The US Treasury's Biggest Short: Duration in the Shadows *

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Abstract

We show the U.S. Treasury prioritizes nominal over market value of debt, at cost to taxpayers. The Treasury absorbs fiscal shocks through bills while maintaining predictable longer-term issuance, and does not adjust duration supply in response to market signals, instead tilting toward maturities with the highest intermediation margins. The 2024–2025 buyback program targeted below-par bonds, freeing $21 billion in nominal fiscal capacity with no market-value gain for taxpayers. Exploiting staggered ESA 2010 adoption, we find core European countries reduced term spreads by 0.28 to 0.37 percentage points by managing duration risk.

Keywords: U.S. Treasury, Debt management, Duration risk, Debt maturity, Market value, Buybacks, Fiscal accounting, ESA 2010.

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1 INTRODUCTION

The U.S. Treasury manages its debt under a "regular and predictable issuance" principle (Garbade, 2007; Treasury Borrowing Advisory Committee, 2015). Treasury Secretary Scott Bessent has stated that "[o]ur guiding principle at the Treasury Department is to finance the government at the least cost over time," and that the "Regular and Predictable" issuance framework "has proven to be the most effective means of achieving those goals" (Bessent, 2025). Assistant Secretary Frost further articulates this commitment and states that the Treasury does "not respond to short-term changes in market pricing or attempt to time the market to capture technical rate dislocations" (Frost, 2024). By avoiding market timing, the Treasury reduces uncertainty, supports secondary market liquidity, and broadens auction participation (Garbade, 2007). However, by applying the "regular and predictable" principle to debt management broadly, the Treasury also foregoes the benefits of simply managing the duration risk of its liabilities and adjusting issuance composition in response to market demand.

Over the past two decades, the Treasury has expanded its unmanaged duration exposure dramatically, growing outstanding marketable debt from \$3 trillion in 2002 to nearly \$30 trillion in 2025 while keeping the weighted-average maturity narrowly between 4.0 and 6.0 years despite substantial changes in market conditions (see Appendix Figure 1). The Treasury issues approximately \$20 trillion of this outstanding debt as fixed-rate notes and bonds, all of which carry duration exposure and on which the Treasury pays term premia as compensation for investors' duration exposure. Because the weighted-average maturity barely moved — from 5.5 years in 2002 to 6.0 years in 2025 — the dollar duration of the total debt stock grew nearly tenfold, from \$119 billion to \$1.2 trillion per percentage-point change in interest rates. Therefore, on the one hand, the Treasury leaves taxpayers directly exposed to \$1.2 trillion in economic losses — nearly 4% of GDP — for a 1% increase in interest rates. On the other hand, investors require term premia as compensation for bearing this duration risk, and the Treasury passes these higher term premia back to taxpayers through elevated borrowing costs. Therefore, by not acknowledging the market value of its liabilities and refusing to tactically manage duration supply, the Treasury forgoes systematic savings in borrowing costs.

We make three contributions to understanding these borrowing costs and their nature. First, we provide comprehensive evidence on the Treasury's approach to debt management. Second, we exploit the recent buyback operations of the Treasury to reveal its preferences for low nominal value of debt over low market value. Third, we exploit the staggered adoption of the European System of Accounts (ESA 2010) across European countries to show the Treasury forgoes significant cost savings by ignoring the market value of its liabilities. Overall, we show that the Treasury incurs large and avoidable borrowing costs by ignoring the market value of its liabilities.

As a first step to analyze the Treasury's approach to debt management, we evaluate how the Treasury chooses between bill and coupon issuance and how it allocates coupon issuance across maturities. We show that the Treasury uses bills effectively as "shock absorbers" (Bessent, 2025) and not as a duration-management tool. First, we exploit the Treasury's quarterly refunding announcements to obtain data on issuance as planned up to five months ahead of actual issuance. We then compare the Treasury's planned issuance with the realized borrowing needs. We show that the Treasury allocates 97.9% of any borrowing surprise over the planned amount to bills. Furthermore, we use time-series data on government deficits, net bill issuance, and net coupon issuance to study how fiscal shocks are financed. Using an unobserved-component model, we decompose fiscal shocks into permanent and transitory components. We show that the Treasury immediately finances both temporary and permanent shocks with bills, but then gradually transitions permanent shocks to coupon issuance over approximately two years.[1]

We then analyze the Treasury's allocation of coupon issuance across maturities. To measure the amount of duration risk the Treasury supplies to the market, we measure the dollar duration at each maturity. To evaluate whether the Treasury shifts duration supply across maturities in response to market demand, we then compute the share of duration supplied at each maturity. Consistent with the Treasury's static approach to total coupon issuance, we find that issuance at each maturity largely matches the issuance announced at the previous quarter's refunding, which happened up to five months before actual issuance. We then analyze the Treasury's response to market signals, using spreads over the one-year bill and spreads over maturity-matched swap rates. We find that the Treasury does not adjust duration supply in response to market signals. If anything, the Treasury appears to tilt issuance toward maturities where intermediaries earn the highest margins in swapping floating to fixed rates.

Although some scholars argue that high Treasury yields over swap rate reflect strong demand for duration by certain investors, such as pension funds and insurance companies (Hanson et al., 2024; He et al., 2022; Jermann, 2020; Kashyap et al., 2025; Klingler and Sundaresan, 2019), this spread also captures an opportunity cost for the Treasury, as well as an intermediation margin for dealers. A dealer that holds the Treasury security,

[1] In contrast, Angeletos (2002) shows that optimal maturity depends on the persistence of fiscal shocks: transitory shocks are optimally financed with short-term debt, but permanent fiscal needs should be immediately financed with longer maturities.

finances it at the floating rate, and hedges with a pay-fixed swap, earns the spread as a risk-free profit. The Treasury could then reduce its borrowing costs by issuing floating rate notes and swapping into fixed rates. However, the Treasury historically and currently rejects the use of interest rate swaps for debt management. Moreover, its floating rate note program is minimal, representing just 3% of outstanding debt. We argue these self-imposed constraints to debt-management are costly.

Then, we provide more direct evidence that the Treasury prefers low nominal value of debt over low market value using the recent buyback operations. The Treasury officially launched its 2024–2025 buyback program to support liquidity in off-the-run securities. However, because the Treasury runs a persistent deficit, any buyback must be financed with new issuance. From a market-value perspective, taxpayers experience no change in the burden of debt. In contrast, from a face-value perspective, the government frees fiscal capacity and lowers the nominal value of debt by retiring bonds trading below par and issuing bonds at par to cover the market value of the repurchased bonds. Under nominal-value-only concerns, the Treasury gains fiscal capacity from this nominal arbitrage.

We find that the Treasury exploits this fiscal-capacity arbitrage and systematically targets bonds with the deepest discounts for repurchase. We show that the Treasury selects eligible bonds for buyback operations that tend to be significantly more discounted than the typical bonds in the market even after controlling for yield, coupons, time to maturity and proxies of illiquidity, namely bid-ask spreads, issue size, and vintage. By targeting discounted bonds, the Treasury freed approximately $21 billion in nominal fiscal capacity on the $280 billion in par repurchased. However, the gain to taxpayers, measured in market value, is exactly zero.

Finally, we provide causal evidence that this accounting friction is costly by exploiting the staggered adoption of market-value reporting requirements under ESA 2010 across European sovereigns. With ESA 2010, European governments agreed to report the market value of debt in national accounts, forcing European sovereigns to confront the market value of their debt and their duration exposure in official statistics and publications. Core European countries that adopted ESA 2010 experienced a drop in sovereign borrowing costs of 38 to 49 basis points on the swap spread and 0.28 to 0.37 percentage points on the term spread, with a corresponding decline of 0.59 percentage points in the realized implicit interest rate for the Core Europe plus Italy aggregate. Applied to the Treasury's $20 trillion in outstanding fixed-rate notes and bonds, the spread-based estimates imply annual savings of approximately $77 to $98 billion, dwarfing the $1.5 billion annual savings attributed to the Treasury regular and predictable strategy (Frost, 2024; Treasury

Borrowing Advisory Committee, 2015).[2]

2 Related Literature

To the best of our knowledge, this is the first paper to identify nominal-value accounting as a key and costly friction in sovereign debt management. While the Treasury's regular-and-predictable issuance framework has received prior attention, the role of nominal-value accounting in distorting the maturity composition of debt has gone unrecognized. In the past, researchers have discussed how accounting practices generate mismeasured estimates of the cost of public debt (Bohn, 1992; Boskin, 1982; Eisner and Pieper, 1984; Hall and Sargent, 2011; Penner, 1982). We argue that such practices not only introduce mismeasurement, but also distort issuance incentives and generate real costs for taxpayers.

We contribute to the literature on government buybacks by showing that the Treasury used the 2024–2025 liquidity-support program to free fiscal capacity, rather than to reduce the market value of duration risk borne by investors. Prior work frames buybacks as operational or liquidity tools and does not consider their role in fiscal capacity management. Garbade and Rutherford (2007) provide the canonical institutional history of the 2000–2001 program and Duffie and Keane (2023) discuss the role of buybacks in ensuring market functionality. Han et al. (2007) find execution costs of only 4.4 cents per $100, yet show that the Treasury preferentially accepted high-coupon, long-maturity bonds, consistent with minimizing reported interest expense rather than the cost of capital. Zhou (2025) evaluates the 2024 program and finds that listing securities narrows off-the-run bid-ask spreads by 0.2 basis points, with effects concentrated at the shortest eligible maturities. The nominal-reduction objective is not unique to the United States: Blommestein et al. (2012) survey 33 OECD debt managers and find that most cite reducing refinancing risk as their primary buyback motive. Greenwood and Vayanos (2010) and Connolly and Struby (2024) provide evidence that buybacks can move the term structure. Bulow and Rogoff (1988) establish that, in Latin American countries, buybacks of deeply discounted sovereign debt transfer most of the gain to creditors through an average-versus-marginal wedge.

We contribute to the literature on the Treasury's "regular and predictable" issuance framework. Garbade (2007) traces how this norm emerged in the 1970s and became institutionally self-reinforcing. Glasserman et al. (2017) and Cassidy and Mirani (2025) study

[2] In Treasury Borrowing Advisory Committee (2015), the Treasury Borrowing Advisory Committee estimates the Treasury saved $27 over the 18-year period from 1998 to 2015.

the implications of this framework on bill issuance. Specifically, Glasserman et al. (2017) estimates that the cost of a regular and predictable bill issuance is only one basis point higher than the cost-minimizing one. Cassidy and Mirani (2025) use the decline in net bill supply during debt-ceiling episodes as an instrument to estimate supply effects on convenience premia. A recent, high-frequency identification literature shows that surprise changes in issuance affect market yields (Bi et al., 2026; Hartley and Rigon, 2026; Joyce and Lengyel, 2024; Mustafi, 2026; Phillot, 2025). Wang and Zhao (2025) exploit the quarterly Refunding Announcement calendar to document a pre-announcement drift in bond returns, which they attribute to fiscal uncertainty resolution rather than borrowing-need surprises.

Most of the literature on Treasury issuance focuses on demand-side factors, while the supply side is often treated as exogenous. Among the recent demand-side literature, Somogyi et al. (2025) measure the slope of auction demand schedules and find that the yield impact of a 1% supply increase has risen from 2 basis points pre-2010 to 10 basis points post-2010. Chaudhary et al. (2025) find that demand for Treasury is highly inelastic and varies across investors and over time. Using more than 5,000 Brazilian Treasury auctions, Andrade and Da Rocha (2026) show that dealers demand larger price concessions for larger offerings. These studies are related to a growing literature that studies investor demand in treasury auctions in the U.S. and internationally (Allen et al., 2022; Back and Zender, 1993; Boyarchenko et al., 2021; Cammack, 1991; Cole et al., 2022; Elsinger et al., 2019; Hamao and Jegadeesh, 1998; Hortaçsu and Kastl, 2012; Hortaçsu et al., 2018; Hortaçsu and McAdams, 2010; Keloharju et al., 2005; Nyborg et al., 2002; Simon, 1994; Umlauf, 1993). In another strand of demand-side literature, researchers have also documented the role of intermediary frictions and dealer's risk-bearing capacity in auction pricing and Treasury-market functionality (Albuquerque et al., 2024; Duffie, 2023; Du et al., 2023; Fleming et al., 2024; Kashyap et al., 2025; Klingler and Sundaresan, 2023; Lou et al., 2013; He et al., 2022).

Unlike this literature, our purpose is to document the issuance distortions originating from a regular and predictable framework and by nominal-value accounting. We therefore study treasury issuance from the supply side. Our result that the Treasury does not respond to market signals stand in sharp contrast with the practice of corporate issuers. In corporate finance, the supply-side literature has documented how firms adjust the supply of securities in response to market conditions and risk management considerations. Previous literature has shown that, in response to changes in relative prices or nonfundamental demand by investors, firms adjust debt composition (Baker et al., 2003; Becker and Ivashina, 2014; Butler et al., 2006; Darmouni and Siani, 2021; De Santis and Zaghini, 2021; Grosse-Rueschkamp et al., 2019; Pegoraro and Montagna, 2025; Todorov, 2020), interest-rate exposure (Faulkender, 2005), equity issuance (Baker and Wurgler, 2000, 2002; Dong et al., 2012; Loughran and Ritter, 1995; Spiess and Affleck-Graves, 1995), and the mix of equity and debt financing (Alti, 2006; Baker and Wurgler, 2000; Gao and Lou, 2012; Ma, 2019).

The relative supply of long-term and short-term Treasuries has measurable effects on financial markets, private-sector issuance, and the real economy. Greenwood and Vayanos (2014) show that duration-weighted government debt supply positively predicts bond yields and excess returns, with effects that are increasing in maturity. Krishnamurthy and Vissing-Jorgensen (2012) further show that the safety and liquidity of Treasuries generate downward-sloping demand, so that changes in aggregate supply of short-term safe assets affect convenience premia and credit spreads across the economy. Greenwood et al. (2015) formalize this logic in a normative framework, showing that the government has a comparative advantage in supplying short-term safe claims and that increases in bill supply raise short-term money premia while crowding out private short-term debt issuance roughly one-for-two. These supply effects are amplified by market segmentation and intermediary constraints (d'Avernas and Vandeweyer, 2024; Stein and Wallen, 2025). Greenwood et al. (2010) show that corporations act as gap-fillers, absorbing government maturity shocks by adjusting their own debt maturity in the opposite direction. Hubert de Fraisse (2024) shows that a longer government maturity profile raises long-term discount rates and crowds out long-duration corporate investment.

Our policy prescription is that the Treasury should internalize the market value of debt and manage its duration risk. One solution would be to shorten the maturity of government debt, as also implied by the work of Greenwood et al. (2015), Greenwood et al. (2010) , and Krishnamurthy and Vissing-Jorgensen (2012). An alternative solution would be to issue more floating-rate notes (FRNs), which would provide both long-term funding and minimal duration-risk exposure. The Treasury, however, issues only marginal quantities of two-year FRNs, generating market incompleteness and costly intermediation (Georgievska and Saunders, 2025).

3 Data

Our empirical analysis draws on three groups of data: U.S. fiscal and issuance data, bond and derivatives market pricing data, and cross-country fiscal and institutional data for eleven sovereigns.

3.1 U.S. Fiscal and Issuance Data

Our U.S. analysis draws on four sources: Treasury auction records and refunding announcements for issuance and borrowing decisions, yield and swap rate data for market signals, monthly fiscal data for the deficit decomposition, and CRSP security-level data for buyback analysis.

3.1.1 Issuance Decisions and Market Signals

We obtain gross issuance data from fiscaldata.treasury.gov, collecting Treasury auction results for Bills, Notes, Bonds, Treasury Inflation-Protected Securities (TIPS), and Floating Rate Notes (FRN). We subtract purchases by the Federal Reserve open-market-account (SOMA) from total accepted amounts so that all issuance measures reflect securities placed with private market participants. Gross issuance is aggregated at the quarterly level after netting bills that are issued and mature in the same quarter.

We supplement the realized issuance data with forward-looking guidance from quarterly Treasury Refunding Announcements (TRA), issued jointly by the U.S. Department of the Treasury and the Treasury Borrowing Advisory Committee (TBAC). For coupon issuance, each announcement publishes a *current recommendation*—the planned issuance for the current quarter—and an *indication for future*—forward guidance for the following quarter. Each announcement also reports total marketable borrowing needs at three successive information stages: the *Forecast* (next quarter's indicated borrowing, announced one quarter ahead), the *Estimate* (current quarter's recommended borrowing, announced at the start of the quarter), and the *Actual* (realized borrowing, reported in the following quarter's announcement).

U.S. Treasury yields come from the Federal Reserve Board's H.15 release (obtained from FRED), providing daily constant-maturity yields at maturities from one month to 30 years (`DGS1MO`–`DGS30`). The *term spread* at each maturity is defined as the constant-maturity yield at that maturity minus the three-month constant-maturity yield, both from H.15. Swap rates are obtained from Bloomberg at daily frequency, covering LIBOR-based and SOFR-based fixed-for-floating interest rate swaps at the same maturities as the yield curve. The *swap spread* is defined as the Treasury constant-maturity yield minus the swap rate at the same maturity. This convention is the reverse of the definition in the swap spreads literature (Klingler and Sundaresan, 2019; Jermann, 2020), who define the swap spread as the swap rate minus the Treasury yield. Under our convention, a positive spread indicates that the sovereign is paying more for fixed-rate funding than the synthetic alternative via a floating-rate instrument and a pay-fixed swap. Because USD LI-

BOR was discontinued in June 2023, we construct a combined swap rate series that uses LIBOR-based rates through the transition date and SOFR-based rates thereafter. These daily series are converted to quarterly frequency using the last daily observation strictly before the quarter start date, so that all market variables are predetermined relative to the quarter's issuance decisions. An observation is set to missing if no reading falls within 15 calendar days of the quarter start date. Summary statistics for all market timing variables are reported in Table 1.

3.1.2 Financing Needs and Issuance Surprises

Using information on the forecast, estimate, and actual borrowing needs and coupon issuance from the TRA announcements, we construct measures of borrowing surprises at each stage of the information flow. We measure surprises as revisions between adjacent stages. The *planning surprise* is the Estimate minus the Forecast, capturing the revision to the borrowing outlook made at the start of the quarter relative to the prior quarter's forward guidance. The *execution surprise* is the Actual minus the Estimate, capturing financing developments that materialized within the quarter. The *total surprise* is the Actual minus the Forecast. Separate surprises are constructed for total marketable borrowing, coupon issuance, and bill issuance.

Because the Treasury does not separately publish planned bill issuance, we infer it at each stage from the following identity:

$$\text{Bill issuance} = \text{Marketable borrowing} + \text{Maturing debt} - \text{Coupon issuance}.$$

Maturing debt is computed as total gross SOMA-adjusted issuance (bills and coupons, excluding bills that mature within the same quarter) minus the quarterly change in Federal Debt Held by the Public (FRED series `FYGFDPUN`).

3.1.3 Monthly Issuance and Deficit Data

We also use monthly data on deficit and marketable borrowing to identify impulse-responses of issuance to deficit shocks. We construct monthly net issuance of bills and coupon securities by first-differencing the outstanding amounts of privately held debt from the Monthly Statement of the Public Debt (MSPD), available from fiscaldata.treasury.gov, covering January 2002 through December 2025. Monthly deficits come from the Monthly Treasury Statement (MTS), also from fiscaldata.treasury.gov, over the same period. All nominal series are deflated by the lagged-quarter GNP deflator (FRED series `GNPDEF`) so that the price index is observable prior to each period's issuance decisions. Summary statistics for these monthly series are reported in Panel A of Table 3.

3.1.4 Buyback and Security-Level Data

For Treasury buyback operations, we collect security-level data from the Treasury Fiscal Data API for two distinct periods: 2000–2003 and 2024–2025. We also obtain the universe of outstanding Treasury securities from the CRSP Treasury issue file (accessed via WRDS), which provides issue characteristics (coupon rate, issue date, and maturity date). We then obtain data on daily nominal prices, bid and ask quotes, yield-to-maturity, and total face value outstanding from the CRSP Treasury daily file (accessed via WRDS). We aggregate all daily CRSP variables to the monthly level by taking the last available daily observation within each calendar month for each security, yielding a panel of security$\times$month observations. Bond age and remaining maturity are computed as the elapsed time from the issue date (respectively, to the maturity date) to the last calendar day of the month. A security is flagged as eligible (accepted) for buyback in month t if it appears as eligible (accepted) in at least one operation during month t. Summary statistics for both buyback samples are reported in Table 4.

3.2 Cross-Country Fiscal and Institutional Data

Our cross-country sample includes eleven countries: the United States (control), two early adopters (Germany and Netherlands, treated from January 2010), and eight mandatory adopters (France, Italy, Spain, Belgium, Austria, Ireland, Portugal, and Greece, treated from the mandatory compliance date of September 2014). The early treatment assignment for Germany and the Netherlands reflects documented changes in their duration management frameworks incorporating market-value considerations, as described in Section 5.1. We classify countries into Core Europe (Germany, Netherlands, France, Belgium, Austria) and Periphery Europe (Italy, Spain, Ireland, Portugal, Greece).

We use monthly sovereign zero-coupon yield curves from Bloomberg spanning January 2000 through June 2023 (282 observations per country). From these curves, we construct two outcome variables: the term spread (10-year minus 1-year sovereign zero rate, in percentage points) and the swap spread, defined as in section 3.1. International bond market data come from the Bundesbank (Germany), the Dutch State Treasury Agency (Netherlands), and the ECB Statistical Data Warehouse. Fiscal fundamentals and balance-sheet variables for the Euro-area sovereigns, in particular general government gross debt at face value, interest payable, the deficit, and the F.7 mark-to-market position on financial derivatives, are sourced from Eurostat. The corresponding U.S. series come from the Treasury Monthly Statement of the Public Debt, the Federal Reserve Z.1 Financial Accounts, the Congressional Budget Office, and the U.S. Bureau of Economic Analysis. Online Appendix IA.2 describes the construction of the cross-country panels in full, including Eurostat instrument codes, Bloomberg ticker conventions, and the U.S. source documents. Our cross-country sample ends in June 2023 to coincide with the cessation of USD LIBOR. One limitation is the absence of sovereign CDS data for the U.S. before 2009, which precludes a direct credit risk control for the full pre-treatment period. We instead proxy for sovereign credit risk using debt-to-GDP and budget balance-to-GDP ratios.

Controls include macroeconomic indicators (GDP, inflation, unemployment) from country-specific sources and the ECB Statistical Data Warehouse, European equity volatility (V2X), country-specific fiscal fundamentals (debt-to-GDP and budget balance-to-GDP ratios), short-term sovereign rates, the policy rate differential between the Federal Reserve and the ECB, and country-specific binary indicators for active quantitative easing (QE) periods. US QE periods span the Federal Reserve's asset purchase programs from November 2008 through March 2022; ECB QE periods cover the Securities Markets Programme, the Public Sector Purchase Programme, and the Pandemic Emergency Purchase Programme. Online Appendix IA.2 contains details on the data collection.

4 The U.S. Treasury's Debt Management

We begin by showing that the U.S. Treasury uses bills as the residual financing instrument that absorbs borrowing surprises, preserving stable fixed-rate issuance. We also examine the maturity composition of fixed-rate debt through the lens of duration supply and find that the Treasury does not adjust the duration profile of its issuance in response to market signals indicating favorable or unfavorable conditions for long-term borrowing. We then document the Treasury's incentives to manage the nominal value of debt through buyback operations.

4.1 Treasury Bills as Fiscal Shock Absorbers

This section presents empirical evidence that the Treasury systematically channels unexpected borrowing needs into short-term bill issuance, preserving the "regular and predictable" fixed-rate issuance schedule.

4.1.1 Absorption of Borrowing Surprises

Our empirical strategy exploits the information structure of Treasury refunding announcements to identify borrowing surprises at different horizons. As described in Section 3.1, we construct measures of total, planning, and execution surprises for marketable borrowing, coupon issuance, and bill issuance, yielding nine series in total. Summary statistics are in Table 2. A first look at the data is already suggestive: the standard deviation of total coupon issuance surprises is $43 billion, roughly one-eighth of the standard deviation of total borrowing surprises ($343 billion) and of total bill issuance surprises ($340 billion). The same pattern holds across planning and execution horizons. Coupon surprises are not only small on average, but also tightly clustered around their mean, reflecting gradual, pre-announced build-ups in the fixed-rate schedule. Bill surprises, by contrast, mirror the full dispersion of total borrowing surprises. This descriptive asymmetry anticipates the main finding: virtually all variation in financing needs is absorbed by bills, while coupon issuance follows a predetermined path.

We test whether borrowing surprises pass through differentially to bills versus coupons by estimating:

$$\text{IssuanceSurprise}_{j,t} = \alpha_j + \beta_j \cdot \text{BorrowingSurprise}_t + \varepsilon_{j,t} \tag{1}$$

where $j \in \{\text{Coupon}, \text{Bill}\}$ indexes the security type, $\text{IssuanceSurprise}_{j,t}$ is the issuance surprise for security type j, and $\text{BorrowingSurprise}_t$ is the total marketable borrowing surprise. Under perfect shock absorption, we expect $\beta_{\text{Coupon}} = 0$ and $\beta_{\text{Bill}} = 1$: all borrowing surprises flow entirely to bills while coupon issuance remains on its predetermined path. Inference uses heteroskedasticity-robust standard errors. The sample spans 2002Q1 through 2025Q4.

Table 5 presents results from estimating equation (1) across three information stages: total surprise (forecast to actual), planning surprise (forecast to estimate), and execution surprise (estimate to actual). For total borrowing surprises, the coefficient on bill issuance is 0.979 (s.e. = 0.007), while the coefficient on coupon issuance is 0.021 (s.e. = 0.007). The R^2 values reinforce this interpretation: bill surprises explain 98.4% of borrowing surprise variation, while coupon surprises explain only 2.9%. This near-complete separation confirms that virtually all unexpected borrowing needs flow to bills.

The decomposition by information stage reveals that shock absorption operates at both the planning and execution margins. Planning surprises show coefficients of 0.980 for bills and 0.020 for coupons, indicating that even when the Treasury revises its borrowing estimate from the previous quarter's forecast, the adjustment occurs almost entirely through bills. Execution surprises exhibit even stronger absorption: the bill coefficient is precisely 1.000 while the coupon coefficient is exactly 0.000, indicating that within-quarter adjustments are channeled exclusively to bill issuance.

4.1.2 Dynamic Responses to Permanent and Transitory Shocks

To examine whether the Treasury differentiates between permanent and transitory financing needs, we decompose the federal deficit into its structural level and temporary components using an unobserved components (UC) model with local-level structure (Durbin and Koopman, 2012; Harvey, 1989). This approach follows Beveridge and Nelson (1981) and Watson (1986) in decomposing macroeconomic time series into trend and cycle. To remove trends attributable to inflation, we follow standard practice in the fiscal policy literature (Blanchard and Perotti, 2002; Romer and Romer, 2010) and deflate all nominal deficit and issuance series by the GNP implicit price deflator (FRED series `GNPDEF`, quarterly, obtained from the Bureau of Economic Analysis via FRED.). Summary statistics for the monthly deficit and net issuance series are reported in Panel A of Table 3.

The model specifies the GNP-deflated deficit series D_t as the sum of a stochastic level τ_t (the structural deficit) and transitory noise ε_t (cyclical fluctuations):

$$D_t = \tau_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma_\varepsilon^2) \tag{2}$$

$$\tau_t = \tau_{t-1} + \eta_t, \quad \eta_t \sim N(0, \sigma_\eta^2) \tag{3}$$

where η_t represents permanent innovations to the deficit level (shifts in the structural deficit) and ε_t captures transitory fluctuations. By construction, permanent and transitory shocks are orthogonal, providing clean identification for the impulse response analysis that follows. Summary statistics for both shocks are reported in Panel B of Table 3.

We then trace the dynamic response of bill and coupon net issuance to each shock type using local projection impulse response functions (Jordà, 2005), which have become standard in applied macroeconomics for their robustness to model misspecification (Stock and Watson, 2018). For each horizon $h = 0, 1, \ldots, H$, we estimate:

$$Y_{i,t+h} - Y_{i,t-1} = \alpha_{i,h} + \beta_{i,h}^{\eta}\eta_t + \beta_{i,h}^{\varepsilon}\varepsilon_t + \mu_{q(t)} + u_{i,t+h} \tag{4}$$

where $Y_{i,t}$ is the GNP-deflated publicly held amount of security type $i \in \{\text{Bills}, \text{Coupons}\}$, so $Y_{i,t+h} - Y_{i,t-1}$ represents cumulative net issuance over the horizon. The coefficients $\beta_{i,h}^{\eta}$ and $\beta_{i,h}^{\varepsilon}$ trace the impulse response to permanent and transitory deficit shocks, respectively. The term $\mu_{q(t)}$ denotes within-quarter month-position fixed effects, where

$q(t) \in \{1, 2, 3\}$ indicates whether month t is the first, second, or third month of its quarter, included to absorb within-quarter cyclicality in fiscal flows. We use Newey-West standard errors with bandwidth set by the Newey and West (1994) plug-in rule, $L = \lfloor 12 \cdot (T/100)^{1/4} \rfloor$, yielding $L = 15$ lags.

Figure 2 presents the UC decomposition and the local projection impulse responses. Panel 2(a) displays the decomposition of the GNP-deflated federal deficit into its permanent (trend) and transitory components, illustrating the identifying variation underlying the impulse response analysis. Panels 2(b) and 2(c) display local projection impulse responses tracing how bill and coupon net issuance respond dynamically to permanent and transitory deficit shocks, respectively. The responses are normalized so that a one-unit shock corresponds to a \$1 billion initial impact on the deficit. Panel 2(d) traces the response of cumulative coupon issuance to a \$1 billion increase in current bill net issuance.

Following a permanent deficit shock, coupon net issuance rises gradually over subsequent quarters, covering the total amount of the additional deficit in 16 months. Bills show a complementary pattern: they absorb the initial shock but their cumulative response declines as coupons gradually take over the financing burden. The gradual transition from bill to coupon financing reflects the institutional lags in the Treasury's announcement and auction cycle.

The contrast with transitory deficit shocks is instructive. Coupon issuance shows essentially no response at any horizon: the point estimates are economically negligible and statistically indistinguishable from zero throughout. Bills absorb the entire transitory shock initially, and because the shock is mean-reverting, the cumulative bill response converges back toward zero as the transitory financing need dissipates. This dynamic pattern provides evidence that the Treasury effectively distinguishes between permanent and transitory financing needs, channeling the latter entirely into bills while gradually transitioning permanent needs to coupon financing, precisely what optimal debt management theory would prescribe (Angeletos, 2002; Barro, 1979).

The permanent-shock impulse-response function implies a testable reduced-form prediction: elevated bill issuance today, which absorbs financing needs that will subsequently migrate to coupons, should predict higher coupon issuance at longer horizons. Panel 2(d) confirms this directly. The response of cumulative coupon issuance to a \$1 billion increase in current bill net issuance is initially negative, suggesting bills and coupons are substitutes within the quarter. It turns positive and grows over the subsequent twelve to eighteen months, reaching a cumulative response of approximately \$0.15 per dollar of initial bill issuance before plateauing. This hump-shaped pattern mirrors the permanent-shock coupon response in Panel 2(b) and is consistent with the Treasury using bills as a bridge instrument whose financing burden is gradually refinanced into the fixed-rate coupon schedule.

The evidence presented so far establishes two important findings. First, the Treasury operates a debt management framework in which bills serve as the residual financing instrument that absorbs borrowing uncertainty. Second, and critically for this paper's argument, this mechanism represents cash management rather than duration risk management.

4.2 Duration Supply and Market Signals

A rational cost-minimizing debt manager should increase duration supply when market conditions are favorable, specifically, when long-term yields are low or when the swap spread indicates strong private-sector demand for duration. We test whether the Treasury responds to these signals by adjusting the maturity composition of its issuance.

We measure Treasury issuance in terms of duration supply rather than dollar quantities. Duration supply is defined as each maturity bucket's share of total DV01-weighted issuance from fixed-rate securities. This choice reflects the economic principle that duration rather than principal determines the interest rate risk transferred to markets (Vayanos and Vila, 2021; Greenwood and Vayanos, 2014). The distinction matters quantitatively: a $1 billion issuance of 30-year bonds adds approximately six times more duration to the market than an equal-sized issuance of 5-year notes. This convention aligns with practice among primary dealers, who manage risk in DV01 terms (Tuckman and Serrat, 2022). For each maturity bucket m in quarter t, we compute:

$$\text{Duration Supply Share}_{m,t} = \frac{\text{DV01}_{m,t}}{\sum_{m'} \text{DV01}_{m',t}} \times 100 \tag{5}$$

where $\text{DV01}_{m,t}$ is the dollar value of a basis point for the issuance in bucket m, computed using the maturity-matched yield from the Treasury yield curve.

Before turning to the formal regression analysis, Figure 3 provides direct visual evidence of the Treasury's commitment to its announced plans. Panel 3(a) plots total marketable issuance over time, showing that actual issuance tracks the TBAC quarterly recommendation closely throughout the sample. Panel 3(b) plots the actual duration supply share against the prior quarter's TBAC indication for each maturity-quarter observation, with observations clustering tightly around the 45-degree line; the correlation exceeds 0.90 and deviations rarely exceed 5 percentage points.

As a measure of market signal, we use term spreads at various maturities. We also use the swap spread, defined as the Treasury yield minus the interest rate swap rate at the same maturity. Both provide measures of the relative cost of issuing fixed-coupon debt at a certain maturity compared to others. A high term spread indicates that long-term yields are relatively expensive compared to short-term yields, signaling unfavorable conditions for issuing long-duration debt. A high swap spread indicates that the Treasury is paying more for fixed-rate funding than the synthetic alternative via a floating-rate instrument and a pay-fixed swap, signaling weaker private-sector demand for Treasury securities relative to the synthetic alternative. If the Treasury engages in market timing of its duration supply, we would expect to see higher duration supply at maturities where term spreads and swap spreads are low, and lower duration supply shares when these spreads are high.

Figure 4 presents scatter plots of duration supply against term spreads. Panel 4(a) plots actual duration supply against the term spread at the beginning of the quarter. Panel 4(b) plots the deviation of actual duration supply from the prior quarter's TBAC indication against the change in the term spread over the previous quarter. If the Treasury timed markets, we would expect a negative relationship in both panels: lower term spreads (indicating relatively cheap long-term borrowing) should be associated with higher duration supply, and increases in the term spread should prompt the Treasury to issue less duration than indicated. Instead, we observe no systematic pattern in either panel.

Table 6 presents formal regression evidence. We estimate:

$$\text{Duration Supply Share}_{m,t} = \alpha_m + \mu_t + \sum_k \beta_k X_{k,t} + \varepsilon_{m,t} \tag{6}$$

where m indexes the maturity bucket, t indexes the quarter, α_m are maturity fixed effects (included in select specifications), μ_t are quarter fixed effects included throughout, and $X_{k,t}$ denotes the market signal variables measured at the start of quarter t: the term spread (Treasury yield minus the three-month bill rate at the corresponding maturity), the swap spread (Treasury yield minus the interest rate swap rate at the same maturity), and the swap rate. The panel is structured by maturity-bucket$\times$quarter observations; standard errors follow Driscoll and Kraay (1998) with $L = 4$ quarterly lags, which permits arbitrary heteroskedasticity, serial correlation up to four quarters, and cross-sectional dependence across maturity buckets.

We estimate equation (6) separately with actual issuance and TBAC indication as the dependent variable. These two measures carry distinct timing implications for interpreting duration supply decisions. As documented so far in this paper, actual issuance follows the prior quarter's indication with a correlation exceeding 0.90, so market conditions prevailing at auction time have little scope to enter the realized quantity. TBAC indications, by contrast, represent the point at which the maturity decision is genuinely made and announced to the public.

Panel A examines the share of duration supply allocated to each maturity bucket as a function of term spreads, swap spreads, and swap rates. The results reveal no evidence that the Treasury increases duration supply when term spreads are low. The swap spread coefficient is even positive and statistically significant: a 1 basis point increase in the swap spread, indicating weaker demand for Treasury securities, is associated with a 14 to 23 basis point increase in the duration supply share. This pattern holds for both actual issuance and TBAC indications, suggesting it reflects systematic policy rather than implementation noise. The positive relationship between swap spreads and duration supply represents an inversion of optimal market timing behavior. When private-sector demand for duration through Treasury securities is strongest (low swap spreads), the Treasury supplies less duration. When demand weakens (high swap spreads), the Treasury supplies more. the Treasury follows a "regular and predictable" strategy that does not respond to market signals, effectively supplying duration when conditions are least favorable and withholding it when conditions are most favorable.

Panel B of Table 6 examines heterogeneity across security types, comparing the issuance shares of Floating Rate Notes (FRNs) versus fixed-coupon securities and TIPS versus fixed-coupon securities. FRNs are issued exclusively at a 2-year maturity, so the FRN comparison pools FRN and fixed-coupon 2-year observations. TIPS are issued at 5-, 10-, 20-, and 30-year maturities, so the TIPS comparison pools TIPS and fixed-coupon observations at those four tenors. Optimal duration management would predict that the Treasury shifts toward FRNs, which carry no duration risk, when swap spreads are high. Instead, for the FRN versus fixed-coupon comparison, the interaction between the fixed-coupon indicator and the swap spread is positive and statistically significant at approximately 10 to 11 basis points per 1 basis point, indicating that fixed-coupon securities comprise a larger share of issuance precisely when private-sector demand for duration is weaker. The corresponding interaction for TIPS versus fixed-coupon securities is economically negligible and statistically insignificant.

In Table 7, we repeat the analysis by explicitly looking at changes in duration supply and their relation to changes in market conditions. As dependent variables we use quarter-over-quarter changes in actual duration supply, changes in TBAC indications, and deviations of actual issuance from prior indications, which together span the full margin of potential adjustment. Across all three, the ΔSwap Spread coefficient is statistically insignificant, confirming that the Treasury neither increases nor decreases duration supply as private-sector demand conditions shift. Changes in swap rates show a significant negative relation with actual duration supply (≈ -1.9 basis points per 1 basis point; $p < 0.05$), but the effect is absent for indication changes and for deviations from prior indications — the two measures where genuine policy revision would appear. Panel B mirrors the pattern in Panel B of Table 6: the interaction between the fixed-coupon indicator and ΔSwap Spread is positive for FRN comparisons, indicating that fixed-coupon share rises precisely when swap spreads widen rather than when they narrow, again opposite to active duration management. Taken together, the levels and changes evidence point to the same conclusion: the Treasury's duration supply does not respond to market signals at any decision margin.

Appendix Tables IA.1 and IA.2 report dynamic robustness specifications that augment the baseline regressions with one-quarter leads and lags of each market signal. The lag terms test whether the Treasury responds with a one-quarter delay to past conditions; the lead terms examine whether today's duration supply predicts future spreads, which would indicate markets reacting to issuance rather than the reverse. Neither lag nor lead is economically large or systematically significant across specifications, ruling out any delayed-response interpretation and confirming that the absence of market timing is not an artifact of the timing of the regressors.

4.3 Evidence from Treasury Buyback Operations

Whereas issuance auctions are institutionally designed so that bonds are issued at par, when the Treasury buys back bonds, it has the flexibility to target specific securities based on their market values. In this section, we exploit recent Treasury buybacks to examine whether the Treasury reveals a preference for minimizing the nominal value of outstanding debt, irrespective of its market value. We find that, during the 2024–2025 buybacks, the Treasury systematically targets bonds trading below par for buyback operations, even after controlling for measures of bond liquidity. By exploiting market discounts to reduce the nominal value of outstanding debt, the Treasury engages in a fiscal capacity arbitrage whereby, by issuing securities at par to finance the purchase of discounted bonds, it reduces the nominal value of debt with no impact on its market value. This pattern provides revealed-preference evidence that the Treasury has incentives to manage the nominal value of debt but not its market value.

Figure 5 documents two distinct buyback periods with fundamentally different fiscal and market conditions. Panel 5(a) shows annual buyback volumes reaching $280 billion in 2024–2025, when bonds trade at discounts: the Treasury paid $259 billion in market value to retire $280 billion in par, freeing approximately $21 billion in fiscal capacity at an average discount of 7.4%. Moreover, in 2024–2025, the federal government is running large deficits, so the Treasury finances buybacks with new issuance at par, amplifying the nominal debt reduction: each dollar of buyback spending retires more than one dollar of outstanding par.

We contrast the 2024–2025 buybacks to an earlier wave of buybacks in 2000-2003, during which the government was running a fiscal surplus and used the surplus to finance the buybacks. Therefore, it did not engage in the fiscal-capacity arbitrage discussed for the 2024–2025 period. Panel 5(b) reveals that the two periods coincide with opposite pricing regimes, with starkly different fiscal consequences. During 2000–2003, older bonds traded at a premium and the Treasury paid $87 billion in market value to retire $68 billion in par.

Figure 6 provides distributional evidence using cumulative distribution functions. Panel 6(a) for 2024–2025 reveals that eligible bonds systematically trade at larger discounts than the overall bond universe. The Kolmogorov-Smirnov test identifies the maximum difference between distributions occurring at a discount level of 2.62 points below par (significant at the 1% level). At this specific price point, only 36.1% of eligible bonds trade at this discount or less, compared to 60.2% of all bonds. This 24.1 percentage point gap demonstrates that the Treasury disproportionately selects bonds from the deeper end of the discount distribution. Panel 6(b) for 2000–2002 shows the opposite pattern: eligible bonds concentrated at premiums, confirming that period's different selection criteria.

Figure 7 provides complementary evidence through quantile-quantile plots. Panel 7(a) for 2024–2025 shows points systematically above the 45-degree line, meaning that at every percentile, eligible bonds have larger discounts than all bonds. The divergence is most pronounced in the upper tail, where the most deeply discounted bonds concentrate, suggesting the Treasury particularly targets bonds with the largest discounts.

To formally test whether the Treasury targets below-par bonds, we estimate:

$$P(\text{Eligible}_{i,t+1}) = \alpha + \beta_1 \text{DiscDepth}_{i,t} + \beta_2 \text{PremHeight}_{i,t} + \gamma X_{i,t} + \epsilon_{i,t} \tag{7}$$

where $\text{DiscDepth}_{i,t} = \max(100 - \text{Price}_{i,t},\, 0)$ captures the depth below par for bonds trading at a discount, $\text{PremHeight}_{i,t} = \max(\text{Price}_{i,t} - 100,\, 0)$ captures the height above par for bonds trading at a premium, and $X_{i,t}$ includes controls for bond characteristics (remaining maturity, yield to maturity, coupon rate) and liquidity measures (bid-ask spread, age, log total outstanding). This piecewise-linear specification allows the price-eligibility relation to differ on either side of par without imposing symmetry. Summary statistics for both samples are reported in Table 4.

Table 8 reveals a fundamental asymmetry in the Treasury's selection of bonds for buyback operations. In 2024–2025, a one-percentage-point increase in discount depth raises eligibility probability significantly, while premium height enters with a near-zero or negative coefficient. This asymmetry is consistent with the Treasury deliberately targeting below-par bonds to reduce the nominal value of outstanding debt. In contrast, in 2000–2003, when bonds predominantly traded at premiums due to the prevailing rate environment, the premium-height coefficient is positive, suggesting the Treasury then targeted bonds with the largest premiums — consistent with the opposite institutional incentive of allowing nominal debt to grow. The results are robust to the inclusion of bond fixed effects (columns 2 and 4), which further controls for time-invariant heterogeneity across securities.

The deepest discounts may concentrate in the oldest, most illiquid, off-the-run bonds, so the observed selection could reflect liquidity provision rather than strategic market-value targeting. In the regressions in Table 8, we control for age, remaining maturity, yield to maturity, bid-ask spread, coupon rate, and the log of total outstanding amount. Hence, the result that the Treasury targets highly discounted bonds holds after controlling for bond vintage and liquidity characteristics. Critically, the liquidity variables themselves suggest different motivations during the 2024–2025 buybacks. The positive coefficient on log outstanding implies that the Treasury targets bonds with larger issue sizes — more liquid securities — rather than illiquid off-the-run bonds, the opposite of what a pure liquidity-provision motive would predict. Internet Appendix Table IA.3 reports analogous regressions for the probability that a bond is accepted (tendered) conditional on eligibility; the pattern of coefficients is consistent with those in the eligibility regressions.

Overall, this pattern provides revealed-preference evidence that the Treasury possesses institutional incentives to manage the nominal value of debt, but not its market value.

5 The Benefit of Market-Value Incentives: European Sovereign Debt Management Under ESA 2010

Having established the U.S. Treasury's approach to debt management, we provide evidence that, by managing the market value of debt rather than its nominal value, a sovereign debt manager would obtain significant cost savings for taxpayers. We exploit the staggered implementation of the 2010 European System of Accounts (ESA 2010) whereby European sovereigns were mandated to measure, report, and monitor the market value of their liabilities.

5.1 Background: European Sovereign Debt Management Under ESA 2010

Unlike the U.S., European sovereigns operating under the ESA 2010 framework face fundamentally different institutional incentives for duration risk management. EU Regulation No 549/2013 established ESA 2010 as the mandatory accounting framework for all EU member states, with full implementation required by September 2014 (European Union, 2013). While fiscal surveillance under the Stability and Growth Pact continues to use face value measurement as specified in Council Regulation 479/2009, ESA 2010 introduced parallel market value reporting requirements that create visibility of duration risk exposure.

This dual reporting system requires governments to maintain two distinct debt metrics. Maastricht debt, used for the 60% debt-to-GDP fiscal rule and excessive deficit procedures, remains at nominal face value. Simultaneously, ESA 2010 mandates comprehensive market value reporting in national accounts balance sheets, published quarterly by Eurostat and national statistical offices. These reports explicitly show gains and losses from interest rate movements on government debt portfolios, creating transparency about duration risk exposure that does not exist in single-metric reporting frameworks.

Although the regulation established a mandatory compliance date of September 2014, Germany and the Netherlands had established transparent duration management frameworks incorporating market-value considerations in portfolio optimization from January 2010, preceding the mandatory adoption by other EU countries.

The Netherlands provides a clear example of early institutional adoption. In the late 2000s, the Dutch State Treasury Agency (DSTA) introduced a formal interest rate risk framework centered on a seven-year benchmark for the national debt portfolio (Dutch State Treasury Agency, 2007). The framework explicitly specified that interest rate swaps would be used to transform the issuance-driven maturity structure into a target duration profile optimized for cost-risk trade-offs. This framework remained in effect through 2015, after which the target was revised from seven years to 6.4 years for the 2016–2019 horizon (Dutch State Treasury Agency, 2015).

Germany's Finance Agency (Deutsche Finanzagentur) similarly maintained an active swap program for portfolio duration management. By end-2014, the federal swap portfolio reached EUR 280.5 billion in interest-rate swap contracts, approximately 18% of general government face-value debt securities (Deutsche Finanzagentur, 2015). The annual Kreditaufnahmeberichte (annual federal borrowing reports published by the German Federal Ministry of Finance) document the evolution of this portfolio and its impact on the mean fixed interest period (Mittlere Zinsbindungsfrist) of the federal debt, demonstrating a sustained commitment to duration-based portfolio optimization that predates the ESA 2010 regulatory framework.

All other EU member states adopted the framework at the mandatory compliance date of September 2014. Our empirical analysis exploits this staggered adoption by classifying countries into two treatment cohorts: early adopters (Germany and the Netherlands, treated from January 2010) and mandatory adopters (France, Belgium, Austria, Italy, Spain, Ireland, Portugal, and Greece, treated from September 2014). We further distinguish between Core Europe (Germany, the Netherlands, France, Belgium, Austria) and Periphery Europe (Italy, Spain, Ireland, Portugal, Greece), reflecting differences in fiscal conditions and institutional capacity that are important for interpreting the treatment effects. Italy, despite its traditional periphery classification, exhibits debt management behavior more similar to Core Europe.

5.2 Cross-Country Balance-Sheet Evidence

Beyond these qualitative case studies, we document the cross-country pattern in derivatives use in a harmonized eleven-country quarterly panel; Online Appendix IA.2 describes the construction and data sources. The United States holds neither notional nor mark-to-market derivative positions throughout the sample, by stated Treasury policy of "stable and predictable" (Garbade, 2007): a debt portfolio of nearly $30 trillion in face value operates with precisely zero derivatives exposure.

Figure 8 therefore restricts attention to the ten Euro-area sovereigns in the panel, reporting two complementary measures of derivatives exposure as a percent of face-value debt securities. Panel A plots notional swap volume from national debt management office reports for Germany and the Netherlands, the two early adopters of ESA 2010 reporting;[3] Panel B plots the corresponding mark-to-market position from Eurostat `gov_10q_ggfa`, instrument F.7, as a country-by-country grid for the ten Euro-area sovereigns; the sandy shading on the Germany and Netherlands subplots marks the staggered ESA 2010 treatment windows, with the darker shade covering January 2010 through September 2014, during which Germany and the Netherlands report under ESA 2010 while the other eight Euro-area sovereigns do not, and the lighter shade covering September 2014 onwards, during which all sovereigns operate under mandatory ESA 2010 reporting. Notional captures the scale of underlying contracts; mark-to-market cap-

[3]Sources: Bundesfinanzministerium, *Kreditaufnahmebericht des Bundes*, annual editions (Germany); Dutch State Treasury Agency, *Outlook* and Annual Reports (Netherlands). Filled markers denote the ESA 2010 timeline reference years: 2010 (early adoption by Germany and the Netherlands), 2012 (the peak of the European sovereign debt crisis, midway between the two adoption dates), and 2014 (the mandatory compliance date applicable to other EU member states). The eight late adopters do not publish notional swap volumes at comparable annual frequency.

tures the present value of net obligations and is the variable that enters the financial balance sheet under ESA 2010 reporting. Because swap mark-to-market typically represents a small fraction of notional, the two differ by approximately an order of magnitude. Germany's notional swap book reaches approximately 18% of face-value debt securities by 2014 and stabilises thereafter, marking to market at -3 to -4% of face value as rates fell below the swaps' fixed legs, consistent with a pay-fixed-dominated book that locked in pre-crisis rates. The Netherlands reaches 33% notional at the 2014 peak before unwinding to 12% by 2022 under the revised DSTA benchmark, with mark-to-market reaching $+8\%$ at peak, consistent with a receive-fixed-dominated book whose value appreciated as rates fell.

The contrast visible in Figure 8 is the most direct balance-sheet evidence that the United States and the ESA-treated sovereigns operate fundamentally different debt-management technologies. Online Appendix Table IA.5 provides country-by-country summary statistics of notional swap volume (where reported) and F.7 net mark-to-market position, expressed as a percent of face-value debt securities, for the broader sample.

The behavioural impact of ESA 2010's enhanced transparency operates through accountability mechanisms. When interest rate changes generate market value swings that appear in official statistics, debt management offices face scrutiny from parliaments, audit offices, financial markets, and the public, generating incentives for more sophisticated risk management.

The institutional practices documented above, together with the cross-country contrast in Figure 8, share a common feature with the transparency requirements later codified in ESA 2010: the explicit consideration of market values in portfolio management decisions. While face-value accounting remained the basis for Maastricht debt calculations, both Germany and the Netherlands incorporated market-value metrics in their internal risk management frameworks, effectively anticipating the dual-reporting requirements that ESA 2010 would impose. Our treatment assignment thus captures the onset of observable duration management behaviour rather than formal regulatory adoption, with the staggered implementation of mandatory ESA 2010 reporting providing variation in when other EU countries were compelled to adopt similar transparency standards.

5.2.1 Empirical Design

We estimate the effect of ESA 2010 adoption on borrowing costs using a difference-in-differences (DiD) design with staggered treatment timing. The United States serves as the control group, providing a counterfactual trajectory for sovereign borrowing costs in the absence of market-value reporting requirements.[4] Section 3 describes the sample, outcome variables, and controls; the monthly panel spans January 2000 through June 2023, providing approximately a decade of pre-treatment data for the early adopters and over four years of pre-treatment data for the mandatory adopters. Online Appendix IA.2 provides additional detail on the construction of all variables and data sources used in this section.

We estimate the following regression:

$$y_{ct} = \alpha + \beta \cdot \mathbf{1}[\text{Post}_{ct}] + \gamma' X_{ct} + \mu_c + \delta_t + \varepsilon_{ct} \tag{8}$$

where y_{ct} is the outcome variable for country c in month t, $\mathbf{1}[\text{Post}_{ct}]$ indicates whether country c has adopted ESA 2010 by month t, X_{ct} is a vector of time-varying controls, μ_c denotes country fixed effects, and δ_t denotes year-month fixed effects. Standard errors are computed using the Newey-West heteroskedasticity and autocorrelation consistent (HAC) estimator with four lags to account for serial correlation in sovereign yield data.

We progressively add controls and fixed effects across specifications, starting from a first specification with no controls or fixed effects. In a second specification we add V2X/VIX equity-volatility indices and the MOVE bond-volatility index. In a third specification, we add debt-to-GDP and budget-balance-to-GDP at the country-quarter frequency. In a fourth specification, country-specific 3-month sovereign zero rate, the United States-Eurozone policy rate differential, and country-specific quantitative-easing (QE) indicators that capture the active Federal Reserve and ECB unconventional programmes over the sample. In a fifth specification, we replace the year-month fixed effect δ_t with a region $\times$ year-month fixed effect δ_{rt}, where region indexes the United States or the Eurozone, where region indexes the United States or the Eurozone. In the sixth and most demanding specification, we additionally include a GIIPS $\times$ Crisis indicator that equals one for Italy, Spain, Ireland, Portugal, and Greece during May 2010 through June 2013, absorbing the absorbing variations originating from the periphery's sovereign debt crisis and the flight-to-quality toward core countries.

5.2.2 Main Results

Table 9 presents the main DiD results across progressively richer control sets and fixed-effect structures. Specification (4), with the full control set including the 3-month sovereign short rate, shows a pooled negative effect on swap spreads of −23.5 basis points

[4] As a complementary identification, Internet Appendix Table IA.6 drops the United States from the sample entirely and we obtain consistent results.

($t = -1.95$) and on term spreads of −0.45 percentage points ($t = -5.94$). Tightening the fixed-effect structure to region × year-month in Specification (5) substantially strengthens the pooled estimate, to −130.5 basis points on swap spreads ($t = -9.33$) and −0.77 percentage points on term spreads ($t = -8.17$). The increase reflects the absorption of the United States-Eurozone monetary regime differential by the region-time fixed effect, which removes attenuation that was operating through the common time fixed effect in Specification (4). Specification (6) additionally absorbs the European sovereign debt crisis dynamics through the GIIPS × Crisis indicator, yielding −58.1 basis points on swap spreads ($t = -6.10$) and −0.54 percentage points on term spreads ($t = -6.51$). The pooled effect survives all six specifications with statistical significance at the one-percent level on both outcomes.

Table 10 presents the heterogeneity decomposition under Specifications (4) and (6) side by side. Panel A shows that Core European countries exhibit significantly negative effects on both outcomes that are stable across specifications: −39.5 basis points under Specification (4) and −38.4 basis points under Specification (6) on swap spreads, and −0.35 and −0.28 percentage points respectively on term spreads. The stability of the Core estimates reflects the fact that the Core subsample contains no GIIPS countries, so the GIIPS × Crisis indicator is mechanically zero throughout and the only effective change between Specifications (4) and (6) is the swap of the time fixed-effect structure, which does not move the within-Core comparison. The Core estimates therefore constitute the cleanest available identification of the ESA 2010 treatment effect: they are unaffected by either the United States-Eurozone monetary differential or the European sovereign debt crisis dynamics.

Panel B reports the early-versus-late adopter decomposition. Under Specification (4), the early adopters (Germany and the Netherlands) exhibit a robust negative effect of −34.2 basis points on swap spreads ($t = -10.36$) and −0.39 percentage points on term spreads ($t = -5.02$). Under Specification (6), the early adopters subsample contains no within-Eurozone untreated unit during the post-treatment period and the coefficient is therefore identification-degenerate; it is reported only for completeness. The late adopters panel under Specification (6) loads residual crisis-recovery dynamics from the post-September-2014 window during which all Eurozone sovereigns are simultaneously treated, and should be interpreted accordingly. Internet Appendix Table IA.6 provides a clean within-Europe identification of the early-adopter effect that addresses both concerns, returning a coefficient on the swap spread of −39.3 basis points ($t = -11.70$) and on the term spread of −0.30 percentage points ($t = -10.95$) when the control group is restricted to the late Core adopters, an estimate that converges with the Panel A Core coefficient under Specification (6).

Panel C presents the preferred specification grouping Italy with Core Europe based on its debt management behaviour. Under Specification (4), the Core Europe plus Italy sample yields −39.8 basis points on swap spreads ($t = -8.86$) and −0.29 percentage points on term spreads ($t = -6.88$). Under Specification (6), the corresponding estimates strengthen modestly to −48.8 basis points ($t = -9.50$) and −0.37 percentage points ($t = -10.68$). Italy's bond-pricing dynamics during the European sovereign debt crisis (2010–2012) were similar to those of the other GIIPS sovereigns, and Italy is therefore included in the GIIPS × Crisis indicator in Specification (6); the Core Europe plus Italy aggregate coefficient remains highly significant after absorbing this crisis component, supporting the institutional-narrative classification of Italy with Core Europe.

Table 11 presents individual country coefficients under Specifications (4) bilateral, (5) interacted, and (6) interacted. The Specification (4) bilateral estimates run a separate DiD regression for each country against the United States control; the Specifications (5) and (6) interacted estimates come from a single regression on the full eleven-country panel that interacts the treatment indicator with country dummies. All Core European countries show significant negative effects on both outcomes across all three specifications, with Specification (6) estimates ranging from −39.3 to −79.9 basis points on swap spreads and from −0.44 to −0.71 percentage points on term spreads. For Italy, the country-specific coefficient under Specification (6) is statistically indistinguishable from zero on both outcomes, indicating that Italy's bond-pricing dynamics in the post-treatment period are absorbed by the GIIPS-Crisis recovery channel rather than by the ESA treatment indicator at the country level. The Core Europe plus Italy aggregate in Panel C of Table 10 remains robust under Specification (6), so the institutional-narrative classification of Italy with Core Europe survives at the aggregate level even though the country-specific coefficient is sensitive to the crisis control. Among the Periphery countries, Spain, Ireland, and Portugal show significant negative effects on both outcomes under Specifications (5) and (6), though the Periphery aggregate in Panel A of Table 10 loads residual crisis-recovery dynamics that should be interpreted with caution.

5.2.3 Effect on Realized Interest Expense

The cross-country results in Tables 9–11 measure ESA 2010's effect on yield-curve quantities, namely sovereign spreads over swaps and term spreads, that price duration risk in secondary markets but do not directly correspond to budgetary outlays. We complement those results with a direct test on the realized interest expense of the general government. If the documented reduction in market-priced duration risk translates into lower funding costs, we should observe a corresponding decline in the implicit interest rate that sovereigns actually pay on their outstanding debt.

We construct an annual panel of implicit interest rates for the United States and the ten Euro-area sovereigns from 2001 through 2023. The implicit interest rate is defined as annual interest payable divided by the prior-year-end face value of general government gross debt, the Maastricht-debt aggregate. Online Appendix IA.2 describes the construction of the numerator, the denominator, and the annual control variables in full.

The annual specification mirrors equation (8) at annual frequency:

$$r_{ct} = \alpha + \beta \cdot \mathbf{1}[\text{Post}_{ct}] + \gamma' X_{ct} + \mu_c + \delta_t + \varepsilon_{ct} \tag{9}$$

where r_{ct} is the implicit interest rate (in percent), $\mathbf{1}[\text{Post}_{ct}]$ takes value one for Germany and the Netherlands from 2010 onward and for late adopters from 2015 onward (i.e., the first full calendar year following the September 2014 mandatory compliance date), with 2014 excluded for late adopters as a mixed-treatment year. The vector X_{ct} contains the annual-frequency analogues of the controls used for equation (8).[5] Standard errors are Newey-West HAC with four lags.

Table 12 presents the main result across the same progressively richer control sets used in Table 9. The pooled point estimate is -0.54 percentage points ($t = -4.31$) in Specification (4) with the full control set, including the 3-month sovereign zero rate. The estimate is stable across specifications, ranging from -0.79 percentage points without controls to -0.54 percentage points with the full control set. Given an average debt-to-GDP ratio of approximately 90 percent for the Core Europe plus Italy aggregate, the point estimate corresponds to fiscal savings of approximately 0.5 percentage points of GDP per annum on the stock of outstanding debt, a substantial magnitude in the context of public finances.

Table 13 presents the heterogeneity decomposition. Panel A separates the Core Europe plus Italy sample from the Periphery countries excluding Italy, yielding -0.59 percentage points ($t = -4.40$) for Core Europe plus Italy and -0.39 percentage points ($t = -2.31$) for the Periphery excluding Italy. Panel B further decomposes the Core Europe plus Italy effect by adoption cohort. Early adopters (Germany and the Netherlands), with the longest post-treatment window, exhibit the largest effect of -0.87 percentage points ($t = -5.16$). Late Core adopters (France, Belgium, Austria) show -0.61 percentage points ($t = -4.01$). The Italy-only coefficient is small and statistically insignificant, an attenu-

[5] The region $\times$ year fixed effects and the GIIPS $\times$ Crisis indicator used in regression (**??**) cannot be cleanly identified at annual frequency given the limited number of country-year observations. We therefore omit them for this test.

ation we attribute to Italy's long weighted-average remaining maturity (approximately seven years) combined with the relatively short post-2014 window, which limits how much of the outstanding stock has been refinanced under the new framework. The late Periphery coefficient is negative but not significant at conventional levels.

The pattern is consistent with the yield-curve evidence in the main DiD results. The effect is concentrated in the country groups for which we estimate the largest spread effects (Core Europe plus Italy), and the magnitude is largest for the group with the longest post-treatment window (early adopters). The implicit interest rate is a measure of the realized cost of the outstanding debt stock, which depends both on the marginal cost of new issuance (where ESA 2010 effects operate) and on the maturity profile of existing debt (which determines the speed of pass-through). The pattern of magnitudes across cohorts is therefore consistent with a mechanism that operates through new issuance and propagates gradually as legacy debt matures and is refinanced under the new framework.

WITHIN-EUROPE ANNUAL SPECIFICATION. A complementary annual specification that drops the United States and identifies the treatment effect from within-Europe staggered timing alone yields a pooled estimate of −0.21 percentage points ($t = -1.65$) under the standard country and year fixed-effect structure, with an early-adopter cohort estimate of −0.25 percentage points ($t = -1.84$) after additionally controlling for the GIIPS×Crisis indicator. The dual-region specification with the United States control is retained as the main annual specification because the within-Europe annual sample of 217 country-years does not have sufficient within-region staggered-timing variation to support the cohort decomposition cleanly; the monthly DiD analysis in Table 9, which is robust across all six control and fixed-effect specifications,including the within-Europe variants of Online Appendix Table IA.6, provides the primary identification of the underlying mechanism.

5.2.4 ROBUSTNESS

We implement a comprehensive battery of robustness tests following recent advances in the difference-in-differences literature, with particular attention to issues specific to staggered adoption designs. We present the pre-trends evidence and the within-Europe identification in the main text and report the remaining tests in Internet Appendix IA.3.

PRE-TRENDS. Figure 9 presents event study coefficients for term spreads (in percentage points) from the three-country specification (Germany and the Netherlands vs. the United States), plotted relative to the treatment date of January 2010. The pre-treatment coefficients provide a direct test of the parallel trends assumption underlying our identification strategy. Only negative pre-trends would be problematic for our analysis, as they could be mistaken for a negative treatment effect. The pre-treatment coefficients fluctuate around zero with no systematic negative trend over the decade preceding adoption: most coefficients are slightly negative or near zero, and none exhibits a sustained downward drift that could be confused with a treatment effect. The post-treatment coefficients, by contrast, shift sharply negative, reaching approximately −1.0 to −1.5 percentage points by years 4–8. This gradual onset is consistent with improved duration management practices taking time to implement rather than an immediate market repricing. Internet Appendix Figure IA.3 presents the companion swap and term spread event studies side by side. Internet Appendix Figure IA.4 plots the raw swap spread and term spread data for all eleven countries, illustrating the Core-Periphery divergence that motivates our empirical design.

WITHIN-EUROPE IDENTIFICATION. The most direct robustness check addresses the central concern with any cross-country design that uses the United States as the control for the Eurozone treated sovereigns: that the treatment windows overlap with divergences in U.S. and Euro-area monetary regimes, including the differential paths of the Federal Reserve and ECB policy rates, the timing of unconventional asset purchases around the September 2014 mandatory adoption date, and broader macroeconomic differences between the two regions. The strongest available response to this concern is to drop the United States from the sample entirely and identify the early-adopter ESA effect from within-Europe staggered timing alone, exploiting the fact that the late Core adopters (France, Belgium, Austria) face the same ECB monetary regime as the early adopters (Germany and the Netherlands). Internet Appendix Table IA.6 reports the within-Europe identification. With the control group restricted to the late Core adopters, the early-adopter effect on the swap spread is −39.3 basis points ($t = -11.70$) and on the term spread is −0.30 percentage points ($t = -10.95$), quantitatively and statistically indistinguishable from the Core panel coefficient under Specification (6) of the main Table 10 (−38.4 basis points and −0.28 percentage points). The convergence between the dual-region DiD with the United States control and the within-Europe identification without the United States provides direct evidence that the estimated effect reflects ESA 2010 adoption rather than cross-region macroeconomic or monetary differences. The within-Europe design also addresses the concern that the European sovereign debt crisis dynamics during 2010 through 2013 might have differentially affected Periphery and Core spreads through flight-to-quality: the same indistinguishable estimate obtains in the full eight-control within-Europe panel once the GIIPS $\times$ Crisis indicator from Specification (6) of Table 9 is included, as documented in row (5) of Internet Appendix Table IA.6.

ADDITIONAL ROBUSTNESS TESTS. Internet Appendix IA.3 reports five additional robustness tests beyond the pre-trends evidence and the within-Europe identification just discussed. First, the HonestDiD sensitivity analysis of Rambachan and Roth (2023) shows that the estimated effect on swap spreads remains statistically significant even when post-treatment violations of parallel trends are allowed to exceed the maximum pre-treatment differential. Second, a leave-one-out analysis confirms that no single country drives the results, with all six leave-one-out coefficients significant at the one-percent level under both Specification (4) and Specification (6). Third, the Callaway-Sant'Anna staggered DiD estimator (Callaway and Sant'Anna, 2021), which is robust to heterogeneous treatment effects across adoption cohorts, yields estimates comparable to the two-way fixed effects estimate (-25.4 basis points for early adopters and -36.0 basis points for late Core adopters). Fourth, a placebo timing test reassigning the late Core cohort to a counterfactual January 2010 adoption date yields an opposite-signed effect of $+182.2$ basis points on swap spreads ($t = +6.80$), validating that the estimated effects emerge at the actual September 2014 adoption date rather than under an arbitrary earlier timing. Fifth, a phased-in adoption analysis allowing treatment intensity to increase linearly from 2010 to alternative phase-end dates produces estimates that are stable across phase-end assumptions and consistent with the binary specification.

6 CONCLUSIONS

We identify nominal-value accounting as a central and costly friction in U.S. Treasury debt management. The Treasury commits to a regular-and-predictable issuance framework that pre-announces fixed-rate auction sizes months in advance. Because the Treasury commits to its coupon issuance months in advance, it uses bills as residual "shock absorbers" rather than a duration-management tool. The Treasury issues nearly \$20 trillion of fixed-rate notes and bonds carrying the risk of a \$1.2 trillion loss for a 1% decline in interest rates, yet it does not adjust the maturity composition in response to market signals about the cost of duration risk at various maturities. The Treasury revealed its preference to manager the nominal value of debt over it market value in its 2024–2025 buyback program, systematically targeting bonds at the deepest discounts and freeing approximately \$21 billion of nominal fiscal capacity while delivering no market-value gain to taxpayers. The Treasury therefore manages the nominal stock of debt and the cash needed to service it, but does not manage the duration risk borne by taxpayers.

Investors who bear the Treasury's static duration supply demand a premium as compensation, and the Treasury passes these premia back to taxpayers through elevated borrowing costs. We quantify this cost by exploiting the staggered adoption of the European System of Accounts (ESA 2010) across eleven European countries. ESA 2010 required sovereigns to publish the market value of their debt in national accounts, making duration risk visible to parliaments, audit offices, and financial markets for the first time. In a staggered difference-in-differences design with country and time fixed effects, Core European sovereigns that adopted ESA 2010 enjoyed a drop of 38 to 49 basis points in their borrowing costs over swap rates and 0.28 to 0.37 percentage points in their term spreads, with the realized implicit interest rate on outstanding debt falling by 0.59 percentage points for the Core Europe plus Italy aggregate. If applied to the Treasury's $20 trillion in outstanding fixed-rate notes and bonds, the spread-based estimates imply annual savings of approximately $77 to $98 billion.

Our work points to three concrete and implementable reforms. First, the Treasury can expand its floating-rate note program, which currently represents only 3% of outstanding debt, eliminating duration exposure on new issuance and the intermediation margins that fixed-rate issuance sustains for dealers. Second, the Treasury can lift its self-imposed prohibition on interest rate swaps, allowing it to convert existing fixed-rate obligations into floating obligations at market rates and capture the swap spread that dealers currently earn as a risk-free profit. Third, the Treasury can short the maturity of its new issuance, thus reducing the duration risk investors need to bear. Together, these three reforms would directly advance Secretary Bessent's stated objective of financing the government at the least cost over time (Bessent, 2025), while preserving the regular-and-predictable auction cadence that supports market liquidity.

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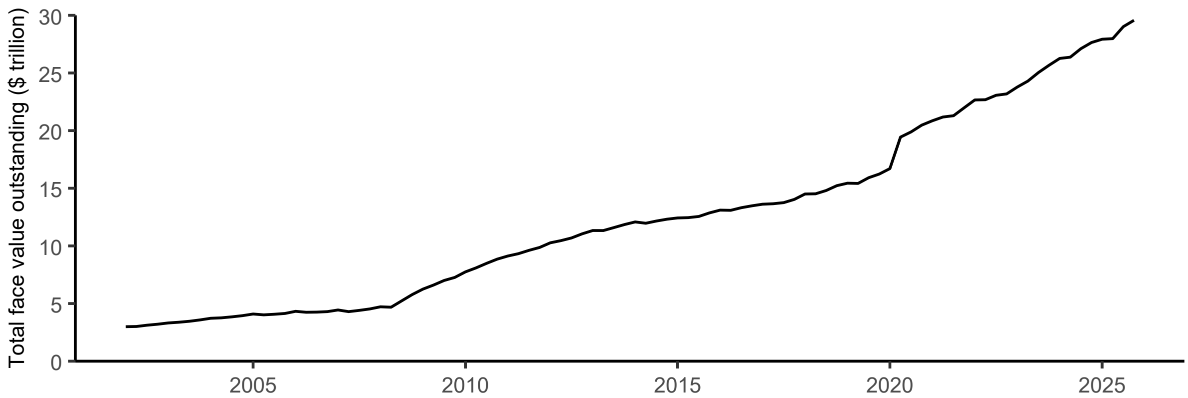
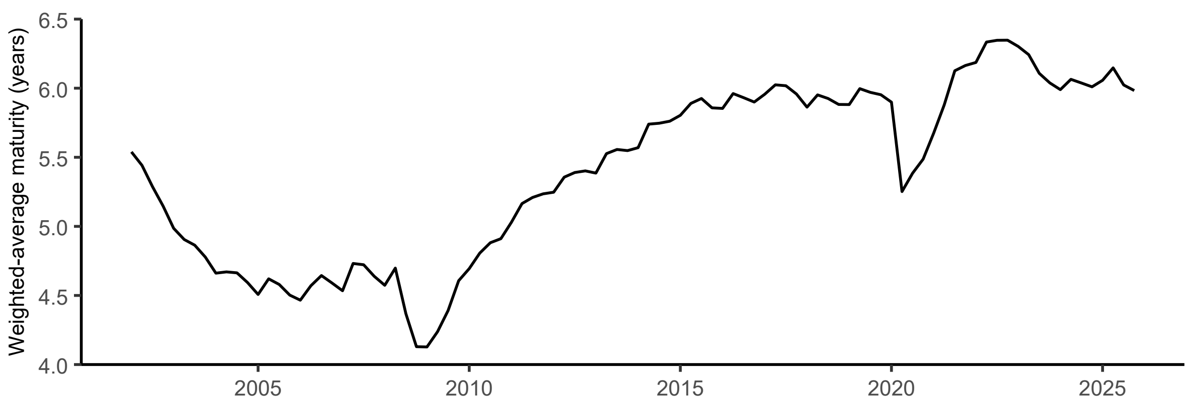
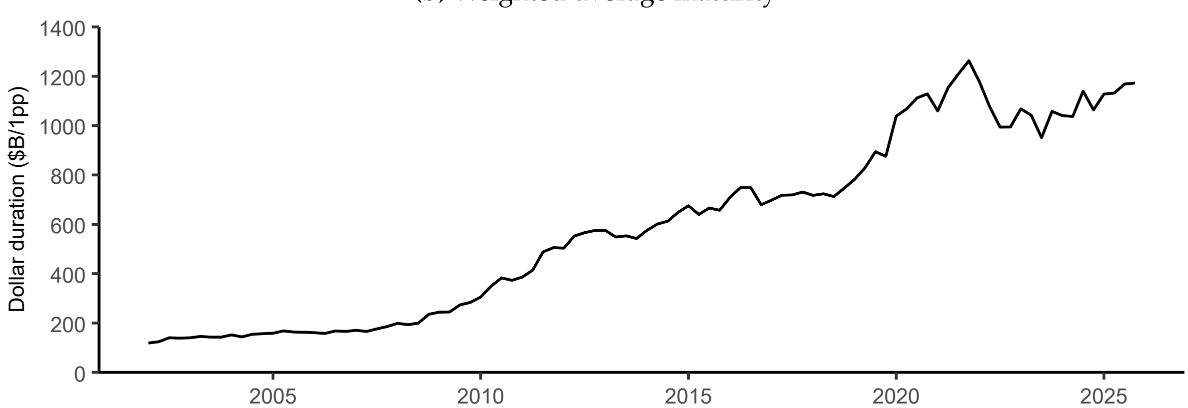


(a) Total face value outstanding

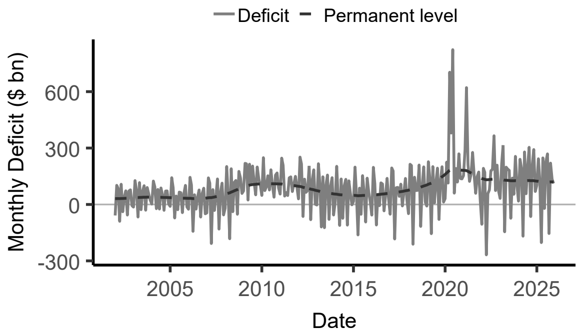


(b) Weighted-average maturity

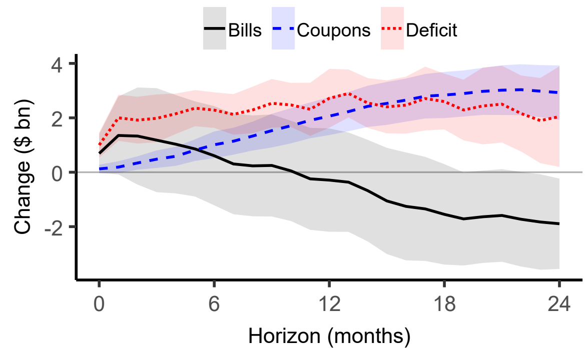


(c) Dollar duration

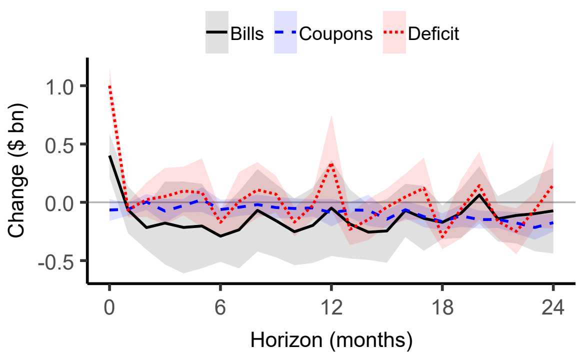
Figure 1: U.S. Treasury Supply Measures, 2002Q1–2025Q4. All series are constructed from the CRSP Treasury daily file. For each quarter we take the last trading-day snapshot of every outstanding Treasury security (bills, notes, bonds, TIPS, and FRNs). Panel 1(a) shows the sum of face values across all outstanding securities ($ trillions). Panel 1(b) shows the face-value-weighted average of the remaining time to maturity in years. Panel 1(c) shows the dollar duration of the total debt stock, defined as $\mathrm{DD}_t = \sum_i MV_{i,t} \times D^{\mathrm{mod}}_{i,t}/100$, where $MV_{i,t} = FV_{i,t} \times P_{i,t}/100$ is market value and $D^{\mathrm{mod}}_{i,t} = D^{\mathrm{Mac}}_{i,t}/(1 + y_{i,t}/2)$ is modified duration; this quantity measures the change in the market value of total debt (in $ billions) for a one-percentage-point increase in interest rates. Macaulay duration is taken from CRSP (`TDDURATN`, reported in days and converted to years).



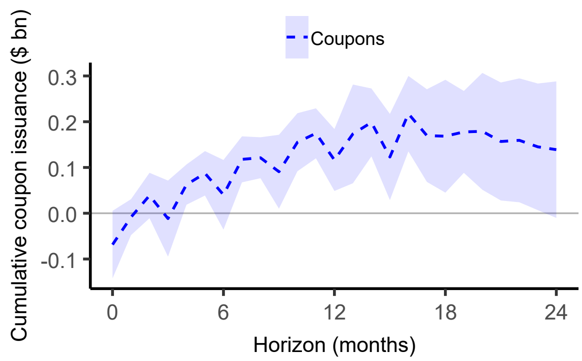
(a) Deficit decomposition



(b) Response to permanent shock

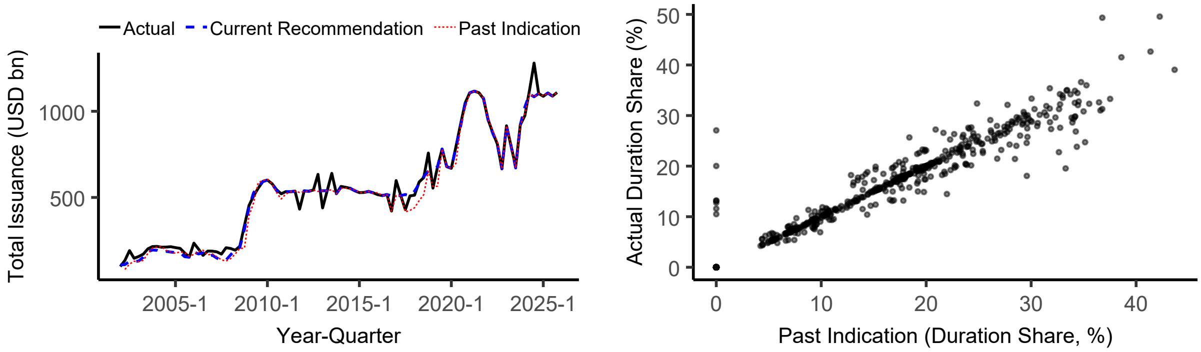


(c) Response to transitory shock



(d) Coupon response to bill issuance

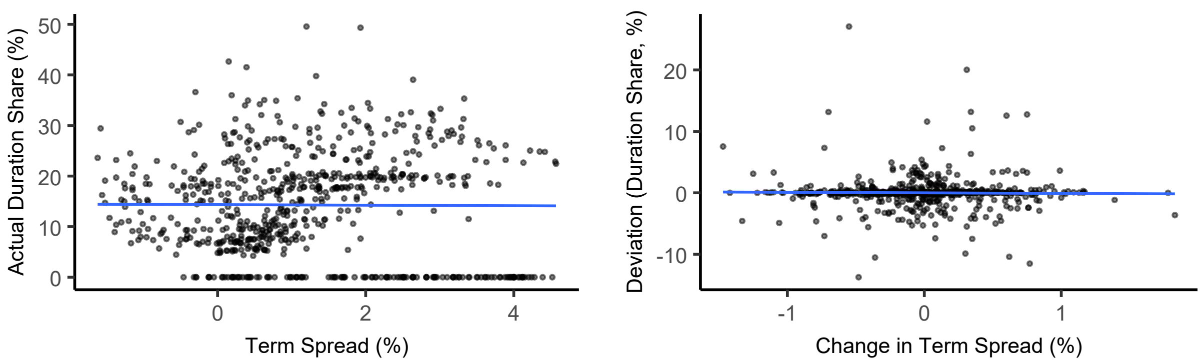
Figure 2: UC Decomposition and Local Projection Impulse Responses. Panel 2(a) plots the GNP-deflated federal deficit (solid gray) against the estimated permanent level τ_t (dashed black) from the local-level unobserved components model. Panels 2(b) and 2(c) display local projection impulse response functions tracing cumulative net issuance of bills (solid black) and coupons (dashed blue) following a permanent shock η_t and a transitory shock ε_t, respectively; responses are normalized so that a one-unit shock corresponds to a $1 billion initial impact on the deficit. Panel 2(d) traces the cumulative response of coupon net issuance to a $1 billion increase in current bill net issuance. All specifications use monthly data (January 2002–December 2025) with within-quarter month-position fixed effects. Shaded areas represent 95% confidence intervals constructed using Newey-West standard errors with $L = 15$ lags.



(a) Total marketable issuance over time

(b) Actual vs. indicated duration supply share

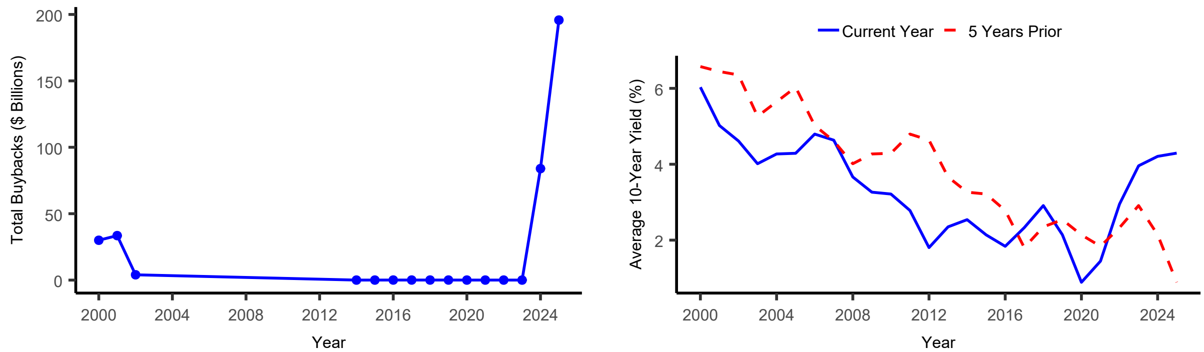
Figure 3: Regular and Predictable Fixed-Rate Issuance. Panel 3(a) plots total marketable fixed-rate issuance over time (USD billions), comparing actual issuance (solid) against the TBAC recommendation for each quarter (dashed). Panel 3(b) plots the actual duration supply share against the prior quarter's TBAC indication for each maturity-quarter observation; the dashed line is the 45-degree line representing perfect adherence. The correlation between past indication and actual duration supply share exceeds 0.90, and deviations rarely exceed 5 percentage points. The sample includes all fixed-rate non-bill Treasury securities from 2002Q1 through 2025Q4.



(a) Actual Duration Supply vs Term Spread

(b) Deviation of Actual from Indicated Duration Supply vs Change in Term Spread

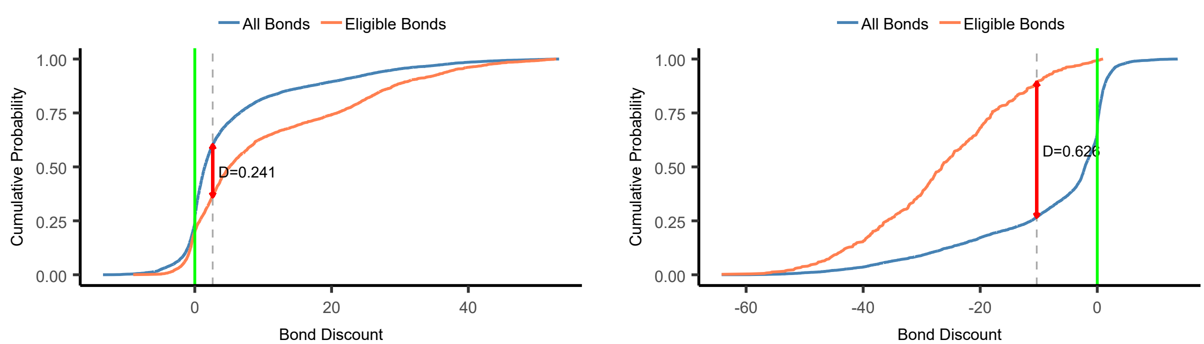
Figure 4: Duration Supply and Term Spreads. Panel 4(a) plots the actual share of duration supply against the term spread at the beginning of the quarter (10-year minus 1-year Treasury yield). Panel 4(b) plots the deviation of actual duration supply from the prior quarter's TBAC indication against the change in the term spread over the previous quarter. Each point represents a maturity-quarter observation. If the Treasury engaged in market timing, we would expect a negative relationship in Panel 4(a) (lower term spreads should be associated with higher duration supply) and a negative relationship in Panel 4(b) (increases in the term spread, signaling costlier long-term borrowing, should prompt the Treasury to issue less duration than indicated). Neither panel reveals a systematic pattern consistent with market timing. The sample includes all fixed-rate Treasury notes and bonds from 2002Q1 through 2025Q4.



(a) Total Buybacks

(b) 10-Year Treasury Yields

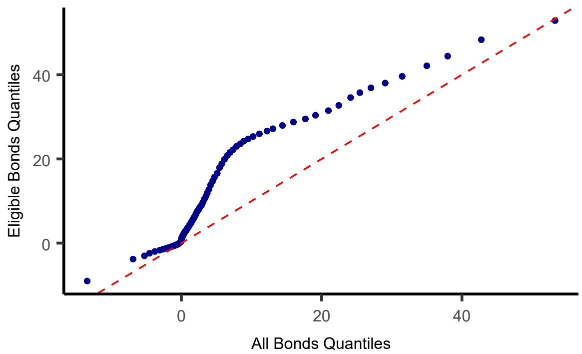
Figure 5: Treasury Buyback Operations and 10-Year Yields. Panel 5(a) shows annual total buyback operations measured by par amount accepted (in billions of dollars). Panel 5(b) shows the annual average 10-year Treasury yield (solid blue line) alongside the 10-year yield from five years prior (dashed red line).



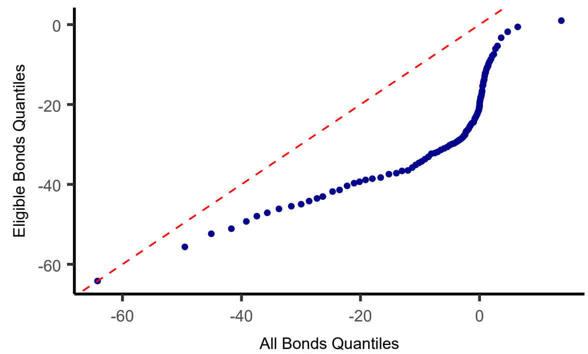
(a) 2024-2025 Period

(b) 2000-2002 Period

Figure 6: Cumulative Distribution Functions: Bond Discount Comparison. The figure compares the empirical cumulative distribution functions (CDFs) of bond discounts between all Treasury bonds and those eligible for buyback operations. Bond discount is defined as $100 - \text{Price}$, where price is the average monthly market price. The green vertical line marks par (discount = 0). The dashed vertical line indicates the location of maximum difference between distributions, with the red arrow showing the Kolmogorov-Smirnov statistic (maximum vertical distance between CDFs). Panel 6(a) shows the 2024–2025 buyback period; Panel 6(b) shows the 2000–2002 buyback period. The cumulative distribution functions compare bond discount distributions between all bonds and eligible bonds for two buyback periods. For 2024-2025, the maximum difference occurs at a discount of 2.62 (KS statistic D = 0.2410, p < 0.0000), where 36.1% of eligible bonds trade at or below this discount level compared to only 60.2% of all bonds, a difference of 24.1 percentage points. This indicates eligible bonds have discounts at least 2.62 points larger than typical bonds with significantly higher probability. For 2000-2002, the maximum difference occurs at a discount of -10.34 (KS statistic D = 0.6260, p < 0.0000), where 89.3% of eligible bonds trade at or below this level compared to 26.7% of all bonds, a difference of 62.6 percentage points.



(a) 2024-2025 Period



(b) 2000-2002 Period

Figure 7: Quantile-Quantile Plots: Bond Discount Comparison. The figure compares the quantile distributions of bond discounts between all Treasury bonds (x-axis) and eligible bonds (y-axis). Bond discount is defined as $100-\text{Price}$, where price is the average monthly market price. Each point represents a percentile of the distribution (1st through 99th percentiles). The red dashed line is the 45-degree line representing identical distributions. Points above the line indicate that eligible bonds have higher discounts than all bonds at that percentile. Panel 7(a) shows the 2024–2025 buyback period; Panel 7(b) shows the 2000–2002 buyback period. The quantile-quantile plots compare discount distributions by matching percentiles between all bonds (x-axis) and eligible bonds (y-axis), with the 45-degree line representing identical distributions. For 2024–2025, points systematically lie above the diagonal line, indicating that eligible bonds have higher discounts than all bonds at nearly every percentile, with the effect most pronounced in the upper tail where bonds are most deeply discounted. For 2000–2002, the pattern is opposite with points below the line showing eligible bonds consistently trade at higher premium across the distribution.

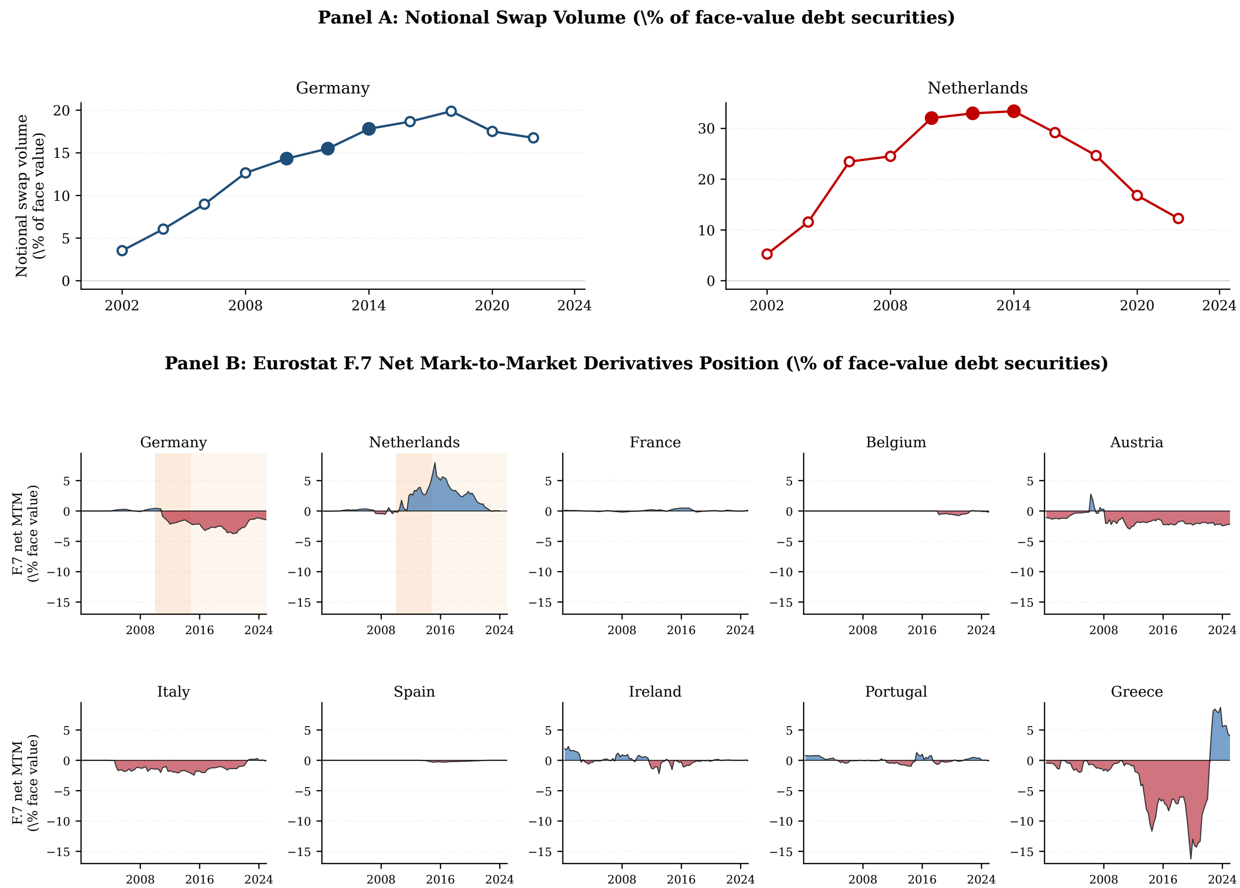


Figure 8: Notional Swap Volume and Mark-to-Market Derivatives Position. This figure displays two complementary measures of sovereign derivatives exposure for the Euro-area sovereigns, both expressed as a percent of the face value of outstanding debt securities (Eurostat `gov_10q_ggdebt`, instrument F.3, sector S.13). Panel A reports the year-end notional volume of interest-rate swap contracts outstanding for Germany and the Netherlands, the two early adopters of ESA 2010 reporting, drawn from national debt management office reports (Bundesfinanzministerium *Kreditaufnahmebericht des Bundes* for Germany; Dutch State Treasury Agency *Outlook* and Annual Reports for the Netherlands). Solid markers highlight the ESA 2010 timeline reference years: 2010 (early adoption by Germany and the Netherlands), 2012 (the peak, midway between the two adoption dates), and 2014 (the mandatory compliance date applicable to other EU member states). Panel B presents a country-by-country grid of net mark-to-market positions from Eurostat `gov_10q_ggfa`, instrument F.7, sector S.13, consolidated, for the ten Euro-area sovereigns in the sample (Germany, the Netherlands, France, Belgium, Austria, Italy, Spain, Ireland, Portugal, and Greece). Within each subplot, positive net positions are shaded blue and negative net positions are shaded red, with the series overlaid as a solid line. Germany and the Netherlands report F.7 only on the asset side, with the reported value carrying sign information; for the other Euro-area sovereigns the net position is constructed as the asset side minus the liability side. All Panel B subplots share a common y-axis range to facilitate cross-country comparison. The sandy shading in the Germany and Netherlands subplots of Panel B marks the ESA 2010 treatment windows for these early adopters: the darker shade covers January 2010 through September 2014, during which Germany and the Netherlands report under ESA 2010 while the other eight Euro-area sovereigns do not; the lighter shade covers September 2014 onwards, during which all sovereigns operate under mandatory ESA 2010 reporting. The United States, which holds neither notional nor mark-to-market derivative positions throughout the sample by stated Treasury "regular and predictable" policy (Garbade, 2007), is omitted from both panels. Sample is 2002 through 2022 (annual) in Panel A and 2000Q1 through 2025Q4 (quarterly) in Panel B.

Figure 9: ESA 2010 Event Study: Term Spreads (Germany & Netherlands vs. U.S.). This figure presents event study coefficients for term spreads (10-year minus 1-year sovereign zero rate, in percentage points) from the three-country DiD specification (Germany and the Netherlands vs. the United States), with annual bins relative to ESA 2010 adoption (January 2010) and 95% confidence bands. The x-axis is calendar year; the dashed vertical line marks January 2010; the sandy shaded region marks the early-adopter ESA window from January 2010 through September 2014, during which Germany and the Netherlands report under ESA 2010 while the remaining EU member states do not yet do so. The white circle marks the omitted reference year (2009, the year immediately preceding the treatment date). Pre-treatment coefficients fluctuate around zero with a pre-treatment average of −0.18 percentage points and a maximum absolute pre-treatment deviation of 0.42 percentage points, supporting the parallel trends assumption underlying the Specification (4) baseline of Table 9, on which the HonestDiD sensitivity analysis in Internet Appendix Table IA.7 provides the formal bounded-violation robustness, that any pre-existing differential would bias against finding the negative treatment effect documented in the main results. Post-treatment, the coefficients shift sharply negative, reaching approximately −1.0 to −1.5 percentage points by years 4–8, consistent with a gradual implementation of improved duration management practices following ESA 2010 adoption. Internet Appendix Figure IA.3 presents the corresponding swap and term spread event studies side by side, and Internet Appendix Figure IA.4 plots the raw data for all eleven countries. All specifications include country and year-month fixed effects with the full Specification (4) control set, including the 3-month sovereign zero rate. Standard errors are Newey-West HAC with four lags.

Table 1: Summary statistics: quarterly panel of issuance and yield data at the security level. The sample is restricted to quarters in which Fixed Coupon securities have both non-missing actual issuance and a TBAC indication, and includes Fixed Coupon observations only. The upper panel covers issuance variables and the lower panel covers market condition variables, all measured at end-of-prior-quarter. *Duration supply share, actual* is each maturity bucket's share of total duration (DV01) supply from fixed-coupon securities in that quarter (%). *Duration supply share, TBAC indication* is the corresponding share from the TBAC indication published at the start of the quarter (%). Δ *Duration supply share, actual* and Δ *Duration supply share, indication* are quarter-over-quarter changes in those shares (percentage points). *Deviation from prior indication* is the difference between realized actual share and the indication published one quarter earlier (percentage points). *Term spread* is the constant-maturity Treasury yield at each maturity minus the three-month Treasury yield (%). *Swap spread* is the Treasury constant-maturity yield minus the interest rate swap rate at the same maturity (%). *Swap rate* is the combined LIBOR/SOFR fixed-for-floating swap rate at the corresponding maturity (%). Δ variables are quarter-over-quarter changes (percentage points).

	Mean	SD	p25	p50	p75
Duration supply share, actual (%)	14.286	10.160	6.716	15.258	20.468
Duration supply share, TBAC indication (%)	14.286	10.306	6.657	15.090	20.550
Δ Duration supply share, actual (pp)	0.000	3.836	-0.613	0.000	0.398
Δ Duration supply share, indication (pp)	0.000	3.182	-0.310	0.000	0.235
Deviation from prior indication (pp)	0.000	2.597	-0.222	0.000	0.180
Term spread (%)	1.191	1.343	0.260	0.980	2.070
Swap spread (%)	-0.123	0.331	-0.358	-0.123	0.051
Swap rate (%)	2.994	1.490	1.779	2.936	4.133
Δ Term spread (pp)	-0.019	0.466	-0.300	-0.020	0.230
Δ Swap spread (pp)	0.011	0.105	-0.050	0.002	0.052
Δ Swap rate (pp)	-0.013	0.515	-0.310	0.027	0.314

Table 2: Summary statistics: quarterly panel of financing need and issuance surprises. The sample covers 2002Q1–2025Q4 ($N = 95$ for marketable borrowing and coupon surprises; $N = 94$ for bill surprises, which are missing in 2025Q4 pending the release of FRED series `FYGFDPUN`). *Total surprise* is the difference between the Actual and the one-quarter-ahead Forecast. *Planning surprise* is the difference between the Estimate (announced at the start of the quarter) and the Forecast. *Execution surprise* is the difference between the Actual and the Estimate. Borrowing surprises are constructed from Treasury Refunding Announcement data; coupon issuance surprises from TRA recommendations and realized auction results; bill issuance surprises are derived residually using the net-borrowing identity. All variables are in billions of dollars.

	Mean	SD	p25	p50	p75	N
Total borrowing surprise ($ bn)	27.305	342.603	-51.000	-2.000	74.500	95
Total coupon issuance surprise ($ bn)	20.319	42.927	0.001	4.001	30.001	95
Total bill issuance surprise ($ bn)	7.486	339.650	-78.458	-19.017	66.249	94
Planning borrowing surprise ($ bn)	49.274	358.479	-39.500	-1.000	60.000	95
Planning coupon issuance surprise ($ bn)	12.042	32.782	-1.000	0.000	8.000	95
Planning bill issuance surprise ($ bn)	37.851	354.743	-49.750	-3.500	59.000	94
Execution borrowing surprise ($ bn)	-21.968	124.483	-18.500	0.000	16.500	95
Execution coupon issuance surprise ($ bn)	8.277	39.847	0.001	0.002	21.420	95
Execution bill issuance surprise ($ bn)	-30.365	131.430	-46.001	-11.233	23.249	94

Table 3: Summary statistics: monthly data for the UC deficit decomposition analysis. The sample covers January 2002 through December 2025 ($N = 288$ months). All nominal series are deflated by the lagged-quarter GNP implicit price deflator (FRED series `GNPDEF`, Bureau of Economic Analysis) so that the price index is predetermined relative to each month's issuance decisions. Panel A reports summary statistics for the three monthly series used as inputs to the UC model and the local-projection regressions. *Federal deficit* is the monthly surplus or deficit from the Monthly Treasury Statement (MTS), expressed as a positive number when the government runs a deficit. *Net bill issuance* and *Net coupon issuance* are the month-over-month changes in the privately held outstanding amounts of bills and coupon securities, respectively, from the Monthly Statement of the Public Debt (MSPD). Panel B reports summary statistics for the two orthogonal structural shocks extracted by the local-level Kalman smoother. The *permanent shock* $\eta_t = \Delta\tau_t$ is the period-t innovation to the random-walk level of the deficit; the *transitory shock* $\varepsilon_t = D_t - \tau_t$ is the deviation of the realized deficit from its smoothed permanent level. Both shocks are in nominal billions of dollars (2012 prices) before the unit-standard-deviation rescaling applied in the impulse-response regressions.

Panel A: Monthly deficit and net issuance series

	Mean	SD	p25	p50	p75	N
Federal deficit ($ bn, 2012 prices)	85.019	128.820	12.255	86.649	152.773	288
Net bill issuance ($ bn, 2012 prices)	18.435	127.637	-45.918	4.945	57.335	288
Net coupon issuance ($ bn, 2012 prices)	75.006	70.991	27.185	55.757	96.739	288

Panel B: Permanent and transitory deficit shocks

	Mean	SD	p25	p50	p75	N
Permanent deficit shock η_t ($ bn)	0.311	1.958	-0.789	0.100	1.135	287
Transitory deficit shock ε_t ($ bn)	0.310	116.570	-63.866	9.991	67.937	287

Table 4: Summary statistics: Treasury buyback regression samples. This table reports summary statistics for all variables used in the buyback eligibility regressions (Table 8). The sample consists of monthly bond-level observations constructed from CRSP daily transaction data. Panel A covers the 2024–2025 buyback period; Panel B covers the 2000–2003 buyback period. *Disc. Depth* is $\max(100 - \text{Price}, 0)$, the depth below par for bonds trading at a discount. *Prem. Height* is $\max(\text{Price} - 100, 0)$, the height above par for bonds trading at a premium. *Yield* is the annualized yield to maturity in percent. *Bid-Ask Spread* is the bid-ask spread relative to midpoint in basis points. *Log Outstanding* is the natural log of total face value outstanding (USD). *Age* is the number of years since issuance. *Remaining Maturity* is the number of years until maturity. *Coupon Rate* is the stated annual coupon rate in percent. P(eligible) equals 100 if the bond appeared on the Treasury's eligible list the following month, and zero otherwise. P(accepted) equals 100 if the bond was actually tendered and accepted in the following month's buyback operation, and zero otherwise. All price and yield variables are measured at month end.

Panel A: 2024–2025

	Mean	SD	p25	p50	p75	N
Disc. Depth (%)	5.866	9.781	0.000	1.464	6.555	8,934
Prem. Height (%)	0.460	1.334	0.000	0.000	0.000	8,934
Yield (%)	4.236	0.754	3.905	4.260	4.667	8,934
Bid-Ask Spread (bps)	3.818	2.982	1.703	3.175	5.004	8,934
Log Outstanding (log USD)	10.967	0.568	10.650	10.951	11.198	8,934
Age (years)	4.389	5.699	0.792	2.542	5.340	8,934
Remaining Maturity (years)	6.374	8.032	0.797	2.797	6.964	8,934
Coupon Rate (%)	2.671	1.727	1.250	2.875	4.125	8,934
P(eligible) (%)	26.203	43.976	0.000	0.000	100.000	8,934
P(accepted) (%)	8.238	27.496	0.000	0.000	0.000	8,934

Panel B: 2000–2003

	Mean	SD	p25	p50	p75	N
Disc. Depth (%)	0.480	1.289	0.000	0.000	0.281	4,987
Prem. Height (%)	8.329	12.507	0.000	2.094	11.303	4,987
Yield (%)	5.087	2.177	4.217	5.579	6.269	4,987
Bid-Ask Spread (bps)	3.012	1.567	2.791	3.074	3.202	4,987
Log Outstanding (log USD)	9.482	0.685	9.309	9.559	9.883	4,987
Age (years)	6.411	6.682	1.000	3.836	9.882	4,987
Remaining Maturity (years)	6.428	8.204	0.501	2.288	9.214	4,987
Coupon Rate (%)	6.163	3.564	5.250	6.250	7.875	4,987
P(eligible) (%)	9.565	29.414	0.000	0.000	0.000	4,987
P(accepted) (%)	6.818	25.208	0.000	0.000	0.000	4,987

Table 5: Absorption of borrowing surprises: Bills vs. coupons. This table reports regression results examining how borrowing surprises pass through to bill versus coupon issuance. Columns (1)–(2) examine total borrowing surprises (actual minus one-quarter-ahead forecast). Columns (3)–(4) examine planning surprises (current estimate minus prior forecast). Columns (5)–(6) examine execution surprises (actual minus current estimate). For each surprise measure, we regress the corresponding issuance surprise for coupons (odd columns) or bills (even columns) on the borrowing surprise. Under complete shock absorption, the bill coefficient should equal one and the coupon coefficient should equal zero. Sample period is 2002Q1–2025Q4. Heteroskedasticity-robust standard errors are reported in parentheses.

	Total		Planning		Execution	
	Coupon	Bill	Coupon	Bill	Coupon	Bill
	(1)	(2)	(3)	(4)	(5)	(6)
Borrowing Surprise (Total)	0.022***	0.979***				
	(0.007)	(0.007)				
Borrowing Surprise (Plan)			0.020***	0.980***		
			(0.007)	(0.007)		
Borrowing Surprise (Exec)					0.000	1.000***
					(0.014)	(0.014)
Observations	95	94	95	94	95	94
R^2	0.030	0.984	0.046	0.992	0.000	0.907
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$					

Table 6: Relationship between market conditions and duration supply. This table reports regression results examining the relationship between term spreads and swap spreads and the share of duration (DV01) supply by maturity. Panel A examines duration (DV01) supply by maturity, expressed as each bucket's share of total duration supply from fixed-coupon securities. Panel B examines the relative issuance of FRNs and TIPS compared to fixed-coupon securities. In Panel A, the dependent variable is the percentage share of total duration (DV01) supply allocated to each maturity bucket. In Panel B, the dependent variable is the issuance share of each security type relative to fixed-coupon securities at the same maturity. *Term Spread* is the maturity-matched term spread from the Treasury yield curve. *Swap Spread* is the difference between the Treasury yield and the swap rate at the same maturity. *Swap Rate* is the interest rate swap rate at the corresponding maturity. *FC* indicates fixed-coupon securities. Columns (1)-(4) examine actual issuance; columns (5)-(8) examine TBAC indications. Driscoll-Kraay standard errors with Newey-West kernel (bandwidth = 4 quarters) are reported in parentheses.

Panel A: Duration Supply – Share by Maturity

	Duration Supply by Maturity (%)							
	Actual Issuance				Issuance Indication			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Term Spread	−0.161	−2.395			0.305	−1.989		
	(1.377)	(1.491)			(1.319)	(1.384)		
Swap Spread			14.871***	22.863***			14.042**	21.236***
			(5.488)	(6.032)			(5.535)	(6.009)
Swap Rate			−2.557	−2.613**			−1.886	−2.189*
			(1.658)	(1.291)			(1.560)	(1.211)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maturity FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	672	672	672	672	672	672	672	672
R^2	0.000	0.437	0.055	0.511	0.001	0.466	0.045	0.526
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$							

Panel B: Issuance Share by Maturity and Security Type

	Issuance by Maturity and Security Type (%)							
	Actual Issuance				Issuance Indication			
	FRN vs FC		TIPS vs FC		FRN vs FC		TIPS vs FC	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FC × Term Spread	−1.669***		−0.230		−2.111***		−0.130	
	(0.603)		(0.169)		(0.744)		(0.180)	
FC × Swap Spread		9.785***		1.088		11.074***		0.729
		(1.239)		(0.972)		(1.510)		(0.987)
FC × Swap Rate		−0.083		−0.175		0.047		−0.110
		(0.193)		(0.245)		(0.185)		(0.245)
Quarter × Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security × Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	96	96	768	768	96	96	768	768
R^2	0.924	0.941	0.957	0.957	0.921	0.942	0.952	0.953
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$							

Table 7: Relationship between changes in market conditions and duration supply adjustments. This table reports regression results examining the relationship between changes in swap spreads and swap rates and adjustments to Treasury duration supply. Panel A examines changes in duration supply for fixed-coupon securities. The dependent variables are: changes in actual duration supply share (columns 1–2), changes in TBAC indication share (columns 3–4), and deviations of actual issuance from prior indications (columns 5–6). Panel B examines changes in the relative issuance of FRNs and TIPS compared to fixed-coupon securities. Δ *Swap Spread* is the quarter-over-quarter change in the swap spread. Δ *Swap Rate* is the quarter-over-quarter change in the swap rate. *FC* indicates fixed-coupon securities. Driscoll-Kraay standard errors with Newey-West kernel (bandwidth = 4 quarters) are reported in parentheses.

Panel A: Changes in Duration Supply (Fixed Coupon)

	Δ Duration Supply and Adjustments (%)					
	Δ Duration Supply (%)		Δ Duration Indication (%)		Duration Deviation (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Swap Spread	−4.299	−4.374	−1.294	−1.394	−1.327	−1.071
	(4.069)	(4.092)	(3.920)	(3.889)	(2.915)	(2.899)
Δ Swap Rate	−1.915**	−1.872**	0.664	0.703	−0.671	−0.752
	(0.849)	(0.859)	(0.646)	(0.659)	(0.636)	(0.614)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity FE	No	Yes	No	Yes	No	Yes
Observations	672	672	665	665	665	665
R^2	0.009	0.012	0.002	0.005	0.002	0.048
Notes:	$^*p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$					

Panel B: Changes in Issuance Share by Security Type

	Changes and Adjustments in Issuance Share (%)					
	Δ Issuance (%)		Δ Indication (%)		Deviation (%)	
	FRN vs FC	TIPS vs FC	FRN vs FC	TIPS vs FC	FRN vs FC	TIPS vs FC
	(1)	(2)	(3)	(4)	(5)	(6)
FC $\times$ Δ Swap Spread	11.298**	0.752	9.030	−1.871	3.846	−0.470
	(5.384)	(1.267)	(6.121)	(1.956)	(3.062)	(0.795)
FC $\times$ Δ Swap Rate	−0.161	0.040	1.500	−0.082	0.426	0.045
	(0.960)	(0.320)	(1.046)	(0.410)	(0.502)	(0.174)
Quarter $\times$ Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes
Security $\times$ Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	96	768	96	488	96	488
R^2	0.237	0.568	0.255	0.494	0.290	0.585
Notes:	$^*p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$					

Table 8: Relation between bond price and buyback eligibility. This table reports linear probability model estimates of the relation between bond characteristics and the probability that a bond appears on the Treasury's buyback-eligible list the following month. Columns (1)–(2) use the 2024–2025 buyback sample; columns (3)–(4) use the 2000–2003 sample. Even-numbered columns add bond fixed effects to the month fixed effects in odd-numbered columns; because bond fixed effects absorb time-invariant characteristics, *Log Outstanding* and *Coupon Rate* are omitted from those columns. *Disc. Depth* is $\max(100 - \text{Price}, 0)$; *Prem. Height* is $\max(\text{Price} - 100, 0)$. *Yield* is the annualized yield to maturity in percent. *Bid-Ask Spread* is the bid-ask spread relative to midpoint in basis points. *Log Outstanding* is the natural log of total face value outstanding (USD). *Age* and *Remaining Maturity* are in years. *Coupon Rate* is the stated annual coupon in percent. Standard errors clustered at the bond level are reported in parentheses.

	P(eligible) in 2024–2025 (%)		P(eligible) in 2000–2003 (%)	
	(1)	(2)	(3)	(4)
Disc. Depth (%)	1.2705***	2.4451***	−2.8819***	−0.8578**
	(0.1587)	(0.3502)	(0.5063)	(0.3613)
Prem. Height (%)	−2.3155***	−0.1003	1.0294***	−0.7511***
	(0.5789)	(0.8966)	(0.0965)	(0.2003)
Yield (%)	3.1606***	1.7745***	−0.5034	−0.4328
	(0.5117)	(0.3286)	(0.3453)	(0.3214)
Bid-Ask Spread (bps)	1.7063***	2.5905***	5.3673***	0.8490
	(0.3732)	(0.3405)	(0.9740)	(1.5436)
Log Outstanding (log USD)	−5.6822***		2.5393*	
	(1.2888)		(1.3481)	
Age (years)	−1.1038***		0.7998***	
	(0.1776)		(0.2249)	
Remaining Maturity (years)	−0.0571		0.5032**	
	(0.1736)		(0.2056)	
Coupon Rate (%)	2.7914***		−3.3193***	
	(0.4931)		(0.4962)	
Month FE	Yes	Yes	Yes	Yes
Bond FE	No	Yes	No	Yes
Observations	8,934	8,934	4,987	4,987
R^2	0.201	0.308	0.363	0.431
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$			

Table 9: ESA 2010 Staggered Difference-in-Differences Results. This table presents the main DiD results for the effect of ESA 2010 adoption on sovereign borrowing costs across progressively richer control sets. The sample includes all eleven countries (United States control, two early adopters, eight mandatory adopters). The dependent variables are the swap spread (10-year sovereign zero rate minus 10-year swap rate, in basis points) and the term spread (10-year minus 1-year sovereign zero rate, in percentage points). Specification (1) includes only country and year-month fixed effects. Specification (2) adds equity volatility (VIX/V2X) and bond volatility (MOVE). Specification (3) adds fiscal fundamentals (debt-to-GDP and budget balance-to-GDP). Specification (4) adds the full control set, including the country-specific 3-month sovereign zero rate, the policy rate differential, and country-specific QE indicators. Specification (5) replaces the year-month fixed effect with a region $\times$ year-month fixed effect, where region is the United States or the Eurozone, absorbing all time-varying factors that differ between the two monetary regimes. Specification (6) additionally includes a GIIPS $\times$ Crisis indicator that equals one for Italy, Spain, Ireland, Portugal, and Greece during May 2010 through June 2013, absorbing the asymmetric dynamics of the European sovereign debt crisis (the GIIPS-side elevation in spreads and the corresponding Core-side flight-to-quality movements through the column-space equivalence with the region $\times$ year-month fixed effects). The crisis window lies strictly between the two ESA adoption dates and does not collide with any country's treatment indicator. Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

	Swap Spread (bps)		Term Spread (pp)	
Specification	Coef.	t-stat	Coef.	t-stat
(1) No Controls	-154.5^{***}	-9.50	$+0.28^{**}$	$+2.25$
(2) + Volatility	-152.2^{***}	-9.43	$+0.24^{**}$	$+1.98$
(3) + Fiscal	-117.8^{***}	-7.27	$+0.32^{***}$	$+2.65$
(4) + Full Controls	-23.5^{*}	-1.95	-0.45^{***}	-5.94
(5) + Region $\times$ Year-Month FE	-130.5^{***}	-9.33	-0.77^{***}	-8.17
(6) + GIIPS $\times$ Crisis	-58.1^{***}	-6.10	-0.54^{***}	-6.51

Table 10: ESA 2010 Heterogeneity by Country Group: Columns (4) and (6). This table presents heterogeneous treatment effects across country groupings under two specifications. Column (4) includes country and year-month fixed effects with the full control set described in Table 9. Column (6) replaces the year-month fixed effect with a region × year-month fixed effect and additionally includes the GIIPS × Crisis indicator described in Table 9. The dependent variables are the swap spread (basis points) and the term spread (percentage points). Panel A separates Core Europe (Germany, the Netherlands, France, Belgium, Austria) from Periphery Europe (Italy, Spain, Ireland, Portugal, Greece). Panel B separates early adopters (Germany and the Netherlands, treated January 2010) from late adopters (treated September 2014); Column (6) on the early-adopters subsample contains no within-Eurozone untreated control during the post-treatment period and is reported only for completeness. Panel C presents the preferred specification grouping Italy with Core Europe based on its debt management behaviour. Under Column (6) the Periphery and Late-adopters panels load some residual crisis-recovery dynamics from the post-September-2014 window when all Eurozone sovereigns are simultaneously treated; the Core and Core + Italy panels, which contain both early and late adopters within the Eurozone, are cleanly identified. Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

	Swap Spread (bps)				Term Spread (pp)				
	Spec. (4)		Spec. (6)		Spec. (4)		Spec. (6)		
Sample	Coef.	t	Coef.	t	Coef.	t	Coef.	t	N
Panel A: Core Europe vs. Periphery									
Core	-39.5^{***}	-14.6	-38.4^{***}	-10.7	-0.35^{***}	-9.6	-0.28^{***}	-11.4	1,596
Periphery	$+83.0^{***}$	$+5.2$	$+180.0^{***}$	$+11.9$	-0.10	-0.7	-1.11^{***}	-10.9	1,625
Panel B: Early vs. Late Adopters									
Early adopters	-34.2^{***}	-10.4	$+88.1^{***}$	$+3.9$	-0.39^{***}	-5.0	$+0.01$	$+0.0$	810
Late adopters	$+102.5^{***}$	$+7.1$	$+152.8^{***}$	$+13.5$	-0.10	-0.9	-1.33^{***}	-13.9	2,411
Panel C: Core Europe + Italy vs. Periphery excl. Italy									
Core + Italy	-39.8^{***}	-8.9	-48.8^{***}	-9.5	-0.29^{***}	-6.9	-0.37^{***}	-10.7	1,867
Periphery excl. Italy	$+61.5^{***}$	$+3.5$	$+158.6^{***}$	$+8.2$	-0.26^{*}	-1.8	-1.25^{***}	-10.8	1,354

Table 11: Country-Specific ESA 2010 Treatment Effects: Swap Spread and Term Spread. This table presents individual country coefficients under three specifications. Column (4) bilateral runs separate DiD regressions, each including only that country and the United States as control, with country and year-month fixed effects and the full Column (4) control set. Specification (5) interacted reports country-by-country coefficients from a single regression on the full eleven-country panel that interacts the treatment indicator with country dummies; the specification includes country fixed effects, region $\times$ year-month fixed effects, and the full control set. Column (6) interacted additionally includes the GIIPS $\times$ Crisis indicator described in Table 9. Countries are classified as Core Europe (Germany, the Netherlands, France, Belgium, Austria), Core-like (Italy, which exhibits debt management behaviour more similar to Core Europe), or Periphery (Spain, Ireland, Portugal, Greece). For Italy, the country-specific coefficient under Column (6) is statistically indistinguishable from zero, indicating that Italy's bond-pricing dynamics in the post-treatment period are absorbed by the GIIPS-Crisis recovery channel rather than by the ESA treatment indicator; the Core + Italy aggregate in Panel C of Table 10 remains robust under S (6). Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

Country	Swap Spread (bps)			Term Spread (pp)			Classification
	Spec. (4) bil.	Spec. (5) int.	Spec. (6) int.	Spec. (4) bil.	Spec. (5) int.	Spec. (6) int.	
Early Adopters (January 2010)							
Germany	-33.0^{***}	-106.8^{***}	-48.6^{***}	-0.34^{***}	-0.86^{***}	-0.65^{***}	Core
Netherlands	-25.5^{***}	-125.9^{***}	-58.4^{***}	-0.35^{***}	-0.73^{***}	-0.48^{***}	Core
Late Adopters (September 2014)							
France	-52.5^{***}	-135.3^{***}	-79.9^{***}	-0.71^{***}	-0.92^{***}	-0.71^{***}	Core
Belgium	-82.7^{***}	-124.6^{***}	-71.8^{***}	-0.97^{***}	-0.63^{***}	-0.44^{***}	Core
Austria	-44.9^{***}	-87.1^{***}	-39.3^{***}	-0.61^{***}	-0.62^{***}	-0.45^{***}	Core
Italy	-53.3^{***}	-99.8^{***}	$+11.0$	-0.43^{***}	-0.37^{***}	$+0.03$	Core-like
Spain	$+30.5^{***}$	-199.6^{***}	-77.5^{***}	$+0.06$	-1.27^{***}	-0.82^{***}	Periphery
Ireland	-38.0^{***}	-162.9^{***}	-73.3^{***}	-0.48^{***}	-0.87^{***}	-0.54^{***}	Periphery
Portugal	-26.4	-162.7^{***}	-58.2^{**}	-0.95^{***}	-0.87^{***}	-0.50^{***}	Periphery
Greece	$+78.6$	$+45.4$	$+136.9^{***}$	-1.76^{***}	-1.12^{***}	-0.79^{**}	Periphery

Table 12: ESA 2010 Effect on Realized Interest Expense. This table reports difference-in-differences estimates of the effect of ESA 2010 adoption on the implicit interest rate of general government debt, defined as annual interest payable divided by the prior-year-end face value of general government gross debt (Maastricht-debt aggregate). Interest payable is sourced from Eurostat `gov_10q_ggnfa` (indicator D.41) for the Euro-area sovereigns and from the U.S. Bureau of Economic Analysis federal government interest payments, via the World Bank `GC.XPN.INTP.CN` series, for the United States. The general-government-gross-debt denominator is sourced from Eurostat `gov_10q_ggdebt` for the Euro-area sovereigns and from the Treasury Monthly Statement of the Public Debt for the United States. The sample is annual, 2001–2023, for the United States control and the ten Euro-area sovereigns. The treatment indicator equals one for Germany and the Netherlands from 2010 and for late adopters from 2015 (the first full calendar year following the September 2014 mandatory compliance date); 2014 is excluded for late adopters as a mixed-treatment year. Controls are constructed at annual frequency by averaging the monthly Bloomberg series used in the main DiD specification. Specification (4) includes the country-specific 3-month sovereign zero rate as the short-rate control to absorb residual differences in the monetary regime across the U.S. and Euro-area panels. All specifications include country and year fixed effects. Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

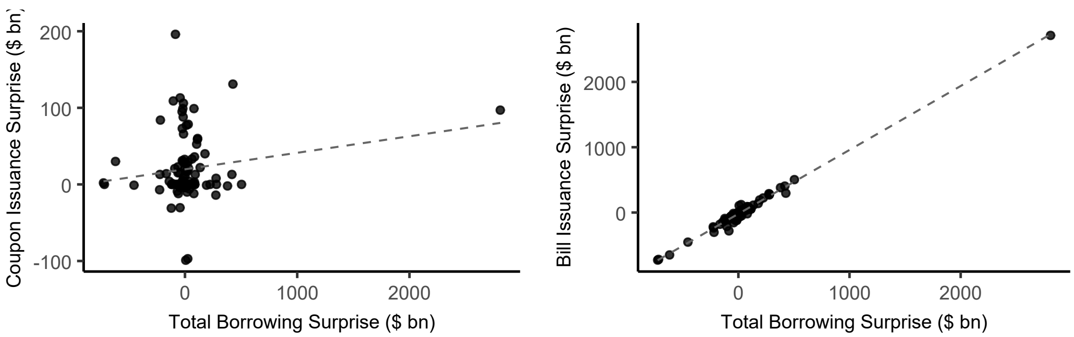
	Implicit Interest Rate on General Government Debt (%)		
Specification	Coef.	t-stat	N
(1) No Controls	-0.791^{***}	−4.42	239
(2) + Volatility	-0.692^{***}	−4.61	239
(3) + Fiscal	-0.578^{***}	−4.00	239
(4) + Full Controls	-0.542^{***}	−4.31	238

Table 13: ESA 2010 Effect on Realized Interest Expense: Heterogeneity by Country Group. This table presents heterogeneous treatment effects on the implicit interest rate of general government debt across country groupings. The specification runs a single regression on the full eleven-country panel and reports the coefficient on a treatment-group-restricted indicator for each country group, while simultaneously including the corresponding indicators for the other groups so that the time fixed effect is not absorbed by any one group's treatment. Panel A separates Core Europe plus Italy (Germany, the Netherlands, France, Belgium, Austria, Italy) from the remaining Periphery (Spain, Ireland, Portugal, Greece). Panel B further decomposes the Core Europe plus Italy effect by adoption cohort, distinguishing early adopters (Germany and the Netherlands, treated from 2010) from late Core adopters (France, Belgium, Austria), Italy, and the late Periphery (Spain, Ireland, Portugal, Greece). The dependent variable is the implicit interest rate on general government debt (percent). All specifications include country and year fixed effects and the full Specification (4) control set including the country-specific 3-month sovereign zero rate. Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

	Implicit Interest Rate (%)		
Sample	Coef.	t-stat	N
Panel A: Core Europe + Italy vs. Periphery excl. Italy			
Core Europe + Italy	-0.593^{***}	-4.40	238
Periphery excl. Italy	-0.390^{**}	-2.31	238
Panel B: Adoption Cohort Decomposition			
Early adopters (DE, NL)	-0.874^{***}	-5.16	238
Late Core (FR, BE, AT)	-0.607^{***}	-4.01	238
Italy	$+0.043$	$+0.23$	238
Late Periphery	-0.286	-1.63	238

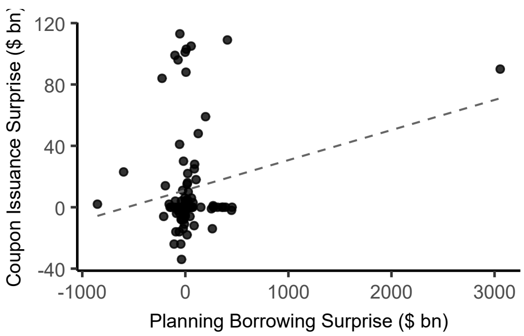
Internet Appendix for
"The US Treasury's Biggest Short: Duration in the Shadows"

IA.1 Additional Figures and Tables

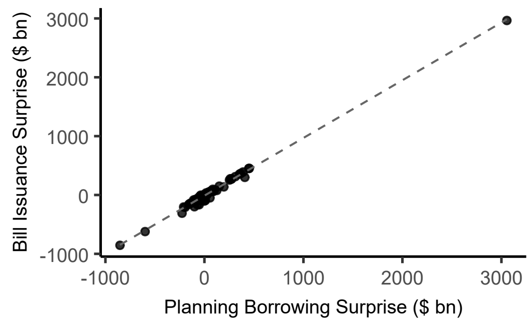


(a) Total Borrowing Surprise vs Coupon Surprise **(b)** Total Borrowing Surprise vs Bill Surprise

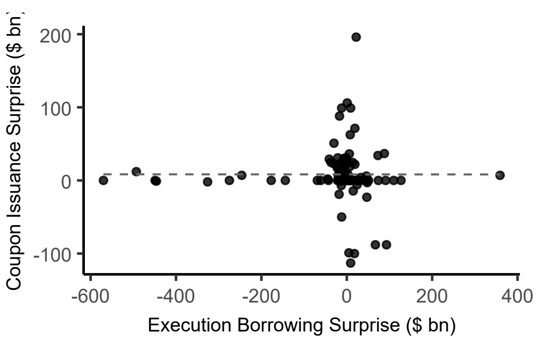
Figure IA.1: Absorption of Borrowing Surprises: Bills vs. Coupons. This figure presents scatter plots of borrowing surprises against issuance surprises for coupons (Panel a) and bills (Panel b). Total borrowing surprise is the difference between actual marketable borrowing and the one-quarter-ahead forecast. Each point represents a quarter from 2002Q1 to 2025Q4. Colors and shapes indicate crisis periods: Normal (black circles), GFC 2007Q3–2009Q2 (red triangles), and COVID-19 2020Q1–2020Q2 (blue squares). The dashed line represents the OLS regression fit. Panel (a) shows near-zero passthrough of borrowing surprises to coupon issuance, while Panel (b) demonstrates near-unity passthrough to bill issuance, confirming that bills serve as the shock absorber for unexpected financing needs.



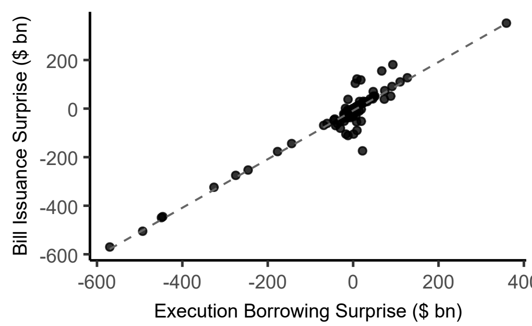
(a) Planning Stage: Coupon



(b) Planning Stage: Bill



(c) Execution Stage: Coupon



(d) Execution Stage: Bill

Figure IA.2: Shock Absorption by Information Stage. This figure decomposes borrowing surprises into planning surprises (Panels a–b) and execution surprises (Panels c–d). Planning surprise is the difference between the current quarter's estimate and the previous quarter's forecast. Execution surprise is the difference between actual borrowing and the current quarter's estimate. Colors indicate crisis periods as in Figure IA.1. Panels (a) and (c) show coupon issuance surprises; Panels (b) and (d) show bill issuance surprises. The results confirm that shock absorption operates at both the planning and execution margins, with bills absorbing virtually all unexpected changes in financing needs at each stage.

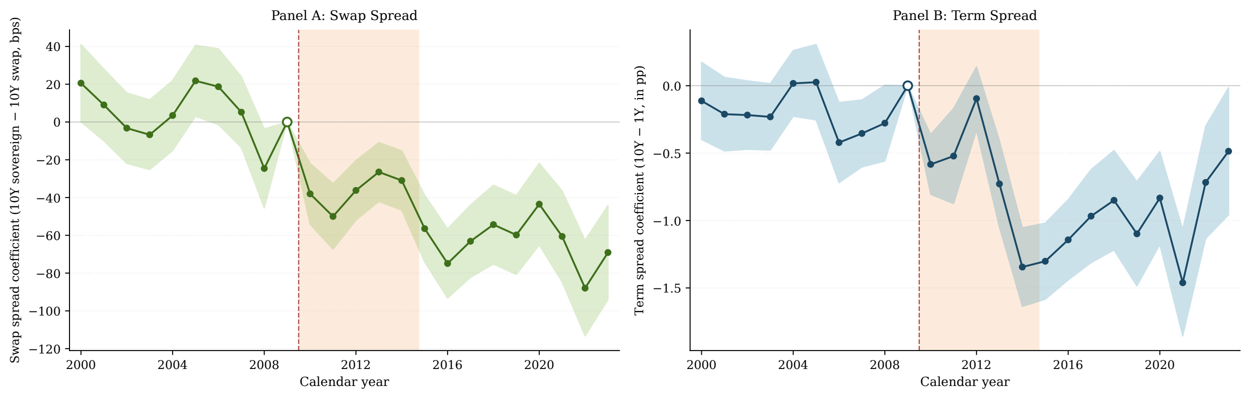


Figure IA.3: Event Study: Early Adopters (Germany & Netherlands vs. U.S.). This figure presents event study coefficients from the three-country DiD specification with annual bins relative to ESA 2010 adoption (January 2010) and 95% confidence bands. Panel A shows swap spread coefficients (10-year sovereign zero rate minus 10-year swap rate, in basis points), with a pre-treatment average of $+4.4$ basis points (positive, biasing against the negative treatment effect) and a post-treatment average of -53.7 basis points. Panel B shows term spread coefficients (10-year minus 1-year sovereign zero rate, in percentage points), corresponding to Figure 9 in the main text, with a pre-treatment average of -0.18 percentage points and a post-treatment average of -0.87 percentage points. In both panels, pre-treatment coefficients fluctuate around zero with no systematic negative trend, while the post-treatment period shows a sustained negative shift. The x-axis is calendar year; the dashed vertical line marks ESA 2010 adoption (January 2010); the sandy shaded region marks the early-adopter ESA window from January 2010 through September 2014, during which Germany and the Netherlands report under ESA 2010 while the remaining EU member states do not yet do so. The white circle marks the omitted reference year (2009, the year immediately preceding the treatment date). All specifications include country and year-month fixed effects with the full baseline Specification (4) of Table 9 control set, including the 3-month sovereign zero rate. Standard errors are Newey-West HAC with four lags. Monthly data from Bloomberg, January 2000 through June 2023.

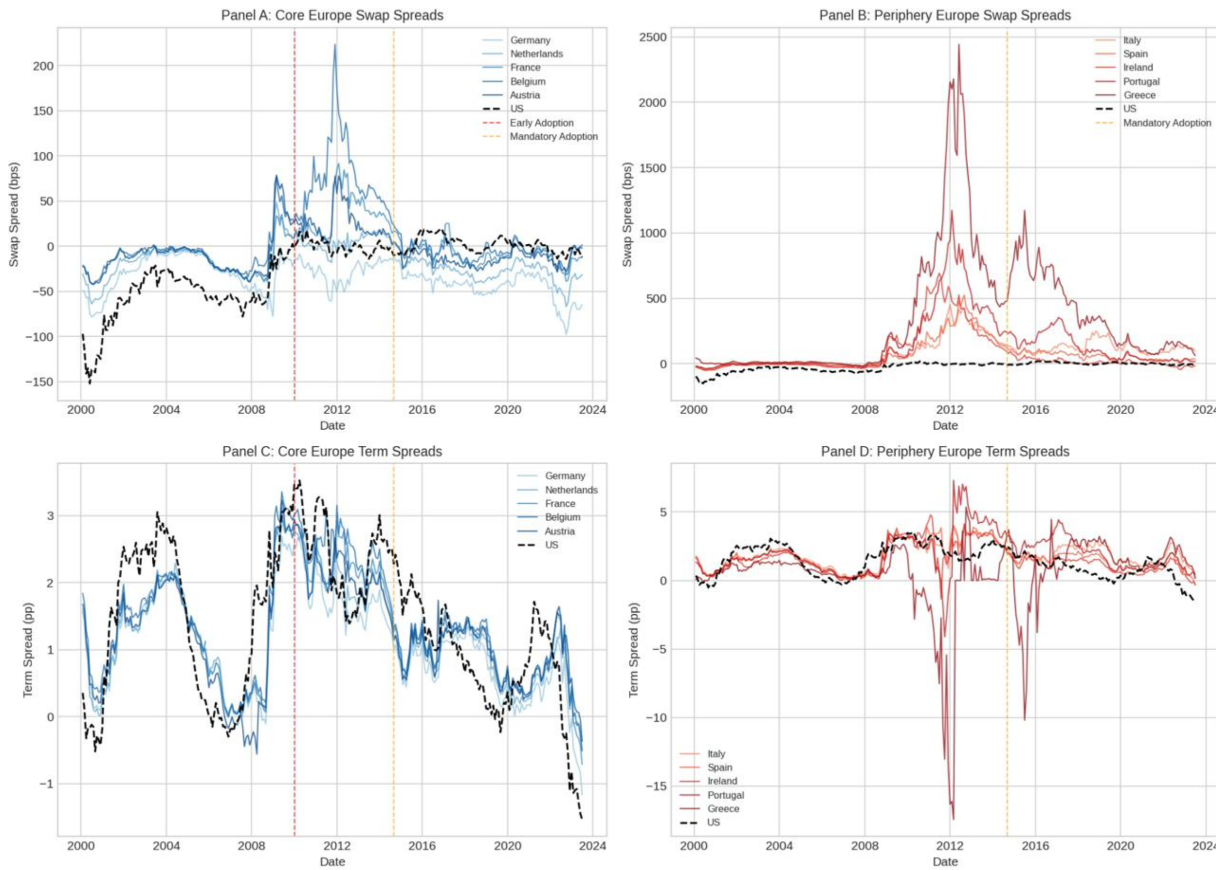
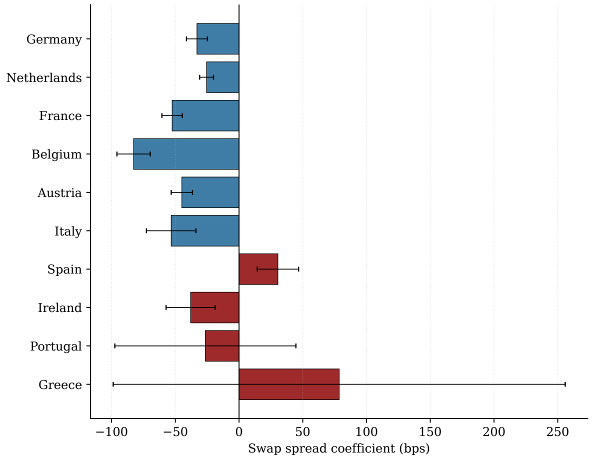
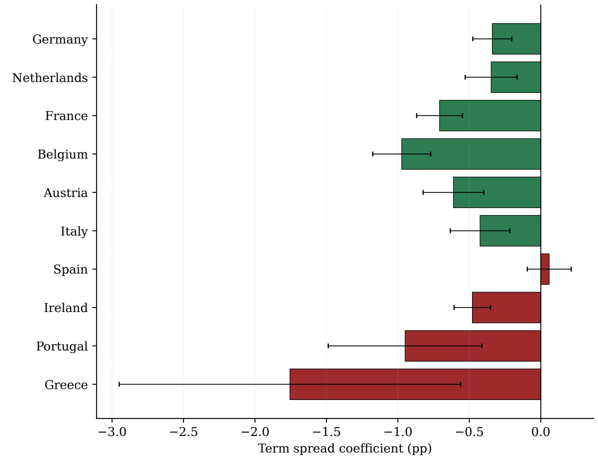


Figure IA.4: Sovereign Spreads: Core Europe, Periphery Europe, and the United States. This figure plots raw swap spreads (top row) and term spreads (bottom row) for Core Europe (left column) and Periphery Europe (right column) alongside the United States (dashed black line). The dashed red vertical line marks early ESA 2010 adoption (January 2010, Germany and Netherlands); the dashed orange vertical line marks mandatory adoption (September 2014, all others). Panel (a) shows that Core European swap spreads move broadly with the US before 2010 but diverge afterward, with the US becoming persistently more negative. Panel (b) reveals massive swap spread widening for Periphery countries during the European sovereign debt crisis (2010–2012), with Greece exceeding 2,400 bps, illustrating why the Core-Periphery distinction is essential for identification. Panel (c) shows Core European term spreads tracking the US closely before 2010, then remaining elevated relative to the US post-2014. Panel (d) shows extreme term spread inversion for Periphery countries during the crisis, confirming that crisis dynamics dominate ESA 2010 effects for these countries. Monthly data from Bloomberg, January 2000 through June 2023.



(a) Swap Spread Effects (bps)



(b) Term Spread Effects (pp)

Figure IA.5: Country-Specific Treatment Effects. This figure presents country-specific DiD coefficients from separate bilateral regressions of each country against the U.S. control, with 95% confidence intervals and significance indicators. Panel (a) shows swap spread effects (in basis points) and Panel (b) shows term spread effects (in percentage points). In both panels, all Core European countries (Germany, the Netherlands, France, Belgium, Austria) and Italy exhibit significant negative coefficients. Periphery countries affected by the European sovereign debt crisis show positive (Spain) or insignificant coefficients on the swap spread; on the term spread, all countries except Spain exhibit negative coefficients, with Greece, Portugal, and Ireland showing significant negative effects. The pattern is broadly consistent across both outcome measures, with the mandatory Core adopters (France, Belgium, Austria) and Italy showing among the largest effects. The results correspond to Table 11 in the main text. All specifications include year-month fixed effects and the full Specification (4) control set, including the 3-month sovereign zero rate. Standard errors are Newey-West HAC with four lags.

Table IA.1: Relation between market conditions and duration supply: dynamic specification. This table extends the baseline levels regression in Table 6 by adding one-quarter leads and lags of the swap spread and swap rate. The lag terms test whether the Treasury responds with a one-quarter delay to past market conditions; the lead terms test whether today's duration supply predicts future spreads, which would indicate that markets react to issuance rather than the reverse. The dependent variable is the duration supply share allocated to each maturity bucket. Columns (1)–(2) use actual issuance as the dependent variable; columns (3)–(4) use TBAC indications. Even-numbered columns include maturity fixed effects in addition to quarter fixed effects. *Swap Spread* is the difference between the Treasury yield and the interest rate swap rate at the same maturity. *Swap Rate* is the interest rate swap rate at the corresponding maturity. Lag and Lead refer to one-quarter lags and leads of each variable, respectively. Driscoll-Kraay standard errors with Newey-West kernel (bandwidth = 4 quarters) are reported in parentheses.

Panel A: Duration Supply – Share by Maturity (Dynamic Specification)

	Duration Supply by Maturity (%)			
	Actual Issuance		Issuance Indication	
	(1)	(2)	(3)	(4)
Swap Spread	0.549	2.251	2.029	3.497
	(6.010)	(5.202)	(5.903)	(5.158)
Lag Swap Spread	4.887	10.268	4.856	9.988
	(10.060)	(6.842)	(10.057)	(6.465)
Lead Swap Spread	10.554	13.932*	8.297	10.702
	(11.070)	(7.724)	(11.228)	(8.202)
Swap Rate	−1.462	−1.331	1.536	1.645
	(2.142)	(1.716)	(2.062)	(1.597)
Lag Swap Rate	−0.549	−0.227	−1.759	−1.711
	(2.996)	(2.215)	(2.986)	(2.218)
Lead Swap Rate	−0.715	−0.976	−1.893	−2.233
	(3.018)	(2.396)	(2.982)	(2.240)
Quarter FE	Yes	Yes	Yes	Yes
Maturity FE	No	Yes	No	Yes
Observations	672	672	672	672
R^2	0.059	0.520	0.049	0.534
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$			

Table IA.2: Relation between changes in market conditions and duration supply adjustments: dynamic specification. This table extends the baseline changes regression in Table 7 by adding one-quarter leads and lags of ΔSwap Spread and ΔSwap Rate. The lag terms test whether the Treasury responds with a one-quarter delay to past price signals; the lead terms test whether today's duration supply adjustments predict future spread changes. Columns (1)–(2) use the quarter-over-quarter change in actual duration supply; columns (3)–(4) use the change in TBAC indications; columns (5)–(6) use the deviation of actual issuance from prior indications. Even-numbered columns include maturity fixed effects in addition to quarter fixed effects. Δ *Swap Spread* is the quarter-over-quarter change in the swap spread. Δ *Swap Rate* is the quarter-over-quarter change in the swap rate. Lag and Lead refer to one-quarter lags and leads of each variable, respectively. Driscoll-Kraay standard errors with Newey-West kernel (bandwidth = 4 quarters) are reported in parentheses.

Panel B: Changes and Adjustments – Duration Supply by Maturity (Dynamic Specification)

	Δ Duration Supply and Adjustments (%)					
	Δ Duration Supply (%)		Δ Duration Indication (%)		Duration Deviation (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Swap Spread	−2.483	−2.586	−1.582	−1.686	−0.672	−0.363
	(3.587)	(3.601)	(3.575)	(3.529)	(2.835)	(2.801)
Lag Δ Swap Spread	2.004	1.882	1.582	1.513	2.459	2.663
	(2.702)	(2.646)	(2.205)	(2.179)	(1.821)	(1.839)
Lead Δ Swap Spread	4.735	4.639	−0.844	−0.910	0.764	0.994
	(2.968)	(2.982)	(3.081)	(3.145)	(2.090)	(2.117)
Δ Swap Rate	−1.950**	−1.918**	0.801	0.828	−0.722	−0.780
	(0.891)	(0.898)	(0.684)	(0.695)	(0.617)	(0.599)
Lag Δ Swap Rate	1.452*	1.476*	−1.069	−1.040	0.215	0.154
	(0.767)	(0.780)	(0.811)	(0.813)	(0.544)	(0.539)
Lead Δ Swap Rate	1.627*	1.660*	−0.731	−0.716	0.769	0.733
	(0.930)	(0.928)	(0.647)	(0.658)	(0.593)	(0.582)
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity FE	No	Yes	No	Yes	No	Yes
Observations	672	672	665	665	665	665
R^2	0.024	0.027	0.007	0.010	0.008	0.054
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$					

Table IA.3: Relation between bond price and buyback acceptance. This table reports linear probability model estimates of the relation between bond characteristics and the probability that a bond is tendered and accepted in the Treasury's buyback operation the following month. The sample consists of all monthly bond-level observations in the regression sample (not restricted to eligible bonds). Columns (1)–(2) use the 2024–2025 buyback sample; columns (3)–(4) use the 2000–2003 sample. Even-numbered columns add bond fixed effects to the month fixed effects in odd-numbered columns; because bond fixed effects absorb time-invariant characteristics, *Log Outstanding* and *Coupon Rate* are omitted from those columns. *Disc. Depth* is $\max(100-\text{Price}, 0)$, the depth below par for bonds trading at a discount. *Prem. Height* is $\max(\text{Price}-100, 0)$, the height above par for bonds trading at a premium. *Yield* is the annualized yield to maturity in percent. *Bid-Ask Spread* is the bid-ask spread relative to midpoint in basis points. *Log Outstanding* is the natural log of total face value outstanding (USD). *Age* and *Remaining Maturity* are in years. *Coupon Rate* is the stated annual coupon in percent. The dependent variable $P(\text{accepted})$ equals 100 if the bond was tendered and accepted in the following month's buyback operation, and zero otherwise. All variables are measured at month end. Standard errors clustered at the bond level are reported in parentheses.

	P(accepted) in 2024–2025 (%)		P(accepted) in 2000–2003 (%)	
	(1)	(2)	(3)	(4)
Disc. Depth (%)	0.6247^{***}	-0.4859^{*}	-2.5895^{***}	-1.0257^{***}
	(0.0978)	(0.2726)	(0.4203)	(0.3462)
Prem. Height (%)	-0.9535^{***}	0.1606	0.8484^{***}	-0.7431^{***}
	(0.2563)	(0.3796)	(0.1200)	(0.1917)
Yield (%)	-0.6266^{**}	-0.0408	-0.4948	-0.4408
	(0.2851)	(0.1573)	(0.3209)	(0.3068)
Bid-Ask Spread (bps)	0.2613	0.4530^{*}	3.5970^{***}	1.1143
	(0.2409)	(0.2531)	(0.9883)	(1.6597)
Log Outstanding (log USD)	-1.7431^{*}		0.9629	
	(0.9051)		(1.6353)	
Age (years)	-0.2556^{***}		0.1815	
	(0.0825)		(0.2512)	
Remaining Maturity (years)	-0.3907^{***}		0.4818^{**}	
	(0.0919)		(0.1972)	
Coupon Rate (%)	1.0710^{***}		-2.3763^{***}	
	(0.3156)		(0.4991)	
Month FE	Yes	Yes	Yes	Yes
Bond FE	No	Yes	No	Yes
Observations	8,934	8,934	4,987	4,987
R^2	0.047	0.157	0.291	0.401
Notes:	$^{*}p \le .10$; $^{**}p \le .05$; $^{***}p \le .01$			

IA.2 Panel Data Construction for the ESA 2010 Analysis

This appendix describes the construction of the eleven-country dataset used in Section 5 of the main text. The dataset comprises three distinct panels at three different frequencies: (1) a monthly cross-country panel of sovereign yields, swap rates, and macroeconomic controls used in the main difference-in-differences analysis in Tables 9–11; (2) an annual panel of implicit interest rates used in the realized cost analysis in Tables 12–13; and (3) a quarterly panel of sovereign balance-sheet derivatives positions used in the descriptive analysis in Figure 8 of the main text and in Table IA.5 of this appendix. The panels share a common country set and treatment assignment, with treatment timing and the Core/Periphery classification as described in Section 3 of the main text and in Section 5.1. Table IA.4 provides a reference summary of the ESA 2010 instrument codes and Eurostat tables referenced throughout, and Table IA.5 reports country-by-country descriptive statistics for the balance-sheet panel.

IA.2.1 Monthly Panel of Sovereign Yields and Macroeconomic Controls

The monthly panel covers eleven countries (the United States, Germany, the Netherlands, France, Belgium, Austria, Italy, Spain, Ireland, Portugal, and Greece) at the last trading day of each calendar month from January 2000 through June 2023, for a total of 282 monthly observations per country and 3,102 country-month observations. The June 2023 endpoint coincides with the cessation of USD LIBOR on 30 June 2023, after which the swap-spread series is no longer based on a single benchmark for the United States.

Sovereign yield curves. Sovereign zero-coupon yield curves are sourced from Bloomberg using the Bloomberg Fair Value (BFV) zero-coupon series at the country-currency level, specifically the BLC2 (Bloomberg Curve Type 2) series with maturity codes from 1-year to 10-year at annual maturity intervals. Term spreads are constructed as the difference between the 10-year and the 3-month zero rate, in percentage points. The short-rate control is the country-specific 3-month sovereign zero rate, sourced from the same BFV series. For the United States, the Treasury constant-maturity yield series from the Federal Reserve H.15 release is used as a cross-check and agrees with Bloomberg BFV to within one basis point at every maturity over the sample period.

Swap rates and swap spreads. Interest-rate swap rates are sourced from Bloomberg at the 10-year maturity, on a fixed-for-floating basis. For the United States, the floating leg is USD LIBOR through 30 June 2023 (the official cessation date), and the swap-spread series ends at that point. For the Euro-area sovereigns, the floating leg is EURIBOR throughout the sample. The swap spread is constructed as the 10-year sovereign zero rate minus the 10-year swap rate, expressed in basis points. This sovereign-yield-minus-swap-rate convention is the reverse of the standard "swap spread" convention commonly used in the United States literature (Klingler and Sundaresan, 2019, 2023; Jermann, 2020; Boyarchenko et al., 2018); we adopt it here, and refer to the variable as the sovereign spread over swaps, because the sovereign yield is the variable of substantive interest in our cross-country setting.

Macroeconomic and fiscal controls. Equity volatility is the V2X index (EURO STOXX 50 implied volatility, Bloomberg ticker `V2X Index`) for the Euro-area sovereigns and the VIX index (Bloomberg ticker `VIX Index`) for the United States. Bond volatility is the MOVE index (Bloomberg ticker `MOVE Index`), applied to all countries. For the Euro-area sovereigns, debt-to-GDP is constructed as Eurostat `gov_10q_ggdebt` (general government gross debt at face value, F.3 instrument, end of quarter) divided by Eurostat `namq_10_gdp` (nominal GDP, current prices), at quarterly frequency and forward-filled to monthly. For the United States, debt-to-GDP is constructed from the Federal Reserve Z.1 Financial Accounts (Table L.106) combined with U.S. Bureau of Economic Analysis nominal GDP. Budget-balance-to-GDP is constructed from Eurostat `gov_10dd_edpt1` (deficit/surplus, EDP table) and `namq_10_gdp` for the Euro-area sovereigns and from Congressional Budget Office Monthly Budget Review data combined with BEA nominal GDP for the United States.

Monetary policy controls. The first monetary-policy control is the country-specific 3-month sovereign zero rate (described above). The second is the policy rate differential, constructed as the Federal Funds Rate (FRED series `FEDFUNDS`) minus the ECB Main Refinancing Operations rate (ECB Statistical Data Warehouse, series `FM.M.U2.EUR.4F.KR.MRR_FR.LEV`). The third is a set of country-specific binary indicators for active quantitative-easing (QE) periods. For the United States, the QE indicator equals one from November 2008 through March 2022, covering the Federal Reserve's QE1, QE2, QE3, and QE4 asset purchase programmes and the COVID-era purchases. For the Euro-area sovereigns, the QE indicator equals one during active dates of the Securities Markets Programme (May 2010 through February 2012, applied to the periphery countries that received purchases under that programme), the Public Sector Purchase Programme (March 2015 through December 2018, restarted November 2019 through March 2022, applied to all Euro-area sovereigns), and the Pandemic Emergency Purchase

Programme (March 2020 through March 2022, applied to all Euro-area sovereigns). The Outright Monetary Transactions programme (announced August 2012) is not coded as active because the Eurosystem made no purchases under that programme.

IA.2.2 Annual Panel of Implicit Interest Rates

The annual panel covers the same eleven countries from 2001 through 2023, for a total of 238 country-year observations. The implicit interest rate, r_{ct}, is defined as the annual interest payable on general government debt divided by the prior-year-end face value of general government gross debt, and is expressed in percent.

Interest payable (numerator). For the Euro-area sovereigns, annual interest payable is sourced from Eurostat `gov_10q_ggnfa` (general government non-financial accounts), indicator D.41 (Interest payable). The quarterly series is summed within each calendar year to obtain annual flows. Data are available consistently from 2001 onward. For the United States, annual federal-government interest payments are sourced from the World Bank World Development Indicators series `GC.XPN.INTP.CN` (Interest payments, current Local Currency Units), which is constructed from U.S. Bureau of Economic Analysis National Income and Product Accounts Table 3.2 (Federal Government Current Receipts and Expenditures).

Face-value debt (denominator). For the Euro-area sovereigns, the denominator is the end-of-year value of Eurostat `gov_10q_ggdebt`, the Maastricht-debt aggregate at face value, which sums currency and deposits (instrument F.2), debt securities (F.3), and loans (F.4) as defined in EU Regulation No 479/2009. For the United States, the denominator is the end-of-year total face value of federal debt from the Treasury Monthly Statement of the Public Debt, Table 1 (Summary of Treasury Securities Outstanding). Using a prior-year-end denominator ensures that the implicit-interest-rate measure has a predetermined denominator and is not mechanically affected by within-year changes in the stock of debt.

Annual controls. The annual control variables used in regression (9) are constructed from the corresponding monthly series described in Section IA.2.1 above by taking simple within-year averages. Equity volatility, bond volatility, the 3-month sovereign zero rate, and the policy rate differential are averaged across the twelve calendar-month observations within each year; debt-to-GDP and budget balance-to-GDP are averaged across the four quarterly observations within each year; and the QE indicator is set to the within-year average (which can take any value in $[0, 1]$, capturing partial-year exposure).

Treatment timing. The treatment indicator $\mathbf{1}[\text{Post}_{ct}]$ in equation (2) of the main text takes value one for Germany and the Netherlands from 2010 onward, consistent with the early-adopter assignment in the monthly panel. For the mandatory adopters (France, Belgium, Austria, Italy, Spain, Ireland, Portugal, and Greece), the indicator takes value one from 2015 onward, the first full calendar year following the September 2014 mandatory compliance date. The year 2014 itself is excluded for the mandatory adopters from the regression sample, since the cohort is treated for only the last four months of that year and the resulting annual flow is a mixture of pre- and post-treatment observations.

IA.2.3 Quarterly Balance-Sheet Panel of Derivatives Positions

The quarterly panel of sovereign balance-sheet derivatives positions used in Figure 8 of the main text and in Table IA.5 of this appendix comprises two complementary measures: notional swap volume, reported annually by national debt management offices, and mark-to-market position, reported quarterly by Eurostat.

Notional swap volume. Year-end notional volume of interest-rate swap contracts outstanding is sourced from national debt management office reports. For Germany, the source is the Bundesfinanzministerium *Kreditaufnahmebericht des Bundes*, annual editions, Table 13 (Zinsswaps des Bundes); the series is available consistently from 2002 to 2022. For the Netherlands, the source is the Dutch State Treasury Agency *Outlook* and Annual Reports, with consistent reporting from 2002 to 2022. For Italy, the source is the Ministero dell'Economia e delle Finanze *Rapporto sul Debito Pubblico*. For France, Belgium, Austria, and the Periphery countries excluding Italy, national notional reporting at comparable frequency is not available; these countries are therefore not reported on the notional measure in Table IA.5. The United States series is identically zero, reflecting the stated Treasury policy of not using derivatives in its debt management.

Mark-to-market derivatives position. The quarterly mark-to-market position of sovereign derivatives is sourced from Eurostat `gov_10q_ggfa` (general government financial accounts), instrument F.7 (Financial derivatives), sector S.13 (General government), on a consolidated basis. A positive value indicates a net derivative asset position; a negative value indicates a net derivative liability position; a zero value indicates no use of derivatives. For Germany and the Netherlands, F.7 is reported on the asset side only, with the reported value carrying sign information that reflects the net position; for the other Euro-area sovereigns, both the asset side and the liability side are reported, and the net position is constructed as the asset side minus the liability side. The United States series is identically zero on the same Treasury-policy grounds described above. The sample for the F.7 series spans 2000Q1 through 2025Q4 for the Euro-area sovereigns, with the Netherlands series ending 2023Q4.

FACE-VALUE DENOMINATOR. Both notional and mark-to-market positions are expressed as a percent of the face value of outstanding debt securities, using Eurostat `gov_10q_ggdebt` (F.3 instrument) for the Euro-area sovereigns and the Treasury Monthly Statement of the Public Debt, Table 1, for the United States.

IA.2.4 VARIABLE DEFINITIONS REFERENCE

Table IA.4 below provides a reference summary of the ESA 2010 instrument codes, the Eurostat tables, and the United States data sources used in the construction of the three panels described above.

Table IA.4: ESA 2010 Instrument Codes and Data Sources Used in Panel Construction. This table provides a reference summary of the ESA 2010 instrument codes, Eurostat tables, and United States data sources used in the construction of the three panels described in this appendix. ESA 2010 instrument codes follow the European System of Accounts 2010 classification of financial instruments, as defined in EU Regulation No 549/2013 (European Union, 2013). Eurostat tables are the standard government-finance tables published quarterly (`gov_10q_*`) or annually (`gov_10dd_*`) by Eurostat. The "Panel" column indicates which of the three panels (monthly, annual, balance-sheet) uses each item.

Code / Source	Description	Used For	Panel
Panel A: ESA 2010 Instrument Codes			
F.3	Debt securities (face value)	Face-value debt denominator	All
F.7	Financial derivatives	Mark-to-market derivatives position	Balance-sheet
D.41	Interest payable	Interest expense numerator	Annual
S.13	General government sector	Consolidating sector	All
Panel B: Eurostat Tables			
`gov_10q_ggdebt`	Quarterly government gross debt (Maastricht)	Face-value debt (F.3)	All
`gov_10q_ggnfa`	Quarterly government non-financial accounts	Interest payable (D.41)	Annual
`gov_10q_ggfa`	Quarterly government financial accounts	Derivatives position (F.7)	Balance-sheet
`gov_10dd_edpt1`	Annual EDP table (deficit/surplus)	Budget balance-to-GDP	Monthly, Annual
`namq_10_gdp`	Quarterly nominal GDP	GDP denominator for ratios	Monthly, Annual
Panel C: Bloomberg and Other Sources			
Bloomberg BFV (BLC2)	Bloomberg Fair Value zero-coupon curves	Sovereign yield curves	Monthly, Annual
Bloomberg `V2X Index`	EURO STOXX 50 implied volatility	Equity volatility (Euro area)	Monthly, Annual
Bloomberg `VIX Index`	CBOE Volatility Index	Equity volatility (U.S.)	Monthly, Annual
Bloomberg `MOVE Index`	ICE BofA MOVE Index	Bond volatility	Monthly, Annual
FRED `FEDFUNDS`	Federal Funds Effective Rate	Policy rate differential	Monthly, Annual
ECB SDW MRR rate	ECB Main Refinancing Operations rate	Policy rate differential	Monthly, Annual
Panel D: United States Sources			
Treasury MSPD Table 1	Monthly Statement of Public Debt	Face-value debt denominator	All
World Bank `GC.XPN.INTP.CN`	Federal interest payments (annual)	Interest expense numerator	Annual
Federal Reserve Z.1 L.106	Flow of funds financial accounts	U.S. debt-to-GDP	Monthly, Annual
CBO Monthly Budget Review	Federal deficit/surplus	U.S. budget balance-to-GDP	Monthly, Annual
Federal Reserve H.15	Constant-maturity Treasury yields	U.S. yields (cross-check)	Monthly

IA.2.5 Country-Level Descriptive Statistics for the Balance-Sheet Panel

Table IA.5 below reports country-by-country mean values of the two derivatives measures plotted in Figure 8 of the main text. The country-level time-series patterns underlying these means are visible in the figure itself.

Table IA.5: Sovereign Derivatives Position: Country-by-Country Descriptive Statistics. This table reports country-level mean values of the two derivatives measures plotted in Figure 8: the mean notional swap volume and the mean Eurostat F.7 net mark-to-market position, both expressed as a percent of face-value debt securities (Eurostat `gov_10q_ggdebt`, instrument F.3, sector S.13). Notional means are computed over the years reported by the national debt management offices, with the parenthetical figure indicating the number of annual observations available for each country; the eight late adopters other than Italy do not publish notional swap volumes at comparable annual frequency. The F.7 net mark-to-market series is quarterly and spans 2000Q1 through 2025Q4 for the Euro-area sovereigns (the Netherlands series ends 2023Q4). The United States series is identically zero throughout the sample by stated Treasury policy (Garbade, 2007). Cohort designations follow the treatment assignment used in Section 5 of the main text. The dash (—) indicates that national notional reporting at comparable annual frequency is not available for the country. A positive F.7 net mean indicates a receive-fixed-dominated derivative book whose value appreciates when interest rates fall; a negative F.7 net mean indicates a pay-fixed-dominated derivative book whose value declines when interest rates fall.

Country	Cohort	Adoption Date	Mean F.7 (% face val.)	Mean Notional (% face val.)	F.7 Sample (Quarters)
Panel A: Early Adopters					
Germany	Early	January 2010	−1.23%	13.8% ($n = 11$)	104
Netherlands	Early	January 2010	+1.54%	22.4% ($n = 11$)	96
Panel B: Late Core Adopters					
France	Late Core	September 2014	+0.06%	—	104
Belgium	Late Core	September 2014	−0.10%	—	104
Austria	Late Core	September 2014	−1.52%	—	104
Italy	Late Core	September 2014	−1.02%	7.5% ($n = 7$)	104
Panel C: Periphery Adopters					
Spain	Periphery	September 2014	−0.05%	—	104
Ireland	Periphery	September 2014	+0.06%	—	104
Portugal	Periphery	September 2014	+0.02%	—	104
Greece	Periphery	September 2014	−2.68%	—	104
Panel D: Control					
United States	Control	—	0.00%	0.00%	—

IA.3 ESA 2010 Robustness Tests

This appendix presents the full results of the robustness tests for the cross-country ESA 2010 analysis summarised in Section 5. We implement six tests beyond the pre-trends analysis reported in the main text: a within-Europe robustness panel that restricts the sample to the pre-September 2014 window and varies the control composition, the HonestDiD sensitivity analysis of Rambachan and Roth (2023), a leave-one-out analysis, the Callaway-Sant'Anna staggered DiD estimator (Callaway and Sant'Anna, 2021), a placebo test using a counterfactual treatment-timing assignment, and a phased-in adoption analysis. We lead with the within-Europe robustness because it addresses the central identification concern with the cross-country design, cross-region monetary regime differences, by construction: the United States is dropped from the sample entirely and the treatment effect is identified from within-Europe staggered timing alone. Together these tests establish robustness to parallel-trends violations (HonestDiD and the event study in the main text), influential observations (leave-one-out), treatment-effect heterogeneity across cohorts (Callaway-Sant'Anna), alternative timing assumptions (placebo timing), functional form (phased-in adoption), and cross-region monetary regime differences (within-Europe robustness). Each subsection below describes the methodology, the specification used, and the result; the specification choices are anchored in the natural object of each test, which we explain inside the relevant subsection.

Figure IA.3 presents the full event study for the early adopters (Germany and the Netherlands vs. the United States), showing both swap spread and term spread coefficients with 95% confidence bands. The swap spread pre-treatment average is $+5.5$ basis points (positive, biasing against the negative treatment effect), with a post-treatment average of -53.4 basis points. Figure IA.4 plots the raw swap spread and term spread data for all eleven countries, illustrating the Core-Periphery divergence that motivates the empirical design. Figure IA.5 presents country-specific DiD coefficients for both outcome variables.

IA.3.1 Within-Europe Robustness for the Early-Adopter Effect

A potential concern with the cross-country DiD design in the main paper is that the treatment windows overlap with divergences in U.S. and Euro-area monetary regimes and with the European sovereign debt crisis dynamics that simultaneously elevated GIIPS sovereign spreads and compressed Core sovereign spreads through flight-to-quality. Although Specifications (5) and (6) of the main DiD table address these concerns by replacing the year-month fixed effect with a region $\times$ year-month fixed effect and by additionally including the GIIPS $\times$ Crisis indicator, this subsection presents a complementary identification strategy that addresses both concerns by construction: restricting the sample to the within-Europe panel and to the pre-September 2014 window during which the eight late adopters are not yet treated.

The within-Europe restriction eliminates the United States-Eurozone monetary regime differential because every observation in the sample faces the same European Central Bank policy regime. The pre-September 2014 restriction eliminates the staggered-treatment issue (Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021) because every control unit in the sample is a not-yet-treated late adopter, with no comparisons between early-treated and already-treated units. The treated units are Germany and the Netherlands, treated in January 2010.

Table IA.6 reports the early-adopter ESA 2010 treatment effect under five alternative within-Europe control compositions, on both the swap spread and the term spread. Row (1) uses all eight not-yet-treated Euro-area sovereigns as controls; this specification is contaminated by the European sovereign debt crisis dynamics that simultaneously compressed Core spreads through flight-to-quality and widened GIIPS spreads. Row (2) restricts the control group to the late Core adopters France, Belgium, and Austria, isolating the early-adopter ESA effect from the crisis-related dynamics. Row (3) extends row (2) to include Italy in the control group. Row (4) uses only the GIIPS countries as controls, illustrating the upper bound of the crisis contamination. Row (5) returns to the full eight-country control sample of row (1) and additionally includes the GIIPS $\times$ Crisis indicator described in the main paper.

The most informative variant is row (2), which delivers -39.3 basis points on the swap spread ($t = -11.70$) and -0.30 percentage points on the term spread ($t = -10.95$). These estimates almost exactly match the Core panel coefficient under Specification (6) of Table 10 in the main text (-38.4 basis points and -0.28 percentage points, respectively). Three different identification strategies, the full-panel DiD with region $\times$ year-month fixed effects and the GIIPS $\times$ Crisis indicator, the within-Europe pre-September 2014 DiD with Core controls, and the leave-one-out analysis from a separate robustness exercise, converge on the same magnitude for the Core ESA effect. This convergence provides strong support for the causal interpretation of the estimated treatment effect.

The variation across rows of Table IA.6 is itself informative. The contrast between row (2) (Core controls only) and row (4) (GIIPS controls only) illustrates the magnitude of the crisis contamination: the early-adopter effect appears five times larger when GIIPS countries serve as controls, because the GIIPS spread widening during 2010 through 2014 adds to the genuine ESA-related compression in Bund and DSL spreads to inflate

Table IA.6: Within-Europe Robustness: Early-Adopter ESA Effect under Alternative Control Compositions. This Internet Appendix table reports the early-adopter ESA 2010 treatment effect under alternative within-Europe control-group compositions, restricted to the pre-September 2014 window. Restricting the sample to the period before the mandatory compliance date eliminates the staggered-treatment issue (all other Euro-area sovereigns are not-yet-treated controls within the window) and the within-Europe restriction eliminates the United States-Eurozone monetary regime differential by construction. The treated units are Germany and the Netherlands from January 2010. The dependent variables are the swap spread (basis points) and the term spread (percentage points). Row (1) uses all eight not-yet-treated Euro-area sovereigns as controls; this specification is contaminated by the European sovereign debt crisis dynamics that simultaneously compressed Core spreads through flight-to-quality and widened GIIPS spreads. Row (2) restricts the control group to the late Core adopters France, Belgium, and Austria, isolating the early-adopter ESA effect from crisis dynamics. Row (3) extends row (2) to include Italy in the control group. Row (4) uses only the GIIPS countries as controls, illustrating the upper bound of the crisis contamination. Row (5) returns to the full eight-country control sample of row (1) and additionally includes the GIIPS $\times$ Crisis indicator described in Table 9 of the main text. The convergence of rows (2) and (5) on coefficients close to the Core panel of Table 10 (-38.4 bps swap, -0.28 pp term under Specification (6)) confirms the early-adopter ESA effect is robust to the flight-to-quality concern. All specifications include country and year-month fixed effects and the full Specification (4) control set. Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

	Swap Spread (bps)		Term Spread (pp)		
Control composition	Coef.	t-stat	Coef.	t-stat	N
(1) Full within-Europe (8 controls)	-103.2^{***}	-7.78	-0.78^{***}	-7.79	1,619
(2) Core controls only (FR, BE, AT)	-39.3^{***}	-11.70	-0.30^{***}	-10.95	795
(3) Core + Italy controls	-64.6^{***}	-10.75	-0.44^{***}	-10.39	960
(4) GIIPS controls only	-197.0^{***}	-10.34	-1.27^{***}	-7.98	1,151
(5) Full sample + GIIPS$\times$Crisis dummy	-45.0^{***}	-4.43	-0.56^{***}	-6.32	1,619

the DiD coefficient. Row (5), which retains all eight controls but adds the GIIPS $\times$ Crisis indicator, returns an intermediate estimate of -45.0 basis points on the swap spread ($t = -4.43$), consistent with the indicator absorbing most but not all of the crisis-induced spread movements in GIIPS sovereigns.

IA.3.2 HonestDiD Sensitivity Analysis

Standard DiD estimation assumes that parallel trends hold exactly in the post-treatment period. The HonestDiD framework of Rambachan and Roth (2023) relaxes this assumption by allowing for bounded violations. Rather than testing whether pre-trends are exactly zero, this approach asks how large post-treatment violations of parallel trends would need to be to overturn our conclusions. We conduct the analysis on the bilateral early-adopter specification (Germany and the Netherlands versus the United States) under the Specification (4) baseline of Table 9, because that bilateral specification is the natural object on which to test parallel trends.

The method proceeds as follows. First, we compute the maximum absolute deviation from zero among pre-treatment differentials, denoted $\bar{\delta}_{pre}$, from the event study coefficients estimated at half-year frequency. Second, we construct bounds on the treatment effect under the assumption that post-treatment violations are at most $\bar{M} \times \bar{\delta}_{pre}$, where $\bar{M}$ is a sensitivity parameter. When $\bar{M} = 0$, we assume parallel trends hold exactly; when $\bar{M} = 1$, we allow post-treatment violations as large as the maximum pre-treatment deviation. Third, we compute robust confidence intervals at each $\bar{M}$ and identify the breakdown value, defined as the smallest $\bar{M}$ for which the confidence interval includes zero.

Table IA.7 presents the sensitivity analysis results. The main treatment effect on swap spreads is −34.2 basis points (SE = 3.30), and the main treatment effect on term spreads is −0.39 percentage points (SE = 0.08). The maximum pre-treatment differentials are 22.46 basis points on swap spreads and 0.461 percentage points on term spreads.

Table IA.7: HonestDiD Sensitivity Analysis (Early Adopters)

$\bar{M}$	Max Allowed Bias	Robust CI Lower	Robust CI Upper	Excludes Zero?
Panel A: Swap Spread (basis points)				
0.00	0.00	−40.67	−27.73	Yes
0.25	5.61	−46.29	−22.11	Yes
0.31	6.96	−47.63	−20.77	Yes
0.50	11.23	−51.90	−16.50	Yes
1.00	22.46	−63.13	−5.27	Yes
Panel B: Term Spread (percentage points)				
0.00	0.000	−0.544	−0.238	Yes
0.25	0.115	−0.659	−0.123	Yes
0.31	0.143	−0.687	−0.096	Yes
0.50	0.230	−0.774	−0.008	Yes
1.00	0.461	−1.005	+0.222	No

Notes: Treatment effect estimates from the three-country specification (Germany, the Netherlands vs. U.S.) with the full Specification (4) control set including the 3-month sovereign zero rate: swap spread −34.20 basis points (SE = 3.30), term spread −0.391 percentage points (SE = 0.08). Maximum pre-treatment differential $\bar{\delta}_{pre}$: 22.46 basis points (swap), 0.461 percentage points (term), computed from the half-year event study coefficients. $\bar{M}$ denotes the ratio of allowed post-treatment violation to $\bar{\delta}_{pre}$. Robust 95% CI computed as point estimate ± (max bias + 1.96 × SE). The breakdown value is $\bar{M} = 1.24$ on the swap spread and $\bar{M} = 0.52$ on the term spread.

The breakdown value is $\bar{M} = 1.24$ on the swap spread, meaning the treatment effect remains statistically significant even when post-treatment violations of parallel trends are allowed to exceed the maximum pre-treatment differential by 24 percent. On the term spread, the breakdown value is $\bar{M} = 0.52$, meaning the effect remains significant as long as post-treatment violations are no more than 52 percent of the maximum pre-treatment differential. Combined with the positive pre-treatment average of $+5.5$ basis points on the swap spread reported in the introduction to this appendix (which indicates that any pre-existing differential trend works against our negative treatment-effect finding), the evidence supports the causal interpretation.

IA.3.3 Leave-One-Out Analysis

With a moderate number of countries, results could potentially be driven by influential observations. The leave-one-out analysis re-estimates the main DiD specification on the Core Europe plus Italy sample, excluding each country in turn. Table IA.8 presents the results under both Specification (4), the standard country and year-month fixed-effect structure of Table 9, and Specification (6), the same fixed-effect structure with region $\times$ year-month interactions and the GIIPS $\times$ Crisis indicator.

Table IA.8: Leave-One-Out Analysis (Core Europe + Italy) under Specifications (4) and (6)

	Swap Spread (bps)		Term Spread (pp)		
Sample	Coef.	t-stat	Coef.	t-stat	N
Panel A: Specification (4)					
Full sample	−39.8***	−8.86	−0.29***	−6.88	1,867
Excluding Germany	−27.3***	−5.63	−0.22***	−4.45	1,596
Excluding Netherlands	−37.2***	−6.54	−0.29***	−5.03	1,599
Excluding France	−44.2***	−7.97	−0.28***	−6.05	1,620
Excluding Belgium	−36.5***	−7.15	−0.25***	−5.55	1,599
Excluding Austria	−45.8***	−9.38	−0.38***	−9.94	1,596
Excluding Italy	−39.5***	−14.55	−0.35***	−9.61	1,596
Panel B: Specification (6)					
Full sample	−48.8***	−9.50	−0.37***	−10.68	1,867
Excluding Germany	−40.0***	−6.47	−0.29***	−6.60	1,596
Excluding Netherlands	−53.7***	−7.22	−0.41***	−8.04	1,599
Excluding France	−59.0***	−9.31	−0.44***	−10.47	1,620
Excluding Belgium	−38.4***	−7.72	−0.31***	−8.52	1,599
Excluding Austria	−53.2***	−9.77	−0.45***	−9.99	1,596
Excluding Italy	−38.4***	−10.73	−0.28***	−11.42	1,596

Notes: Panel A re-estimates the main DiD specification on the Core Europe plus Italy sample, excluding each country in turn, under Specification (4) of Table 9 (country and year-month fixed effects with the full control set). Panel B repeats the exercise under Specification (6) of Table 9, which replaces the year-month fixed effect with a region × year-month fixed effect and additionally includes the GIIPS × Crisis indicator. Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

Under Specification (4) (Panel A), all leave-one-out estimates remain statistically significant at the one-percent level. On the swap spread, coefficients range from −45.8 to −27.3 basis points, with a mean of −38.4 basis points, close to the full-sample estimate of −39.8 basis points. On the term spread, coefficients range from −0.22 to −0.38 percentage points, all significant.

Under Specification (6) (Panel B), all leave-one-out estimates also remain statistically significant at the one-percent level, with coefficients ranging from −59.0 to −38.4 basis points on the swap spread and from −0.45 to −0.28 percentage points on the term spread. The Italy-exclusion result under Specification (6) (swap −38.4 basis points, term −0.28 percentage points) recovers exactly the Core panel coefficient reported in Panel A of Table 10 in the main text, providing an internal consistency check across specifications.

Across both specifications, excluding Germany attenuates the swap spread coefficient most while excluding France or Austria strengthens it, but the effect remains highly significant in every leave-one-out sample. The stability of results across both leave-one-out samples and across the two specifications confirms that no single country drives the findings and that the effect is robust to the inclusion of the region $\times$ year-month fixed effects and the GIIPS $\times$ Crisis indicator. Figure IA.5 presents the full set of country-specific coefficients for both swap spreads and term spreads, showing that the pattern of significant negative effects for Core countries and Italy is consistent across both outcome measures.

IA.3.4 Callaway-Sant'Anna Staggered DiD Estimator

Standard two-way fixed effects estimation can produce biased estimates in staggered adoption settings with heterogeneous treatment effects (Callaway and Sant'Anna, 2021). The Callaway-Sant'Anna estimator addresses this by estimating group-time average treatment effects $ATT(g,t)$ for each cohort g at each post-treatment period t, using only the never-treated unit as control, and aggregating with transparent weights. We apply the estimator to the Core Europe plus Italy sample using the never-treated United States as control, under the Specification (4) controls.

We define two cohorts: early adopters (Germany and the Netherlands) treated in January 2010, and late Core adopters (France, Belgium, Austria, Italy) treated in September 2014. Group-time ATTs are estimated by long-difference outcome regression using the full Specification (4) control set, including the 3-month sovereign zero rate. Table IA.9 presents the results.

Table IA.9: Callaway-Sant'Anna Staggered DiD Estimates (Swap Spreads)

Aggregation	Coef. (bps)	SE	t-stat	p-value
By Cohort				
Early Adopters (DE, NL)	-25.4^{***}	1.38	-18.39	0.0000
Late Core (FR, BE, AT, IT)	-36.0^{***}	1.45	-24.89	0.0000
Overall Aggregation				
Simple Average	-29.6^{***}	1.06	-27.95	0.0000
Comparison				
Standard TWFE	-39.8^{***}	4.49	-8.86	0.0000

Notes: Group-time ATTs estimated by long-difference outcome regression using only the never-treated United States as control. Simple average weights all $ATT(g,t)$ equally. Sample: Core Europe + Italy. Full Specification (4) controls with the 3-month sovereign zero rate. Standard errors are Newey-West HAC with four lags. $^{***}p < 0.01$.

The simple-average estimate is -29.6 basis points ($t = -27.95$), comparable to the TWFE estimate of -39.8 basis points. Both cohorts show significant negative effects, with the late Core cohort showing a stronger effect (-36.0 basis points) than the early cohort (-25.4 basis points). The similarity between the staggered DiD and TWFE estimates suggests that treatment-effect heterogeneity across cohorts is not severely biasing the TWFE results.

Table IA.10 presents the event-time aggregation, showing how treatment effects evolve in the post-treatment period. The effect is initially small at month 0, becomes substantially negative by month 6, and remains negative and relatively stable thereafter. This gradual onset is consistent with the hypothesis that ESA 2010 effects operate through changes in debt-management practices that take time to implement, rather than through an immediate market repricing.

Table IA.10: Callaway-Sant'Anna Dynamic Effects (Swap Spreads)

Months Post-Treatment	Mean ATT (bps)	N Cohorts
0	−7.0	2
6	−30.0	2
12	−32.2	2
18	−44.8	2
24	−35.4	2

Notes: Mean ATT computed across the two cohorts for each event-time. The values are from the group-time average treatment effects estimated with the full Specification (4) control set including the 3-month sovereign zero rate.

IA.3.5 Placebo Test: Counterfactual Treatment Timing

The Callaway-Sant'Anna estimator in the previous subsection identifies the late Core cohort treatment effect under the actual September 2014 adoption date. If the estimated effect is genuinely tied to ESA 2010 adoption, assigning the late Core cohort to a counterfactual earlier treatment date should not produce a similar negative effect; if anything, it should produce a result of opposite sign because the counterfactual treatment window overlaps with the European sovereign debt crisis years during which Periphery and late-adopter spreads were elevated rather than compressed.

Table IA.11 reports this timing placebo. We assign the late Core cohort (France, Belgium, Austria, Italy) to a counterfactual January 2010 adoption date, three years and eight months earlier than the actual September 2014 date, and re-estimate the Callaway-Sant'Anna group-level ATT against the never-treated United States control. The point estimate under the counterfactual timing is $+182.2$ basis points on the swap spread ($t = +6.80$) and $+0.84$ percentage points on the term spread ($t = +4.23$), both opposite in sign and substantially larger in magnitude than the corresponding actual-timing estimates. This pattern is consistent with the European sovereign debt crisis dynamics that affected late-adopter sovereigns during 2010 through 2012, and reinforces the conclusion that the negative effects estimated under the actual September 2014 adoption date reflect genuine ESA 2010 implementation rather than crisis-period dynamics. The raw data plotted in Figure IA.4 provide visual confirmation: the late-adopter spread widening during 2010 through 2012 makes clear why counterfactual 2010 treatment dates for these countries capture crisis dynamics rather than ESA 2010 effects.

Table IA.11: Placebo Test: Late Adopters Treated As If January 2010

	Swap Spread (bps)		Term Spread (pp)	
Sample	Coef.	t-stat	Coef.	t-stat
Actual (September 2014)	-36.0^{***}	-24.89	—	—
As If January 2010 (counterfactual)	$+182.2^{***}$	$+6.80$	$+0.84^{***}$	$+4.23$

Notes: "Actual" uses the true September 2014 adoption date and reports the Callaway-Sant'Anna group-level ATT for the late Core cohort (France, Belgium, Austria, Italy) on swap spreads. "As If January 2010" assigns the counterfactual January 2010 adoption date and re-estimates the same Callaway-Sant'Anna group-level ATT. Both rows use the full Specification (4) control set with the country-specific 3-month sovereign zero rate; the never-treated United States is the comparison unit in both cases. The Specification (4) fixed-effect structure is used here because the late Core subsample contains no within-Eurozone untreated unit during the post-treatment period, leaving the region $\times$ year-month fixed-effect specifications in Table 9 identification-degenerate on this subsample (the same issue documented for the Early-adopters panel in Table 10 under Specification (6)). Standard errors are Newey-West HAC with four lags. $^{***}p \leq .01$.

IA.3.6 Phased-In ESA Adoption Analysis

Although the main ESA analysis uses a binary treatment indicator, Germany and the Netherlands implemented ESA 2010 requirements gradually over the 2010 through 2014 period. We test functional form on the bilateral early-adopter specification under the Specification (4) baseline, the same natural object used for the HonestDiD analysis above. Table IA.12 presents results allowing for phased-in adoption, where treatment intensity increases linearly from 2010 until reaching full effect at alternative phase-end dates. The phased-in treatment variable is constructed as:

$$\text{PhaseESA}_{it} = \begin{cases} 0 & \text{if } t < 2010 \\ \frac{t-2010}{T_{end}-2010} & \text{if } 2010 \leq t < T_{end} \\ 1 & \text{if } t \geq T_{end} \end{cases} \tag{IA.1}$$

Results are stable across phase-end assumptions. The swap spread coefficient ranges from -23.5 to -31.7 basis points across phased-in specifications, all highly significant and consistent with the binary specification (-34.2 basis points). The term spread coefficient ranges from -0.44 to -0.92 percentage points, all significant.

Table IA.12: Phased-In Adoption Analysis (Early Adopters)

	Swap Spread (bps)		Term Spread (pp)	
Phase-End Year	Coef.	t-stat	Coef.	t-stat
2012	-23.53^{***}	-5.35	-0.439^{***}	-4.35
2013	-23.96^{***}	-5.06	-0.692^{***}	-7.62
2014	-26.74^{***}	-5.50	-0.868^{***}	-9.68
2015	-31.72^{***}	-6.42	-0.916^{***}	-10.08
Binary (main spec)	-34.20^{***}	-10.36	-0.391^{***}	-5.02

Notes: All specifications include country and year-month fixed effects and the full Specification (4) control set with the country-specific 3-month sovereign zero rate. $N = 810$ for the three-country sample (Germany, the Netherlands, U.S.). Standard errors are Newey-West HAC with four lags. $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$.

IA.3.7 Robustness Summary

The convergence of evidence across these methodologically diverse tests (summarized in Table IA.13) provides support for the causal interpretation. The within-Europe robustness panel provides the most direct evidence by demonstrating that the early-adopter effect emerges in a sample that contains no U.S. observations at all, isolating the ESA 2010 effect from any cross-region monetary or macroeconomic difference by construction. The positive pre-treatment average on the swap spread shows that any pre-existing bias works against our finding. HonestDiD confirms robustness to substantial violations of parallel trends. The leave-one-out analysis shows stability across countries under both Specification (4) and Specification (6), confirming that no single country drives the result and that the effect survives the tightened fixed-effect structure with region $\times$ year-month interactions and the GIIPS $\times$ Crisis indicator. The Callaway-Sant'Anna estimator confirms the result under heterogeneity-robust estimation. The placebo timing test validates that the effect emerges at the actual September 2014 adoption date rather than at counterfactual earlier timings. The phased-in adoption analysis confirms that the result does not depend on the specific functional form of the treatment indicator. Together these tests rule out the main alternative interpretations of the documented effect: cross-region monetary regime differences, pre-existing trends, influential observations, treatment-effect heterogeneity, alternative timing assumptions, and functional form.

Table IA.13: Summary of ESA 2010 Robustness Analysis

Test	Key Finding	Implication
One-Sided Pre-Trends	Swap spread pre-treatment average is +5.5 basis points (positive, biasing against); term spread pre-trends show no systematic negative drift	Pre-trends bias *against* finding negative effects; strengthens causal claim
Within-Europe Robustness	Early-adopter effect of −39.3 basis points on swap spreads and −0.30 percentage points on term spreads with late Core controls only; converges with the Core panel coefficient under Specification (6) of Table 10	Effect emerges in a sample that contains no U.S. observations, isolating the ESA effect from cross-region monetary or macroeconomic differences by construction
HonestDiD Sensitivity	Breakdown $\bar{M} = 1.24$ on swap, $\bar{M} = 0.52$ on term	Robust to substantial post-treatment violations of parallel trends
Leave-One-Out	All swap spread estimates significant at 1%; range $[-45.8, -27.3]$ basis points under Specification (4) and $[-59.0, -38.4]$ basis points under Specification (6)	No single country drives results under either fixed-effect structure
Callaway-Sant'Anna	Simple average: -29.6 basis points ($t = -27.95$) on swap spreads	Results robust to heterogeneous treatment effects in staggered design
Placebo Test (Timing)	Late adopters assigned counterfactual January 2010 date yield +182.2 basis points on swap spreads, opposite in sign to the actual effect	Effects emerge at the actual September 2014 adoption date rather than at arbitrary earlier timings
Phased-In Adoption	Swap spread coefficient −23.5 to −31.7 across phase-end assumptions; all significant	Results consistent across alternative treatment specifications