Conditional Sovereign Backstops: Price Compression, Fiscal Eligibility, and Welfare*

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Abstract

Euro-area sovereign backstops such as OMT and TPI promise market stabilization without an unconditional fiscal transfer. This paper studies that promise in a long-term sovereign-default model with risk-averse lenders, global risk premia, fiscal eligibility, and an eligibility-conditional support price. The key distinction is between the transaction price paid by the sovereign and the shadow private valuation of the same claim. In a Spanish calibration, committed support lowers observed spreads sharply at eligible stress states and in dynamic replay, while leaving a positive private-market risk premium. The calibration matches debt/GDP and calm spreads, delivers the right order of event-window price compression and broad official absorption, and underpredicts purchases in the narrower compliant-stress sample. Welfare does not follow mechanically from spread compression. Fixed-policy incidence accounting gives commitment a positive value relative to discretion, and a Floden-style decomposition shows that this gain is almost entirely a level effect rather than a change in lifetime uncertainty or ex-ante state risk; the benchmark value-function comparison nevertheless assigns support regimes negative transition consumption-equivalent values once borrowing incentives and intervention costs are included.

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1 Introduction

Euro-area sovereign backstops promise a difficult combination: they must stop self-reinforcing market stress without becoming an unconditional fiscal transfer. OMT and TPI are designed around that tension. The central bank announces that it can support sovereign debt markets when monetary transmission is impaired, but access to that support is conditional on fiscal and institutional eligibility. Conditionality is meant to preserve discipline: a sovereign should know that fiscal slippage today can reduce support tomorrow. Yet the same conditionality is hardest to enforce precisely when the backstop is most valuable. In a stress episode, the central bank may prefer to intervene ex post to protect transmission, even if the sovereign has weakened its fiscal position. Investors then price not only fundamentals, but also the credibility of the support rule.

This paper studies the price and welfare consequences of that credibility problem. The central question is not whether a backstop can lower observed spreads. It can. The question is what those lower spreads mean. A fall in the sovereign's borrowing spread may reflect lower default risk, lower risk premia, improved market functioning, or an administered support price that moves the transaction price away from the private valuation of the same claim. These interpretations have different welfare implications. If a backstop removes a bad equilibrium or a nonfundamental liquidity premium, spread compression is insurance. If it also weakens fiscal discipline or shifts losses to the official sector, the same spread compression can come with lower welfare. A quantitative analysis of OMT- and TPI-style policies must therefore separate observed borrowing costs from the latent price of sovereign risk.

The paper makes that separation in a long-term sovereign-default model with risk-averse lenders, a priced global-risk factor, fiscal eligibility, and central-bank support. The sovereign issues long-duration defaultable debt and chooses borrowing while internalizing the support rule. Lenders price the same claim under a stochastic discount factor that loads on global stress. The central bank maps the private-market price into the transaction price faced by the sovereign when eligibility and stress conditions are satisfied. The model therefore contains three distinct price objects: a risk-neutral expected-loss price, a shadow private-market valuation, and the observed price paid by the sovereign. The difference between the private-market spread and the observed spread is the model's hidden support wedge, Ω_S. This wedge is not estimated directly from cash spreads; it is a structural valuation object, computed from the same state and bond claim under different pricing rules.

The empirical evidence plays a disciplined but limited role. It documents two facts that the model must respect. First, global risk shocks raise spreads more for fiscally vulnerable sovereigns. In the monthly euro-area panel, the coefficient on the interaction between ΔVIX_t and lagged debt/GDP is positive and precise. The result survives country-clustered inference, a wild-cluster bootstrap, and leave-one-country-out checks; omitting Spain leaves the coefficient essentially unchanged. Second, ECB backstop announcements can produce large cash-spread movements in short windows, especially around Draghi's London speech, OMT, and PEPP. The TPI event is weaker in the displayed window, which is informative in itself: announced eligibility and market interpretation matter. These facts motivate the global-risk state, the fiscal eligibility rule, and the price-compression target. They do not by themselves identify the hidden wedge, because observed spreads also contain liquidity, benchmark, redenomination, and term-premium components.

Spain is the quantitative laboratory. The calibration is organized in two stages. The first stage fixes the no-backstop sovereign-default block using pre-OMT Spanish moments: average debt/GDP, calm spreads, and consumption smoothing. The second stage chooses the policy parameters governing support intensity and private absorption, holding the default block fixed. This ordering is deliberate. The support instrument is not allowed to repair the sovereign-default block, because the object of interest is the gap created by support between the private-market valuation and the observed borrowing price. The maintained calibration matches the level of debt and calm spreads closely, generates the right order of event-window price compression and broad official absorption, and underpredicts purchases in the stricter compliant-stress sample. The last fact is a limitation of the quantity side of the policy block, not a reason to collapse the price and welfare objects into a single spread statistic.

The model's first result is that conditional support creates a meaningful but state-contingent hidden wedge. In the historical decomposition, the average model wedge between the shadow private spread and the observed spread is 9.5 basis points. The average masks large event-state effects. At the SMP state, the observed model spread is 37.1 basis points, compared with a private-market spread of 75.9 basis points and a risk-neutral spread of 6.7 basis points. At the TPI state, the observed spread is 69.8 basis points, the private-market spread is 90.0 basis points, and the wedge is 20.2 basis points. The model therefore does not interpret all observed spread compression as a fall in expected default losses. Support changes the price paid by the sovereign while private investors can still attach a positive valuation premium to the same claim.

The second result is that commitment has a large price value at active support states. Commitment and discretion differ because a committed rule prices support before the ex-post intervention temptation is realized, while a discretionary authority cannot make the same eligibility promise credible. At the TPI state, the observed spread is 90.0 basis points without support, 69.8 basis points under discretion, and 11.9 basis points under commitment. In the dynamic replay, committed support lowers the average observed spread from 59.7 to 36.2 basis points relative to no support, while discretion lowers it to 46.2 basis points. The commitment-discretion gap is not an unconditional effect across every state. It is concentrated where eligibility, stress, and support interact, which is exactly the institutional logic of OMT and TPI.

The third result is that price compression is not a sufficient welfare statistic. In the benchmark value-function comparison, support regimes have negative transition CE values relative to no support when evaluated from the no-backstop stationary distribution: -2.15 percent under commitment, -2.81 percent under discretion, and -1.84 percent under unconditional support. These numbers do not contradict the spread results. They add the missing welfare terms. Support improves the borrowing price in eligible stress states, but it also changes borrowing incentives and uses official resources. The welfare question is whether the insurance value of the supported price exceeds those incentive and balance-sheet costs.

The welfare decomposition clarifies that distinction. Holding the exported modal policies fixed, commitment has a positive value relative to discretion: 0.033 percent of consumption when official losses are not charged to the recipient and 0.015 percent when official losses are fully charged domestically. The structural fixed-policy decomposition shows why the sign is small but stable. For commitment, direct price insurance contributes 0.034 percent of consumption, the borrowing-policy component contributes 0.027 percent, and balance-sheet incidence subtracts 0.039 percent, leaving a net gain of 0.023 percent under full domestic incidence. A separate Floden-style decomposition shows that this fixed-policy gain comes almost entirely through the level effect: committed support raises the deterministic path of mean consumption by 0.061 percent, while the lifetime-uncertainty and ex-ante state-risk terms are essentially zero. The decomposition is the main lesson: backstops insure by raising resources in supported states, but whether that insurance improves welfare depends on conditionality, incentives, and incidence.

The paper contributes to three literatures. Relative to models of sovereign crises and belief-driven rollover risk, especially Bocola and Dovis (2019), the central object is not a switch between good and bad equilibria but a policy-created gap between the observed borrowing price and the shadow private valuation. Relative to the bailout and fiscal-rule literatures, eligibility is not modeled as a simple borrowing cap. It is a state-contingent price schedule that affects today's issuance incentives because it changes tomorrow's access to support. Relative to the empirical literature on ECB interventions and asset purchases, the paper treats event-window spread compression as evidence about the scale of support, not as a direct welfare statistic. The same event that lowers spreads can also alter incentives and official-sector exposure.

The broader message is that conditional backstops should be evaluated as pricing rules with incentive effects. A credible rule can stabilize market prices while preserving some fiscal discipline. A discretionary rule can still compress spreads, but it offers weaker discipline and therefore a lower value of commitment. An unconditional rule delivers stronger price insurance but abandons the eligibility margin. The relevant policy comparison is not "support or no support" in isolation. It is the joint design of support, eligibility, and loss incidence.

The rest of the paper proceeds as follows. Section 2 positions the contribution. Section 3 presents the motivating evidence. Section 4 defines the model. Section 5 explains the valuation-wedge mechanism. Section 6 describes the calibration. Section 7 reports the model experiments. Section 8 discusses welfare. Section 9 reports robustness and validation checks. Section 10 concludes.

2 Related Literature

This paper is related to four strands of work. The first is the quantitative sovereign-default literature. The model builds on the Eaton–Gersovitz tradition (Eaton and Gersovitz, 1981), as developed in quantitative form by Arellano (2008) and extended to long-term debt by Hatchondo and Martinez (2009) and Chatterjee and Eyigungor (2012). Relative to that benchmark, the object of interest here is not only how debt and default respond to shocks, but how the equilibrium changes when the sovereign can obtain conditional spread support from a central bank.

The second strand studies official intervention, bailouts, and conditionality. Fink and Scholl (2016) analyze sovereign debt, bailouts, and fiscal conditionality; Roch and Uhlig (2018) study the dynamics of sovereign debt crises and bailout guarantees; and Dovis and Kirpalani (2020) show how fiscal rules interact with bailout expectations and reputation in federal governments. Hatchondo et al. (2022) study fiscal rules and show that debt-based and spread-based rules can generate similar welfare gains. The distinction here is that the fiscal object is not an enforced borrowing constraint. It is an eligibility criterion for a support price. Discipline therefore operates through the loss of future insurance and the current price schedule, not through a direct fiscal-rule cap.

The third strand studies self-fulfilling debt crises, rollover risk, and the role of official intervention. Bocola and Dovis (2019) provide a quantitative analysis of self-fulfilling crises and the OMT program, showing that observed spread declines cannot be interpreted only through rollover-risk elimination. This paper does not try to identify a sunspot rollover component. It instead quantifies a policy-induced wedge between the borrowing price paid by the sovereign and a shadow private valuation under risk-averse pricing, with endogenous eligibility, official absorption, and explicit welfare incidence. That wedge can make observed spreads a poor sufficient statistic for sovereign risk and welfare even when the policy stabilizes market prices.

The fourth strand is the empirical literature on global risk, sovereign spreads, and ECB asset purchases. A large literature shows that sovereign spreads comove with international risk premia, including Borri and Verdelhan (2011), Longstaff et al. (2011), and Gonzalez-Rozada and Levy Yeyati (2008). The ECB-specific evidence shows that unconventional policies and distressed-market interventions affect sovereign yields. Trebesch and Zettelmeyer (2018) study ECB interventions in Greek sovereign debt markets, while Koijen et al. (2021) analyze the transmission of euro-area quantitative easing. More broadly, Krishnamurthy and Vissing-Jorgensen (2011) and D'Amico and King (2013) document the channels through which asset purchases affect long-term yields. The empirical section below uses this literature as motivation and calibration discipline, focusing on global-risk exposure and event-window spread compression. Additional reduced-form exercises are preserved in Appendix D.

The final strand concerns welfare measurement. Flodén (2001) decomposes welfare effects of policy in economies with uninsurable idiosyncratic risk, and Aguiar et al. (2022) study welfare losses from external sovereign borrowing. This paper adapts that logic to a representative-agent sovereign-default environment with conditional intervention. The welfare question is not whether lower spreads are mechanically beneficial. It is whether the consumption gains from cheaper crisis borrowing exceed the costs created by equilibrium borrowing responses, risk-bearing, and possible official-sector losses.

3 Motivating Evidence

The empirical section has a narrow role. It documents two objects that the model needs: global risk is priced more strongly for fiscally vulnerable sovereigns, and ECB backstop announcements can move sovereign cash spreads in short windows. These facts discipline the state variables and the order of magnitude of price support. They do not identify the model's observed-latent wedge directly. The wedge $\Omega_S = S^{\text{mkt}} - S^{\text{obs}}$ is a structural decomposition, evaluated inside the calibrated model.

3.1 Data and Empirical Objects

Table 1 lists the empirical objects used in the paper. The monthly panel covers euro-area sovereign spreads, VIX, and fiscal variables. The event panel uses daily benchmark yields around five ECB announcements. Fiscal vulnerability is predetermined: the baseline measure is lagged debt/GDP, forward-filled from Eurostat quarterly data to the monthly panel. This is not the same object as model eligibility. Vulnerability indexes the exposure of spreads to global risk; model eligibility is the fiscal compliance rule that governs access to the support price schedule.

Table 1: Empirical data objects and paper role

Object	Variables	Source	Sample	Role
Monthly sovereign panel	10y spread, VIX, debt/GDP	Terminal benchmark yields; FRED; Eurostat	2006-05–2026-05; AT, BE, DE, ES, FI, FR, GR, IE, IT, NL, PT	Motivating fact
Fiscal vulnerability	Lagged debt/GDP baseline	Eurostat debt, forward-filled to month	2006-05–2026-05	Interaction variable
Announcement windows	10y descriptive changes; 5y target changes	Daily benchmark yields; ECB event dates	SMP, Draghi, OMT, PEPP, TPI; periphery	Descriptive table and policy target
Cash-CDS basis	5y CDS minus cash/ASW spread	Terminal CDS and benchmark data	CDS coverage varies; denomination mixed/unknown	Diagnostic only
Official purchases	ECB programme purchases and holdings	ECB programme data; Tesoro issuance	Programme-specific coverage	Absorption accounting

The available cash-CDS basis data are kept out of the main empirical argument. The problem is not conceptual: a same-currency cash-CDS basis could be useful for measuring a latent credit-risk component. The problem is measurement. The available periphery CDS series are USD-denominated or denomination-unknown in the current data stack, so the basis mixes credit, redenomination, and quanto components. Appendix D reports those diagnostics as a failed identification exercise rather than evidence for Ω_S.

3.2 Global Risk and Vulnerability

The first fact is that global risk shocks have larger spread effects for more vulnerable sovereigns. The estimating equation is

$$\Delta s_{it} = \alpha_i + \gamma_t + \beta \left(\Delta VIX_t \times V_{i,t-1} \right) + \Gamma X_{i,t-1} + \varepsilon_{it}, \tag{1}$$

where s_{it} is the sovereign spread, $V_{i,t-1}$ is a predetermined fiscal-vulnerability measure, and γ_t absorbs common monthly shocks. Identification comes from cross-country differences in exposure within month, not from the level of VIX itself.

Table 2 reports the interaction coefficient under alternative vulnerability definitions.

The debt/GDP measure gives a positive and precise coefficient. The broader measures are noisier and one spread-based proxy changes sign. This is why the paper treats the fact as state-variable discipline rather than as a tight structural moment. The model must make stress matter more in vulnerable states, but the coefficient is not used as a one-for-one estimate of a structural price-of-risk parameter. Figure 1 displays the same estimates with two-standard-error bands, making clear that the debt/GDP interaction is the stable empirical input.

Table 2: Global-risk exposure by fiscal vulnerability

Vulnerability measure	Coeff.	s.e.	N	Countries	R^2
Debt/GDP	0.013***	(0.003)	2618	11	0.198
Deficit	0.095	(0.094)	2629	11	0.195
Pre-backstop spread	-0.086	(0.509)	2629	11	0.195
Composite	0.389	(0.314)	2629	11	0.196

The debt/GDP interaction is not driven by a single country. Table 3 repeats the headline specification with country-clustered inference, a wild-cluster bootstrap, and a leave-one-country-out check. The baseline coefficient is 0.012, with a country-clustered standard error of 0.003; the leave-one-country-out range is 0.007 to 0.013, and omitting Spain leaves the coefficient at 0.013. The exercise supports the sign and scale of the vulnerability fact, while still leaving the structural price of global risk to the calibrated model.

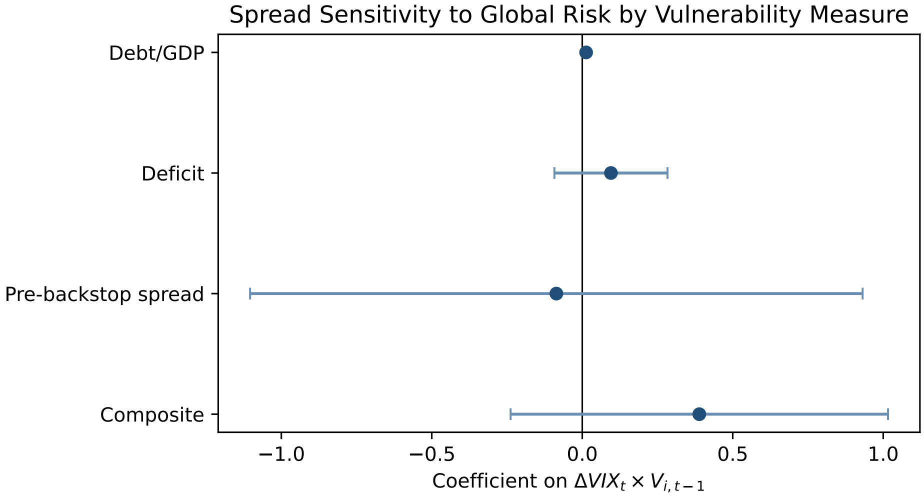
Table 3: Inference checks for the global-risk interaction

Check	Coeff.	s.e.	p_{cl}	p_{wild}	N	Countries
Baseline	0.012	(0.003)	0.000	0.000	2629	11
Leave-one-out min	0.007					
Leave-one-out max	0.013					
Omit Spain	0.013	(0.003)				

3.3 Backstop Announcement Windows

The second fact is descriptive: credible backstop news can compress sovereign cash spreads in short windows. Table 4 reports country-level changes in 10-year spreads for Spain, Italy, Portugal, Ireland, and Greece around the five announcements. The table uses a symmetric $[-1, +1]$ calendar-day window and reports the 10-year OIS change when the EA-MPD event file contains a matched monetary-policy surprise. Negative values are spread compression.

Figure 1: Global-risk interaction estimates across vulnerability measures. Markers report coefficients on $\Delta VIX_t \times V_{i,t-1}$; horizontal bars are two standard errors.



The event responses are heterogeneous, which is exactly why the calibration does not treat the event table as a clean causal experiment. Draghi's London speech, OMT, and PEPP produce large periphery spread declines in this narrow window. TPI does not: Spain is essentially unchanged and Italy widens. The paper therefore uses announcement-window evidence as an order-of-magnitude discipline for support prices, with the exact policy target and residual reported in the calibration section. Figure 2 shows the country-level heterogeneity behind the averages.

Table 4: Periphery spread changes around ECB backstop announcements

Event	Date	ES	IT	PT	IE	GR	Avg.	OIS
SMP	2010-05-10	0.6	-1.4	-13.9	-4.4	-25.1	-8.8	
Draghi speech	2012-07-26	-77.6	-64.9	-24.9	-29.5	-137.9	-67.0	
OMT	2012-09-06	-84.8	-52.7	-113.8	-33.3	-44.9	-65.9	2.9
PEPP	2020-03-18	-39.7	-80.4	-41.1	-21.4	-136.8	-63.9	
TPI	2022-07-21	1.0	15.8	2.6	6.4	7.7	6.7	-5.2

3.4 Mapping to the Calibration

Table 5 states the evidentiary hierarchy. The global-risk interaction motivates the state dependence of spreads. The announcement-window evidence gives a scale for observed price compression. The official-absorption statistics discipline quantities, with A_1 measuring broad intervention-state absorption and A_3 retained as the stricter compliant-stress diagnostic. The observed-latent wedge is not a reduced-form estimate from this section; it is the model-implied difference between the shadow private valuation and the transaction price faced by the sovereign.

Figure 2: Country-level 10-year spread changes in the $[-1, +1]$ calendar-day event window. Negative values indicate spread compression.

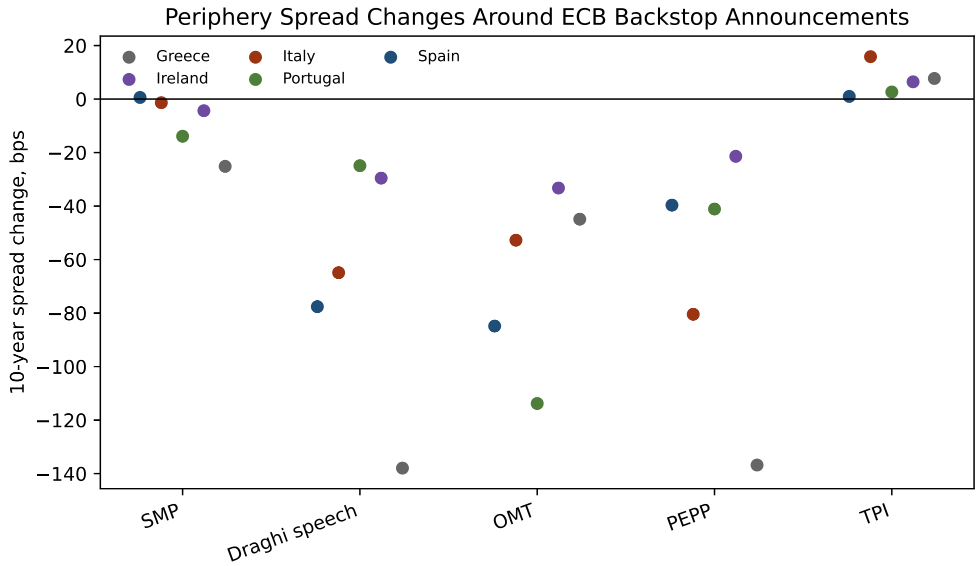


Table 5: Empirical objects and model counterparts

Empirical object	Paper role	Model counterpart	Use
Global-risk interaction	Motivating fact	State dependence of spreads on global risk	Sign/discipline, not tight target
Announcement-window compression	Policy-price target	E[S_mkt - S_obs | C=1,H]	5y fiscal-compliant [-3,+3] mean
Official absorption A1	Quantity diagnostic	Broad intervention-state absorption	Reported fit
Official absorption A3	Quantity diagnostic	Compliant-stress issuance absorption	Diagnostic, not current blocker
Omega_S wedge	Structural object	S_mkt - S_obs	Model-implied decomposition
Cash-CDS basis	Rejected diagnostic	None without verified same-currency leg	Appendix only

4 Quantitative Model

The quantitative model is a long-term sovereign-default economy in the spirit of Chatterjee and Eyigungor (2012), extended to study conditional central-bank backstops. The extension has one central implication: the bond price observed by the sovereign can differ from the shadow private valuation of the same claim. A backstop can therefore lower the spread at which the government borrows while leaving a latent compensation for sovereign risk in private valuations. The model uses this distinction to measure the observed-latent spread wedge, the eligibility value of fiscal discipline, and the welfare value of commitment relative to discretion.

4.1 Environment

Time is quarterly. The sovereign receives endowment y and enters the period with long-term defaultable debt b. The exogenous state is $z = (y, \chi)$, where χ is the priced global-risk factor. Output has a persistent component and a small loading on innovations to the global factor,

$$\log y' = \rho_y \log y + \sigma_{y\chi}\varepsilon'_\chi + \sigma_\eta \eta', \qquad \eta' \sim N(0,1), \tag{2}$$

with η' independent of the global innovation. The loading $\sigma_{y\chi}$ lets low domestic output co-move with high lender marginal value without changing the audited unconditional output volatility. The global factor follows

$$\chi' = \rho_\chi \chi + \varepsilon'_\chi, \qquad \varepsilon'_\chi \sim N(0,1). \tag{3}$$

The binary stress state used by the policy rule is derived from the priced factor, $\zeta(\chi) = H$ if and only if $\chi \geq \bar{\chi}$. Preferences are

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t), \qquad u(c) = \begin{cases} \dfrac{c^{1-\gamma}-1}{1-\gamma}, & \gamma \neq 1, \\ \log c, & \gamma = 1. \end{cases} \tag{4}$$

The bond convention is fixed throughout the paper. A fraction λ of principal matures each quarter, the remaining fraction $1-\lambda$ survives, and surviving principal pays coupon κ. Debt service on inherited debt is

$$[\lambda + (1-\lambda)\kappa]b, \tag{5}$$

and old principal carried forward is $(1-\lambda)b$. If the government chooses next-period debt b', net issuance is

$$n(b,b') = b' - (1-\lambda)b. \tag{6}$$

Annual debt-to-GDP in the data maps to $b/(4y)$ in the quarterly model.

4.2 Timing and Government Problem

The period timing separates the policy price from the government's borrowing choice. After observing (z,b), the eligibility rule and the support schedule for each candidate b' are known. The government then chooses whether to default and, if it repays, chooses b'. Let $q^{\text{obs}}(z,b,b')$ be the price faced by the sovereign and let $\mathcal{T}^{\text{cb}}(z,b,b')$ be any domestic resource incidence of central-bank exposure. Repayment consumption is

$$c^R(z,b,b') = y - g - [\lambda + (1-\lambda)\kappa]b + q^{\text{obs}}(z,b,b')\left[b' - (1-\lambda)b\right] - \mathcal{T}^{\text{cb}}(z,b,b'). \tag{7}$$

The observed price matters because it is the price at which the government actually issues debt, even when that price differs from the private valuation. The fixed claim g captures non-discretionary spending needs and is paid in repayment and default.

With taste shocks used for numerical smoothing, the repayment value is the log-sum over feasible borrowing choices,

$$V^R(z,b) = \sigma_B \log \sum_{b' \in \mathcal{B}} \exp\left(\frac{u(c^R(z,b,b')) + \beta \mathbb{E}[V(z',b') \mid z]}{\sigma_B}\right), \tag{8}$$

with infeasible choices assigned value $-\infty$. As σ_B approaches zero, this converges to the usual maximum over b'.

Default entails a utility penalty and temporary exclusion. The baseline leaves output itself undistorted in default, so default consumption is $y-g$ and the cost is a non-resource utility penalty,

$$\chi_D(y) = \chi_{D0} + \chi_{D1}\log y. \tag{9}$$

The default value is

$$V^D(z) = u(y-g) - \chi_D(y) + \beta \mathbb{E}\left[(1-\xi)V^D(z') + \xi V(z',0) \mid z\right], \tag{10}$$

where ξ is the re-entry probability. The baseline quantitative build sets zero recovery and re-entry with zero performing debt. Positive recovery is a robustness extension. The total value is the smoothed default-repayment choice,

$$V(z,b) = \sigma_D \log\left[\exp\left(\frac{V^R(z,b)}{\sigma_D}\right) + \exp\left(\frac{V^D(z,b)}{\sigma_D}\right)\right]. \tag{11}$$

The associated borrowing and default probabilities are denoted $\pi_B(b'|z,b)$ and $\pi_D(z,b)$.

4.3 Pricing

Private lenders value the bond with an affine stochastic discount factor that loads on innovations to the global-risk factor:

$$M^{\text{mkt}}(z,z') = \exp\left\{-(\phi_0+\phi_1\chi) - \frac{1}{2}\kappa(\chi)^2 + \kappa(\chi)\varepsilon'_\chi\right\}, \qquad \kappa(\chi) = \kappa_0 + \kappa_1\chi. \tag{12}$$

The risk-neutral kernel sets the price-of-risk loading to zero while keeping the same local safe-rate component. The union valuation kernel, M^{UN}, has the same form as (12) but can use a lower global-risk loading. In the numerical implementation the discretized transition matrix is normalized so the safe long-bond benchmark is respected on the grid.

Long-term debt makes the resale price endogenous. If the government repays next period with inherited debt b', the valuation-specific expected resale price is

$$\bar{q}^a(z',b') = \sum_{b''\in\mathcal{B}} \pi_B(b''|z',b')q^a(z',b''). \tag{13}$$

This equation is a key computational restriction: the recursion uses future borrowing probabilities, not only the most likely borrowing choice.

For valuation kernel $a \in \{\text{mkt}, \text{RN}, \text{UN}\}$, define

$$q^a(z,b') = \mathbb{E}\Big[M^a(z,z')\{1-\pi_D(z',b')\}\left[\lambda + (1-\lambda)\left(\kappa + \bar{q}^a(z',b')\right)\right] \mid z\Big], \tag{14}$$

where the baseline omits recovery payments in default. The private-market price is q^{mkt}, and the risk-neutral price uses the corresponding risk-neutral recursion. The observed price below is the price faced by the sovereign after current support.

4.4 Observed Prices, Eligibility, and Support

The central bank supports the current issuance price by partially closing the gap between the shadow private valuation and the risk-neutral valuation:

$$q^{\text{obs}}(z,b,b') = q^{\text{mkt}}(z,b') + x(z,b,b')\left[q^{\text{RN}}(z,b') - q^{\text{mkt}}(z,b')\right]_+, \tag{15}$$

where $x(z,b,b') \in [0,1]$ is support intensity. The observed-latent spread wedge is

$$\Omega_S(z,b,b') = S^{\text{mkt}}(z,b') - S^{\text{obs}}(z,b,b'). \tag{16}$$

When $\Omega_S > 0$, the spread paid by the sovereign is lower than the spread implied by the shadow private valuation of the same claim.

The two-price notation is a reduced-form trading architecture. The object q^{mkt} is the competitive private valuation of the bond under the continuation equilibrium and the lender pricing kernel. The object q^{obs} is the supported transaction price relevant for the government budget constraint. Private absorption at that administered price is not assumed to clear a competitive market; it is governed by the reduced-form demand schedule in (20), with the central bank absorbing the residual flow. The model should therefore be read as a price-support technology with a shadow private valuation, not as a literal two-price arbitrage-free secondary market.

Fiscal eligibility determines access to the conditional backstop. The baseline rule is

$$e(z,b,b') = \mathbb{1}\left\{b' \le 4\bar{d}\,y + (1-\theta_c)\max\{b - 4\bar{d}\,y, 0\}\right\}. \tag{17}$$

The rule is a reduced-form debt-convergence compliance criterion. It gives the sovereign an option value of discipline: lower debt today can preserve access to insurance in future stress states.

The quantitative exercises compare four regimes. With no backstop, $x_0(z,b,b') = 0$. Under committed conditional support,

$$x_C(z,b,b') = \bar{x}\,\mathbb{1}\{\zeta(\chi) = H\}\,e(z,b,b'). \tag{18}$$

Under unconditional support, $x_U(z,b,b') = \bar{x}\,\mathbb{1}\{\zeta(\chi) = H\}$. Under discretion, the central bank chooses x pointwise for each candidate debt choice in stress states:

$$\begin{aligned} x_D(z,b,b') \in \arg\min_{x\in[0,1]} \Bigg\{ &\Phi(S^{\text{obs}}(x)) + \frac{\psi_m}{2} m^{\text{cb}}(x)^2 + \tau \ell^{\text{mkt}}(x) \\ &+ (1 - e(z,b,b'))\left[\nu_1 x + \frac{\nu_2}{2}x^2\right] \Bigg\}. \end{aligned} \tag{19}$$

The linear credibility cost ν_1 creates a threshold for supporting an ineligible sovereign. This is the source of the commitment-discretion tradeoff: discretion can stabilize prices ex post, but it weakens the threat embedded in eligibility.

4.5 Official Exposure and Welfare

Central-bank purchases are outcome objects, not additional state variables in the baseline. Let $n^+(b,b') = \max\{b' - (1-\lambda)b, 0\}$ be positive net issuance. Private absorption at the supported price is

$$h^p(z,b,b') = n^+(b,b') \exp\left[-\eta_q \frac{q^{\text{obs}}(z,b,b') - q^{\text{mkt}}(z,b')}{\max\{q^{\text{mkt}}(z,b'), \epsilon_q\}}\right], \tag{20}$$

and central-bank absorption is

$$m^{\text{cb}}(z,b,b') = n^+(b,b') - h^p(z,b,b'). \tag{21}$$

The model records valuation wedges relative to market, risk-neutral, and union valuations:

$$\ell^a(z,b,b') = m^{\text{cb}}(z,b,b')\left[q^{\text{obs}}(z,b,b') - q^a(z,b')\right], \qquad a \in \{\text{mkt}, \text{RN}, \text{UN}\}. \tag{22}$$

Domestic resource incidence is $\mathcal{T}^{\text{cb}}(z,b,b') = \omega_i \ell^{\text{UN}}(z,b,b')$.

The headline welfare calculation does not use the raw inclusive value from the taste-shock Bellman equation. After solving each regime, the code evaluates the solved borrowing and default probabilities using the welfare payoff, including domestic incidence of official exposure where specified. This policy-evaluation value is then converted into transition consumption-equivalent welfare from the no-backstop stationary distribution. Separate fixed-policy diagnostics in Section 8 strip the object down further by holding modal borrowing policies fixed and varying only the incidence of official-sector losses.

4.6 Equilibrium

A recursive equilibrium for a regime consists of value functions, borrowing and default probabilities, valuation prices $(q^{\text{mkt}}, q^{\text{RN}}, q^{\text{UN}})$, observed prices q^{obs}, eligibility, support intensities, central-bank exposure objects, and loss incidence such that government choices solve (8)–(11), prices satisfy (13)–(14), observed prices satisfy (15), support follows the regime rule, and exposure objects satisfy (20)–(22).

Under discretion, the equilibrium is Markov perfect in the state (z,b), in the sense of Maskin and Tirole (2001). The government chooses repayment and next-period debt taking the central-bank response schedule as given; after observing the candidate issuance in stress states, the central bank chooses support intensity according to (19). The fixed point requires the government's policy, the bank's response, and the valuation prices to be mutually consistent.

5 Two-Period Mechanism

The model mechanism is easiest to see in a two-period version. A sovereign enters the first period with inherited debt and chooses new debt before the second-period default risk is resolved. A global stress shock raises the market price of risk, so private lenders lower the private-market price $q^{\mathrm{mkt}}(b')$ for risky debt. A central bank can instead let the sovereign issue at the observed price

$$q^{\mathrm{obs}}(b,b') = q^{\mathrm{mkt}}(b') + x(b,b') \left[q^{\mathrm{RN}}(b') - q^{\mathrm{mkt}}(b')\right]_{+}. \tag{23}$$

The intervention does not eliminate default incentives. It changes the price at which the government borrows today and therefore changes both insurance and incentives.

The first force is crisis insurance. When the sovereign is eligible in a stress state, a positive x raises the issuance price and lowers the observed spread. For a given debt choice, this relaxes the current budget constraint and reduces the risk-premium component of debt-service costs. The empirical counterpart is spread compression around backstop announcements.

The second force is the valuation wedge. The private valuation $q^{\mathrm{mkt}}(b')$ remains the price that compensates private investors for future default risk under the continuation equilibrium. The observed spread can therefore fall even when the latent market spread does not. The wedge

$$\Omega_S(b,b') = S^{\mathrm{mkt}}(b') - S^{\mathrm{obs}}(b,b') \tag{24}$$

is positive when the backstop compresses the sovereign's borrowing spread below the private-market spread. This is why observed spreads become an imperfect summary statistic for sovereign risk under support.

The third force is eligibility. A conditional backstop gives the government an option value of staying eligible. If a higher b' violates the eligibility rule, the government loses future access to crisis insurance. This creates a disciplining effect that is absent under unconditional support. The disciplining effect is not a mechanical borrowing cap: it is an equilibrium price effect because eligibility changes future support and therefore current continuation values.

Commitment matters because discretion weakens this eligibility threat. A committed central bank refuses support when the sovereign is ineligible, so the current borrowing choice internalizes the loss of future insurance. A discretionary central bank reoptimizes after observing stress. If the marginal stabilization benefit from support exceeds the finite non-compliance cost ν_1, the bank supports even an ineligible sovereign. Discretion can therefore deliver more ex-post stabilization but less ex-ante discipline.

Proposition 5.1 (Conditional support, valuation wedges, and commitment)**.** *Consider the two-period environment described above. Suppose that global stress lowers the private-market price of risky sovereign debt, $q^{\text{mkt}}(b') < q^{\text{RN}}(b')$, and that support intensity is positive only when the sovereign is eligible and the support wedge $[q^{\text{RN}}(b') - q^{\text{mkt}}(b')]_+$ is positive. Then:*

1. *supported eligible states have $\Omega_S \geq 0$, with strict inequality whenever support is interior;*
2. *commitment weakly increases the continuation cost of violating eligibility relative to discretion;*
3. *when the eligibility constraint is locally relevant for borrowing, commitment lowers the value of debt choices that sacrifice future support and can lower equilibrium borrowing relative to discretion;*
4. *a positive commitment-discretion spread gap is a price object, while a positive welfare value of commitment requires the saved intervention and incentive costs to exceed the private insurance lost from stricter enforcement.*

Proof sketch. The first claim follows directly from (23). If $x > 0$ and $q^{\text{RN}} > q^{\text{mkt}}$, the observed borrowing price exceeds the private-market price, so the yield or spread implied by q^{obs} is below the spread implied by q^{mkt}. For the second claim, compare the continuation value after an ineligible choice. Under commitment, support is set to zero by the rule. Under discretion, the central bank reoptimizes after stress and may support when the ex-post stabilization benefit exceeds the non-compliance cost. The discretionary continuation value after violating eligibility is therefore weakly higher for the sovereign, which weakly lowers the private cost of non-compliance. The third claim is the single-crossing implication at a locally relevant eligibility boundary: removing future support reduces the value of debt choices that cross the boundary. The final claim follows because the spread gap is computed from prices at a state, whereas welfare also includes current resources, future borrowing incentives, default risk, and official-sector losses. □

The quantitative model measures the net effect of these forces. The relevant comparison is not simply whether support lowers observed spreads. It is whether credible conditionality provides enough insurance, preserves enough discipline, and limits enough official-sector exposure to dominate discretionary or unconditional support in welfare terms.

6 Calibration

The quantitative exercise is calibrated in two stages. The first stage pins down the sovereign-default block in a no-backstop economy. The second stage takes that economy as fixed and chooses the policy parameters that govern official support. This order is part of the identification strategy. The paper's main object is the gap between the observed spread under support and the latent private-market price of sovereign risk, so the policy block cannot be used to repair the default block.

6.1 Data, Units, and Model Counterparts

The model period is one quarter and the reference country is Spain. The structural moments use the pre-OMT sample, 2000Q1–2012Q2, so that the no-backstop block is disciplined before the announcement of OMT and TPI-style conditional support. Output and consumption are taken from Eurostat quarterly national accounts. Debt is the Eurostat gross general-government consolidated debt ratio in the first-stage target. Long-term spreads are Spain-Germany ten-year sovereign yield spreads from Eurostat. For the historical bridge in Section 7, the state variable is mapped to a narrower defaultable-market debt concept using Tesoro holder data, netting Banco de Espana and public-administration holdings from State debt. The distinction matters: the first-stage calibration targets the standard aggregate debt moment, while the historical decomposition evaluates the model at the market debt stock most directly exposed to rollover and purchase support.

The model and the data are put in common units before the moments are compared. The model debt stock is measured in units of quarterly output, while the data report debt relative to annual GDP. The corresponding model moment is therefore $\mathbb{E}[b/(4y)]$, computed over repayment states with market access. Annualized spreads are computed from the model's long-bond price using the same coupon-bond yield formula used in the solution. The consumption-smoothing moment is the ratio of HP(1600)-filtered log consumption volatility to HP(1600)-filtered log output volatility. The model counterpart conditions on market access and no current default, because Spain has no default or exclusion observations in the calibration sample.

Global stress states are measured outside the sovereign spread equation. A Hamilton-smoothed VIX classifier separates calm and stress quarters, and the same classifier defines the calm-spread target and the stress-minus-calm validation moment. This choice keeps the first-stage spread target close to normal-times private credit risk. Stress spreads, full-sample spread volatility, excess bond premia, and distress frequencies are reported as validation objects because they contain crisis, market-functioning, and policy components that the paper is designed to decompose.

6.2 Parameterization

Table 6: Calibration parameters and sources

Block	Parameter	Value	Source
Output process	ρ_y	0.970	Hatchondo-style Spain income process
Output process	σ_ε	0.0104	Hatchondo-style Spain income process
Output process	Δy^H	0.0103	Hamilton-smoothed stress wedge
Risk-state process	π_0	0.0521	VIX Hamilton smoother
Risk-state process	π_{HL}	0.0643	VIX Hamilton smoother
Risk-state process	π_1	0	Baseline restriction after TVTP test
Debt pricing	r^*	0.00934	German 10y benchmark
Debt pricing	λ	0.0309	Six-year duration fixed point
Debt pricing	κ	0.00969	Par coupon normalization
Fiscal block	g	0.181	Spain government final consumption/GDP
Lender SDF	ϕ_0	0.005	Bocola-Dovis benchmark block
Lender SDF	ϕ_1	0.002	Bocola-Dovis benchmark block
Lender SDF	κ_0	0.161	Bocola-Dovis benchmark block
Lender SDF	κ_1	0.374	Bocola-Dovis benchmark block
Lender SDF	ρ_χ	0.513	Bocola-Dovis benchmark block
Lender SDF	$\sigma_{y\chi}$	-0.002	GDP–priced-factor comovement
Default core	β	0.960	High-patience benchmark
Default core	χ_{D0}	1.000	First-stage calibration
Default core	χ_{D1}	1.092	First-stage calibration

Notes: The parameter block separates measured inputs from internally calibrated parameters. The reported first-stage row is the maintained benchmark used in the quantitative exercises.

Table 6 reports the benchmark parameter values and sources. The output process fixes ρ_y and σ_ε from Spain's detrended real GDP. The stress-output wedge Δy^H is estimated from the same output sample and the global-stress classifier. The stress-frequency parameters pin down the threshold $\bar{\chi}$ that maps the priced global factor into the binary policy stress state. The baseline keeps $\pi_1 = 0$ because the time-varying-transition-probability check does not support an additional output-dependence term.

The bond parameters are fixed before solving the default problem. The quarterly safe rate r^* is taken from the German benchmark, λ is chosen to match a six-year average duration, and the coupon κ normalizes the corresponding safe long bond. The fiscal block contains a fixed non-discretionary spending claim g, set to the Spanish government-final-consumption share of GDP. This term matters for repayment resources and is not a policy-stage parameter.

The lender pricing kernel is also fixed outside the sovereign-default SMM. The benchmark uses the Bocola-Dovis block for $(\phi_0, \phi_1, \kappa_0, \kappa_1, \rho_\chi)$, with the output loading $\sigma_{y\chi}$ set from GDP–priced-factor comovement. Keeping this block external prevents Spanish sovereign spreads from simultaneously identifying default risk and the price of global risk. The internally chosen first-stage parameters are therefore the discount factor and the two default-cost parameters, $(\beta, \chi_{D0}, \chi_{D1})$. The maintained row has $\beta \simeq 0.96$, in the high-patience region used in quantitative sovereign-default calibrations.

6.3 First-Stage Moments

Table 7: First-stage calibration targets and model moments

Block	Moment	Data	Model	Source
Structural core	Debt/GDP	0.5035	0.5026	Eurostat gross debt
Structural core	Calm spread	47.2 bp	47.7 bp	Eurostat Spain-Germany 10y spread
Structural core	Consumption smoothing	1.104	1.248	Eurostat consumption and GDP
Validation	Stress-calm spread	34.0 bp	33.0 bp	Eurostat Spain-Germany 10y spread
Validation	Mean excess bond premium	29.4 bp	–	Federal Reserve EBP
Validation	Distress frequency	8 per 100 years	–	Spain severe-spread threshold

Notes: The structural core is identified off the no-backstop economy. The stress-calm spread, the excess bond premium, and the distress frequency are validation objects rather than tight targets in the first-stage objective.

Table 7 reports the first-stage targets and the model moments at the benchmark row. The owned moments are debt/GDP, the calm spread, and the consumption-smoothing ratio. Debt identifies average leverage. The calm spread identifies the normal-times compensation required by private lenders. The consumption-smoothing ratio disciplines the default-cost slope because it governs how tightly repayment resources move with output and borrowing conditions.

The benchmark row matches the two level moments tightly. The model debt ratio is 0.5026, compared with 0.5035 in the data. The calm spread is 47.7 basis points, compared with 47.2 basis points in the data. The consumption-smoothing ratio is higher than the data, 1.248 versus 1.104. This gap is visible because the model compresses the rich dynamics of Spanish fiscal adjustment into a small number of state variables. The maintained calibration nevertheless delivers the leverage and normal-times spread levels required for the historical price-schedule exercises.

The lower panel reports validation moments. The stress-minus-calm spread is 33.0 basis points in the model and 34.0 basis points in the data, so the stress-state spread increment is close even though it is not used as a tight first-stage target. The excess bond premium and distress frequency are listed as empirical validation objects rather than matched moments. They discipline whether the model is in the right region for risk premia and tail events, but assigning them the same status as the calm spread would force the latent default block to absorb crisis-era market-functioning components.

6.4 Policy-Stage Moments

Table 8: Policy-stage targets and benchmark row

Block	Moment	Data target	Model	Source
Policy support	Event-window compression	28.7 bp	34.6 bp	ECB backstop event windows
Policy support	Broad absorption, A_1	0.239	0.251	Spain PSPP/PEPP over Tesoro supply
Policy residual	Compliant-stress absorption, A_3	0.239	0.034	Fixed compliant-stress issuance sample
Measurement bridge	Composite eligibility	0.480	0.480	Institutional eligibility proxy

Notes: The benchmark policy row is $(\eta_q, \psi_m) = (19.1, 0.1505)$. It produces event-window compression close to the targeted magnitude and matches the broad intervention-state absorption scale, but it undershoots the stricter fixed compliant-stress absorption statistic.

The policy stage estimates the intervention-cost and private-absorption parameters conditional on the first-stage sovereign-default block. The price moment is the event-window compression in fiscal-compliant high-spread episodes: the target is the mean of minus the 5-year cash-spread change over the $[-3, +3]$ calendar-day backstop-event window, restricted to periphery observations that satisfy the debt-convergence compliance rule using the latest completed quarter. This object equals 28.7 basis points in the target file (10 event-country observations; Spain's corresponding mean is 39.6 basis points). It is separate from the descriptive 10-year country-event table in Section 3.3, which documents the event variation but is not the exact policy-stage moment.

The quantity moments compare model purchases with official-sector absorption of Spanish issuance. The calibration hierarchy uses A_1, the broad intervention-state statistic, as the purchase-scale fit. The stricter fixed compliant-stress statistic, A_3, keeps the TPI-like stress sample fixed and counts zero purchases when support is inactive; it is reported as a secondary quantity statistic rather than as the fitting criterion. Structural fiscal compliance is held fixed at the debt-convergence rule in Section 4.4: $\bar{d} = 0.60$ of annual GDP and $\theta_c = 1 - (1 - 0.05)^{1/4}$, the quarterly counterpart of a 5 percent annual convergence rate. The eligibility row is a measurement bridge: the institutional eligibility proxy fixes the mapping between observed legal eligibility and the model's fiscal-compliance state rather than estimating a new structural threshold.

Table 8 reports the benchmark policy row, $(\eta_q, \psi_m) = (19.1, 0.1505)$. It produces 34.6 basis points of event-window compression, compared with the 28.7 basis-point target, and it matches the broad absorption scale, $A_1 = 0.251$ against a 0.239 empirical ratio.

The stricter fixed-sample absorption statistic is not matched: $A_3 = 0.034$, compared with 0.239 in the data. This is an economically meaningful limitation, not a table rounding issue. The maintained benchmark therefore fits the price compression and broad purchase scale while leaving the allocation of purchases across compliant stress states as the main policy-stage limitation. The reason is that the two policy moments discipline different margins. Price compression is governed by how far the support price moves the sovereign toward the risk-neutral valuation in eligible stress states. Absorption is governed by the private-demand schedule at that supported price and by whether positive issuance occurs in the narrow compliant-stress sample. The benchmark can move prices by the right amount while still leaving too much of the compliant-stress flow with private investors.

6.5 Use of the Benchmark Calibration

The calibration supports the historical decomposition, regime revaluation, dynamic replay, and welfare exercises. The first-stage row reproduces average leverage and normal-times spreads. The policy row reproduces the empirical scale of broad intervention-state absorption and generates event-window compression close to the data, but it underpredicts absorption in the fixed compliant-stress sample. These facts discipline the model's central economic force while also identifying its main quantity-side tension: conditional support compresses observed spreads by moving the borrowing price toward a safer valuation, but the benchmark does not allocate enough purchases to every compliant stress state.

The reported quantitative results should therefore be read as model-based valuations at the benchmark calibration. Historical decompositions condition on Spain's observed states, while dynamic replays let the regime-specific debt policy operate along the observed sequence of output and global-risk states. Welfare results use the paired value functions and the no-backstop access distribution as the reference distribution.

7 Quantitative Results

The quantitative exercise asks whether conditional support changes prices without fully eliminating the private valuation of sovereign risk. In the maintained Spanish benchmark, it does. The model can evaluate almost all observed states on the maintained grid, and it generates a persistent gap between the spread paid by the sovereign and the spread implied by private market pricing. That gap is concentrated in eligible stress states. Commitment is therefore valuable as a pricing technology: it gives investors a predictable support rule and lowers observed spreads more than discretion. The welfare calculation then adds the other side of the ledger. Lower observed spreads are not enough to overturn the incentive and intervention costs of support in the benchmark calibration.

All spread numbers in this section are annualized basis points. Debt is reported relative to annual GDP. The historical decompositions condition on Spain's observed state and issuance choice; the dynamic replay lets the regime-specific borrowing policy operate along the observed sequence of output and global-risk states.

7.1 Latent Risk and Observed Spreads

The decomposition is a useful historical object only if the observed states are inside the solved model economy. Table 9 shows that this condition is satisfied in the maintained calibration. The bridge evaluates 78 of 81 quarterly observations. Among successful observations, 98.7 percent are inside the computational grid and 100 percent lie in positive ergodic support. The exercise is therefore not an off-grid extrapolation from states outside the solved economy.

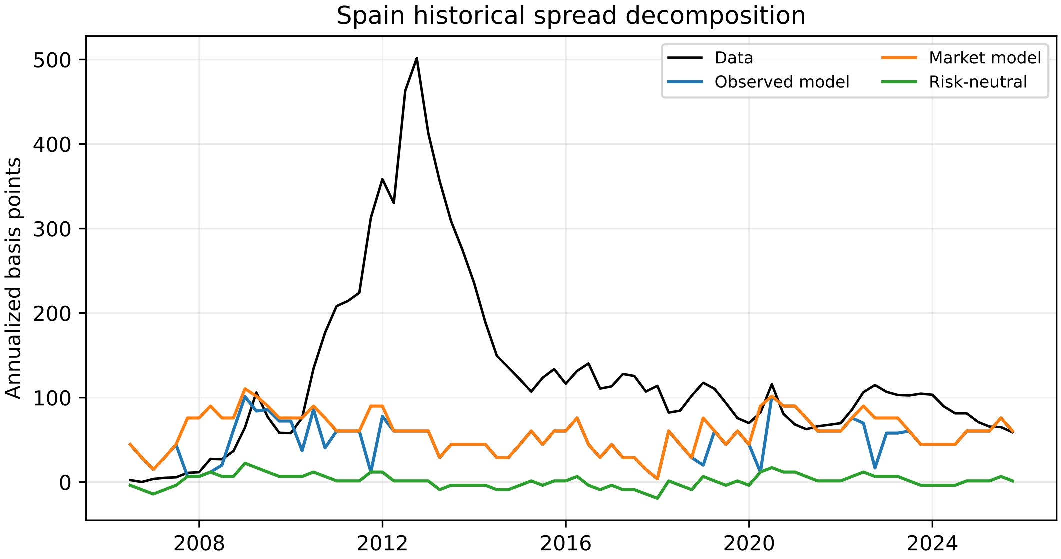
Table 9: Historical decomposition audit for Spain's quarterly state panel

Object	Value	Unit
Rows	81.0	quarters
Successful lookups	78.0	quarters
Inside grid	98.7	percent
Inside ergodic support	100.0	percent
Mean model compression	9.5	bps
Mean risk premium	58.3	bps

The average decomposition has two distinct components. The hidden support wedge, $S^{\mathrm{mkt}} - S^{\mathrm{obs}}$, is 9.5 basis points. The private market spread remains about 58 basis points above the risk-neutral expected-loss spread on average. Section 9 reports the safe-long-bond dominance audit for this object. The robust economic interpretation is the price-compression result: official support moves the borrowing price faced by the sovereign without mechanically eliminating the shadow private valuation of the same claim. The large gap between the private-market and risk-neutral spreads is the compensation risk-averse lenders require for holding sovereign debt in states that covary with global stress. The support wedge is different: it is the part of the transaction spread compressed by the policy price. The decomposition therefore separates risk compensation from policy support rather than treating the observed spread as a sufficient statistic for default risk.

Figure 3 makes the same point over time. The market spread remains above the exported risk-neutral benchmark in most of the historical panel because lenders price exposure

Figure 3: Spain: observed, private-market, and risk-neutral model spreads



to global stress. The observed spread can fall below that market spread when support is active. The wedge is therefore a price wedge, not a claim that default probabilities mechanically fall whenever the central bank intervenes.

The event-state decomposition in Table 10 shows where the mechanism is strongest. At the SMP state, the observed model spread is 37.1 basis points, compared with a latent market spread of 75.9 basis points and a risk-neutral spread of only 6.7 basis points. The hidden wedge is 38.8 basis points. At the TPI state, the observed spread is 69.8 basis points, the market spread is 90.0 basis points, and the wedge is 20.2 basis points. Draghi's London speech and the OMT announcement have no contemporaneous model wedge at the mapped state; their large event-window spread movements are therefore interpreted as announcement and expectations effects rather than current-state purchase support.

Table 10: Event-state spread decomposition, annualized basis points

Event	Data	Observed	Market	RN	Wedge
SMP announcement	76.0	37.1	75.9	6.7	38.8
Draghi speech	463.0	60.4	60.4	1.4	0.0
OMT announcement	463.0	60.4	60.4	1.4	0.0
PEPP announcement	69.8	44.5	44.5	-3.8	0.0
TPI announcement	106.4	69.8	90.0	11.9	20.2

7.2 Announcements, Purchases, and Compliance

The model separates announcement effects from current support at the mapped state. Table 11 compares the three-day spread movement around each policy event with support intensity at the mapped model state. SMP, Draghi, and OMT are classified as announcement episodes: the data spreads fall by 95 to 132 basis points, while current model support is either limited or zero. PEPP has purchase-program evidence in the data, but zero current support at the mapped model state. TPI is different again: the model assigns support and official absorption, but the immediate data spread change is weak. This is the right pattern for a conditional instrument: the announcement can be valuable even when the current-state purchase margin is not the whole event-window movement.

Table 11: Announcement and purchase classification at mapped event states

Event	Change	Support	Absorp.	Type
SMP announcement	-95.2	0.55	0.221	announcement
Draghi speech	-120.0	0.00	0.000	announcement
OMT announcement	-132.4	0.00	0.000	announcement
PEPP announcement	-16.4	0.00	–	price + data purchase
TPI announcement	1.9	0.25	0.243	weak/residual

The quantity moment is tighter than the price moment. Table 12 reports three measures of official absorption. The broad intervention-state average, $A_1 = 0.251$, is close to the empirical target of 0.239. The narrower compliant-stress ratio, $A_3 = 0.034$, is much smaller. This gap is informative rather than cosmetic. The benchmark puts the right order of purchases into broad support states, but it under-allocates purchases to the specific compliant-stress states that are closest to the TPI-like policy environment. Economically, the price and quantity margins are not the same object. A modest support price can generate the observed order of spread compression without forcing the central bank to absorb a large share of issuance in every compliant stress state. The low A_3 says that, conditional on the strict TPI-like state definition, the calibrated private-absorption schedule leaves too much issuance with private investors. It is therefore a quantity-side limitation of the support block, not a failure of the price-wedge mechanism.

Compliance matters because it preserves access to the support price schedule. At the SMP and TPI states, current-period support raises consumption by 0.13 and 0.11 percent, respectively. These are local gains from applying the support price to the observed issuance choice. The continuation values in Table 13 are negative, between -1.66 and -2.23 percent in consumption-equivalent terms, because the full regime also changes

Table 12: Official absorption ratios in model and data

Object	Ratio
Model A1	0.251
Model A2	0.116
Model A3	0.034
Data target	0.239
State-panel mean	0.222

borrowing incentives and carries intervention costs. Eligibility is therefore valuable at the margin, even though the lifetime value of the regime is not summarized by the one-period gain. The sign difference is important. The current-period number asks what happens if the sovereign can issue the observed amount at the supported price today. The continuation number asks what the whole regime does once the sovereign anticipates that support rule in future borrowing decisions and once official exposure is charged according to the maintained incidence convention. A positive local compliance option value can therefore coexist with a negative full-regime continuation value.

Table 13: Option value of fiscal compliance at event states, percent

Event	Current gain	Continuation CE	Support
SMP announcement	0.13	-1.95	0.550
Draghi speech	0.00	-1.66	0.000
OMT announcement	0.00	-1.66	0.000
PEPP announcement	0.00	-1.89	0.000
TPI announcement	0.11	-2.23	0.250

7.3 Commitment Versus Discretion

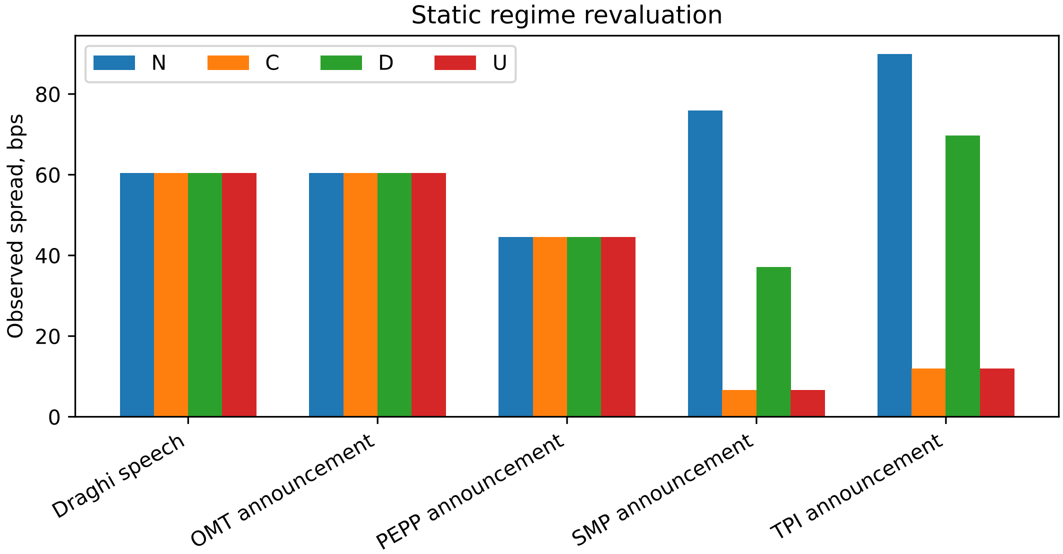
Commitment is most valuable at the states where support is priced. Table 14 values the same historical state and observed issuance choice under no support, commitment, discretion, and unconditional support. At the SMP state, no support implies a 75.9 basis-point spread. Discretion lowers the spread to 37.1 basis points. Commitment lowers it further to 6.7 basis points. At the TPI state, the same ordering is sharper: 90.0 basis points without support, 69.8 under discretion, and 11.9 under commitment. The difference is the credibility of the support rule. Commitment embeds support in prices before the ex-post intervention choice is made; discretion leaves investors with a weaker guarantee. Figure 4 plots the same event-state spread ordering.

The commitment premium is economically large but state-contingent. Table 15 shows that commitment lowers the observed spread relative to discretion by 30.4 basis points

Table 14: Static regime revaluation at event states, annualized basis points

Event	N	C	D	U
Draghi speech	60.4	60.4	60.4	60.4
OMT announcement	60.4	60.4	60.4	60.4
PEPP announcement	44.5	44.5	44.5	44.5
SMP announcement	75.9	6.7	37.1	6.7
TPI announcement	90.0	11.9	69.8	11.9

Figure 4: Event-state observed spreads under alternative regimes



at the SMP state and by 57.9 basis points at the TPI state. It also raises support intensity and official holdings at those states. The remaining event states have essentially zero commitment-discretion gap because the support margin is not active at the mapped state. The result is not that commitment lowers every spread in every quarter; it lowers spreads where eligibility, stress, and support interact.

Table 15: Commitment minus discretion at event states

Event	Spread	Support	Holdings
Draghi speech	0.000	0.000	0.000
OMT announcement	0.000	0.000	0.000
PEPP announcement	0.000	0.000	0.000
SMP announcement	-30.426	0.450	0.009
TPI announcement	-57.854	0.750	0.031

The dynamic replay preserves the same ordering. Table 16 follows Spain's observed sequence of output and global-risk states while applying each regime's policy functions. No support generates the highest mean observed spread, 59.7 basis points. Discretion lowers the mean spread to 46.2 basis points. Commitment lowers it to 36.2 basis points. Unconditional support produces the lowest spread, 33.2 basis points, because it removes the eligibility margin entirely. Average debt remains close to 0.50 across regimes, so the spread ranking is not driven by large differences in mean leverage along the replay path. The replay therefore isolates the price-rule channel. The same output and global-risk sequence is fed through different support rules; commitment and unconditional support lower spreads mainly by changing the price attached to comparable debt positions, not by sending the economy to a different average leverage path. Figure 5 shows the replay paths for debt and observed spreads.

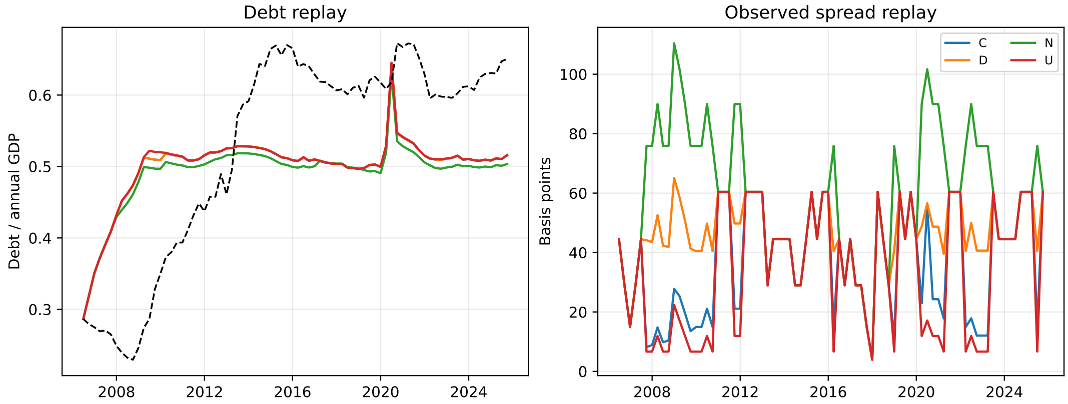
Table 16: Dynamic historical replay by policy regime

Regime	Mean debt	Final debt	Spread	Support	Holdings
C	0.500	0.516	36.2	0.320	0.020
D	0.500	0.516	46.2	0.182	0.001
N	0.492	0.503	59.7	0.000	0.000
U	0.501	0.516	33.2	0.359	0.031

7.4 Welfare and Exit

The spread results do not imply that support is welfare improving. Table 17 compares regime value functions in consumption-equivalent units, averaging over the no-backstop access distribution. All support regimes have negative transition values

Figure 5: Dynamic debt and observed-spread replay



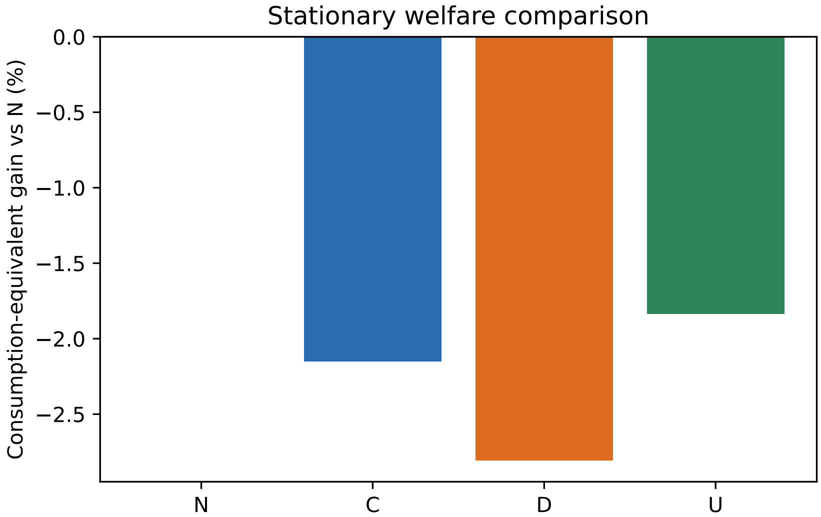
relative to no support from that distribution in the benchmark. The reason is economic, not mechanical: support lowers crisis borrowing costs, but the sovereign then reoptimizes under the supported price schedule. The cheaper price provides insurance, but it also weakens market discipline, changes future debt choices, and uses official balance-sheet capacity. In the full value-function comparison those incentive and resource-cost terms exceed the direct insurance gain. Commitment is less costly than discretion, -2.15 percent versus -2.81 percent, because eligibility restores part of the discipline lost under discretionary intervention. The committed rule makes future support valuable before the intervention state arrives, so the sovereign has a reason to preserve eligibility. Unconditional support has the least negative value, -1.84 percent, because it removes eligibility risk and delivers the largest price-insurance margin; it does so by abandoning the conditionality mechanism that defines OMT and TPI. Figure 6 visualizes these consumption-equivalent comparisons.

Table 17: Welfare comparisons relative to no support

Regime	Value gain	CE gain	P10 CE	P90 CE
N	0.000	0.00	0.00	0.00
C	-0.075	-2.15	-6.66	-0.82
D	-0.098	-2.81	-9.36	-1.19
U	-0.063	-1.84	-5.93	-0.63

Section 8 decomposes this result further. Holding the exported modal policies fixed and varying only the incidence of official losses, the commitment channel is positive relative to discretion: the fixed-policy commitment premium is 0.033 percent of consumption when official losses are not charged domestically and 0.015 percent when all official losses are charged domestically. The contrast between that positive diagnostic and the negative full value-function comparison is the policy tradeoff in quantitative form: commitment improves the support technology, but support also changes incentives and

Figure 6: Consumption-equivalent gains relative to no support



absorbs official resources.

Exit costs are concentrated in the same states where support matters for prices. Table 18 holds the state fixed and removes support. Moving from commitment to no support raises the spread by 69.2 basis points at the SMP state and by 78.1 basis points at the TPI state. At the Draghi, OMT, and PEPP states, the withdrawal effect is essentially zero. The result is useful for policy interpretation: a backstop can have a large normalization cost even when its average wedge is modest, because the cost is concentrated in eligible stress states. Figure 7 plots the event-state withdrawal effects.

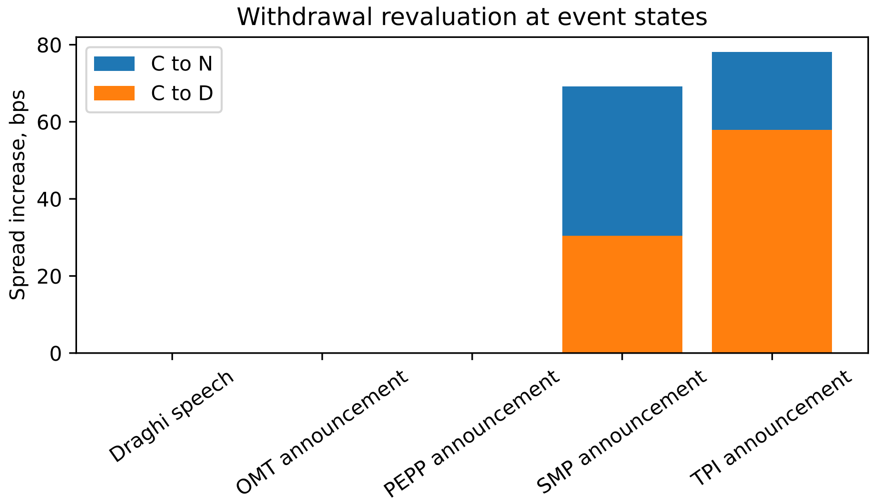
Table 18: Withdrawal and normalization at event states

Event	D-C spr.	N-C spr.	C-D m^{cb}	C-N m^{cb}
Draghi speech	-0.0	0.0	0.000	0.000
OMT announcement	-0.0	0.0	0.000	0.000
PEPP announcement	-0.0	0.0	0.000	0.000
SMP announcement	30.4	69.2	0.009	0.027
TPI announcement	57.9	78.1	0.031	0.047

7.5 Validation and Boundary Checks

The model wedge is not a high-frequency measurement equation for Spanish spreads. Table 19 shows that observed spreads regressed on the model private spread and model wedge have an R^2 of only 0.015. Adding fiscal fundamentals and backstop interactions raises the observed-spread R^2 to 0.662. This is exactly why the paper treats the wedge as a structural price-schedule object rather than as a sufficient statistic for the cash spread. The model performs better where it is supposed to: compliance-boundary distance

Figure 7: Spread revaluation under withdrawal from committed support



explains 33.7 percent of model-wedge variation and 22.2 percent of near-boundary support intensity. The economics is that cash spreads contain benchmark, liquidity, redenomination, and news components that are outside the model's state vector. The model is instead designed to predict how the policy rule changes the price schedule as the country approaches or moves away from fiscal eligibility.

Table 19: Information content and compliance-boundary regressions

Block	Specification	N	R^2
Information	Observed spread: market spread and wedge	78	0.015
Information	Observed spread: fundamentals and backstop interactions	78	0.662
Information	Official absorption: wedge, support, holdings	39	0.028
Boundary	Observed spread: compliance distance	78	0.299
Boundary	Model wedge: compliance distance	78	0.337
Boundary	Support intensity: near-boundary states	49	0.222

The boundary pattern is also visible nonparametrically. Below the fiscal compliance threshold, Table 20 shows zero model wedge and zero support. Just above the boundary, the wedge is 6.8 basis points and support intensity is 0.096. Farther above the boundary, the wedge rises to 20.4 basis points and support intensity rises to 0.275. Conditional support is therefore a boundary object, not an unconditional spread subsidy.

The reduced-form event-study counterpart points in the same direction but is imprecise. Table 21 shows that high-spread eligible observations have 19.6 basis points more three-day compression, with a standard error of 17.3 basis points. The sign and magnitude are consistent with the policy block, but the sample is small. The estimate is therefore used as calibration discipline rather than as a stand-alone causal estimate of TPI.

Table 20: Compliance-boundary bins for model wedge and support

Distance bin	N	Data spread	Wedge	Support	Holdings
lt_m10pp	1	115.9	0.0	0.000	0.000
m10_to_m5pp	0				
m5_to_0pp	24	107.7	0.0	0.000	0.000
0_to_5pp	25	125.2	6.8	0.096	0.003
5_to_10pp	0				
gt_10pp	28	142.5	20.4	0.275	0.005

Table 21: TPI fiscal-compliance event study, three-day compression

Term	Coef.	S.E.	N	R^2
high_spread_eligible	19.6	17.3	25	0.423

External CDS validation is deliberately conservative. In the available post-2017 overlap, the model wedge has a correlation of 0.25 with Spain's five-year CDS series, while the risk-neutral and market spread objects have correlations close to zero. The weak correlations in Table 22 prevent over-interpreting the wedge as a full time-series explanation of Spanish credit risk. They do not invalidate the price-schedule exercise; they delimit what it is measuring.

Table 22: External validation against sovereign CDS and cash spreads

Outcome	Model object	N	Correlation
esp_cds_5y_bps	S_RN_bps	34	0.06
esp_cds_5y_bps	S_mkt_bps	34	0.04
esp_cds_5y_bps	piD	34	
esp_cds_5y_bps	Omega_S_model_bps	34	0.25
S_data_bps	S_RN_bps	78	-0.03
S_data_bps	S_mkt_bps	78	-0.03
S_data_bps	piD	78	
S_data_bps	Omega_S_model_bps	78	-0.12

The maintained model has one long bond, so the term-structure check is a diagnostic rather than a multi-maturity extension. Table 23 shows that the long-bond market spread is approximately unchanged across regimes, near 59.9 basis points. What changes is the observed borrowing spread faced by the sovereign. This is the paper's central decomposition in another form: support changes the price paid by the sovereign, not the latent private valuation of the same risk.

Local stress tests close the section by checking the direction of the mechanism around

Table 23: Long-bond market and observed-spread diagnostic

Regime	Observed spread	Market spread
N	59.9	59.9
C	37.1	59.9
D	45.6	59.9
U	33.3	59.9

historical states. Higher next-period debt or lower output raises observed spreads by 15.6 basis points on average and lowers support intensity. Moving to a higher-stress state raises the hidden wedge by 30.8 basis points and support intensity to 0.800. The model's support wedge is therefore most sensitive to the interaction of stress and eligibility, not to inherited debt alone. The zero response to a pure inherited-debt perturbation is also informative: holding the issuance choice and the eligibility classification fixed, inherited debt alone does not create a new support margin. The spread schedule moves when the perturbation changes repayment resources, the chosen next debt, or the stress state that activates support. This is the model's conditionality mechanism in local form, rather than an unconditional debt-level subsidy. Figure 8 summarizes the same local stress responses visually.

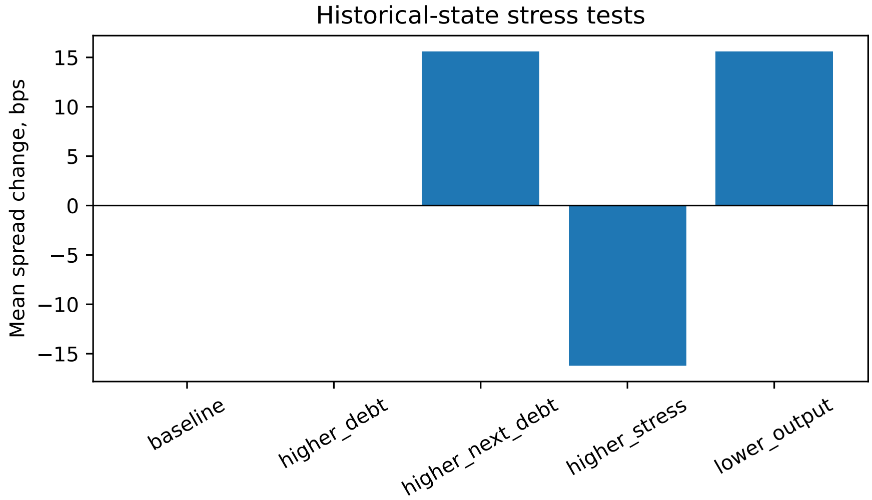
Table 24: Historical-state local stress tests

Scenario	Spread change	Wedge change	Support
baseline	0.0	0.0	0.400
higher_debt	0.0	0.0	0.400
higher_next_debt	15.6	-15.6	0.200
higher_stress	-16.2	30.8	0.800
lower_output	15.6	-15.6	0.200

8 Welfare

Spread compression is not a welfare theorem. A backstop lowers the transaction spread by moving the sovereign from a private-market price to a supported price. Welfare also depends on how the lower price changes borrowing incentives, how official losses are financed, and whether conditionality is credible. This section therefore reports three welfare objects. The first is the full regime value-function comparison. The second is a fixed-policy incidence map that varies who bears official losses. The third decomposes the fixed-policy welfare effect into price insurance, borrowing incentives, and balance-sheet incidence, and then reports a separate Floden-style decomposition of consumption-equivalent welfare into level, uncertainty, and ex-ante state-risk components.

Figure 8: Local stress tests around historical states



8.1 Regime Values

The benchmark object is the transition consumption-equivalent gain from switching regimes at the no-backstop access distribution. For each regime, the calculation converts the solved value function into the constant quarterly consumption level that delivers the same lifetime utility under CRRA preferences,

$$ce(V) = [1 + (1 - \gamma)(1 - \beta)V]^{1/(1-\gamma)}$$

for $\gamma \neq 1$, with the log-utility limit used when $\gamma = 1$. The reported number averages state-level gains over the no-backstop access distribution. This is a transition policy comparison, not a comparison of regime-specific invariant distributions.

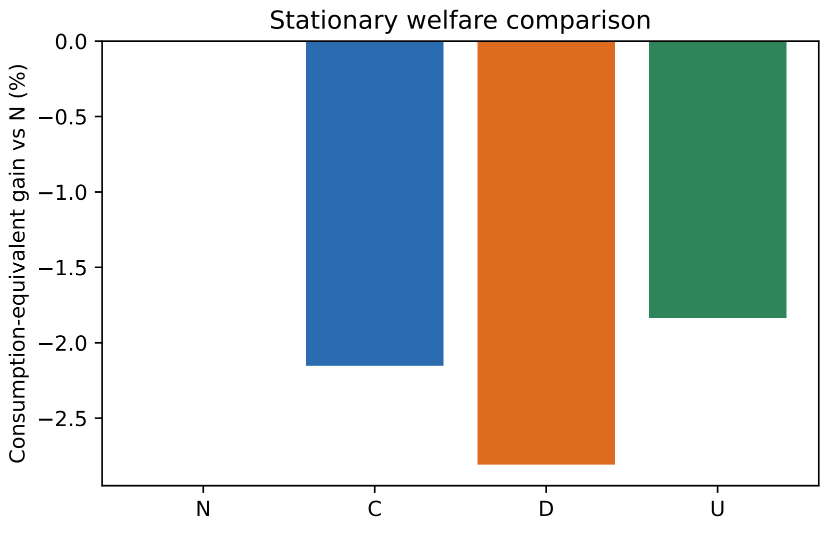
Table 25: Welfare comparison across backstop regimes

Regime	Value gain	CE gain	P10 CE	P90 CE
N	0.000	0.00	0.00	0.00
C	-0.075	-2.15	-6.66	-0.82
D	-0.098	-2.81	-9.36	-1.19
U	-0.063	-1.84	-5.93	-0.63

Table 25 gives the benchmark welfare ranking. Relative to no support, discretion has a mean transition consumption-equivalent loss of 2.81 percent. Commitment improves on discretion, with a loss of 2.15 percent. Unconditional support has the least negative value, 1.84 percent, but only by abandoning the eligibility margin that defines OMT and TPI. The first part of the ranking is the distinction between price compression and welfare. Support lowers the transaction spread in stress states, but the full value-function comparison lets the government reoptimize under the supported price schedule. Cheaper crisis borrowing relaxes market discipline, changes continuation debt choices, and requires official absorption. In the benchmark calibration those incentive and balance-sheet terms dominate the direct insurance value, so all three support regimes have negative transition values relative to no support.

The ranking among support regimes has a different economic logic. Commitment dominates discretion because a committed eligibility rule is priced before the intervention decision is taken. Investors understand that eligible stress states receive a predictable support price, while the sovereign understands that losing eligibility sacrifices future crisis insurance. The rule therefore combines insurance with an intertemporal discipline margin. Discretion weakens that margin: ex-post support is less predictable for investors and less useful as a promised reward for fiscal restraint. Unconditional support has the least negative full-regime value because it eliminates eligibility risk and maximizes price insurance in stress states. This is not the paper's preferred institutional regime. It is the model counterpart of a larger insurance transfer without the fiscal-eligibility mechanism that OMT and TPI are designed to preserve. The ordering is therefore not a rejection of the price mechanism: commitment lowers observed spreads relative to discretion in active support states. It says that welfare depends on the insurance, incentive, and balance-sheet terms jointly, not on spread compression alone. Figure 9 plots the same regime ranking.

Figure 9: Consumption-equivalent gains relative to no support



8.2 Incidence and Commitment

The fixed-policy incidence exercise isolates a narrower question: conditional on the exported modal policies and price schedules, how much value is created by support when different fractions of official losses are charged to domestic resources? The parameter ω_i indexes the domestic incidence of official losses. At $\omega_i = 0$, the recipient sovereign receives the price insurance but does not internalize official balance-sheet losses. At $\omega_i = 1$, those losses are charged fully in the domestic resource constraint. The exercise is a diagnostic revaluation, not a fresh strategic policy solve.

Table 26: Fixed-policy welfare sensitivity to official-loss incidence

Regime	$\omega_i = 0$	0.25	0.50	1
N	0.000	0.000	0.000	0.000
C	0.061	0.051	0.042	0.022
D	0.028	0.023	0.018	0.007
U	0.083	0.073	0.063	0.043

Table 26 shows that the pure fixed-policy insurance channel is positive. With no domestic incidence of official losses, committed support raises welfare by 0.061 percent of consumption relative to no support, discretion by 0.028 percent, and unconditional support by 0.083 percent. Charging all official losses domestically lowers those gains to 0.022, 0.007, and 0.043 percent, respectively. These are small numbers, but their signs are economically important: the exported support schedules provide insurance in the states where support is active.

Table 27: Value of commitment under fixed-policy incidence accounting

ω_i	Δ^{commit}	C vs N	D vs N
0.00	0.033	0.061	0.028
0.25	0.028	0.051	0.023
0.50	0.024	0.042	0.018
1.00	0.015	0.022	0.007

The value of commitment is the gap between the committed and discretionary fixed-policy valuations. Table 27 reports that this gap is 0.033 percent when official losses are not charged to the recipient and 0.015 percent when they are fully charged. Commitment retains a positive value because it provides a more predictable support price in eligible stress states. The number is not large because default risk is essentially absent in the current paired exports and because the official balance-sheet cost is also small.

Table 28: Welfare sign map over incidence and official-cost scale

Regime	Min	Max	No incidence	Baseline	Zero ω_i
C	-0.095	0.061	0.061	0.022	1.57
D	-0.055	0.028	0.028	0.007	1.36
U	-0.076	0.083	0.083	0.043	

The sign map in Table 28 is a useful guardrail. Over the grid of ω_i and official-cost scales, committed support ranges from a gain of 0.061 percent to a loss of 0.095 percent; discretion ranges from 0.028 to -0.055 percent. At the baseline cost scale, the fixed-policy commitment gain crosses zero only when ω_i rises to about 1.57, above full domestic incidence. The fixed-policy result is therefore not balanced on a knife edge, but neither is it a large welfare gain. It is a small insurance benefit whose sign depends on how intervention losses are assigned.

Table 29: Commitment accounting under alternative incidence conventions

Accounting	ω_i	Δ^{commit}	C vs N	D vs N
Recipient	0.00	0.033	0.061	0.028
Shared	0.25	0.028	0.051	0.023
Consolidated	1.00	0.015	0.022	0.007

Table 29 reports the same commitment object under three incidence conventions. The recipient accounting ($\omega_i = 0$) gives the largest commitment value, 0.033 percent. A shared loss convention ($\omega_i = 0.25$) gives 0.028 percent. Consolidated domestic incidence ($\omega_i = 1$) gives 0.015 percent. These numbers discipline the interpretation of the full value-function comparison: commitment improves the support technology relative to discretion, but the full welfare ranking also reflects endogenous policy responses and continuation values.

8.3 Decomposition

The structural decomposition separates the fixed-policy welfare effect into three ordered components. The first replaces the no-backstop price schedule by the support-regime price schedule while holding the no-backstop borrowing rule fixed; this is direct price insurance. The second lets the support-regime borrowing rule operate under the support price schedule; this is the borrowing and incentive component. The third charges official losses to domestic resources; this is the balance-sheet incidence component. The reported order is price first, policy second, balance sheet last. Reversing the price and policy order changes the split between the first two components, but the balance-sheet term and total are unchanged in the generated diagnostic.

Table 30 shows the tradeoff directly. For commitment, direct insurance contributes 0.034 percent of consumption and the policy component contributes another 0.027 percent. Official-loss incidence subtracts 0.039 percent, leaving a total fixed-policy gain of 0.023 percent under full domestic incidence. Discretion has the same sign pattern

Table 30: Fixed-policy welfare decomposition: insurance, incentives, and balance sheet

Regime	Insurance	Policy	Balance sheet	Total	Error
C	0.034	0.027	-0.039	0.023	0.0e+00
D	0.020	0.008	-0.021	0.007	0.0e+00
U	0.034	0.049	-0.039	0.043	0.0e+00

but smaller insurance and policy components. Unconditional support has the largest policy component because it removes the eligibility margin. The additive errors are zero at reported precision, so the decomposition is an accounting identity rather than a narrative split.

The next table answers a different question. The Floden-style decomposition does not ask which policy channel creates welfare. It asks whether the fixed-policy consumption-equivalent gain comes from a higher path of mean consumption, from a different amount of consumption risk along the lifetime allocation, or from ex-ante risk about the state in which the country starts. The calculation uses the no-backstop access distribution as the common initial distribution. For each support regime, the code evolves that distribution under the regime's modal-policy transition matrix and constructs the deterministic path of mean consumption $\{\bar{c}_{j,t}\}_{t\geq 0}$.

Let C_j^A be the aggregate ex-ante consumption equivalent under regime j, C_j^L the consumption equivalent of the deterministic mean consumption path, and C_j^U the no-backstop-weighted average of state-contingent lifetime consumption equivalents. The following proposition is the welfare-decomposition result; Appendix A.2 gives the proof.

Proposition 8.1 (Welfare decomposition)**.** *For any support regime $j \in \{C, D, U\}$, define the total fixed-policy welfare factor relative to no support as $1 + \Delta_j = C_j^A / C_N^A$. Then*

$$1 + \Delta_j = (1 + \Delta_j^L)(1 + \Delta_j^U)(1 + \Delta_j^R),$$

where

$$1 + \Delta_j^L = \frac{C_j^L}{C_N^L}, \qquad 1 + \Delta_j^U = \frac{C_j^U / C_j^L}{C_N^U / C_N^L}, \qquad 1 + \Delta_j^R = \frac{C_j^A / C_j^U}{C_N^A / C_N^U}.$$

The level factor compares deterministic mean-consumption paths. The uncertainty factor compares the welfare value of the stochastic lifetime allocation relative to that mean path. The ex-ante state-risk factor compares aggregate welfare before the initial state is known with the average of state-contingent lifetime consumption equivalents.

This object should not be confused with the structural decomposition above. The structural table asks which policy channel changes welfare; the Floden table asks what type of consumption-equivalent welfare change those channels produce.

Table 31: Floden-style fixed-policy welfare decomposition

Regime	Total	Level	Uncertainty	Ex-ante risk	Error
C	1.000607	1.000606	1.000007	0.999993	0.0e+00
D	1.000284	1.000248	1.000030	1.000006	-2.2e-16
U	1.000826	1.000810	1.000015	1.000001	0.0e+00

Table 31 shows why the fixed-policy gains are small even before domestic official-loss incidence is charged. Commitment raises total fixed-policy welfare by 0.061 percent, and almost the entire gain comes from the level factor: the deterministic path of mean consumption rises by 0.061 percent. The uncertainty term is economically zero, 0.001 percent, and the ex-ante state-risk term is also essentially zero, -0.001 percent. Discretion and unconditional support have the same structure. Discretion raises total welfare by 0.028 percent, mostly through a 0.025 percent level gain; unconditional support raises total welfare by 0.083 percent, mostly through a 0.081 percent level gain. The decomposition therefore says something sharper than the structural channel table. In this fixed-policy diagnostic, support creates welfare by raising the mean consumption path, not by changing the lifetime risk profile or reallocating value across initial states. The product-identity error is below 10^{-15}, so the table is an exact decomposition of the generated time-path object.

9 Robustness and Validation

The main quantitative results use a single maintained calibration, so the relevant robustness question is whether the price-schedule mechanism survives basic support, boundary, and external-validation checks. The answer is mixed in the way the model predicts. The historical decomposition is well supported on the maintained grid, the commitment-discretion gaps appear only in eligible stress states, and the compliance-boundary diagnostics show that support is not an unconditional spread subsidy. At the same time, the model wedge is not a sufficient statistic for the Spanish spread time series, and the CDS correlations are weak. These checks discipline the interpretation of the results: the model is a structural valuation of support at observed states, not a high-frequency forecasting model for cash spreads.

Three checks are central. First, the bridge audit in Table 9 shows that the historical states used in the decomposition are inside the solved economy. Second, the boundary regressions and bins in Tables 19 and 20 show that the wedge and support intensity rise near the fiscal-compliance boundary. Third, the local stress tests in Table 24 show that the wedge responds strongly to the interaction of stress and eligibility. These are the checks a skeptical reader needs for the paper's mechanism.

The validation limits are also part of the result. Table 22 shows that the model wedge has only a modest correlation with post-2017 Spain CDS, and Table 19 shows that observed cash spreads require fiscal fundamentals and backstop interactions in addition to the model wedge. The paper therefore does not claim that observed spreads reveal latent default risk directly. Its claim is narrower: conditional support can move the sovereign's observed borrowing price away from the private valuation of the same risk, and the welfare value of doing so depends on commitment.

9.1 Price Recursions, Eligibility, and Selection

The first set of checks verifies that the price recursions and regime comparisons have the intended interpretation. Table 32 reports the regime-level objects. The paired exports are intentionally close in average debt, about 0.50 of annual GDP, and in the private-market spread, about 60 basis points. Support changes the price faced by the sovereign, not the shadow private valuation. The same table also shows that default probabilities are essentially zero in these exports. The maintained calibration therefore supports the price-compression interpretation; it does not support a stronger claim that the central bank is hiding large realized default probabilities.

Table 32: Regime-level default-risk and support diagnostics

Regime	Debt/GDP	S^{obs}	S^{mkt}	S^{RN}	$S^{mkt} - S^{RN}$	Max p_D	A3
No support	0.504	58.2	58.2	-0.0	58.2	3.4e-167	0.000
Commitment	0.506	33.0	58.2	-0.0	58.2	9.7e-161	0.632
Discretion	0.507	42.3	58.2	-0.0	58.2	3.5e-161	0.038
Unconditional	0.508	28.7	58.2	-0.0	58.2	3.4e-161	0.632

The risk-neutral benchmark passes the stricter safe-bond audit after aligning the RN recursion with the safe-spread convention. A zero-recovery defaultable bond priced with the risk-neutral kernel should not trade above the matching safe long bond. Table 33 verifies this condition: the minimum risk-neutral spread is zero up to numerical tolerance, and no nodes have $q^{RN} > q^f$. The price-yield mapping is also numerically stable. The risk-premium decomposition is therefore internally consistent with the long-bond benchmark used in the paper.

The commitment-discretion comparison also needs a precise interpretation. In the cur-

Table 33: Risk-neutral safe-bond dominance audit

Regime	Min RN	Neg. share	Max $q^{RN} - q^f$	$q^{RN} > q^f$	Audit
No support	-0.0	0.000	0.0000	0.000	pass
Commitment	-0.0	0.000	0.0000	0.000	pass
Discretion	-0.0	0.000	0.0000	0.000	pass
Unconditional	-0.0	0.000	0.0000	0.000	pass

rent paired export, Table 34 shows that essentially all of the absolute $C - D$ spread gap comes from state-actions that are eligible under both regimes. Discretion does not provide ineligible-state support in this diagnostic. The reported commitment premium is therefore a credible-intensity comparison at eligible states, not a clean enforcement-only estimate in which support intensity is held fixed and only conditionality enforcement changes.

Table 34: Commitment-discretion intensity decomposition

Sample	Mass	$S_C - S_D$	x_C	x_D	$x_C - x_D$
All state-actions	1.000	-9.5	0.311	0.193	0.117
Eligible in both regimes	0.859	-11.0	0.362	0.225	0.137
Ineligible under discretion	0.141	0.0	0.000	0.000	0.000
Ineligible with D support	0.000				
Eligible share of abs. gap		100.0			

Table 35 implements that fixed-intensity comparison directly. It takes the discretionary support intensity as the common eligible-state intensity, sets committed support to zero only when the state-action is ineligible, and then recomputes spreads. The average enforcement-only spread gap is essentially zero because the discretionary export itself does not support ineligible state-actions. This result is useful because it disciplines the interpretation of Table 15: the current C-D gap is an eligible support-intensity effect, not evidence that discretion relaxes conditionality off the eligibility set.

Table 35: Enforcement-only commitment comparison with fixed eligible intensity

Sample	Mass	Enforce gap	Inelig. support
All state-actions	1.000	0.000	0.000
Eligible state-actions	0.857	0.000	0.000
Ineligible state-actions	0.143	0.000	0.000
Ineligible with D support	0.000		0.000

The eligibility rule itself is also not the source of the main price result. Table 36 revalues the committed modal policy under alternative debt-convergence thresholds, holding the solved policy and price arrays fixed. The reported exercise changes the debt reference from 50 to 70 percent of annual GDP while keeping the annual excess-debt gap-closing rate at five percent. Support mass, mean compression, fixed-policy A3, and consumption-equivalent welfare barely move because the stationary support states in the maintained export are already inside the relevant compliance region. Historical event classifications do move at the margin, which is why the paper treats eligibility as a quantitatively important state variable rather than a decorative label.

Table 36: Eligibility-rule robustness under fixed-policy revaluation

Debt ref.	Eligible	Support	Compression	A3	CE	Switches
0.50	100.0	36.3	29.5	0.632	0.022	6
0.60	100.0	36.3	29.5	0.632	0.022	6
0.70	100.0	36.3	29.5	0.632	0.022	12

Default and recovery assumptions are not doing the work in the paired exports. Table 37 reports maximum default probabilities, risk-neutral expected-loss spreads, recovery-scaled expected-loss spreads, private-market spreads, and the implied exclusion duration. Default probabilities are numerically negligible, so changing zero-recovery expected-loss spreads by applying positive recovery rates has no economic effect in this export. The result narrows the interpretation of the paper: the quantitative wedge is a price-compression and risk-premium object in the maintained calibration, not evidence of large hidden expected default losses.

Table 37: Default and recovery accounting in the paired exports

Regime	Max π^D	S^{RN}	S^{RN} rec. 40	S^{mkt}	Excl. years
N	3.4e-167	-0.00	-0.00	58.2	3.0
C	9.7e-161	-0.00	-0.00	58.2	3.0
D	3.5e-161	-0.00	-0.00	58.2	3.0
U	3.4e-161	-0.00	-0.00	58.2	3.0

The same paired exports are also stable to a simple equilibrium-selection audit. Table 38 resolves each regime from three different initial long-bond price levels. All twelve solves converge, and the largest range in the mean observed spread across starts is less than one hundredth of a basis point. This check does not prove global uniqueness of the long-term-debt fixed point, but it rules out the practical concern that the reported regime ordering is an artifact of the initial price schedule used in the maintained export.

Table 38: Multi-start fixed-point selection audit

Regime	Starts	Debt range	S^{obs} range	Wedge range	Status
N	3	4.42e-07	3.60e-03	0.00e+00	pass
C	3	3.82e-07	3.43e-03	5.45e-04	pass
D	3	3.96e-07	3.08e-03	3.29e-04	pass
U	3	4.38e-07	3.66e-03	6.82e-04	pass

The central bank's timing is deliberately static-follower. For each state and issuance choice, the support rule maps the private valuation into the transaction price faced by the sovereign; the support authority does not carry an additional balance-sheet state or maximize a separate intertemporal value function. This timing matches the object estimated in the event evidence: a conditional pricing facility that compresses spreads when eligibility and stress interact. A fully dynamic central-bank problem would require official holdings, future losses, and future intervention constraints to become state variables and would be a different quantitative model. The paper therefore reports dynamic sovereign reoptimization under the maintained support rule, not a strategic dynamic game between the sovereign and a forward-looking central bank.

Finally, the official-absorption frontier is reported as a diagnostic rather than an acceptance criterion for the maintained draft. Table 39 and Figure 10 summarize the frozen policy grid. Requiring both the price-compression target and the narrow A3 absorption target would leave no jointly accepted frozen-frontier rows: the row closest to the price-compression target has little A3 absorption, while the row closest to A3 leaves compression about 31 basis points too high. Following the calibration hierarchy, this frontier is an absorption diagnostic rather than a reason to discard the maintained price-compression calibration. Economically, the frontier shows that the current two-parameter support block cannot independently control the price paid by the sovereign and the quantity absorbed by the central bank in the narrow compliant-stress sample. Raising support enough to move purchases in that sample also moves the supported price too far, while rows that keep price compression near the event target do not generate enough central-bank take-up in those same states. The welfare conversion itself is not the source of the tradeoff: Table 40 reports exact algebraic tests of the normalized-CRRA consumption-equivalent formula.

10 Conclusion

Conditional sovereign backstops are valuable only if their conditionality is credible. This paper frames OMT- and TPI-style policies as a commitment problem in a long-term

Table 39: Frozen policy frontier around compression and A3 absorption

Criterion	η_q	ψ_m	Compression	Gap	A3	A3 gap	Accepted
Best compression	160.0	3.000	38.2	9.5	0.000	-0.239	0
Best A3	20.0	0.003	59.6	30.9	0.225	-0.015	0
Best joint distance	40.0	0.003	55.1	26.4	0.203	-0.037	0
Accepted rows							0

Figure 10: Frozen policy frontier for price compression and official absorption

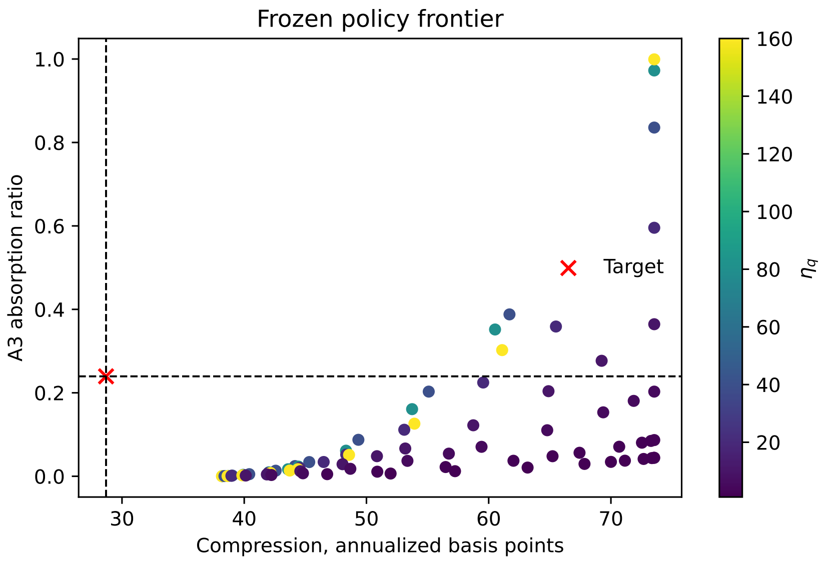


Table 40: Consumption-equivalent algebra checks

Test	Max abs. error	Status
constant-consumption inversion	0.0e+00	pass
scaling by seven percent	0.0e+00	pass
weighted constant-consumption aggregation	0.0e+00	pass

sovereign-default model. A committed central bank can insure eligible sovereigns in stress states while preserving fiscal discipline. A discretionary central bank may instead create a bailout expectation, lowering observed spreads today while weakening the incentives that determine future default risk.

The paper's contribution is the model-based welfare measurement. The quantitative analysis reports the observed-latent spread wedge, Ω_S, the commitment-discretion price gap, and consumption-equivalent welfare under a specified incidence of official-sector costs. The euro-area evidence motivates the relevant channels and provides calibration discipline: global risk matters more for vulnerable sovereigns, and several ECB backstop announcements generate large cash-spread compression in short windows. The wedge itself is identified by the calibrated comparison between the observed borrowing price and the shadow private valuation of the same claim.

The maintained calibration delivers a sharp quantitative message. The average hidden spread wedge in the Spanish panel is 9.5 basis points. At active support states the commitment-discretion gap is much larger: commitment lowers observed spreads relative to discretion by 30.4 basis points at the SMP state and 57.9 basis points at the TPI state. In the dynamic replay, committed support lowers the mean observed spread from 59.7 to 36.2 basis points relative to no support. The model also exposes a quantity-side limitation: broad intervention-state absorption is close to the empirical purchase scale, but fixed compliant-stress absorption remains too small.

The welfare result qualifies the price result. In the benchmark value-function comparison, support regimes generate negative transition consumption-equivalent gains relative to no support from the no-backstop stationary distribution: -2.15 percent under commitment, -2.81 percent under discretion, and -1.84 percent under unconditional support. The ordering reflects the model's central tradeoff: cheaper crisis borrowing provides insurance, but it also changes endogenous debt choices and absorbs official resources; commitment partly restores discipline through the value of eligibility, while unconditional support maximizes insurance by removing that discipline margin altogether. At the same time, a fixed-policy incidence diagnostic gives commitment a positive value relative to discretion: 0.033 percent of consumption when official losses are not charged domestically and 0.015 percent when they are fully charged domestically. The Floden-style decomposition shows that the fixed-policy gains are almost entirely level effects: support raises the deterministic path of mean consumption, while lifetime uncertainty and ex-ante state-risk terms are close to zero. The external CDS validation is weak, which cautions against treating the model wedge as a complete time-series explanation of Spanish spreads. The framework therefore quantifies both sides of the policy tradeoff: backstops can stabilize market prices, but credible conditionality and the allocation of intervention costs determine whether that stabilization improves welfare.

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A Derivations

A.1 Household First-Order Conditions

The model is an endowment sovereign-default economy, so the main first-order conditions are embedded in the sovereign's repayment problem and the lenders' pricing recursion. The household side is represented by the valuation kernel in Section 4.3; the relevant equilibrium restrictions for the quantitative exercises are the government repayment problem, the default condition, and the long-bond price recursion.

A.2 Proof of the Floden-Style Welfare Decomposition

This appendix proves Proposition 8.1. The proposition adapts the logic of Flodén (2001) to the representative-agent fixed-policy welfare diagnostic used in Table 31.

Proof. Start from the total ex-ante consumption-equivalent factor:

$$1 + \Delta_j = \frac{C_j^A}{C_N^A}.$$

Multiply and divide by the level and intermediate lifetime-risk objects:

$$\frac{C_j^A}{C_N^A} = \frac{C_j^L}{C_N^L} \times \frac{C_j^U / C_j^L}{C_N^U / C_N^L} \times \frac{C_j^A / C_j^U}{C_N^A / C_N^U}.$$

Using the definitions of Δ_j^L, Δ_j^U, and Δ_j^R gives

$$1 + \Delta_j = (1 + \Delta_j^L)(1 + \Delta_j^U)(1 + \Delta_j^R).$$

□

The first factor is the level effect: it compares average current consumption paths, abstracting from stochastic consumption risk. The second factor is the uncertainty effect: it compares the welfare value of the stochastic lifetime allocation relative to the deterministic mean path. The third factor is the ex-ante risk effect: it compares welfare before the initial state is known with the average of state-contingent lifetime consumption equivalents. The product is exact because all three factors are measured in consumption-equivalent units.

B Data Appendix

The empirical objects used in the calibration and event studies are constructed from public Eurostat, ECB, FRED, and market-yield series. The main text reports the model-facing moments and event-window objects; the reduced-form companion appendix below reports the supporting empirical specifications.

C Computational Appendix

The quantitative tables and figures are generated from saved model output under the maintained split-threshold calibration. The solution uses the recursive objects in Section 4: smoothed borrowing and default choices, long-bond resale pricing, observed and private-market price schedules, and regime-specific central-bank support rules.

Table 41 lists the main generated assets used in the draft and the scripts that produce them. The manifest is generated from the repository state and is intended as a reproducibility index rather than a substantive result.

Table 41: Generated-output manifest for paper-v2 quantitative assets

Object	Producer	Exists
Empirical data map	empirical assets	1
Fact 1 global risk	empirical assets	1
Fact 2 event windows	empirical assets	1
Fact 1 inference	empirical assets	1
Historical price gaps	model assets	1
Official absorption	model assets	1
Regime revaluation	model assets	1
Dynamic replay	model assets	1
Benchmark welfare	model assets	1
Welfare incidence	welfare diagnostics	1
Welfare sign map	welfare diagnostics	1
Structural welfare decomposition	welfare diagnostics	1
Floden factorization	welfare diagnostics	1
Eligibility robustness	remaining diagnostics	1
Default/recovery diagnostic	remaining diagnostics	1
Risk-neutral dominance	model diagnostics	1
Commitment-intensity diagnostic	model diagnostics	1
Multi-start diagnostic	multistart audit	1

D Reduced-Form Empirical Companion

This appendix preserves the reduced-form empirical work that is not part of the paper's main spine. The main text uses two facts as motivation and calibration discipline: global-risk heterogeneity and announcement-window spread compression. The exercises below ask whether the same data can also identify the model's observed-latent wedge. The answer in the current data is no. The cash-CDS basis is implemented, but the available sovereign CDS leg is not the clean EUR-denominated contract needed for euro-denominated cash bonds.

D.1 Denomination Audit and Interpretation

The model wedge is $\Omega_S = S^{\text{mkt}} - S^{\text{obs}}$. The intended reduced-form analogue is the currency-matched cash-CDS basis,

$$\text{Basis}_{it} = S_{it}^{CDS,EUR} - S_{it}^{cash,EUR}. \tag{25}$$

The current data do not deliver this object. The denomination audit saved under the empirical output directory shows that local Refinitiv periphery 5-year sovereign CDS RICs use the `USAC=R` suffix, and online Investing.com checks verify the Spain, Italy, and Greece public 5-year series as USD contracts. WorldGovernmentBonds files do not retain a contract-currency label and are therefore treated as denomination-unknown. No verified EUR-denominated 5-year CDS series is available locally for the periphery.

This matters economically. A USD-denominated CDS on a euro-area sovereign compensates investors for euro default risk and a quanto or redenomination premium. The 2012 announcements were designed in large part to remove redenomination risk. A collapse in USD CDS around Draghi or OMT can therefore narrow $S^{CDS,USD} - S^{cash,EUR}$ even if the model wedge in EUR credit-risk compensation moves in the opposite direction. The wrong-signed USD basis is a known contamination, not evidence against the model.

D.2 Summary of Active Reduced-Form Facts

Table 42 reports the three empirical facts as they stand in the current pipeline. The first two are retained in the main text as motivation. The third, the cash-CDS basis, is reported here because its sign fails the pre-specified sign-sanity gate.

Table 42: The three empirical facts

fact	term	coefficient	std_error	p_value	nobs	r2	predicted_sign	controls
Fact 1: global risk x vulnerability	dVIX x Vulnerability lag	0.389	0.314	0.215	2,629.0	0.196	+	none
Fact 2: backstop compression	high_spread_eligible	19.63	17.32	0.257	25.00	0.423	-	none
Fact 3: cash-CDS basis wedge	Vulnerability x eligibility	-88.65	15.81	2.05e-08	20.00	0.766	+	none

The event-compression specification with a predetermined eligibility interaction is also weak. It does not overturn the unconditional announcement evidence in Section 3.3, but it does mean the current eligibility proxy is not a clean source of identification.

Two reduced-form signals survive as diagnostics. First, Table 48 shows that backstop periods weaken the link between debt and the CDS-implied default probability: the debt-by-backstop coefficient is -0.075 and statistically significant. Second, Table 45 shows that the 2012-style event pattern is driven by a fall in USD CDS, which is naturally interpreted as redenomination or quanto compression rather than a clean EUR credit-risk wedge.

Table 43: Fact 2: backstop compression

	Estimate
Backstop x high spread	1.521
	(1.611)
Observations	1,200
R^2	0.363
Fixed effects	Country and date
Controls	none

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 44: Fact 2: event compression by eligibility

	Estimate
high_spread_eligible	19.63
	(17.32)
Observations	25
R^2	0.423
Fixed effects	Country and date
Controls	none

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

D.3 Cash-CDS Basis Event and Panel Results

The implemented event specification is

$$\Delta \text{Basis}_{i,t_e} = \alpha + \beta_1 Vulnerability_{i,t_e^-} + \beta_2 Eligibility_{i,t_e^-} + \beta_3 \left(Vulnerability_{i,t_e^-} \times Eligibility_{i,t_e^-} \right) + u_i. \quad (26)$$

The model-motivated prediction for a clean EUR basis is $\beta_3 > 0$. In the current USD-contaminated basis, the 3-day event coefficient is negative. The decomposition shows why: the CDS leg falls sharply around the events while the cash leg does not compress enough in the eligible-vulnerable cell. This pattern is consistent with redenomination or quanto compression in USD CDS. Figures 11 and 12 show the event basis response and its cash/CDS decomposition.

Figure 11: Cash-CDS basis response around backstop events. The figure compares the 3-day change in the ASW-based 5-year basis for eligible-vulnerable sovereigns and other sovereigns.

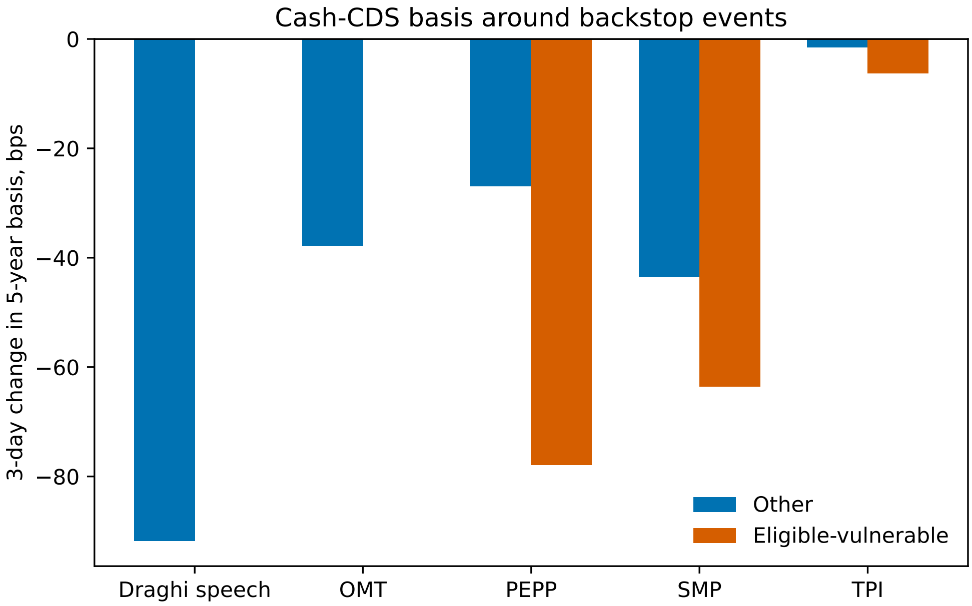


Table 45: Fact 3: cash-CDS basis decomposition

	Basis	Cash spread	CDS
Vulnerability x eligibility	-88.65***	104.4	-42.50**
	(15.81)	(74.13)	(17.97)
Observations	20	25	20
R^2	0.766	0.622	0.690

Notes: ASW is the asset-swap spread and CDS PD is the CDS-implied default probability. Standard errors clustered by country in parentheses. All specifications include country and date fixed effects. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Figure 12: Basis decomposition. The bars report the eligible-vulnerable event coefficient for the basis, the cash spread, and CDS.

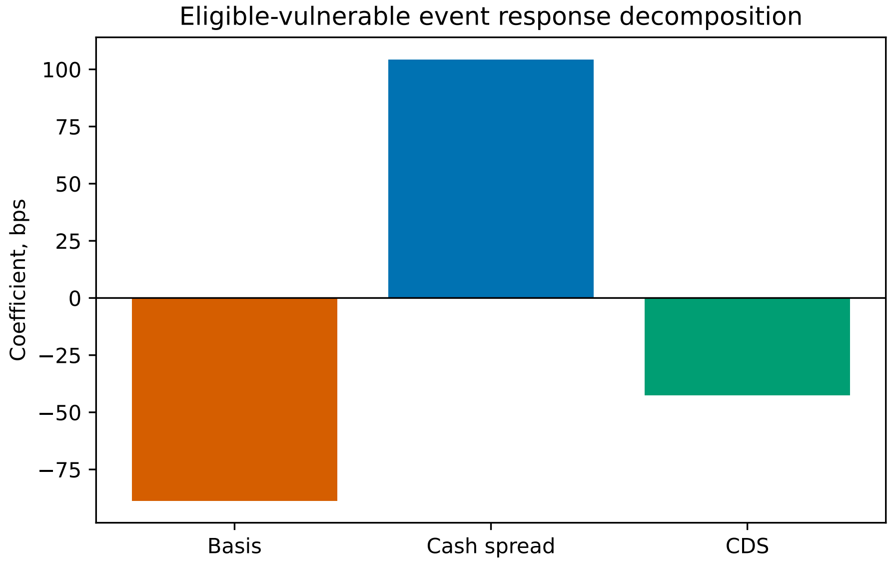


Table 46: Fact 3: cash-CDS basis panel

	ASW basis
Backstop x vulnerability x eligibility	-7.036
	(16.40)
Observations	895
R^2	0.789

Notes: ASW is the asset-swap spread and CDS PD is the CDS-implied default probability. Standard errors clustered by country in parentheses. All specifications include country and date fixed effects. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 46 reports the corresponding panel specification. Table 47 reports robustness checks across event windows, placebo dates, Greece exclusions, Spain and Italy slices, and alternative cash legs. The negative short-window result is not a single fragile estimate. This is why the result remains in the appendix as a diagnostic rather than being promoted to the main text.

Table 47: Fact 3: basis robustness

Event set	±1d	±3d	±5d	±10d	±31d
Baseline events	-44.55***	-88.65***	-65.71***	-31.93	31.26**
	(10.70)	(15.81)	(19.48)	(42.52)	(13.71)
Placebo +60d	6.172*	3.018	3.647	-14.78	-43.57
	(3.233)	(8.076)	(13.28)	(9.894)	(43.32)

Notes: Entries are coefficients on vulnerability times eligibility for the ASW-based 5-year cash-CDS basis. Standard errors clustered by country in parentheses. Placebo dates are shifted 60 days after each event.

D.4 Secondary Informativeness Checks

The older informativeness tests ask whether observed spreads become less sensitive to fiscal fundamentals during backstop periods:

$$s_{it} = \alpha_i + \gamma_t + \beta_1 Debt_{i,t-1} + \beta_2 \left(Debt_{i,t-1} \times Backstop_t\right) + \Gamma X_{it} + \varepsilon_{it}. \qquad (27)$$

This is not a clean wedge estimate because observed spreads combine default risk, liquidity, benchmark, redenomination, and policy components. It is still informative as a secondary diagnostic. Across measures, the fiscal-fundamentals interaction is negative and significant for the CDS-implied default probability, but not consistently negative for cash-spread measures. Tables 49, 50, and 51 report the CDS and fundamentals versions of this exercise. Figure 13 displays the corresponding fundamentals-sensitivity pattern.

Table 48: Fiscal fundamentals across risk measures

	Bund	ASW	Z-spread	OIS	5Y CDS	CDS PD
Debt	1.256**	1.953***	0.898	0.061	0.780	0.147***
	(0.527)	(0.515)	(1.195)	(1.525)	(0.863)	(0.048)
Debt x Backstop	0.633**	-0.222	-1.139	0.297	0.568	-0.075***
	(0.264)	(0.389)	(0.713)	(0.240)	(0.503)	(0.020)
Observations	2,651	2,651	2,098	2,244	2,185	1,435
R^2	0.520	0.646	0.578	0.549	0.603	0.795

Notes: ASW is the asset-swap spread and CDS PD is the CDS-implied default probability. Standard errors clustered by country in parentheses. All specifications include country and date fixed effects. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 49: Global risk shocks and vulnerable sovereigns: CDS controls

	Estimate
dVIX x Vulnerability lag	0.007***
	(0.001)
Observations	1,011
R^2	0.174
Fixed effects	Country
Controls	deficit, gdp_growth, inflation, unemployment, cds_5y

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 50: Fiscal fundamentals and observed spreads

	Estimate
Debt	1.256**
	(0.527)
Debt x Backstop	0.633**
	(0.264)
Observations	2,651
R^2	0.520
Fixed effects	Country and date
Controls	none

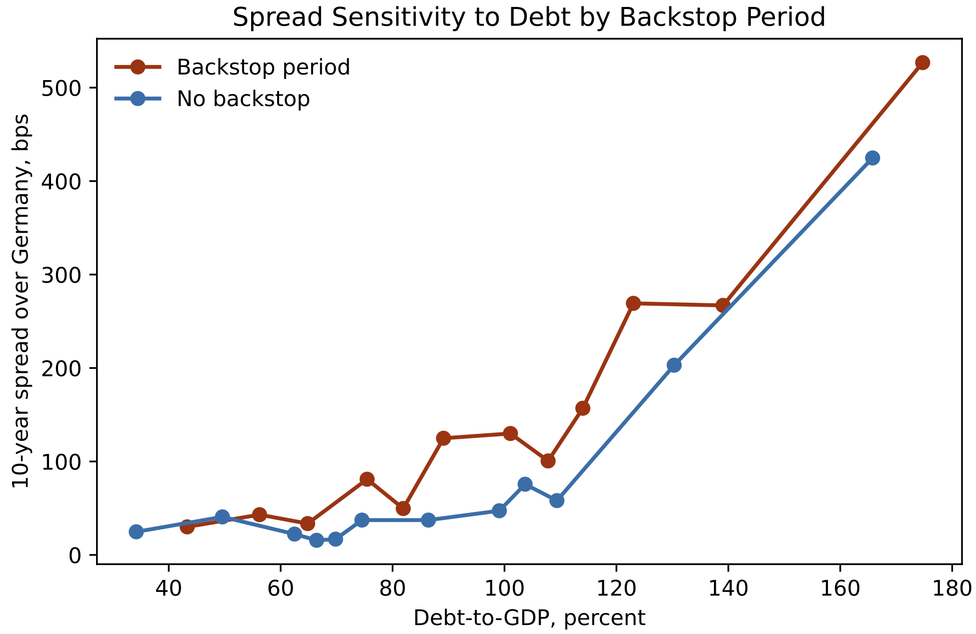
Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 51: Fiscal fundamentals and observed spreads: CDS controls

	Estimate
Debt	0.411
	(1.798)
Debt x Backstop	0.257
	(0.441)
Observations	1,012
R^2	0.808
Fixed effects	Country and date
Controls	deficit, gdp_growth, inflation, unemployment, cds_5y

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Figure 13: Fiscal fundamentals and risk measures during backstop periods. The figure is a secondary informativeness check, not a clean estimate of the model wedge.



D.5 Holdings and Crowding-Out Deferral

The holdings exercise is also deferred. The current public SHSS private-holdings proxy is constructed as total euro-area holdings less central-bank holdings. Regressing that object on central-bank holdings is too close to an accounting identity to be used as a headline crowding-out estimate. True sectoral private holdings by issuer country are required before this channel can carry quantitative weight. Table 52 summarizes the data status, while Tables 53 and 54 report the current crowding-out regressions. Figures 14 and 15 document the current holdings proxy and why it remains a diagnostic object.

Table 52: Fact 4: crowding-out status

Status	deferred
Reason	Current private_holdings equals total euro-area holdings minus central-bank holdings, so the regression is too close to an accounting identity for a headline crowding-out fact.
Required input	True sectoral private holdings by issuer country, preferably SHSS/SHS/CPIS or security-level holdings.

D.6 Event-Study and Policy-Intensity Diagnostics

The unconditional event-study evidence is the part of the reduced-form analysis that survives into the main text. The additional tables and figures below document the broader event-study and policy-intensity outputs generated by the pipeline. Table 57 reports the policy-intensity regression. Figure 16 reports the broader event-study diagnostics, while Figure 17 shows the underlying spread and global-risk series.

Table 53: Central-bank holdings and private proxy holdings

	Estimate
Central-bank holdings	-0.835**
	(0.399)
Observations	434
R^2	0.992
Fixed effects	Country and date
Controls	none

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Table 54: Central-bank holdings and private proxy holdings: CDS controls

	Estimate
Central-bank holdings	-0.599
	(0.668)
Observations	280
R^2	0.993
Fixed effects	Country and date
Controls	deficit, gdp_growth, inflation, unemployment, cds_5y

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Figure 14: Central-bank holdings and private proxy holdings. The figure is retained as a diagnostic because the current private-holdings proxy embeds central-bank holdings mechanically.

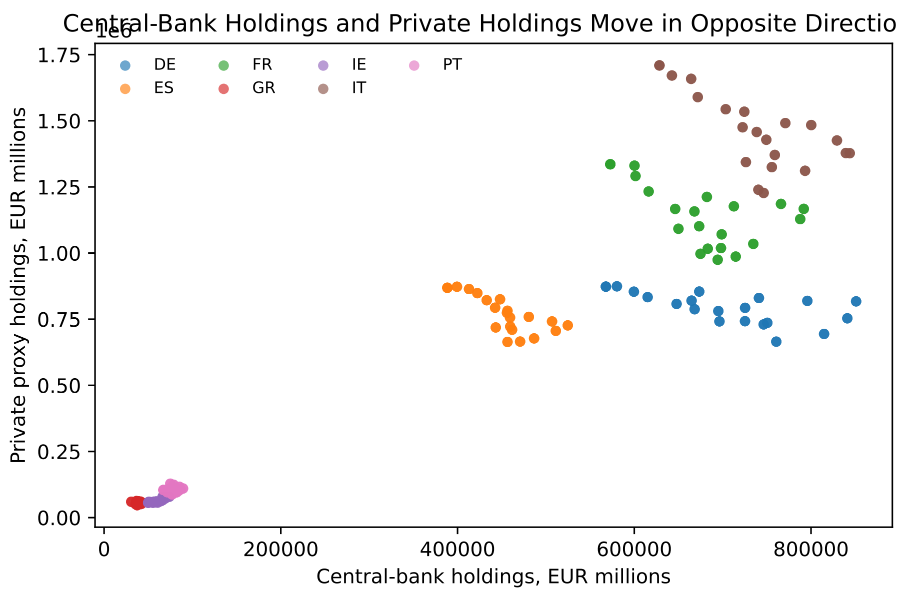


Figure 15: Central-bank and private proxy holdings. The figure documents the available series but is not used as a structural crowding-out estimate.

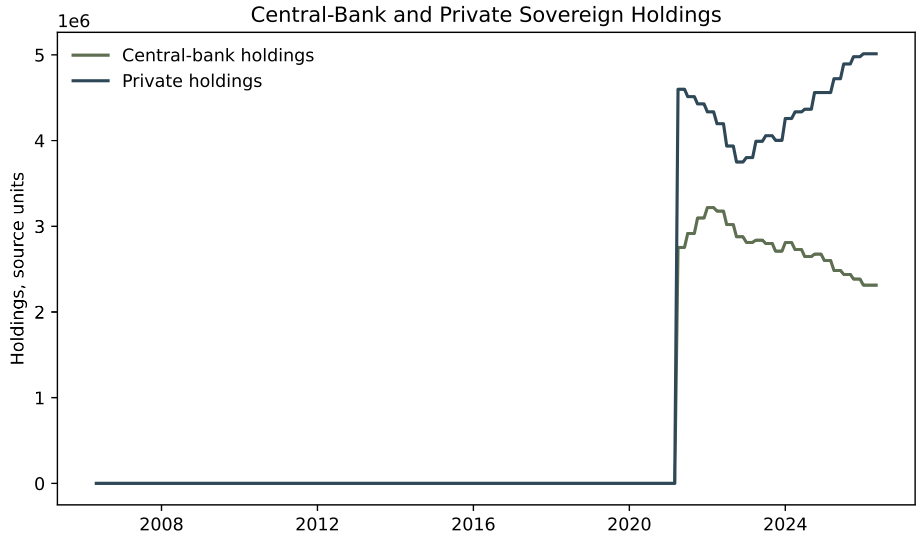


Table 55: ECB backstop event study

event	program	event_date	avg_spread_change	countries	window_before	window_after	status	eampd_ois_1y	eampd_ois_10y	eampd_es_10y	eampd_it_10y	data_frequency
ECB decides on Securities Markets Programme	SMP	2010-05-10	67.24	51.00	31.00	31.00	estimated					daily
Draghi whatever it takes remarks	Draghi speech	2012-07-26	-1.641	53.00	31.00	31.00	estimated					daily
Technical features of Outright Monetary Transactions	OMT	2012-09-06	-41.18	53.00	31.00	31.00	estimated	0	2.890	-16.00	-11.00	daily
ECB announces Pandemic Emergency Purchase Programme	PEPP	2020-03-18	12.89	53.00	31.00	31.00	estimated					daily
The Transmission Protection Instrument	TPI	2022-07-21	18.30	54.00	31.00	31.00	estimated	9.000	-5.200	-3.050	4.800	daily

Table 56: ECB backstop event study

event	program	event_date	avg_spread_change	countries	window_before	window_after	status	data_frequency
ECB decides on Securities Markets Programme	SMP	2010-05-10	84.06499999999996	7	31	31	estimated	daily
Draghi whatever it takes remarks	Draghi speech	2012-07-26	-43.44566666666668	6	31	31	estimated	daily
Technical features of Outright Monetary Transactions	OMT	2012-09-06	-178.99933333333334	6	31	31	estimated	daily
ECB announces Pandemic Emergency Purchase Programme	PEPP	2020-03-18	59.32228571428571	7	31	31	estimated	daily
The Transmission Protection Instrument	TPI	2022-07-21	6.421142857142859	7	31	31	estimated	daily

Table 57: ECB purchase intensity and spread changes

	Estimate
PSPP+PEPP net purchases, EUR bn	0.123
	(0.091)
Observations	2,640
R^2	0.195
Fixed effects	Country and date
Controls	none

Notes: Standard errors clustered by country in parentheses. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Figure 16: ECB backstop event-study diagnostics across event windows.

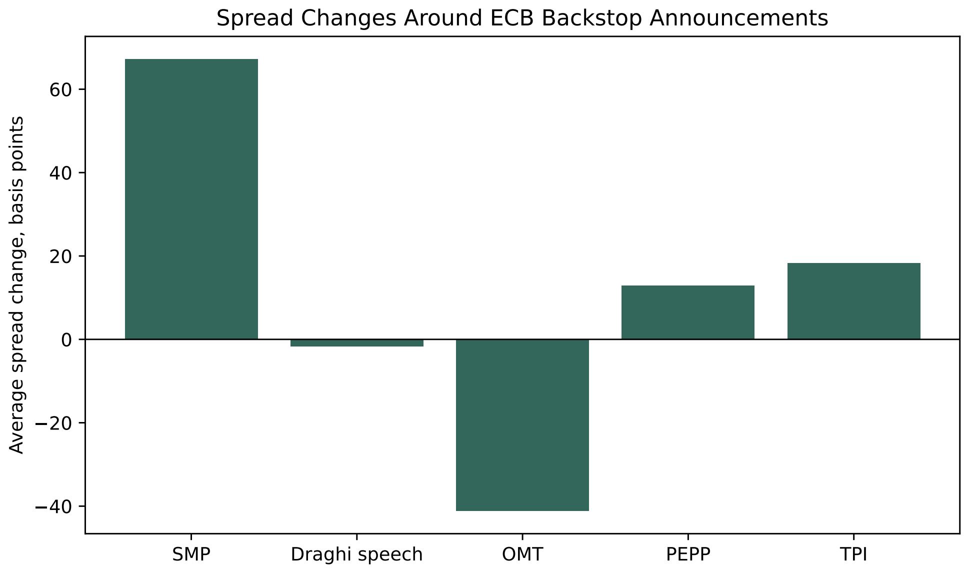
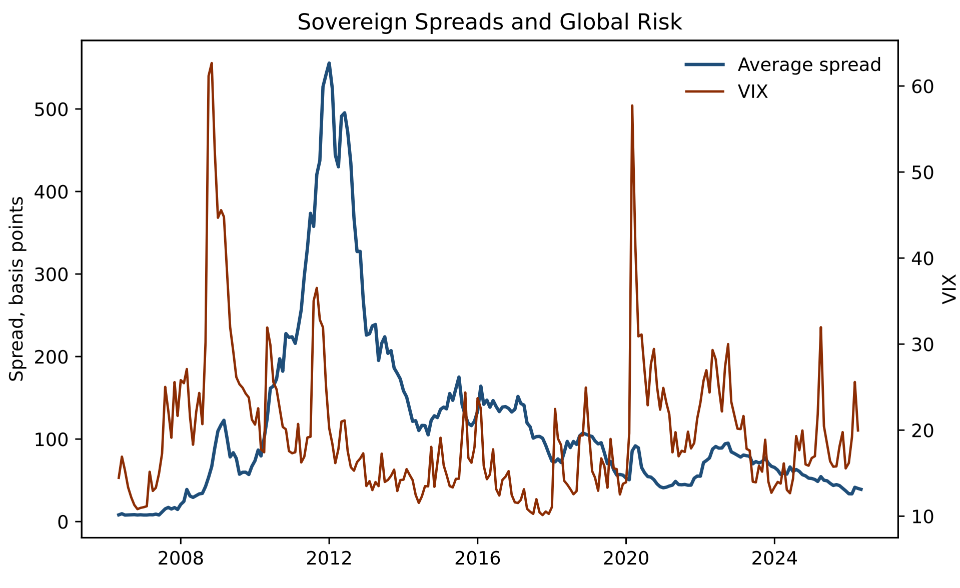


Figure 17: Sovereign spreads and global risk.



D.7 Upgrade Path

The upgrade path is clear. If clean EUR-denominated sovereign CDS later validates the currency-matched basis, the basis result can be promoted into Section 3 as a third motivating fact and the introduction can add one sentence saying that the reduced-form wedge moves in the direction predicted by the model. If the EUR basis remains weak or wrong-signed, nothing in the main text needs to change. The model and welfare contribution does not depend on reduced-form identification of Ω_S.

E Additional Results

Additional robustness exercises vary eligibility rules, event-state mappings, and support regimes around the maintained benchmark.