bond auctions were discriminatory, and since 2014, T-bonds have been sold in single-price auctions.[5]

The IGCP issues Treasury securities under a primary dealership model. A small group of financial intermediaries (the primary dealers) participates and is responsible for participation in the primary market, for marketing Portuguese debt securities to final investors, and for

[3] Albuquerque et al. (2024) also use the same dataset from 2014 to 2020 only for T-bonds to study the marginal elasticity and its relationship with the risk-bearing capacity of primary dealers. In contrast to this paper, they neither study the institutional design nor exploit the unique longitudinal dimension of the data, which allows tracking bidders over time.

[4] There is an exception during the sovereign debt crisis, when 5 auctions of 18-month T-bills were conducted.

[5] The new auction format was intended to increase investor participation by reducing the winner's curse. The winner's curse is marked by aggressive bidders winning large allocations by paying more than the market price for the securities.

ensuring liquidity in the secondary market. This small group comprises 20 active and 30 participating primary dealers throughout the sample period, demonstrating the depth of the market. The auctions comprise a competitive phase, where each participant may submit multiple bids, each comprising a bidding quantity in multiples of €1 million and a bidding price in multiples of €0.01, without exceeding the upper limit of the auction indicative amount. There is no minimum bid in each auction, but each primary dealer is expected to take up at least 2% of the auction issuance amount every two years. In return, the IGCP grants dealers intermediation gains resulting from exclusive direct access to the primary market, access to a post-auction non-competitive bidding phase, and issuance fees when selected as lead managers in syndicated deals.

During our sample period, auctions can occur on pre-determined dates, the second, fourth, or fifth Wednesdays of each month.[6] The Friday before each of these days, the IGCP contacts primary dealers to solicit their views on market conditions, collecting their opinions on whether an auction should be conducted, the lines to be auctioned, and the issuance amounts. On the afternoon of the Friday before the auction, the IGCP announces whether an auction will occur, and, if so, it discloses the specific security (or securities) to be issued and the indicative issuance amount (typically announced as an interval for the total to be raised across the lines being offered). In practice, the IGCP generally uses only one of the available windows each month. As a result, the likelihood of conducting an auction when the previous window has not been used is relatively high.

A. Post-Auction Non-Competitive Offerings

A special feature of Portuguese Treasury auctions, as well as those in some other euro area countries, is that both T-bill and T-bond auctions are immediately followed by a non-competitive subscription phase. The auction determines the subscription price, and dealers then decide whether to purchase additional quantities at that price, considering secondary market conditions. This sequencing differs from that in the U.S., Germany, and

[6] Since 2024, only the second and fourth Wednesdays of each month were considered.

France, where non-competitive demand must be submitted prior to the auction. The Portuguese arrangement effectively grants dealers a low-risk option: if secondary market prices exceed the auction outcome, non-comp purchases yield mechanical profits.

Access to the non-competitive phase depends on a dealer's average allocation in the prior three auction dates of the same type (T-bills or T-bonds), excluding the current date. On an auction date, there may be a single auction or multiple auctions to issue different maturities with different amounts. Dealers seeking to secure or expand non-comp rights must bid more aggressively in competitive auctions to raise their allocation shares. Conversely, a weak allocation in even a single auction depresses the average and reduces eligibility for subsequent non-comp purchases, creating persistent incentives to maintain high participation.

The scale and design of non-competitive offerings also differ across security types. For T-bills, the maximum offering amount is 40% of the competitive auction size, while for T-bonds it was 20% through most of our sample.[7] Moreover, T-bill non-comp rights are split into two components: (i) 25% of issuance is allocated proportionally based on allocations in the prior three T-bill auction dates, and (ii) 15% is distributed in equal 3% shares to the top five dealers ranked by their fulfillment of secondary market quoting obligations. The latter mechanism is designed to reward secondary market making and promote liquidity in Treasury bills.

B. Syndicated Offerings

In Portugal, T-bills are issued exclusively via auctions, whereas T-bonds are issued both via auctions and through syndicated offerings. In a syndicated offering, the Treasury selects a small group of primary dealers as lead managers to underwrite and distribute a newly issued bond to institutional investors. Unlike competitive auctions, the bond is priced through a book-building process coordinated by the lead managers, who collect investor demand and help determine the final issue price. The Treasury oversees the order book and is thus able to

[7] Since 2024, this share was raised to 30%, with the additional 10 percentage points distributed among the five best performers in terms of secondary market quoting obligations.

have some control over the final distribution of the bonds in terms of geography and investor type. In return, the selected dealers receive syndication fees that are proportional to the issuance size. These fees represent a major channel of remuneration for primary dealers. In Portugal, for each syndication, the IGCP selects a small group of joint lead managers (JLM), who receive 90% of total syndication fees evenly split across the five or six dealers typically selected. The other active primary dealers split the remaining 10% according to the volume of orders placed and accepted through each of these dealers.

Selection as JLM is based on the IGCP's dealer scorecard, which evaluates each dealer's performance as an intermediary and liquidity provider. Auction allocations carry the greatest weight in the scorecard, ensuring that competitive auction participation directly affects eligibility for syndication rights. The scorecard is updated monthly, with own individual rankings privately communicated, and the annual top-5 primary dealers made public at year-end. Syndication roles are awarded based on the scorecard performance of the previous year, plus elapsed months in the current year. Syndicated T-bond issues in Portugal typically involve newly issued securities with long maturities, with the 10-year maturity being a frequent choice. For a brief history and benefits/drawbacks of sovereign debt syndications, see World Bank (2015).

Table III summarizes syndication activity and fees by year. We include the year 2025 in this table because we use syndication fees for the profit analysis of the auctions that occurred in 2024. With the exception of 2012, when Portugal temporarily lost market access, there are between one and four syndications per year. Most of these occur early in the year (68% through April). This pattern is consistent with the conservative funding strategy of the IGCP: issuance volumes are typically higher in the first half of the year, when market liquidity conditions are more favorable, and funding needs are largely secured before the seasonal decline in market activity after the summer. The number of lead managers varies with issuance needs, and in some years, a dealer may serve as a lead manager in multiple syndications.

In countries relying heavily on syndication deals, syndication fees typically follow a schedule that rises with maturity and falls with credit rating.[8] Fees are expressed as a percentage of the notional value and split evenly among lead managers. In Portugal, indicative fees have ranged from 12.5 bps for 5-year bonds to 25 bps for 30-year bonds. Column (5) of Table III reports estimated total fees by year; columns (6) and (7) show the maximum and average fees per lead manager, respectively. In the years 2014 and 2025, some individual dealers earned as much as €3.4 million from multiple long-term syndication mandates. Across our sample, total fees amount to €245.4 million—roughly 18 basis points of the €137.3 billion in syndicated issuance.

These arrangements matter only for T-bonds, not T-bills. The opportunity to earn syndication fees thus creates a sharp divide in dealer incentives across instruments: aggressive bidding in T-bond auctions can be rationalized as an investment in syndication eligibility, whereas no such incentive exists in T-bill auctions.

3. Data & Definitions

This section describes the datasets used, defines the auction and bidder variables, and presents some summary statistics.

A. Data Sources

Our primary market dataset originates from the Portuguese Treasury and Debt Management Agency (IGCP) and encompasses all Treasury Bill (BT) and Treasury Bond (OT) auctions conducted between 2004 and 2024.[9] Each record reports the bid price and yield, the quantity demanded, the quantity awarded, a dealer code (including a flag indicating whether the dealer is domestic or foreign), and n auction identifier. A key feature of this dataset is that dealer codes remain constant throughout the sample, allowing us to track individual bidding

[8]See, for example, the indicative figures provided on page 33 of World Bank (2015).

[9]We exclude Treasury Bond auctions for the year 2011, as there are no syndications in the following year. Following the same reasoning, we also exclude syndication data for the years 2013 and 2014 from the baseline results, as there are no Treasury bond auctions in 2012 and 2013.

behavior over time. In addition to the competitive auction phase, we also have data for the post-auction non-competitive subscriptions, which are matched to the same dealer codes used in the competitive auctions. Finally, we use publicly available data on syndication issues, including the total amount of bond issuance and the identities of lead managers. Unfortunately, IGCP cannot provide a match between the identities of the dealers in the syndicates (which is public information) and the auction data (which is anonymized). Later in the paper, we describe our method for obtaining a good match to identify the ranking of dealers and their selection for the syndicate.

We obtain secondary market data from Bloomberg, which aggregates indicative bid and ask quotes posted on electronic platforms and over-the-counter markets. Primary dealers are required to provide firm quotes, and Bloomberg records the daily midpoint between bid and ask across dealers. This midpoint of the auction day serves as our benchmark for estimating bid discounts and measuring auction underpricing. As robustness checks, we alternatively use the bid and ask of the auction day, and also the three measures (the mid, bid, and ask) from the previous trading day as benchmark prices. These alternative benchmarks address potential concerns related to quote timing and bid–ask bounce. The results are reported in the online appendix and support the conclusion that there is overpricing in the Portuguese T-bond auctions.

Table IV reports auction summary statistics for the full sample, with breakdowns by security type. We provide a further breakdown by security maturity and auction year in the online appendix. Among the 653 auctions in our sample, there are 447 T-bill auctions and 206 T-bond auctions. T-bill auctions are always conducted using a multiple-price format, while T-bond auctions were multi-price before 2011 and single-price thereafter. *Expected Size* is the maximum of the pre-announced range, and *Size* is the effective auction size (both in millions of euros). On average, 677 million euros are issued in each auction, which is close to the indicative expected amount of 670. On average, 27 bids are awarded out of 38 bids in the T-bills auctions, and 34 out of 56 bids are awarded in the T-bonds auctions. The

Bid-to-Cover ratio (euro amount of bids received to the amount sold) averages 2.5, indicating a high level of competition. *Expected Bidders* is the number of potential participating bidders in an auction, *Participating Bidders* is the number of actual bidders, and *Allocated Bidders* is the number of winning bidders. On average, auctions attract 16 bidders, with roughly three-quarters receiving allocations.

B. Bidder Variable Definitions

Bidder demand curves can be described by a bidder's bid discount, profit, bid dispersion, quantity bid, and quantity awarded (Nyborg et al., 2002). In the following sections, we index by auction j on day a, bidder i, and bid k.

The bid discount variable, *DISC*, measures the amount of bid shading by bidder i in auction j relative to the secondary market price P_j,

$$DISC_{ij} \equiv P_j - P_{ij}^{Bid} \tag{1}$$

in which P_{ij}^{Bid} is the quantity-weighted average bid price of bidder i in auction j. A positive discount implies the average bid is below the market price, and larger discounts reflect greater potential compensation to dealers for acting as intermediaries. Smaller (or negative) values indicate more aggressive bidding. A positive discount is the generally accepted stylized finding for underpriced auctions.

The bidder profit variable, *PROFIT*, measures the amount of profit for bidder i relative to the price of the secondary market P_j,

$$PROFIT_{ij} \equiv P_j - P_{ij}^{Win}. \tag{2}$$

in which P_{ij}^{Win} is the quantity-weighted average award price.[10] Similarly, auction underpricing, $\Delta_j \equiv P_j - P_j^{Win}$, measures the difference between the secondary market P_j and the

[10] For single-price auctions, all winning bids are awarded at the stop-out price.

quantity-weighted average award price of all winning bids P_j^{Win} for auction j.

The variables bid share ($QBID$) and allocated share ($QWIN$) measure the shares of a bidder's demand and award relative to the size of auction j, respectively, and are defined as:

$$QBID_{ij} \equiv \frac{Q_{ij}^{Bid}}{Size_j} \tag{3}$$

and

$$QWIN_{ij} \equiv \frac{Q_{ij}^{Win}}{Size_j} \tag{4}$$

As previously described, in Portuguese Treasury auctions, access to the post-auction non-competitive subscription is determined by the dealer's average auction allocation in the prior three competitive auction dates of the respective type (T-bills and T-bonds). We define, $QWIN3_{i,a}$, as the average percent allocation of bidder i over the prior three auction dates $a-1, a-2, a-3$ of the same type (T-bills or T-bonds):

$$QWIN3_{i,a} = \frac{Q_{i,a-1}^{Win} + Q_{i,a-2}^{Win} + Q_{i,a-3}^{Win}}{Size_{a-1} + Size_{a-2} + Size_{a-3}} \tag{5}$$

where $Q_{i,a-r}^{Win}$ is the aggregated awarded quantity of bidder i in auction date $a-r$ of the same type and $Size_{a-r}$ is the aggregated auction size in auction date $a-r$ of the same type, with $r = 1, 2, 3$. There may be multiple auctions on the same date a. $QWIN3$ is the relevant measure for evaluating access to the non-competitive option among primary dealers.

Table V reports the distribution of bidder-level variables separately for T-bond and T-bill auctions. On average, bid discounts are positive for T-bills (0.03) but slightly negative for T-bonds (–0.01), consistent with more aggressive bidding in the bond market. The distributions are wide: T-bond bid discounts range from –1.76 to 10.35, while T-bill discounts range from –1.12 to 1.81, indicating substantial heterogeneity in bid shading strategies. Dealer profits are, on average, negative in both markets (–0.11 for T-bonds and –0.01 for T-bills), confirming that most competitive auction outcomes are loss-making. Still, the upper tails show that some dealers occasionally realize large gains, with maxima of 1.28 for T-bonds and 0.40 for T-bills. Dispersion is generally low, though relatively higher in T-bonds, suggesting that dealers submit a wider range of bids in longer-maturity auctions.

Quantity shares also differ: bidders request on average 18.2% of the auction size in T-bills and 12.1% in T-bonds, with allocations averaging 6.7% and 5.6%, respectively. Some dealers demand more than three times the auction amount (for strategic competition at the stop-out price), and one single dealer can buy everything in an auction. Finally, past allocation performance measures (*QWIN3*) average around 6.4% for T-bills to 5.6% for T-bonds of the auction size, but their upper quartiles and maxima suggest that a small subset of dealers accumulate disproportionate allocations, which determine access to non-competitive offerings. Overall, the bidder variable distributions suggest that while most dealers experience losses and small allocations, a subset secures much larger positions, foreshadowing the asymmetries in profits examined next.

4. Primary Dealer Remuneration Structure

A central puzzle motivating this paper is why primary dealers (PDs) consistently bid aggressively in Treasury auctions that, on average, are overpriced. On the surface, overpriced auctions imply systematic losses: securities are purchased at prices above their secondary market value, resulting in dealers' negative profits. In this section, we take a broader view of dealer profitability by incorporating all *primary market* revenue components that PDs derive from their role in the Portuguese Treasury market. Specifically, we examine total profits defined as the sum of (i) competitive auction profits (CP), (ii) post-auction non-competitive profits (NCP), and (iii) syndication fees (SP). This decomposition enables us to directly assess whether PDs, in aggregate or in subgroups, incur financial losses by participating in this market.

A. Aggregate Dealer Profits

Competitive auction profits (CP). For a given auction-dealer observation, CP is the profit on the quantity awarded from the competitive phase, computed as the difference between the secondary market price and the dealer's quantity-weighted awarded price, multiplied by the dealer's allocation. Aggregations to dealer–year are obtained by summing across all auctions within the year, and CP is scaled by the total auction size in that year.

Non-competitive profits (NCP). Dealers gain access to post-auction non-competitive subscriptions based on recent auction performance. Given that the subscription price is set at the competitive auction outcome and is known at the time of subscription, NCP is calculated as the secondary market price minus the subscription price, multiplied by the dealer's non-competitive allocation. Dealer–year aggregates are obtained by summing across all non-competitive auctions within the year, and NCP is also scaled by the total auction size for that year.

Syndication fees (SP). Annual syndication fees accrue to dealers selected as lead managers in syndicated T-bond offerings. As the matching between syndication primary dealers' identification and auctions primary dealers' identification is not provided by IGCP, we link syndication outcomes to bidder identities by ranking PDs based on their cumulative auction allocations in the preceding year up to the month prior to the syndication date, consistent with the IGCP's institutional scorecard.[11] Because syndication fees depend on prior-year auction performance, SP is scaled by the total auction size in the previous year.

[11] Our dataset also allows us to distinguish between domestic and foreign dealers. Using this information, we replicate the actual number of domestic and foreign dealers selected for each syndication, which is publicly observable. When a dealer is selected for more than one syndication in a given year, we also incorporate this into our replication procedure. Based on discussions with the IGCP, this quantitative proxy is highly correlated with the true scorecard, and we are confident that our approach closely replicates the primary dealer selection process for syndicated offerings.

Total profits (TP). Based on the structure of the PD remuneration system and ignoring the time value of money, we define:

$$TP_t \equiv CP_t + NCP_t + SP_{t+1}. \tag{6}$$

Note that all profit components are scaled by the total auction size.

Figure I presents annual dealer profits decomposed into these three components. Panel A aggregates profits across all dealers. Consistent with our earlier findings, the competitive phase is systematically unprofitable: *CP* is negative in most years, confirming that overpricing translates into realized losses at auction. *NCP* allocations, while offering some profit opportunities, contribute little and do not compensate for the losses from *CP*. The key driver of positive overall profitability is syndication fees. Once *SP* is incorporated, aggregate dealer profits turn positive in most years, showing that the incentive structure of the Portuguese Treasury market effectively redistributes value from auctions to syndications. Based on our estimates, the average *CP* amounts to –12.7 bps, *NCP* to 0.7 bps, and *SP* to 14.9 bps, resulting in a total profit of 2.9 bps relative to the face value issued in competitive auctions. Thus, while auctions are overpriced, the system as a whole does not, on average, leave dealers uncompensated. Instead, dealers recoup losses through outside-of-auction mechanisms, primarily syndications.

The aggregate picture masks sharp heterogeneity across dealers. We split dealers in each year into those selected as syndication lead managers in the following year (Panel B) and those not selected (Panel C). Both groups incur similar auction losses in *CP*, but only syndicated dealers are well compensated through *SP*. Among dealers selected for lead managers (Panel B), *CP* averages –7.5 bps, while *NCP* is small (0.4 bps). *SP*, however, is substantial (13.9 bps), resulting in a positive *TP* of 6.8 bps. In contrast, dealers not selected as lead managers (Panel C) experience *CP* losses of –5.2 bps, receive small compensation from *NCP* (0.3 bps) and minimal *SP* (1.0 bp), yielding a negative *TP* of –3.9 bps.

This asymmetric outcome highlights how the bundling of auction participation with syndication rights creates "winners" and "losers" among dealers. The non-lead managers seem to bear the cost of auction overpricing, while lead managers recover and exceed their auction losses through fee-based compensation. Importantly, most PDs are selected as lead managers at least once during their tenure, but the frequency and magnitude of selection and syndication fees vary substantially. The Portuguese Treasury's design thus generates a skewed payoff structure, where aggressive bidding is rational for dealers who expect access to syndication leading roles, but unsustainable for others.

B. Syndication Selection as the Mechanism

To explore how bidding strategies translate into annual profitability, we implement a two-step OLS regression framework. In the first step, we regress a dealer's annual auction allocation share ($QWINY$) on its measures of bidding aggressiveness—the annual average bid discount ($DISCY$) and the annual bid share ($QBIDY$). This step extracts the component of auction allocations that reflects deliberate bidding behavior, as higher quantities demanded and lower bid shading result in increased allocations. In the second step, we relate dealer profitability to the predicted allocations from the first regression, denoted $\widehat{QWINY}$. This captures the extent to which profitability is driven by allocations arising from dealers' own bidding strategies. Table VI reports these results across profit components. In the first step reported in column (1), as expected, allocations increase with larger quantities demanded (positive and significant coefficient on $QBIDY$) and decrease with greater bid shading (negative and significant coefficient on $DISCY$). We then use the fitted values from this regression, denoted $\widehat{QWINY}$, in the second step in columns (2)–(5) to study its relation with each profit component. We observe that higher predicted allocations are strongly associated with lower profits during the competitive phase (CP), consistent with aggressive bidding leading to losses at auction. In contrast, $\widehat{QWINY}$ loads positively on non-competitive profits (NCP) and especially on syndication fees (SP), indicating that larger allocations improve access to these revenue channels. The relationship with total profits (TP) is negative overall, suggesting that, for dealers as a whole, auction losses tend to dominate despite the compensating effects of non-comp and syndications. These results reinforce the findings presented in Panel A of Figure I.

Syndication is relevant only for T-bond issuance, and accordingly, aggressive bidding has very different implications across T-bill and T-bond auctions. For T-bills, more aggressive bidding is associated with lower profits in CP and higher profits in NCP, but the latter are too small to offset the former. As T-bill allocations do not influence syndication selection, the incentive to bid aggressively is weaker. This contrast provides a useful counterfactual: the overpricing phenomenon is concentrated in the T-bond market, where syndications are bundled with auction performance, reinforcing our interpretation of syndication as the primary driver of auction overpricing.

Next, we test the direct link between aggressive bidding and the probability of future syndication lead managers' selection. Using a *Probit* model, in which the dependent variable is chosen as a syndication lead manager in the subsequent year, we find that, in column (2) in Table VII, dealers with higher predicted QWIN, $Q\widehat{WINY}$, are significantly more likely to be selected in the subsequent year. This result provides suggestive evidence that aggressive bidding is rewarded with access to syndication. In other words, the Portuguese Treasury's scorecard mechanism converts losses in competitive auctions into a rational investment for dealers seeking to secure future syndication fees. This economic mechanism explains why overpricing persists: it is not a mistake or mispricing, but the predictable outcome of a system where auction allocations serve as a key determinant of syndication privileges.

C. The Role of Post-Auction Non-Competitive Offerings

Access to post-auction non-competitive allocations depends on a dealer's average allocation in the prior three auction dates of the same type (T-bonds or T-bills). Following a similar two-step procedure as before, in the first step, we regress the allocation in the prior three auction dates of the same type ($QWIN3$) on bidding behavior variables in the three auction dates, the weighted average bid discount ($DISC3$), and the bid share ($QBID3$). We report the results in Table VIII. Only the quantity is significant and loads with the expected sign, as in the annual regressions. In the second step, we regress the profit in the non-competitive phase of each auction (NCP) on the predicted auction allocations from the first step, $\widehat{QWIN}3$, and find a positive association. In other words, NCP gains are related to more aggressive bidding — demanding larger quantities (higher quantity demanded). Results for T-bonds and T-bills are qualitatively the same.

For T-bills and T-bonds, higher allocations in the prior three auction dates translate into higher NCP gains, achieved through more aggressive bidding on the quantity. The NCP effect for T-bonds is less relevant, with syndication fees remaining the dominant source of ex post profits. As a result, total profits are positive for the subset of dealers that secure lead syndication roles, while others continue to face persistent losses.

This section shows that focusing only on competitive auction outcomes provides an incomplete view of dealer profitability. Once both post-auction non-competitive allocations and syndication fees are incorporated, a clearer picture emerges. Auction overpricing in Portugal is therefore not simply an inefficiency, but rather a predictable outcome of an incentive structure that ties auction allocations to subsequent privileges. In the next section, we examine how these incentives shape dealers' competitive bidding strategies in auctions.

5. Methodology and Results for Bidder Behavior

In this section, we present our empirical methodology and estimation results for bidder behavior. Given bidders' anticipation of the potential profits outside of the competitive auction, how do they bid in the auction?

A. Methodology

We formalize the link between remuneration incentives and bidding behavior by examining how dealers adjust their pricing and quantity decisions, captured by *DISC* and *QBID*, in response to variables related to the remuneration incentives. The empirical methodology involves estimating two forms of linear regression specifications. Quantity variables are estimated using ordinary least squares (OLS), and pricing variables are estimated using volatility-weighted least squares (WLS), as in Nyborg et al. (2002). Regressions take the general form:

$$y_{i,j} = X_{i,j}\Gamma + \epsilon_{i,j}, \tag{7}$$

for dependent variables $y_{i,j}$, and a matrix of independent variables $X_{i,j}$ for dealer i and auction j. All regressions include auction-level control variables: expected auction size ($ESIZE_j$), volatility (VOL_j), and whether the auction format is uniform-price or discriminatory (UPA_j), as well as year-fixed effects. Standard errors are clustered at the dealer level.

Our first variable of interest, $Q4_j$, captures the timing incentive linked to the IGCP's scorecard cycle. Syndication appointments are usually made early in the calendar year—often in January—based on dealers' cumulative auction performance from the previous January through the end of December. Dealers seeking to improve their rankings thus tend to bid more aggressively near year-end. The dummy variable $Q4_j$ equals 1 when an auction occurs in the fourth quarter, when the next year's syndication opportunities are most salient. A negative coefficient on $Q4_j$ in the bid discount regression or a positive coefficient in the bid share regression would indicate intensified aggressiveness as the syndication selection window approaches.

To capture potential heterogeneity in dealers' behavior depending on their real-time position in the scorecard ranking, we design a grouping framework. Specifically, we classify each dealer into quartiles of cumulative auction allocations—computed from January of the previous year up to the month preceding each auction—and define three indicator variables: $G1_{i,j}$, $G2_{i,j}$, and $G3_{i,j}$. $G1_{i,j}$ takes the value 1 for dealers in the top quartile (highest cumulative take-up), $G2_{i,j}$ for those in the second quartile, and $G3_{i,j}$ for those in the third quartile, while the bottom quartile serves as the reference group. This grouping approximates dealers' relative standing on the IGCP scorecard or league table, which determines their eligibility for upcoming syndication. T-bond auctions typically attract 16 to 20 bidders (with an average of 17.8), so this four-group structure naturally divides the market into sets of approximately four to five dealers each. This specification allows us to assess whether bidding aggressiveness varies systematically across the distribution of dealer performance.

Beyond the timing and the ranking incentives related to syndicated offerings, we also account for the influence of bidders' *recent* allocation performance through $QWIN3_{i,j}$—the dealer's average allocation over the three preceding auction dates of the same security type. This variable reflects both the outcome of past aggressiveness and the basis for continued eligibility in post-auction non-competitive offerings. Dealers with higher $QWIN3_{i,j}$ are those who have previously bid more assertively, securing larger allocations and thereby reinforcing their position for future non-competitive access. Maintaining this eligibility requires ongoing strong participation, as a single weak auction can quickly lower the average of the three auction dates. Consequently, high-QWIN3 dealers are expected to remain aggressive bidders, continuing to submit larger and higher-priced tenders to protect their standing and sustain future privileges. Including $QWIN3_{i,j}$ thus captures the persistence of strategic aggressiveness among dealers who consistently compete for non-competitive access.

We separate the T-bill and T-bond samples because the incentive structures are different, as previously discussed. Then, we run two regressions for each group. The first regression specification includes the two main variables of interest $Q4_j$ and $QWIN3_{i,j}$ besides the auction control variables $ESIZE_j$, VOL_j, and UPA_j. The second regression adds the grouping variables to capture additional bidder heterogeneity.

B. Bid Discount

The bid discount variable, *DISC*, measures the extent of bid shading—the difference between the secondary market price and a dealer's weighted-average bid price. A lower discount indicates more aggressive bidding. Table IX reports the regression results for bid discount. Columns (1)–(2) correspond to T-bond auctions and columns (3)–(4) to T-bill auctions.

We begin by examining the control variables. Volatility, *VOL*, enters positively and significantly across all specifications, consistent with the theory that bidders possess private information and rationally adjust their bids for the winner's curse. This finding aligns with Nyborg et al. (2002), who interpret volatility as a proxy for the information structure of bidders' signals. Expected auction size, *ESIZE*, is negative and statistically significant, but economically small, i.e., the impact of changing *ESIZE* by EUR 100 million is only about 0.04 bps of face value, equivalent to about 10% of the sample standard deviation of *DISC*. This pattern suggests that bidding behavior is only weakly sensitive to the scale of issuance, implying that the aggregate demand curve in Treasury auctions is highly elastic, consistent with Nyborg et al. (2002) and Albuquerque et al. (2024). For T-bond auctions that have experienced two auction formats, the uniform-price method is associated with more aggressive bidding, consistent with the empirical findings by Goldreich (2007) or Noël and Wu (2025).[12]

Turning to our variables of interest, *Q4* is negative and highly significant for T-bonds (–0.377), indicating that dealers substantially reduce their discounts at year-end, when the next year's syndication appointments are imminent. The same effect is small (0.011) and not significant for T-bills, as expected, because T-bill auction allocations contribute little to determining syndication eligibility.

The grouping variables *G1*-*G3* show clear heterogeneity across the scorecard distribution. For T-bonds, the coefficients on *G1*, *G2* and *G3* are highly significant at -0.137, –0.187 and –0.172, respectively. These results offer an intuitive pattern. Dealers already in the top quartile bid no more aggressively than those in *G2* and *G3*, presumably because their prior performance has already secured lead syndication rights. In contrast, dealers in the middle quartiles bid most aggressively: as they are positioned near the cutoff, they have the greatest incentive to perform well, since incremental improvements in ranking can determine whether they lead the next syndicate. The bottom quarter, serving as the reference group

[12] While theoretical studies reach mixed conclusions (e.g. Wilson 1979; Milgrom and Weber 1982; Back and Zender 1993; Chatterjea and Jarrow 1998; Wang and Zender 2002; Kremer and Nyborg 2004; Nyborg and Strebulaev 2004; Kang and Puller 2008; Kastl 2011), the majority of empirical work comparing the two formats finds that uniform-price auction are associated with greater bidder participation and higher issuer revenue (see also Umlauf 1993 and Nyborg and Sundaresan 1996).

in our model, submits bids with the largest discounts, as their likelihood of catching up to obtain syndication leads is minimal. Recall that each dealer receives monthly updates of its ranking and that syndication opportunities are limited—typically two to four deals per year with four or five lead managers per deal. Consequently, in a league table of 16 active dealers, the top four have guaranteed placements, the next four have a high probability of selection, the third group remains on the margin, and the last group faces little chance. In contrast, T-bill regressions display no meaningful differences across quartiles, consistent with the absence of syndication incentives in that market. This natural placebo reinforces our causal interpretation of syndication rights on bidder behavior.

The coefficient on *QWIN3* is negative and significant in all specifications. Dealers with larger average allocations in the previous three auction dates–those already eligible for the post-auction non-competitive phase–continue to bid aggressively in current auctions. This persistence underscores that high-QWIN3 dealers maintain intensity to preserve their privileged access rather than relaxing once eligibility is achieved.

Overall, the results in Table IX reveal several coherent patterns. Bidding aggressiveness increases (discounts shrink) when (i) the scorecard period approaches year-end, (ii) a bidder holds a high marginal standing in the league table, and (iii) a bidder's recent allocations (*QWIN3*) are larger. Taken together, the evidence shows that primary-dealer bidding in Portuguese Treasury auctions responds systematically to both syndication-related and non-competitive-access incentives. Dealers strategically reduce discounts when future syndication and non-competitive rewards are at stake, providing micro-level behavioral support for interpreting auction overpricing as an equilibrium outcome of the broader remuneration framework.

C. Bid Share

The bid share variable, *QBID*, measures the proportion of auctioned securities a dealer demands relative to the total auction size. A higher *QBID* indicates more aggressive bidding, as the dealer requests a larger share of the issue. Table X reports the regression results for bid share. As earlier, columns (1)–(2) correspond to T-bond auctions, and columns (3)–(4) to T-bill auctions.

Among the control variables, expected auction size, *ESIZE*, is negative and highly significant across all specifications, indicating that dealers demand a smaller share in larger auctions. Volatility, *VOL*, is negative and significant for T-bonds, suggesting that dealers moderate their quantity bids when uncertainty increases. For T-bills, volatility is economically small and statistically insignificant. The dummy for the uniform-price format, *UPA*, is negative and significant for T-bonds, showing that bidders request smaller quantities under the uniform-price method-—an effect opposite to that on pricing aggressiveness. These results are broadly in line with the established auction literature following Nyborg et al. (2002), Keloharju et al. (2005), and Albuquerque et al. (2024).

Turning to the variables of interest, the fourth-quarter indicator, *Q4*, is positive and significant for T-bonds at 0.012 but economically small. Dealers marginally increase their requested quantities toward year-end, consistent with intensified participation as syndication appointments approach. The effect disappears for T-bills (–0.011, not significant), confirming that syndication incentives are confined to the bond market.

The grouping variables, *G1*–*G3*, again reveal systematic heterogeneity across the scorecard distribution. For T-bonds, the coefficients on *G1*, *G2*, and *G3* are all positive and highly significant (0.076, 0.047, and 0.041, respectively), indicating that higher-ranked dealers demand larger shares of each issue. The magnitude declines gradually down the ranking, suggesting that even dealers outside the top quartile remain competitively engaged in pursuing syndication visibility. For T-bills, only the top-quartile coefficient remains highly significantly positive, consistent with limited differentiation when syndication incentives are absent for T-bills. Taken together with bid discount results, they reveal a clear behavioral hierarchy. Top-quartile T-bond dealers routinely submit large quantity bids but may bid less aggressively on price once their ranking is secure. Dealers in the middle quartiles—those close to the cutoff for syndication selection—have the strongest incentive to demonstrate both high demand and higher bidding prices. In contrast, bottom-quartile dealers participate passively, submitting smaller quantities at lower prices, reflecting their limited likelihood of advancing into the syndicate. These results suggest that aggressiveness peaks at the margin of lead syndication eligibility.

The coefficient on *QWIN3* is large and highly significant in all specifications. Dealers with higher allocations in the previous three auction dates–those with stronger eligibility for post-auction non-competitive offerings–continue to submit larger quantity bids in the current auction. For T-bonds, the coefficient ranges from 0.174 to 0.534, while for T-bills, it ranges from 1.009 to 1.279, all significant at the 1% significance level. These results confirm that maintaining non-competitive eligibility is a powerful driver of quantity aggressiveness: high-QWIN3 dealers continue to demand large shares to sustain their average allocation and ensure continued access.

Overall, the results in Table X complement those for bid discounts. Bidding aggressiveness—in both price and quantity dimensions—increases when (i) lead syndication opportunities become salient near year-end, (ii) lead syndication eligibility is at stake based on the scorecard ranking, and (iii) latest allocations (*QWIN3*) are larger. These patterns reinforce the interpretation that Treasury-bond overpricing arises not from anomalous behavior but from rational, incentive-compatible bidding within a remuneration system that links auction participation to future privileges.

6. Discussion and Conclusion

Our analysis reveals that the incentive structures embedded in sovereign debt management frameworks play a central role in shaping the behavior of primary dealers and auction outcomes. These mechanisms offer insight into how institutional design influences pricing and participation dynamics in sovereign bond markets. Competitive Treasury auctions in several euro area countries exhibit systematic overpricing. Evidence from Portugal indicates that this pattern reflects strategic bidding by primary dealers seeking access to post-auction non-competitive offerings and, mainly, to syndication mandates, which generate future profits. These anticipated rewards offset potential losses from aggressive bidding in auctions, leading dealers to submit larger and higher-priced bids.

Syndicated offerings remain an essential component of sovereign debt programs. They enable governments to place large benchmark bonds, diversify the investor base, and reduce issuance uncertainty, particularly in fragile market conditions or for specialized products such as long-term or green bonds. Habib and Ziegler (2007) show that sellers prefer auctions when information acquisition costs are low, and posted-price mechanisms when such costs are high. Syndications resemble posted-price selling in that they provide placement certainty and reduce the role of information acquisition. Euro area DMOs appear to leverage both mechanisms simultaneously: regular auctions to discover prices, and syndications to ensure reliable distribution. By bundling syndication rights with auction performance, they create a hybrid structure that both stabilizes primary-market demand and generates strong incentives for aggressive bidding. In Portugal, syndications are conducted on a best-effort basis, meaning dealers do not underwrite or warehouse risk; their compensation is primarily fee-based. This institutional and contractual remuneration channel, rather than speculative trading, explains the link between auction overpricing and future dealer income. Future work could examine how differences in syndication design—such as fee structures, lead-manager rotation, or investor targeting—affect bidding incentives and market outcomes. Our analysis focuses on primary market activities. We do not observe, nor attempt to measure, primary dealers' market-making revenues in the secondary market. These activities may represent an additional source of compensation and could further influence bidding incentives (e.g., Duffie 2010; Fleming et al. 2024). Our results should therefore be interpreted as identifying the primary-market channel of remuneration embedded in the institutional design.

Our analysis centers on explicit profits from sovereign debt issuance. Repeated selection as a syndication lead manager may also generate indirect benefits beyond the sovereign market. Lead-manager status can strengthen a dealer's reputation and visibility, potentially enhancing its ability to secure underwriting mandates in the corporate bond or equity market (Fang 2005). Such implicit reputational benefits could further amplify the incentives to bid aggressively in sovereign auctions, reinforcing the results we document. One may also question whether lead-manager selection is driven solely by performance-based criteria or whether relationship-based or career-linked channels play a role. Recent work, such as Silano (2022), highlights how career connections may influence sovereign debt management practices. While such mechanisms cannot be entirely ruled out, our evidence shows a strong and systematic association between aggressive bidding, cumulative allocations, and subsequent syndication selection. This performance-based link mitigates concerns that lead-manager appointments are driven by networks or personal relationships. Lastly, the behavior of less successful primary dealers further illustrates the equilibrium nature of the system. Dealers that fail to secure lead syndication roles typically exit the primary dealer pool within a few years, while profitable dealers remain active. This dynamic suggests that syndication-based incentives sustain participation but may lead to reduced competition among dealers over time.

In conclusion, our findings underscore the importance of analyzing sovereign debt issuance as an integrated system, rather than focusing solely on auction outcomes. Competitive auctions, non-competitive reopenings, and syndications operate jointly to shape both financing costs and dealer behavior. Recognizing this institutional interdependence is crucial for evaluating market efficiency, understanding dealer incentives, and designing more transparent and effective frameworks for sovereign debt.

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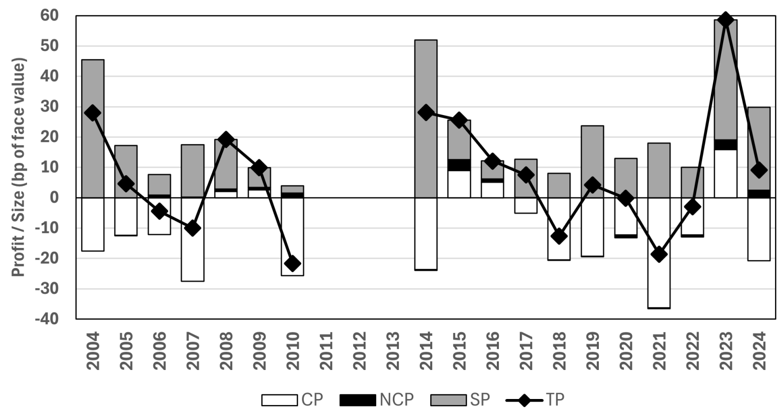
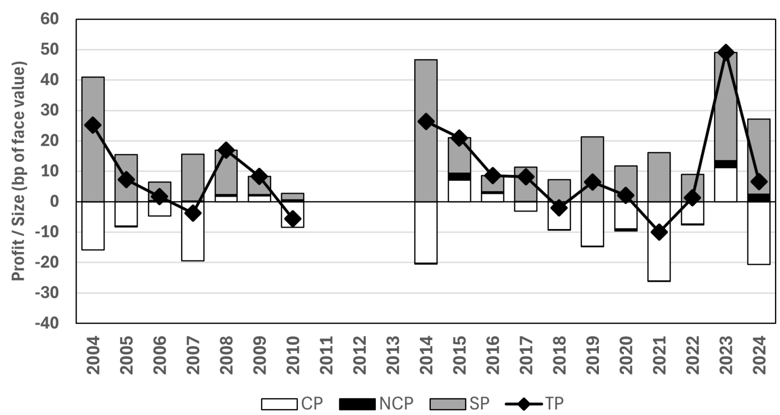
Figure I: **Dealer Annual Profits as a Percentage of Annual Issuance for T-bonds.** This figure presents dealer annual profits in the T-bonds segment as a percentage of annual auction issuance in basis points of face value. Total profits (black diamonds) are decomposed into profits from competitive auctions (white), from non-competitive auctions (black), and from syndication fees in the following year (gray). Panel A presents the sum of profits for all dealers, Panel B presents the sum of profits for the dealers selected at least once as lead managers in syndications of the following year, and Panel C presents the sum of profits for the dealers not selected as lead managers in any of the syndications in the following year.

Panel A. All dealers.



Panel B. Dealers selected as lead managers in syndications of the following year.



Panel C. Dealers not selected as lead managers in syndications of the following year.

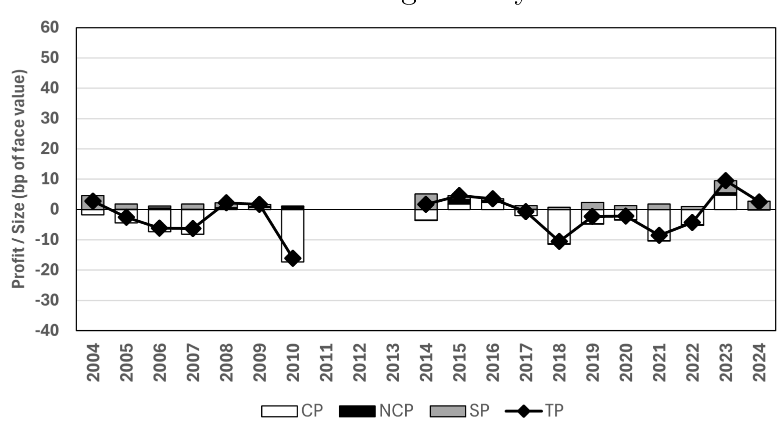


Table I: **Treasury Bond Offering Summary Information by Country for Advanced Economies.**
This table reports bond offering summary information for twenty-two advanced economies. Panel A reports information for countries that frequently use syndications, Panel B for countries that infrequently use syndications, and Panel C for other selected advanced economies. *Use of syndications* (Yes/Rarely/No) and *Auction method* (Discriminatory-Price Auction / Uniform-Price Auction) are based on ESDM's issuance information, in the case of EU countries, and based on responses to the OECD Surveys on Primary Markets Developments, for other countries. *Non-comp* is the post-auction non-competitive phase (Yes/No) based on information obtained from national debt management agencies' websites. *Share of Syndications* is the fraction of T-bonds issuance amount through syndicated deals over the corresponding sample period. For auctions, the number of auctions, N, is reported. Underpricing (UP) is reported as a percentage of par, and is calculated as the secondary market price (mid) minus the auction price. Observations with an absolute value of underpricing above 250 bps on prices and 50 bps on yields are excluded. For Italy, the auction price net of placement fees is considered. We also report the percentage of auctions that are overpriced (negative underpricing, $\%UP < 0$). Stars indicate significance levels corresponding to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Sources: Bloomberg, ESDM - EFC Sub-Committee on EU Government Bonds and Bills Markets, and OECD and national debt management agencies.*

	Use of Syndications	Auction Method	Post-auction Non-comp	Sample	Share of Syndications	Auctions		
						N	UP	$\% UP < 0$
Panel A: Euro area countries with frequent syndications								
Austria	Y	DPA	Y	1999-2024	38%	399	-0.160***	73%
Belgium	Y	DPA	Y	1999-2024	28%	432	-0.100***	67%
Finland	Y	UPA	N	2000-2024	48%	150	-0.061***	61%
Ireland	Y	UPA	Y	2003-2024	55%	140	-0.030	57%
Portugal	Y	DPA/UPA	Y	2004-2024	40%	222	-0.131***	73%
Slovakia	Y	DPA/UPA	Y	2001-2024	32%	435	0.007	47%
Spain	Y	DPA	Y	2014-2024	21%	609	-0.089***	62%
Panel B: Euro area countries with infrequent syndications								
France	R (since 2007)	DPA	Y	1999-2024	3%	1,992	0.016	51%
Germany	R (since 2020)	DPA	N	1999-2024	2%	946	0.019	51%
Italy	R (since 2010)	UPA	Y	2000-2024	11%	1,328	0.057***	41%
Netherlands	N	DPA/UPA	Y	1999-2024	-	374	0.007	52%
Panel C: Other selected advanced economies								
Australia	Y (since 2011)	DPA	N	1999-2024	21%	1,385	0.021***	47%
Canada	N	DPA	Y	1999-2024	-	773	0.005	39%
Denmark	N	UPA	N	2008-2024	-	540	0.020	48%
Iceland	N	UPA	Y	2000-2024	-	180	0.241***	18%
Israel	N	DPA	Y	2007-2024	-	1,264	-0.014**	56%
Japan	N	DPA/UPA	Y	1999-2024	-	729	0.028	46%
New Zealand	Y (since 2013)	DPA	N	1999-2024	28%	1,495	0.046***	37%
Norway	Y (since 2018)	UPA	N	1999-2024	15%	334	0.126***	22%
Sweden	Y	DPA	N	2004-2024	20%	389	0.011	47%
UK	Y (since 2005)	DPA	Y	1999-2024	17%	1,064	0.095***	43%
US	N	DPA/UPA	N	1999-2024	-	1,219	0.057***	39%

Table II: **Underpricing and Syndications: Cross-Country Analysis.**
This table reports regression results for annual *underpricing* on the annual *share of debt issued via syndicated deals* for the countries in the time span in Table I, *Share of Syndication.* We control for the size of the economy with country-level GDP in millions of U.S. dollars (*GDP*), for debt market depth and liquidity with the ratio of debt to GDP, *Debt-to-GDP*, for global bond market volatility (*MOVE*), and for global risk with MSCI World Index realized volatility (*MSCI Vol*). All regressions include year-fixed effects, and t-statistics are in parentheses with significance levels * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are clustered at the country level.

	Underpricing					
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Syndication	-0.166**	-0.158**	-0.169***	-0.166**	-0.167**	-0.164***
	(-2.59)	(-2.42)	(-3.73)	(-2.70)	(-2.59)	(-4.14)
GDP		2.754*				1.458
		(1.86)				(0.98)
Debt-to-GDP			-0.097 *			-0.081*
			(-2.08)			(-1.76)
MOVE				-0.108		-0.180*
				(0.89)		(-1.74)
MSCI Vol					2.129	0.669
					(1.43)	(1.21)
Constant	0.027	-0.074	0.117*	0.030	-0.232	-0.141
	(0.53)	(-0.91)	(1.73)	(0.57)	(-1.43)	(-1.01)
N	513	512	440	468	501	403
Adj. R^2	0.022	0.064	0.090	0.020	0.024	0.116

Table III: **Syndicated Offerings and Syndication Fees by Year.**
This table presents syndication and syndication fees data by year for the Portuguese T-bond market. Columns (1) and (2) present the total number of syndicated offerings in a given year and in the first four months of each year, respectively. Column (3) reports the total number of unique joint lead managers (JLM) selected in a given year. JLM are selected from the primary dealer pool based on their scorecard ranking. Some dealers are chosen to be JLM more than once in a given year. Column (4) reports the total debt offered through syndications in a given year in billions of euros. Columns (5) through (7) are estimated based on the current syndication fee schedule, in which fees increase with maturity. Column (5) reports the estimated total syndication fees paid by the Treasury in millions of euros. Column (6) reports the estimated maximum fees earned by any JLM, which considers dealers selected more than once. Column (7) reports the average fees earned per JLM.

	# Syndications		Joint Lead	Total Offered	Syndication Fees (EUR millions)		
Year	Total	Jan-Apr	Man. (JLM)	(EUR billions)	Total	Max per JLM	Avg per JLM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2004	1	0	4	2.5	3.1	0.7	0.7
2005	3	1	13	9.0	15.0	1.8	1.0
2006	2	1	10	6.0	12.8	1.4	1.1
2007	1	1	5	3.0	5.3	0.9	0.9
2008	2	1	10	6.0	11.3	1.1	1.0
2009	2	1	10	7.3	11.1	1.3	1.0
2010	1	1	5	3.0	5.3	0.9	0.9
2011	1	1	6	3.5	4.4	0.7	0.7
2012	-	-	-	-	-	-	-
2013	2	1	10	5.5	8.4	0.8	0.8
2014	4	2	13	13.0	22.1	2.7	1.5
2015	3	2	14	11.0	20.4	1.6	1.3
2016	2	2	11	5.5	9.8	1.3	0.8
2017	1	1	6	3.0	5.3	0.8	0.8
2018	2	2	11	7.0	13.0	2.0	1.1
2019	1	1	6	4.0	7.0	1.1	1.1
2020	3	2	12	13.0	22.5	3.4	1.7
2021	2	2	11	7.0	14.5	2.2	1.2
2022	2	2	11	6.0	12.0	1.8	1.0
2023	1	1	6	3.0	6.0	0.9	0.9
2024	2	1	10	7.0	14.5	2.2	1.3
2025	3	2	12	12.0	22.0	2.7	1.7
Total	41	28		137.3	245.4		

Table IV: **Portuguese Treasury Auction Data Summary.**

This table presents a description of the data for the full dataset, as well as a disaggregation by T-bills and T-bonds. *Auctions* is the number of auctions and the following 2 columns disaggregate this number by *multi-price* and *single-price* auctions. Next columns present average values for the variables. *E[Size]* is the maximum of the pre-announced range, and *Size* is the effective size (both in millions of euro). *Bids* is the number of bids in each auction and *Awards* is the number of bids awarded in each auction. *Bid-to-Cover* is the ratio of the dollar amount of bids received in the auction to the amount sold. *Expected Bidders* is the number of potential participating dealers in each auction. *Participating Bidders* is the number of participating dealers in each auction. *Allocated Bidders* is the number of dealers allocated in each auction.

	Auctions	Multi-price	Single-price	E[Size]	Size	Bids	Awards	Bid-to-Cover	Expected Bidders	Participating Bidders	Allocated Bidders
All	653	517	136	670	677	44.00	29.70	2.50	16.00	15.80	12.50
T-bills	447	447	0	657	671	38.00	27.40	2.69	15.00	14.90	11.80
T-bonds	206	70	136	697	691	56.20	34.40	2.12	18.00	17.80	14.10

Table V: **Distribution of Bidder Variables by T-bonds and T-bills.**
This table reports the distribution statistics for the variables, bidder discount (DISC), profit (PROFIT), price dispersion (DISP), quantity bid (QBID), quantity awarded (QWIN), and the average allocation over the last three auction dates (QWIN3). The left panel reports summary statistics for 3,665 T-bonds bidder-auction pairs (for the variable QWIN3, only 3,629 observations). The right panel reports summary statistics for 5,773 T-bill bidder-auction pairs.

	T-bonds							T-bills						
	Mean	Std.	Min	25%	50%	75%	Max	Mean	Std.	Min	25%	50%	75%	Max
DISC	-0.014	0.481	-1.758	-0.251	-0.040	0.191	10.350	0.031	0.147	-1.120	-0.006	0.003	0.020	1.808
PROFIT	-0.110	0.333	-1.585	-0.270	-0.096	0.018	1.280	-0.005	0.063	-1.120	-0.008	0.000	0.000	0.402
DISP	0.108	0.213	0.000	0.017	0.066	0.148	10.087	0.015	0.044	0.000	0.000	0.003	0.009	0.802
QBID	0.121	0.112	0.002	0.061	0.100	0.145	2.160	0.182	0.194	0.002	0.067	0.125	0.230	3.003
QWIN	0.056	0.066	0.000	0.000	0.047	0.085	1.000	0.067	0.097	0.000	0.000	0.033	0.100	1.000
QWIN3	0.056	0.046	0.000	0.025	0.054	0.078	0.974	0.064	0.066	0.000	0.018	0.050	0.087	0.602

Table VI: **Primary Dealer Annual Profits and Annual Bidding Behavior.**

This table presents the two-step regression results of primary dealer annual profits by source on annual bidding behavior. Sources of profit include contemporaneous profit from competitive auctions (CP), contemporaneous profit from non-competitive auctions (NCP), and syndication fees from the following year (SP). Total profit (TP) is the sum of the previous three components (note there are no syndication profits for T-bills). Bidding behavior variables include *DISCY*, a yearly bidder's discount computed as the weighted average of DISC by the quantity bid, and *QBIDY*, which is the annual quantity bid divided by the annual total issued. $\widehat{QWINY}$ is the predicted value from columns (1) and (6) for T-bonds and T-bills, respectively. All regressions include year-fixed effects, and t-statistics are in parentheses. Standard errors are clustered at the dealer level. Stars indicate significance levels corresponding to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	T-bonds					T-bills			
		Profit					Profit		
	QWINY	Total	Competitive	Non-comp	Syndication	QWINY	Total	Competitive	Non-comp
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
DISCY	-0.161***					-0.512***			
	(-9.81)					(-4.00)			
QBIDY	0.440***					0.410***			
	(13.23)					(11.80)			
$\widehat{QWINY}$		-0.679*	-1.540***	0.041***	0.820**		-0.131**	-0.149***	0.018***
		(-1.80)	(-9.58)	(3.41)	(2.19)		(-2.64)	(-3.04)	(3.19)
Constant	-0.013*	0.179***	-0.013	-0.003***	0.195***	-0.021	0.008	0.009*	-0.001**
	(-2.02)	(5.82)	(-0.78)	(-3.15)	(5.38)	(-1.51)	(1.58)	(1.80)	(-2.67)
N	295	295	295	295	295	310	310	310	310
Adj. R^2	0.614	0.490	0.631	0.540	0.393	0.631	0.084	0.119	0.018

Table VII: **The Probability of Syndication Selection and Bidding Behavior.**
This table presents the estimated two-step Probit regression linking aggressive bidding behavior in year *T* with the probability of being selected as a lead manager of a new bond syndication in year *T+1*. The selection variable, *SYND(T+1)*, takes the value 1 if the dealer participated as a lead manager in at least one of the syndication deals the following year. Bidding behavior variables at the annual level include *DISCY*, a bidder's annual discount weighted by the quantity bid (QBID), and *QBIDY*, which is the annual quantity bid divided by the total issued by year. $Q\widehat{WIN}Y$ are the same predicted values calculated in Table VI and presented in column (1) of this table. Both regressions include yearly fixed effects, and t-statistics are reported in parentheses. Standard errors are clustered at the dealer level. Stars indicate significance levels corresponding to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	QWINY	SYND(T+1)
	(1)	(2)
DISCY	-0.161***	
	(-9.81)	
QBIDY	0.440***	
	(13.23)	
$Q\widehat{WIN}Y$		12.670*
		(1.89)
Constant	-0.013*	-0.087
	(-2.02)	(-0.22)
N	295	279
Pseudo R^2		0.112

Table VIII: **Profits from Post-auction Non-competitive Offerings and Bidding Behavior.**
This table presents the two-step regression results linking bidding behavior to profits from post-auction non-competitive offerings. Access to non-competitive offerings is determined by auction performance over the prior three auction dates of the same type (T-bonds and T-bills). Step-one regresses $QWIN3$ ($QWIN$ for the prior three auction dates of the same type) on $DISC3$ ($DISC$ over the prior three auction dates of the same type) and $QBID3$ ($QBID$ over the prior three auction dates of the same type), and generates a prediction value $\widehat{QWIN}3$. The second step regresses the profits from non-competitive offerings (NCP) on the bidding behavior prediction value $\widehat{QWIN}3$. All regressions include year-fixed effects, and t-statistics are in parentheses. Standard errors are clustered at the dealer level. Stars indicate significance levels corresponding to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	T-bonds		T-bills	
	QWIN3	NCP	QWIN3	NCP
	(1)	(2)	(3)	(4)
DISC3	-0.001		-0.001	
	(-1.11)		(-0.20)	
QBID3	0.439***		0.340***	
	(9.06)		(7.44)	
$\widehat{QWIN}3$		0.027***		0.088***
		(5.98)		(4.65)
Constant	0.003	-0.002***	-0.006	-0.005**
	(0.19)	(-5.14)	(-0.29)	(-2.77)
Observations	3,600	3,600	6,139	6,139
Adj. R^2	0.499	0.063	0.484	0.135

Table IX: **Regressions of Bidder Discount on Competition Variables.**
This table presents regression results for the dependent variable bidder discount, $DISC$, which describes part of a dealer's demand schedule. $ESIZE$ is the upper limit of the announced range of the auction size. VOL is the realized volatility over the previous 20 days of the bond being auctioned. UPA is a dummy variable with a value of 1 when the auction pricing format is uniform. $Q4$ is a dummy variable that takes the value 1 if the auction occurs in the fourth quarter of the year. $QWIN3$ is the allocation to each dealer as a proportion of the total issuance amount in the same auctions in the last 3 auction dates of the same type. $G1$, $G2$, and $G3$ are dummy variables that take the value 1 if the dealer is in the upper quartile, second quartile, and third quartile, respectively, of the cumulative take-up of auctions of the same type since January of the previous year until the month before the auction takes place. All regressions are estimated using volatility-weighted least squares and include year-fixed effects. *t-statistics* are in parentheses and significance levels correspond to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are clustered at the dealer level.

	T-bonds		T-bills	
	(1)	(2)	(3)	(4)
ESIZE	-0.438***	-0.438***	-0.151***	-0.151***
	(-10.02)	(-10.25)	(-6.00)	(-5.92)
VOL	0.660**	0.665**	1.802***	1.815***
	(2.73)	(2.74)	(4.10)	(4.11)
UPA	-0.219***	-0.235***		
	(-5.21)	(-5.97)		
Q4	-0.377***	-0.377***	0.010	0.011
	(-12.62)	(-12.55)	(0.84)	(0.84)
QWIN3	-1.220***	-0.650**	-0.609***	-0.466***
	(-3.45)	(-2.35)	(-5.84)	(-3.42)
G1		-0.137***		-0.046
		(-2.80)		(-1.22)
G2		-0.187***		0.007
		(-4.11)		(0.25)
G3		-0.172***		0.002
		(-3.57)		(0.05)
Constant	0.302***	0.413***	0.130***	0.127***
	(6.31)	(7.51)	(7.76)	(5.12)
Observations	3,629	3,629	6,220	6,220
Adj. R^2	0.186	0.198	0.166	0.170

Table X: **Regressions of Bid Share on Competition Variables.**
This table presents regression results for the dependent variable bid share, $QBID$, which describes part of a dealer's demand schedule. Check Table IX for variable definitions. All regressions are estimated by ordinary-least-squares and include year-fixed effects. *t-statistics* are in parentheses and significance levels correspond to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are clustered at the dealer level.

	T-bonds		T-bills	
	(1)	(2)	(3)	(4)
ESIZE	-0.088***	-0.089***	-0.149***	-0.149***
	(-8.23)	(-8.96)	(-10.52)	(-10.33)
VOL	-0.049**	-0.049**	-0.068	-0.089
	(-2.33)	(-2.17)	(-0.29)	(-0.38)
UPA	-0.064***	-0.060***		
	(-3.62)	(-3.41)		
Q4	0.012**	0.012**	-0.010*	-0.011*
	(2.07)	(2.16)	(-2.02)	(-2.03)
QWIN3	0.534***	0.174***	1.279***	1.009***
	(6.32)	(3.94)	(12.75)	(12.90)
G1		0.076***		0.081***
		(7.72)		(3.54)
G2		0.047***		0.028*
		(4.68)		(1.79)
G3		0.041***		0.018
		(4.69)		(1.54)
Constant	0.187***	0.160***	0.257***	0.248***
	(9.12)	(7.24)	(5.88)	(5.16)
Observations	3,629	3,629	6,220	6,220
Adj. R^2	0.099	0.135	0.264	0.280

Appendix

Table A1: Variable Definitions

Variable	Definition
Panel A. Bidder–Auction Variables	
DISC	Bidder discount: difference between the secondary-market mid-price and the dealer's quantity-weighted average bid price. Lower or negative values indicate more aggressive bidding.
PROFIT	Dealer's ex post profit in auction j: secondary-market price minus the dealer's weighted-average award price.
UP	Auction-level underpricing: difference between the secondary-market price and the weighted-average award price across all winners.
QBID	Dealer i's bid quantity divided by total auction size; measures demand aggressiveness.
QWIN	Dealer i's awarded quantity divided by total auction size; measures relative auction success.
DISP	Dispersion of bid prices submitted by dealer i within auction j; captures within-dealer bid heterogeneity.
Panel B. Bidder–Date (Recent History) Variables	
QWIN3	Cumulative allocation share over all auctions held on the *three preceding auction dates* of the same security type (T-bill or T-bond), excluding the current date; determines access to non-competitive offerings.
DISC3	Quantity-weighted average of *DISC* over the previous three auction dates of the same security type.
QBID3	Sum of *QBID* over the previous three auction dates (same security type), scaled by corresponding auction sizes.
$\widehat{QWIN3}$	Fitted value of *QWIN3* based on *DISC3* and *QBID3*.
G1	Indicator equal to 1 if the dealer is in the upper quartile of the cumulative take-up of auctions of the same type since January of the previous year until the month before the auction takes place.
G2	Indicator equal to 1 if the dealer is in the second quartile of the cumulative take-up of auctions of the same type since January of the previous year until the month before the auction takes place.
G3	Indicator equal to 1 if the dealer is in the third quartile of the cumulative take-up of auctions of the same type since January of the previous year until the month before the auction takes place.

Continued in the next page

Table A1: Variable Definitions (continued)

Variable	Definition
Panel C. Dealer–Year (Annual Aggregates)	
QWINY	Dealer's annual allocation share: sum of awarded quantities over the year divided by total issued for that year and security type.
DISCY	Annual bidder discount: quantity-weighted average of *DISC* over the year.
QBIDY	Annual bid share: total bid quantity over the year divided by total issued that year.
$\widehat{QWINY}$	Fitted value of *QWINY* based on *DISCY* and *QBIDY*.
CP	Competitive-auction profit aggregated to dealer–year level and scaled by annual issuance.
NCP	Non-competitive profit aggregated to dealer–year level and scaled by annual issuance.
SP	Syndication profit: total fees from syndication mandates in year t+1, scaled by total issuance in year t.
TP	Total profit defined as $TP_t = CP_t + NCP_t + SP_{t+1}$.
Panel D. Auction- and Market-Level Controls	
E[SIZE]	Expected auction size, defined as the upper bound of the pre-announced issuance range.
Q4	Indicator equal to 1 if the auction occurs in the fourth quarter (scorecard period).
SIZE	Realized auction size.
SYND(t+1)	Indicator equal to 1 if dealer i is selected as a lead manager in at least one syndication in year t+1.
UPA	Indicator equal to 1 if the auction follows a uniform format.
VOL	Realized secondary-market volatility over the 20 trading days preceding the auction (security-specific).

Online Appendix

Overpriced Treasury Auctions

This online appendix presents additional details to the full text. Appendix A describes the historical background of the Portuguese sovereign debt issuance. Appendix B lists the current primary dealers for the Portuguese sovereign debt issuance. Appendix C presents additional figures and tables.

A Historical Background of Portuguese Sovereign Debt Issuance

This appendix provides additional historical background to the institutional setting referred to in Section 2.

In 1999, Portugal was one of the 11 European countries to adopt the euro as a single currency. In 1996, the Portuguese Government Debt Agency, now known as the Portuguese Treasury and Debt Management Agency and abbreviated as IGCP, was established under the Ministry of Finance to re-denominate the existing debt of escudos into euros and to prepare for issuance in a single-currency market. During the initial phase, IGCP concentrated on issuing a narrower range of standardized public debt securities, mainly to improve liquidity. The two main types were similar to securities issued in the United States: (1) Treasury bills (BT), which are issued at a discount of par with maturities of up to twelve months, and (2) Treasury bonds (OT), which are fixed-rate bonds issued with maturities between two and thirty years. In the run-up to the euro, interest rates on Portuguese government bonds quickly converged with German benchmark rates. By 1999, the spread between 10-year Portuguese bonds and 10-year German bonds had already narrowed to below 40 basis points, and it remained very low, fluctuating around 20 basis points until mid-2008.

Things began to turn after the Great Financial Crisis, especially after the Greek government requested international financial assistance in early 2010. In 2010 and 2011, Portugal was one of the countries most affected by the euro sovereign debt crisis. In April of 2011, when 10-year yields in Portugal were trading more than 5 percentage points above the German yields, the Portuguese Republic requested international financial assistance and agreed on a 3-year economic adjustment program in exchange for access to funding of up to 78 billion euro, which was about 50% of public debt outstanding at the time, from the International Monetary Fund and European Union institutions. Over the next 18 months, IGCP did not issue medium- or long-term debt through public capital market channels. However, it continued to issue short-term debt through Treasury bill auctions, focusing on shorter maturities (up to six months) and reducing debt outstanding, which decreased by roughly 40%. In late 2012, Portugal returned to public capital markets to issue medium- and long-term debt. However, in 2012 and 2013, Treasury bonds were issued only through syndicated and exchange offerings as a kind of warm-up to the auction market. In April 2014, IGCP announced its first Treasury bond auction, signaling a renormalization of entry back into public capital markets. The 10-year spread against Germany was still above 200 basis points, and the rating remained below Investment Grade across the three main credit rating agencies, leading to significant uncertainty about dealers' auction participation at the time. For this reason, the IGCP decided to adopt a new auction format, moving from a discriminatory-price to a uniform-price auction. This was intended to increase investor participation by reducing the winner's curse.

In January 2015, the ECB announced the start of large-scale purchases of government bonds under the *Public Sector Purchase Programme* (PSPP) and, from March 2020, under the *Pandemic Emergency Purchase Programme* (PEPP). Purchases were conducted on a regular basis between March 2015 and December 2018 and between November 2019 and March 2022. Financing conditions for the issuance of Portuguese bonds improved dramatically over the last few years, as the macroeconomic environment improved, the public debt as a ratio to GDP declined from a peak of 134% in 2020 to 94% in 2024, and credit rating agencies increased the credit classification of the Portuguese Republic to an A-level status. IGCP's issuance strategy remained focused on syndicated deals for new T-bonds and regular re-openings via auctions. In 2024, it increased the amount available in T-bond non-competitive offerings from 20% to 30%, with the additional 10 percentage points attributed to the top-5 market makers in the secondary market (unrelated to competitive auction participation). It also extended the bid submission deadline for non-competitive offerings by a few hours, thereby increasing the option value of these offerings.

B Current List of Primary Dealers for Portuguese Sovereign Debt Issuance

This appendix provides the list of primary dealers for Portuguese Treasury auctions and debt issuance as of November 2025.

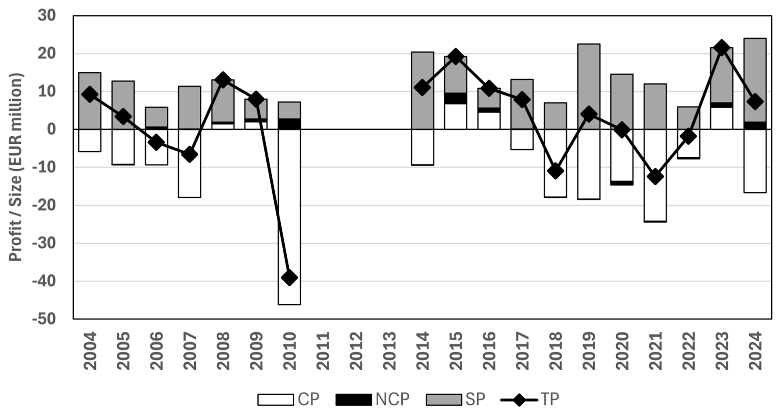
- Banco Santander, S.A
- Bank of America Securities Europa SA
- Barclays Bank Ireland PLC
- BBVA
- BNP Paribas
- Caixa Banco de Investimento, S.A.
- Citibank Europe plc
- Crédit Agricole CIB
- Deutsche Bank, AG
- Goldman Sachs Bank Europe SE
- HSBC Continental Europe
- Jefferies GmbH
- J.P. Morgan SE
- Morgan Stanley Europe SE
- Nomura Financial Products Europe GmbH
- Novo Banco, S.A.

C Additional Figures and Tables

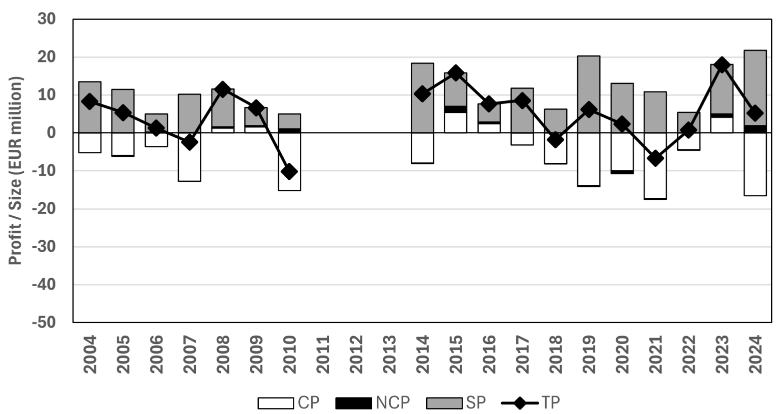
This section provides additional figures and tables that further describe the data and report robustness results.

Figure C1: **Dealer Annual Profits for T-bonds (in millions of EUR).**
This figure presents dealer annual profits in the T-bonds segment in millions of EUR. Total profits (black diamonds) are decomposed in profits from competitive auctions (white), from non-competitive auctions (black), and from syndication fees in the following year (gray). Panel A presents the sum of profits for all dealers, Panel B presents the sum of profits for the dealers selected at least once as lead managers in syndications of the following year, and Panel C presents the sum of profits for the dealers not selected at all as lead managers in syndications of the following year.

Panel A. All dealers.



Panel B. Dealers selected as lead managers in syndications of the following year.



Panel C. Dealers not selected as lead managers in syndications of the following year.

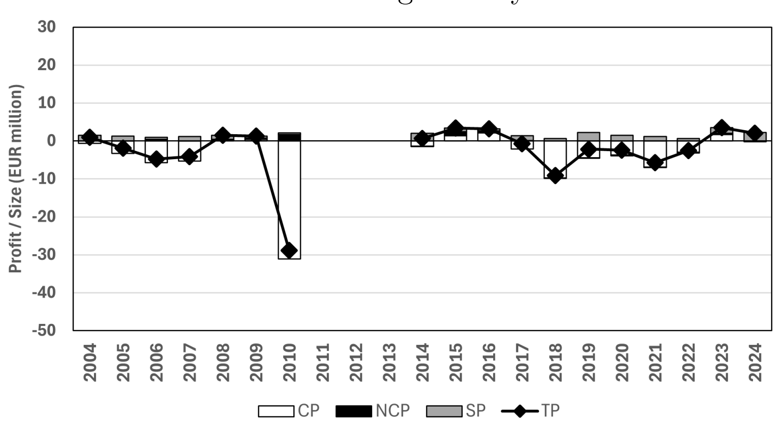


Table C1: **Portuguese Treasury Auction Summary Data by Maturity**

This table presents auctions-level averages for different cuts of the data. The first row reports the results for the full sample of auctions. The next 2 rows report the results split by T-bills and T-bonds. The following rows report results by maturity bucket. *N* is the number of auctions and the following 2 columns disaggregate this number by *multi-price* and *single-price* auctions. *Underpricing* (in Euro) is the difference between the secondary market price and the weighted average of the awarded prices. *Vol* is the realized volatility in the previous 20 trading days of the bond being issued. *E[Size]* is the maximum of the pre-announced size range and *Size* is the effective size (both in billions of euro). *Bid-to-cover* is the ratio of the dollar amount of bids received in the auction to the amount sold. *# Bidders* is the number of bidders in each auction. *Allocated Bidders* is the number of bidders allocated in each auction. *# Bids* is the number of bids in each auction and *# Awarded Bids* is the number of bids awarded in each auction.

	Auctions	Multi-price	Single-price	Under-pricing	Vol	E[Size]	Size	Bids	Awards	Bid-to-Cover	Expected Bidders	Bidders	Allocated Bidders
All	653	517	136	-0.04	0.03	670	677	44.00	29.70	2.50	16.00	15.80	12.50
T-bills	447	447	0	-0.01	0.01	657	671	38.00	27.40	2.69	15.00	14.90	11.80
T-bonds	206	70	136	-0.11	0.07	697	691	56.20	34.40	2.12	18.00	17.80	14.10
3M	114	114	0	-0.01	0.00	495	474	34.80	24.80	3.14	15.20	14.60	10.80
6M	110	110	0	-0.02	0.01	490	500	36.40	25.40	2.95	15.20	15.00	11.30
9M	11	11	0	-0.01	0.01	598	627	36.50	31.30	2.28	13.30	13.60	11.90
12M	205	205	0	-0.01	0.00	841	860	41.00	29.60	2.30	14.90	15.10	12.50
18M	7	7	0	0.04	0.02	1016	1070	39.60	39.60	2.32	15.70	15.40	15.40
2Y	2	2	0	-0.15	0.02	794	841	55.00	55.00	2.41	16.20	19.50	19.50
3Y	13	10	3	-0.09	0.03	742	746	53.20	45.70	2.32	16.60	17.50	15.80
5Y	41	15	26	-0.08	0.06	707	708	55.30	35.10	2.23	18.20	18.60	14.50
7Y	18	3	15	-0.19	0.05	575	556	56.90	29.70	2.20	18.50	18.20	13.40
10Y	88	26	62	-0.13	0.07	769	766	59.40	35.00	2.06	18.10	17.90	14.30
15Y	28	9	19	-0.16	0.08	613	581	52.10	30.20	1.93	17.60	16.50	12.80
30Y	16	5	11	0.06	0.12	508	511	49.90	29.80	2.27	17.70	16.80	12.80

Table C2: **Portuguese Treasury Auction Summary Data by CalendarYear**

This table presents auctions-level averages for different cuts of the data. The first row reports the results for the full sample of auctions. The next 2 rows report the results split by T-bills and T-bonds. The following rows report results by calendar year. *N* is the number of auctions and the following 2 columns disaggregate this number by *multi-price* and *single-price* auctions. *Underpricing* (in Euro) is the difference between the secondary market price and the weighted average of the awarded prices. *Vol* is the realized volatility in the previous 20 trading days of the bond being issued. *E[Size]* is the maximum of the pre-announced size range and *Size* is the effective size (both in billions of euro). *Bid-to-cover* is the ratio of the dollar amount of bids received in the auction to the amount sold. *# Bidders* is the number of bidders in each auction. *Allocated Bidders* is the number of bidders allocated in each auction. *# Bids* is the number of bids in each auction and *# Awarded Bids* is the number of bids awarded in each auction.

	Auctions	Multi-price	Single-price	Under-pricing	Vol	E[Size]	Size	Bids	Awards	Bid-to-Cover	Expected Bidders	Bidders	Allocated Bidders
All	653	517	136	-0.04	0.03	670	677	44.00	29.70	2.50	16.00	15.80	12.50
T-bills	447	447	0	-0.01	0.01	657	671	38.00	27.40	2.69	15.00	14.90	11.80
T-bonds	206	70	136	-0.11	0.07	697	691	56.20	34.40	2.12	18.00	17.80	14.10
2004	25	25	0	-0.03	0.01	594	600	33.80	31.70	3.14	12.40	12.50	11.90
2005	32	32	0	-0.03	0.01	740	740	37.50	36.00	2.35	12.90	13.20	12.80
2006	31	31	0	-0.03	0.01	608	623	39.50	38.20	2.43	13.50	13.60	13.30
2007	26	26	0	-0.08	0.01	642	638	36.30	35.50	2.43	13.50	13.60	13.30
2008	31	31	0	0.02	0.03	684	658	35.70	35.70	2.42	13.20	12.60	12.60
2009	33	33	0	0.01	0.02	795	839	39.10	39.10	2.51	12.90	13.10	13.10
2010	55	55	0	-0.10	0.06	675	698	49.90	49.90	2.35	14.90	16.50	16.50
2011	33	33	0	-0.07	0.02	760	687	40.10	40.10	2.71	15.00	14.80	14.80
2012	25	25	0	-0.02	0.01	725	814	40.10	40.10	4.09	15.30	15.60	15.60
2013	23	23	0	0.00	0.01	650	728	38.50	38.50	2.63	15.90	14.70	14.70
2014	27	23	4	-0.05	0.02	602	658	50.00	16.00	2.82	16.40	16.60	8.80
2015	32	24	8	0.01	0.03	669	716	48.40	19.50	2.58	18.20	18.20	11.30
2016	37	22	15	0.04	0.04	614	693	43.40	21.60	1.99	18.90	17.50	11.90
2017	38	22	16	-0.01	0.02	691	681	44.70	19.40	2.38	18.20	17.70	10.70
2018	37	22	15	-0.09	0.02	669	633	44.30	18.30	2.42	18.20	17.20	10.80
2019	36	20	16	-0.09	0.03	661	632	43.90	19.60	2.39	17.50	16.60	10.00
2020	36	18	18	-0.09	0.03	669	670	55.50	25.90	2.28	17.50	17.90	11.70
2021	23	11	12	-0.18	0.03	614	627	58.20	23.80	2.58	18.60	18.90	12.00
2022	24	14	10	-0.06	0.04	667	656	47.70	23.50	2.15	18.50	17.30	12.50
2023	15	8	7	0.10	0.05	567	510	45.30	17.10	3.04	17.50	17.10	11.90
2024	34	19	15	-0.10	0.05	676	612	47.90	21.80	2.21	17.20	17.00	12.00

Table C3: **Alternative Definitions of Underpricing by Maturity Bucket**

This table reports estimates of underpricing by sample cut, mainly by maturity bucket. *Auctions* is the number of auctions, and the following two columns disaggregate this number by *multi-price* and *single-price* auctions. *UPP* is the price underpricing using end-of-the-day mid-prices. *UPP1* is the price underpricing using previous day end-of-the-day mid-prices. *UPA* is the price underpricing using end-of-the-day ask-prices. *UPA1* is the price underpricing using previous day end-of-the-day ask-prices. *UPB* is the price underpricing using end-of-the-day bid-prices. *UPB1* is the price underpricing using previous day end-of-the-day bid-prices. *UPY* is the price underpricing (in %) using end-of-the-day mid-yields. Coefficients are reported with significance stars based on the corresponding p-values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

	Auctions	Multi-price	Single-price	UPP	UPP1	UPA	UPA1	UPB	UPB1	UPY
All	657	463	140	-0.05***	-0.05***	0.03***	0.02**	-0.13***	-0.14***	-0.92***
T-bills	447	389	0	-0.01***	0.00	0.06***	0.07***	-0.08***	-0.08***	-0.03***
T-bonds	206	70	136	-0.11***	-0.14***	-0.03	-0.06**	-0.22***	-0.25***	-2.71***
3M	114	114	0	0.00***	-0.01***	0.03***	0.03***	-0.04***	-0.04***	-0.01***
6M	110	110	0	-0.01**	0.00	0.03***	0.03***	-0.04***	-0.03***	-0.01**
9M	11	11	0	-0.01	0.02	0.04**	0.07**	-0.06***	-0.03	-0.01
12M	205	205	0	-0.01	0.02**	0.03***	0.06***	-0.05***	-0.02**	-0.01
18M	7	7	0	0.04	-0.10	0.41**	0.44	-0.33**	-0.64	0.05*
2Y	2	2	0	-0.15	-0.02	-0.09	0.06	-0.22	-0.10	-2.51**
3Y	13	10	3	-0.09	-0.08	-0.04	-0.03	-0.15*	-0.13*	-2.79***
5Y	41	15	26	-0.08*	-0.09**	0.00	-0.02	-0.16***	-0.17***	-2.79***
7Y	18	3	15	-0.19**	-0.16**	-0.12	-0.09	-0.26***	-0.23***	-2.23***
10Y	88	26	62	-0.13***	-0.16***	-0.05	-0.08**	-0.23***	-0.26***	-2.57***
15Y	28	9	19	-0.16**	-0.28***	-0.09	-0.20***	-0.33***	-0.43***	-2.84***
30Y	16	5	11	0.06	0.03	0.24	0.23	-0.15	-0.23	-3.62***

Table C4: **Alternative Definitions of Underpricing by Calendar Year**

This table reports estimates of underpricing by sample cut, mainly by calendar year. *Auctions* is the number of auctions, and the following two columns disaggregate this number by *multi-price* and *single-price* auctions. *UPP* is the price underpricing using end-of-the-day mid-prices. *UPP1* is the price underpricing using previous day end-of-the-day mid-prices. *UPA* is the price underpricing using end-of-the-day ask-prices. *UPA1* is the price underpricing using previous day end-of-the-day ask-prices. *UPB* is the price underpricing using end-of-the-day bid-prices. *UPB1* is the price underpricing using previous day end-of-the-day bid-prices. *UPY* is the price underpricing (in %) using end-of-the-day mid-yields. Coefficients are reported with significance stars based on the corresponding p-values: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

	Auctions	Multi-price	Single-price	UPP	UPP1	UPA	UPA1	UPB	UPB1	UPY
All	657	463	140	-0.05***	-0.05***	0.03***	0.02**	-0.13***	-0.14***	-0.92***
T-bills	447	389	0	-0.01***	0.00	0.06***	0.07***	-0.08***	-0.08***	-0.03***
T-bonds	206	70	136	-0.11***	-0.14***	-0.03	-0.06**	-0.22***	-0.25***	-2.71***
2004	25	24	0	-0.03	-0.03**	-0.01	-0.01	-0.05**	-0.04***	-0.53**
2005	32	32	0	-0.03**	-0.08**	-0.01	-0.05*	-0.06***	-0.11***	-0.77***
2006	31	31	0	-0.03*	-0.07*	-0.01	-0.04	-0.05**	-0.09**	-0.86***
2007	26	26	0	-0.08**	-0.03	-0.06*	-0.01	-0.10***	-0.05**	-1.09***
2008	31	31	0	0.02	0.01	0.05	0.04	-0.03	-0.04	-1.34***
2009	33	33	0	0.01	0.01	0.05**	0.05*	-0.07***	-0.07***	-1.00***
2010	55	55	0	-0.10*	0.07*	-0.04	0.13***	-0.21***	-0.04	-1.63***
2011	37	6	4	-0.09**	-0.13**	0.37***	0.38***	-0.55***	-0.63***	-0.22**
2012	25	18	0	-0.02	-0.01	0.26***	0.27***	-0.31***	-0.29***	-0.04*
2013	23	20	0	0.00	0.00	0.13***	0.10**	-0.12***	-0.10***	0.00
2014	27	20	4	-0.05**	-0.07*	0.00	-0.02	-0.11***	-0.13**	-0.74**
2015	32	23	8	0.01	-0.01	0.05	0.03	-0.03	-0.06	-0.78***
2016	37	19	15	0.04	0.00	0.09*	0.06	-0.02	-0.06	-1.29***
2017	38	22	16	-0.01	-0.13***	0.08***	-0.04	-0.10***	-0.22***	-1.23***
2018	37	22	15	-0.09***	-0.12***	-0.03	-0.05	-0.15***	-0.19***	-1.00***
2019	36	17	16	-0.09***	-0.08	-0.05	-0.04	-0.13***	-0.12	-0.97***
2020	36	13	18	-0.09**	-0.11*	-0.05	-0.08	-0.12***	-0.15**	-1.06***
2021	23	10	12	-0.18***	-0.17**	-0.16**	-0.15**	-0.20***	-0.19***	-0.53***
2022	24	14	10	-0.06**	-0.07	-0.02	-0.03	-0.09***	-0.11*	-0.58***
2023	15	8	7	0.10	-0.11**	0.20*	0.00	0.00	-0.21***	-0.63***
2024	34	19	15	-0.10**	-0.13***	-0.03	-0.03	-0.18***	-0.22***	-1.05***

Table C5: **Treasury Bill Dependent Variable Summary Statistics Averages by Calendar Year**
This table reports, by calendar year, the number of bidder level observations ($N1$), the number of auctions ($N2$), the average size ($Size$), and the dependent variable averages for underpricing, bidder discount, bidder profit, and intrabidder dispersion, cumulative take-up in the previous three auction dates (QWIN3), and volatility (Vol) for all the T-bills auctions. Values are reported in euro for a notional face value of 100€.

Year	N1	N2	Size	Underpricing	Discount	Profit	Dispersion	QWIN3	Vol
2004	237	22	548	-0.00327	0.00293	-0.00209	0.00264	0.08346	0.00192
2005	303	25	674	-0.00263	0.00200	-0.00128	0.00210	0.07801	0.00150
2006	303	24	515	-0.00501	0.00127	-0.00386	0.00295	0.07620	0.00162
2007	234	20	530	-0.00447	0.00179	-0.00272	0.00270	0.07756	0.00198
2008	252	22	650	0.01192	0.04073	0.00744	0.01602	0.08029	0.00496
2009	294	25	820	-0.00203	0.02280	-0.00031	0.01146	0.07982	0.00292
2010	456	32	661	-0.01937	0.07511	-0.00616	0.04276	0.06682	0.00786
2011	443	34	721	-0.06415	0.16695	-0.01739	0.05787	0.06601	0.01894
2012	280	26	739	-0.02538	0.11846	-0.01750	0.05990	0.05987	0.00917
2013	293	24	673	0.00517	0.08503	-0.00100	0.02954	0.06297	0.00720
2014	316	24	559	-0.00753	0.00829	-0.00580	0.00591	0.06021	0.00347
2015	400	25	649	-0.00757	-0.00052	-0.00483	0.00298	0.05303	0.00109
2016	307	23	688	-0.00859	0.00145	-0.00572	0.00375	0.05559	0.00128
2017	363	23	714	-0.00366	0.00480	-0.00196	0.00236	0.05262	0.00169
2018	350	23	684	-0.00996	-0.00167	-0.00553	0.00272	0.05576	0.00132
2019	256	21	613	-0.00811	-0.00238	-0.00430	0.00161	0.06098	0.00065
2020	231	19	756	-0.00845	0.00171	-0.00497	0.00763	0.05530	0.00139
2021	191	12	678	-0.00997	-0.00361	-0.00601	0.00265	0.05126	0.00062
2022	247	15	702	-0.00690	0.00880	-0.00521	0.00735	0.05587	0.00292
2023	137	9	496	-0.02977	0.00108	-0.00678	0.01384	0.05602	0.01159
2024	327	20	673	-0.00677	0.00609	-0.00475	0.00620	0.05745	0.01557
Total	6,220	447	661	-0.01147	0.03099	-0.00514	0.01530	0.06393	0.00509

Table C6: **Treasury Bond Dependent Variable Summary Statistics Averages by Calendar Year**

This table reports, by calendar year, the number of bidder level observations ($N1$), the number of auctions ($N2$), the average size ($Size$), and the dependent variable averages for underpricing, bidder discount, bidder profit, and intrabidder dispersion, cumulative take-up in the previous three auction dates (QWIN3), and volatility (Vol) for all the T-bonds auctions. Values are reported in euro for a notional face value of 100€.

Year	N1	N2	Size	Underpricing	Discount	Profit	Dispersion	QWIN3	Vol
2004	63	4	825	-0.1854	-0.1313	-0.1439	0.0294	0.0611	0.0284
2005	124	9	925	-0.1239	-0.0829	-0.1058	0.0267	0.0644	0.0289
2006	128	9	965	-0.1214	-0.0811	-0.1004	0.0336	0.0621	0.0396
2007	119	8	937	-0.2778	-0.2176	-0.2156	0.0392	0.0574	0.0384
2008	138	11	767	0.0221	0.1530	0.0482	0.0509	0.0621	0.0638
2009	138	10	904	0.0489	0.1615	0.0155	0.0683	0.0614	0.0583
2010	451	25	745	-0.2033	0.0061	-0.2048	0.1601	0.0529	0.1178
2014	82	5	975	-0.2452	-0.0639	-0.2452	0.2037	0.1019	0.0793
2015	160	9	956	0.0797	0.1758	0.0797	0.1367	0.0487	0.1031
2016	289	16	605	0.0876	0.1259	0.0876	0.0961	0.0511	0.0847
2017	310	17	646	-0.0159	0.0994	-0.0159	0.0915	0.0510	0.0569
2018	285	16	585	-0.1969	-0.0737	-0.1974	0.1570	0.0511	0.0498
2019	290	17	594	-0.1700	-0.0433	-0.1701	0.1087	0.0548	0.0599
2020	325	19	619	-0.1393	-0.0612	-0.1393	0.1128	0.0546	0.0537
2021	224	13	556	-0.3171	-0.2186	-0.3171	0.0982	0.0530	0.0481
2022	168	11	601	-0.1238	-0.0953	-0.1238	0.1071	0.0586	0.0803
2023	119	8	524	0.2497	0.3466	0.2497	0.1211	0.0588	0.0873
2024	252	16	537	-0.2275	-0.2189	-0.2275	0.1282	0.0591	0.0882
Total	3,665	206	693	-0.1132	-0.0139	-0.1096	0.1084	0.0559	0.0698

Table C7: **Regressions of Bid Dispersion on Competition Variables, and Competition Interacted with Bidder Type.**
This table presents regression results for the dependent variable bid dispersion, $DISP$, which describes part of a dealer's demand schedule. $E[Size]$ is the upper limit of the announced range of the auction size. Vol is the realized volatility over the previous 20 days of the bond being auctioned. UPA is a dummy variable with a value of 1 when the auction follows a uniform pricing. $Q4$ is a dummy variable that takes the value 1 if the auction occurs in the fourth quarter of the year. $QWIN3$ is the proportion of allocation in the last 3 auction dates of the same type. $G1$, $G2$, and $G3$ are dummy variables that take the value 1 if the dealer is in the upper quartile, second quartile, and third quartile, respectively, of the cumulative take-up of auctions of the same type since January of the previous year until the month before the auction takes place. All regressions are estimated by weighted-least-squares and include year-fixed effects. Standard errors are in parentheses and significance levels correspond to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are clustered at the dealer level.

	T-bonds		T-bills	
	(1)	(2)	(3)	(4)
ESIZE	-0.040*	-0.040*	-0.009	-0.009
	(-1.98)	(-1.99)	(-1.51)	(-1.51)
VOL	0.473***	0.473***	0.381***	0.382***
	(4.25)	(4.24)	(4.50)	(4.44)
UPA	0.068***	0.068***		
	(3.09)	(3.11)		
Q4	0.007	0.007	-0.007**	-0.007**
	(0.68)	(0.68)	(-2.48)	(-2.41)
L3	-0.105	-0.140	-0.055	-0.046
	(-0.58)	(-1.30)	(-1.51)	(-1.06)
G1		0.007		-0.003
		(0.26)		(-0.34)
G2		0.008		0.004
		(0.32)		(0.29)
G3		0.001		-0.003
		(0.08)		(-0.32)
Constant	0.055**	0.053	0.013***	0.013
	(2.25)	(1.68)	(2.91)	(1.58)
Observations	3,629	3,629	6,220	6,220
Adj. R^2	0.079	0.078	0.157	0.158

Table C8: **Regressions of Bidder Discount on Competition Variables: Adding MAT.**
This table presents regression results for the dependent variable bidder discount, $DISC$, which describes part of a dealer's demand schedule, adding the variable MAT to Table IX. MAT is the residual maturity of the issued security in years. Check Table IX for the definitions of the remaining variables. All regressions are estimated using volatility-weighted least squares and include year-fixed effects. *t-statistics* are in parentheses and significance levels correspond to * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are clustered at the dealer level.

	T-bonds		T-bills	
	(1)	(2)	(3)	(4)
ESIZE	-0.282***	-0.283***	-0.221***	-0.220***
	(-7.64)	(-7.92)	(-6.34)	(-6.30)
VOL	0.394	0.400*	1.657***	1.670***
	(1.69)	(1.71)	(3.94)	(3.96)
MAT	0.012***	0.012***	0.169***	0.168***
	(7.47)	(7.58)	(4.56)	(4.56)
UPA	-0.284***	-0.300***		
	(-6.86)	(-7.34)		
Q4	-0.374***	-0.374***	0.027**	0.027**
	(-12.58)	(-12.52)	(2.20)	(2.17)
L3	-1.228***	-0.657**	-0.608***	-0.466***
	(-3.51)	(-2.40)	(-6.10)	(-3.61)
G1		-0.137***		-0.043
		(-2.75)		(-1.24)
G2		-0.186***		0.007
		(-4.01)		(0.28)
G3		-0.172***		0.002
		(-3.55)		(0.08)
Constant	0.096**	0.207***	0.023	0.020
	(2.25)	(4.08)	(0.92)	(0.57)
Observations	3,629	3,629	6,220	6,220
Adj. R^2	0.196	0.208	0.194	0.198