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ABSTRACT

In a monetary union, the risk-free rate cannot adjust to country-level fiscal positions, leaving only default spreads and convenience yields to respond. Empirically, we find that convenience yields explain a large share of the variation in Eurozone sovereign bond yields. Eurozone sovereign bonds earn larger convenience yields when their governments run larger surpluses. Since convenience yields generate substantial seigniorage revenue from debt issuance, our estimates imply economically large fiscal costs from low convenience yields for peripheral countries in the Eurozone.

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1 Introduction

Government bonds of fiscally strong countries provide safety and liquidity services that investors value. To own such money-like assets, investors are willing to forgo a sizable return, called the convenience yield. The convenience yield literature has focused on the U.S. Treasury, the reserve asset *par excellence* in the international monetary system after the Second World War. This paper studies the convenience yields in the Eurozone, and applies its results to shed light on government bond pricing in the Eurozone. This setting is interesting for two reasons. First, convenience yields on Eurozone sovereign bonds exhibit large variation in both the time series and the cross-section. Second, as nominal short-term interest rates are fixed in a currency union, convenience yields can play an important role as shock absorbers in response to country-specific fiscal shocks. We find that convenience yields drive much of the variation in Eurozone bond yields and that they respond to country-specific fiscal news.

Sovereign bond yields can be decomposed into a risk-free rate, a default spread, and a convenience yield. Time-series and cross-sectional variation in bond yields must reflect variation in these three components. Since the risk-free rate is common in a currency union, yield differences of Eurozone countries relative to Germany, must reflect default premium or convenience yield differentials with Germany. A simple variance decomposition reveals how much each component contributes.

In the absence of arbitrage and in the presence of a transversality condition, bond yields also reflect the present discounted value of current and future primary surpluses and of seigniorage revenues from convenience according to the intertemporal government budget constraint (IGBC). Between countries with flexible interest rates, nominal interest rates can adjust to enforce the IGBC in response to a fiscal shock in each country. In contrast, in a currency union, nominal short-term interest rates have to be the same across countries despite fiscal conditions that vary across member countries. While the union-wide interest rate can adjust in response to union-wide fiscal shocks, it cannot adjust to simultaneously satisfy each country's IGBC following different country-specific fiscal shocks. Variation in the country-specific fiscal conditions of a currency union member must then be reflected in either the default premium differential or the convenience yield differential. If the country has no default risk, all the adjustment to the fiscal news must be reflected in its convenience yield. We develop a simple conceptual framework that links the current and the expected future primary surplus to the market price of the bond, and to the convenience yield in the absence of sovereign default risk.

Guided by these theoretical results, we turn to the Eurozone sovereign debt market and examine the properties of the convenience yields. First, we find that bond convenience yields in the Eurozone exhibit economically significant fluctuations. We measure the convenience yield differential between a Eurozone country and Germany as the difference between their sovereign bond yields with the same tenor minus these bonds' credit default spread differential, obtained from credit default swap data. It is convenient to study these convenience yield differentials as they difference out the common risk-free yield curve which is unobserved. Figure 1 plots these convenience yield differentials at the five-year tenor. If a country's convenience yield differential is negative, the five-year German government bond enjoys a higher convenience yield than this country's five-year government bond. This figure shows that convenience yield differentials vary substantially both across countries and over time. As Germany is the bond market's preferred safe asset supplier within the Eurozone, it has the highest convenience yield (about 30 basis points on average), and the convenience yield differentials are overwhelmingly negative. Convenience yield differentials peak during the Eurozone sovereign debt crisis of 2011–12. They spike again in some countries during the Covid-19 crisis in March 2020.

We conduct a variance decomposition of Eurozone sovereign bond yield differentials relative to Germany. Contrary to the popular belief that bond yield differentials in the Eurozone differ mostly due to default spread differentials between member countries, we find that the convenience yield differentials are a large driver of bond yield differentials. In the 2002–2007 subsample, in which the bond yields are much more similar across Eurozone countries, nearly all of the

Figure 1: The Time Series of Convenience Yield Differentials

Notes: This figure plots the convenience yield differential between each country's government bond and Germany government bond. The convenience yields are constructed from 5-year bond yields and 5-year CDS spreads. Reported in percentage points.

variation in bond yield differentials is due to convenience yields, on average across countries. In the 2008–2024 subsample, in which the bond yields vary significantly more over time and across Eurozone countries, nearly 40% of the variation in bond yield differentials is due to the convenience yields, with the remaining 60% accounted for by default spread differentials. Changes in convenience yields account for an even larger share (about 60%) of relative bond yield changes over this period.

One way to quantify the economic significance of these convenience yields is to consider the heterogeneous fiscal burdens they imply. We consider a simple calculation in which all countries earn the same convenience yield as Germany at each point of time. We calculate the amount of additional revenue each country would have raised from the actual amount of bonds it issued. We then compound this revenue at German bond yields to obtain a measure of the cumulative revenue loss that each country suffered because its bonds did not earn the same convenience yield as German bonds. We find cumulate revenue losses over the period 2003—2024 of 3.0% of 2024 GDP for Ireland, 6.2% for Italy, and 6.4% for Spain, amounting to 16, 137, and 102 billions euros, respectively. Even "core" countries such as Austria and France suffer cumulative revenue losses of 2% to 3% of 2024 GDP. Together, the cumulative revenue losses amount to 4.1% of their aggregate GDP, a sizable number.

After we document the magnitude of these convenience yields, we examine their connection to government fiscal conditions, which is the main contribution of our paper. Consistent with our conceptual framework, we find a positive relationship between Eurozone governments' primary surpluses and convenience yields. In the cross-section, countries with higher average primary surpluses earn higher convenience yields than countries with lower primary surpluses. In the time series, when a country improves its fiscal condition, its convenience yield rises. This relationship is economically significant. A one standard-deviation increase in the government surplus/GDP ratio, which is about 3.8%, is associated with a 20.6 basis point increase in the convenience yield. The magnitude of the coefficient estimate on the surplus/GDP ratio is very similar in the cross-section and in the time series: about a 5.4 basis point increase in the convenience yield for a one percentage point increase in the surplus/GDP ratio.

We also obtain data on forecasts of government surpluses for a subset of Eurozone countries from Consensus Economics. We find that expectations of improving fiscal conditions are also associated with increases in convenience yields. The economic magnitude of this association is comparable to that based on realized fiscal shocks, about 5.6 basis point for each point of higher predicted surplus/GDP. This result highlights the standard asset pricing intuition that, as convenience yields reflect the present value of future government cash flows, they are forward-looking variables.

In summary, these empirical results show that the bond convenience yields account for a large fraction of variations in bond yield differentials across Eurozone countries, and they are positively correlated with the current and expected future country-specific fiscal situation (primary surplus). Convenience yields play an important role as fiscal shock absorbers in a currency union. Of course, the fiscal fundamentals also affect the default spread. The surplus/GDP ratio is a driver of the common component in convenience yields and default spreads.

These results are not driven by one or two countries, are robust to including measures of bond liquidity or proxies for national bond market segmentation as control variables, and remain significant when estimated with generalized least squares or when periods of significant ECB intervention in the sovereign bond markets are removed.

Lastly, we show that investment-grade corporate bonds also benefit from improved fiscal fundamentals. Each percentage point of higher government bond convenience yields results in a 40 basis points increase in corporate bond convenience yields. Furthermore, an improved fiscal surplus in a Eurozone country results in a higher corporate bond convenience yield in that country with an elasticity that is about one-third as strong as the elasticity of the corresponding government bond convenience yield. The theory suggests that this positive, but weaker effect arises when corporate bonds are imperfect substitutes for government bonds in terms of providing convenience yield services.

Related Literature Our paper contributes to the literature on the convenience yields of government debt (Krishnamurthy and Vissing-Jorgensen, 2012; Nagel, 2016; Du, Im, and Schreger, 2018; Valchev, 2020; He, Nagel, and Song, 2022). These convenience yields are quantitatively important and time-varying. Jiang, Krishnamurthy, and Lustig (2020, 2021); Koijen and Yogo (2020) estimate that foreign investors have enjoyed convenience yields in excess of 200 bps per annum on their Treasury holdings.[1] This literature emphasizes that U.S. Treasurys occupy a special place in global financial markets.[2] In this paper, we show that convenience yields are also an important consideration in the Eurozone's sovereign bond markets, and that these convenience yields respond to fiscal shocks.

In the Eurozone, Germany is the preferred safe asset supplier. Empirically, we find that the level of the convenience yield of Eurozone countries' sovereign bonds correlated with traditional flight-to-safety measures such as the U.S. Treasury basis and global stock market volatility, whereas convenience yield differentials between Eurozone countries respond to country-level differences in fiscal conditions. These results suggest that safe asset demand affects the average convenience

[1] Jiang, Richmond, and Zhang (2020) quantifies the exorbitant privilege of the U.S. as manifested in capital flows. Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2024) investigate the extent to which convenience yields can help resolve the U.S. government debt valuation puzzle. Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2025) study how the exposure of convenience yields to output risk affects the trade-off between insuring bondholders and taxpayers.

[2] For example, investors are typically willing to pay more for an actual Treasury than for a synthetic Treasury manufactured from corporate bonds (Longstaff, Mithal, and Neis, 2005; Bai and Collin-Dufresne, 2019), TIPS (Fleckenstein, Longstaff, and Lustig, 2014), or foreign sovereign bonds (Du, Im, and Schreger, 2018; Jiang, Krishnamurthy, and Lustig, 2021).

yield, while country-specific fiscal conditions govern the differences in the convenience yield across Eurozone bond markets.

We measure the convenience yields as CIP deviations in the Eurozone's government bond markets (Jiang, Krishnamurthy, and Lustig, 2021). Intermediary balance sheet constraints have been noted as a key driver of CIP deviations in the Libor market in the aftermath of the Great Financial Crisis (Du, Tepper, and Verdelhan, 2018). However, CIP deviations in the government bond markets are different. First, these deviations in Treasury markets have been around long before the GFC. A synthetic U.S. Treasury constructed from a German Bund or a U.K. gilt has invariably been cheap compared to an actual U.S. Treasury. Second, the U.S. Treasury, or any other Treasury, does not adjust the supply of Treasurys to eliminate these CIP deviations in bond markets, unlike unconstrained global banks in Libor markets. Third, these CIP deviations likely reflect the demand of global investors for the safety and liquidity of U.S. Treasurys (Jiang, Krishnamurthy, and Lustig, 2021). To these investors, these CIP deviations in government bond markets do not represent an arbitrage opportunity.

Gourinchas and Rey (2016); Farhi and Maggiori (2018); He, Krishnamurthy, and Milbradt (2019) analyze the determinants of safe asset demand in the international financial system. Their theories emphasize the importance of macro fundamentals in determining the relative safety of a country's debt. Our paper puts forth a conceptual framework that explains why fiscal fundamentals are particularly important for the convenience yields in a currency union. In related work, Chernov, Schmid, and Schneider (2020) analyze the CDS premium on U.S. Treasurys and relate it to macro fundamentals. Augustin, Sokolovski, Subrahmanyam, and Tomio (2020) find that fiscal constraints help to explain the reaction of sovereign default spreads to economic shocks. Jiang (2021, 2022) studies the response of exchange rates to fiscal shocks in flexible exchange rate regimes. Croce, Nguyen, and Schmid (2012); Croce, Nguyen, Raymond, and Schmid (2019); Croce, Nguyen, and Raymond (2021) study the trade-off arising from short-run debt stabilization in models with long-run innovation risk, and characterize time-varying debt paydown rates.

Koijen and Yogo (2020) estimate a global demand system for safe and risky assets. In a similar setting, Koijen, Koulischer, Nguyen, and Yogo (2017, 2021) study the effect of ECB bond purchases on the demand for safe and risky assets in the Eurozone. In the long-run, countries that reap the rewards of larger convenience yields can run smaller surpluses (Brunnermeier, Merkel, and Sannikov, 2020; Reis, 2021).

In the wake of the Eurozone crisis of 2011–12, there was an extensive debate on the merits of an increased fiscal union.[3] While the Eurozone still does not produce a safe asset that can

[3] This debate is summarized by Claessens, Mody, and Vallee (2012) and Tumpel-Gugerell, Bénassy-Quéré, Bento, Bishop, Hoogduin, Mazák, Romana, Šimonytė, Vihriälä, and Weder di Mauro (2014). Proposals for the creation of union-wide safe assets ranged from eurobonds with joint liability (Commission, 2011; Ubide, 2015), to intermediate solutions with joint liability for some of the debt (Delpla and Von Weizsäcker, 2010; Hellwig and Philippon, 2011), to no joint liability in the ESBies proposal of Brunnermeier, Garicano, Lane, Pagano, Reis, Santos, Thesmar, Van Nieuwer-

rival U.S. Treasurys, the European Union started issuing debt backed by tax revenue of each and all the EU member states in June 2021 as part of the NextGenerationEU scheme. On the one hand, our findings shed light on one potential benefit of transforming the Eurozone into a fiscal union. Such new Eurozone debt should trade at the same overall yield and the same level of convenience yields as German bunds. Our results indicate that this may lead to substantial cost savings especially for peripheral countries. A large-scale Eurozone fiscal union would equalize convenience yields for all countries. This would lead to a revenue transfer from Germany to other Eurozone countries. The distributional effects might be offset by the additional convenience revenue generated by the creation of a new global safe asset, which would benefit both Germany and other Eurozone countries. In related work, Bilbiie, Monacelli, and Perotti (2020) highlights the importance of fiscal policy coordination in the Eurozone, given that monetary policy tools are not available to respond to country-specific shocks. Leombroni, Vedolin, Venter, and Whelan (2021) document that the sovereign CDS premia adjust across Eurozone countries in response to the ECB's monetary policy. On the other hand, our paper shows that convenience yields and hence government funding costs can and do vary across countries, and respond to fiscal conditions, rewarding good fiscal stewardship at the country-level even in a currency union. This incentive effect could disappear in a fiscal union, a potential cost of increased fiscal integration.

Textbook finance implies that governments in the Eurozone borrow at the same interest rates after correcting for default risk differences. This is not what we find. Within the Eurozone, bond market investors have assigned the role of safe-asset supplier to Germany. The resulting gap in convenience yields does not represent an arbitrage opportunity as long as the marginal Eurozone bond investor derives safety and liquidity benefits from a cash position in German bonds. Only investors that do not value these benefits may view the sovereign CDS-bond basis as an arbitrage opportunity. The literature on the CDS-bond basis often proposes trading frictions such as margin costs and funding constraints (Longstaff, Mithal, and Neis, 2005; Bai and Collin-Dufresne, 2019; Oehmke and Zawadowski, 2017). In Mota (2023) and related papers on the convenience yield of safe assets, frictions like collateral utility, flight-to-safety, or repo eligibility are not just costs, they represent value to investors, i.e., convenience. Fontana and Scheicher (2016) compute the CDS-bond bases for Eurozone government bonds in the sample from 2007 to 2012, and attribute these bases to short-selling and funding frictions. Nissinen and Sihvonen (2024) show that convenience yield differentials increase in bond maturity, and argue that higher funding costs in the repo market and uncertainty about future funding costs help explain the term structure of convenience yields. Gyntelberg, Hördahl, Ters, and Urban (2013, 2017) study Eurozone convenience yields and relate them to market microstructure issues such as transaction costs and liquidity. Our paper

burgh, and Vayanos (2011, 2016); Brunnermeier, Langfield, Pagano, Reis, Van Nieuwerburgh, and Vayanos (2017). Corsetti, Feld, Koijen, Reichlin, Reis, Rey, and di Mauro (2016) discuss reform to Eurozone institutions in the wake of the twin eurozone debt and refugee crises.

provides a complementary perspective by analyzing the role of fiscal conditions as determinants of convenience yields. We view both convenience yields and liquidity as endogenous outcomes that evolve together with fiscal conditions.[4] Consistent with this view, we find that convenience yields and bid-ask spreads are correlated. However, fiscal shocks remain a significant predictor of the convenience yield, even after controlling for the bid-ask spread. Kremens (2024) studies redenomination risk using CDS data, and interprets Germany's negative redenomination risk as a potential source of convenience yield. The last section of the paper discusses measurement concerns associated with CDS contracts.

The rest of the paper is organized as follows. Section 2 develops a simple conceptual framework of convenience yields in a currency union, and their relationship to government surpluses. Turning to the data, Section 3 decomposes bond yields into default spreads and convenience yields and measures their relative importance. Section 4 studies the fiscal determinants of convenience yields in the data. Section 5 discusses the technical issues associated with CDS contracts and their implications for the measurement of convenience yields. Section 6 concludes.

2 Conceptual Framework

To guide the empirical work, this section provides a conceptual framework of bond convenience yields in a currency union.

2.1 A Model of Convenience Yield and Fiscal Policy

We start with a simple three-period model (times $t-1$, t and $t+1$) that abstracts from sovereign default to illustrate the relationship between fiscal policy and convenience yields. The main source of uncertainty is the primary surplus at time t, s_t. As discussed below, we also consider a second source of uncertainty regarding a possible breakup of the currency union.

Let $q_t(n)$ denote the quantity of government debt outstanding of country n at the end of period t. We assume that the bonds outstanding at time $t-1$, $q_{t-1}(n)$, are two-period risk-free bonds that promise to pay one euro in period $t+1$. The bonds outstanding at time t, $q_t(n)$, are one-period risk-free bonds that promise to pay one euro in period $t+1$.

Investor Optimality. A representative investor derives utility from consumption as well as direct ownership of the bonds:

$$U = u(c_t) + (1-\phi_t)v_1(\mathbf{q}_t) + \phi_t v_2(\mathbf{q}_t) + \beta u(c_{t+1}) \tag{1}$$

[4]The models in He and Xiong (2012), He and Milbradt (2014), Chen, Cui, He, and Milbradt (2018), Morelli, Ottonello, and Perez (2022) highlight the endogenous relationship between liquidity and default risk.

where the bond-in-utility functions are

$$v_1(\mathbf{q}_t) = \frac{\ell_t}{1-\theta}\left(\sum_{n=1}^{N}\omega_t(n)q_t(n)^{\rho}\right)^{(1-\theta)/\rho}, \tag{2}$$

$$v_2(\mathbf{q}_t) = \frac{\ell_t}{1-\theta}\left(q_t(DE)\right)^{1-\theta}. \tag{3}$$

In normal times, which occur with probability $1-\phi_t$, the investor derives utility from holding a basket of the various Eurozone government bonds issued by the different countries. Different bonds provide different amounts of convenience utility as captured by the weights $\omega_t(n)$. ℓ_t captures the investor's time-varying liquidity preference. The investor has a downward-sloping demand for the total basket of government bonds. We assume that $\rho < 1$ and $1-\theta-\rho < 0$ so that the various government bonds are imperfect substitutes for each other. This setting generalizes Krishnamurthy and Vissing-Jorgensen (2012), and is similar to Mota (2023), Krishnamurthy and Li (2025), and Jiang and Richmond (2024). Moreover, we assume $\omega_t(n) \geq 0$ for all bonds n, and we normalize the convenience weights such that $\sum_{n=1}^{N}\omega_t(n) = 1$. We assume that there is a large number of country issuers, so that a change in bond quantity $q_t(n)$ in any one country does not affect the aggregate liquidity.

In bad times, which occur with probability ϕ_t, the Eurozone unravels. In that state of the world, only German government bonds provide convenience services.

The investor is endowed with a set of bond $q_{t-1}(n)$ going into period t. The investor faces the following time-t and time-$t+1$ budget constraints:

$$c_t + \sum_{n=1}^{N} q_t(n) \leq y_t + \sum_{n=1}^{N} q_{t-1}(n)\exp(r_t(n)), \tag{4}$$

$$c_{t+1} \leq y_{t+1} + \sum_{n=1}^{N} q_t(n)\exp(r_{t+1}(n)). \tag{5}$$

The investor's first-order condition w.r.t. $q_t(n)$ implies that the convenience yield of asset n is

$$\beta\frac{u'(c_{t+1})}{u'(c_t)}\exp(r_{t+1}(n)) = \exp(-\lambda_t(n))$$
$$\equiv 1 - \ell_t\frac{(1-\phi_t)\left(\sum_{n=1}^{N}\omega_t(n)q_t(n)^{\rho}\right)^{(1-\theta-\rho)/\rho}\omega_t(n)q_t(n)^{\rho-1} + \phi_t q_t(n)^{-\theta}1_{\{n=DE\}}}{u'(c_t)}. \tag{6}$$

The derivation is in Appendix A.1. This expression implies that the convenience yield $\lambda_t(n)$ is a decreasing function of the quantity of outstanding bonds $q_t(n)$.

For simplicity, we assume that the investor is risk-neutral. Then, $u(c) = c$ and the intertemporal marginal rate of substitution becomes $m_{t+1} = \beta u'(c_{t+1})/u'(c_t) = \beta$. The frictionless discount rate—in the absence of convenience yields—is β.

Since the bonds outstanding at time $t-1$ are two-period risk-free bonds that promise to pay one euro in period $t+1$, their price at time $t+1$ is $p_{t+1}(n) = 1$. That price $p_t(n)$ depends on the convenience yield:

$$\exp(-\lambda_t(n)) = \beta \exp(r_{t+1}(n)) = \beta \frac{1}{p_t(n)}.$$

Rearranging terms yields:

$$\lambda_t(n) = \log p_t(n) - \log \beta = r_{t+1}(n) - \log \beta. \tag{7}$$

The convenience yield captures how the log bond price or yield deviates from the frictionless discount rate $\log \beta$.

The price $p_{t-1}(n)$ is predetermined and reflects the discounted expectation of the time-t bond price:

$$p_{t-1}(n) = \beta \mathbb{E}_{t-1}[p_t(n)].$$

As we explain below, the bond price at t is stochastic due to the surplus shock.

Fiscal Policy. The government budget constraint is:

$$\begin{aligned} s_t(n) + q_t(n) &= q_{t-1}(n) \frac{p_t(n)}{p_{t-1}(n)}, \\ s_{t+1}(n) &= q_t(n) \frac{1}{p_t(n)}, \end{aligned} \tag{8}$$

where $p_t(n) = \beta \exp(\lambda_t(n))$. If the government has a positive amount of debt outstanding at the end of period t, it must run a surplus at time $t+1$ to repay the debt.

We consider an exogenous increase in the government surplus s_t at time t. The economy in this period can be characterized by the government budget constraint (8) and the Euler equation (6). We apply a first-order approximation to these two equations around a steady state, and obtain the following result.

Proposition 1. *If the sovereign bonds are imperfect substitutes, i.e., $\rho < 1$, then, to a first-order approximation, a higher surplus in country n, $s_t(n)$, today will increase that bond's convenience yield, $\lambda_t(n)$:*

$$\lambda_t(n) = a + b\, s_t(n)$$

with $b > 0$.

The proof is presented in Appendix A.2. To understand this proposition, note that a higher surplus $s_t(n)$ reduces the need to issue as many new bonds in period t, which in turn reduces the amount of bonds investors must absorb. As the supply of bonds shrinks, its convenience yield increases. Higher surpluses result in higher contemporaneous government bond prices.

Iterating forward the government budget constraint yields:

$$q_{t-1}(n)\frac{p_t(n)}{p_{t-1}(n)} = s_t(n) + s_{t+1}(n)p_t(n).$$

Even though a higher surplus $s_t(n)$ today implies that a lower surplus $s_{t+1}(n)$ in the next period is required to pay off the remaining debt, the present value of surpluses still increases as $s_t(n)$ rises. This happens because of discounting; the surpluses become more front-loaded.

The Role of Fiscal Expectations. Next, we study the relationship between expected future surpluses and current bond prices. We consider the effect of a shock to the expectation of a future government surplus. Specifically, suppose that in period $t-1$, the investor learns that country n's expected surplus in period t is higher than previously thought, i.e., $\mathbb{E}_{t-1}[s_t(n)] > \bar{s}(n)$. Since

$$p_{t-1}(n) = \beta\mathbb{E}_{t-1}[p_t(n)]$$

and $p_t(n)$ depends on surplus $s_t(n)$ by Proposition 1, we obtain the following result:

Proposition 2. *If the sovereign bonds are imperfect substitutes, i.e., $\rho < 1$, then, to a first-order approximation, a higher expected surplus $\mathbb{E}_{t-1}[s_t(n)]$ will increase the bond's price $p_{t-1}(n)$:*

$$p_{t-1}(n) = \beta^2\mathbb{E}_{t-1}[\exp(a + bs_t(n))]$$

with $b > 0$.

Similar to (7), we can define the convenience yield in period $t-1$ as the per-period spread between bond price and the frictionless discount rate:

$$\lambda_{t-1}(n) = \frac{1}{2}(\log p_{t-1}(n) - \log\beta^2) = \frac{1}{2}\log\mathbb{E}_{t-1}[\exp(a + bs_t(n))] \approx \frac{1}{2}(a + b\mathbb{E}_{t-1}[s_t(n)])$$

The proof is in Appendix A.3. This proposition shows that the bond convenience yield increases when the expectation of future surpluses increases.

Currency Union Fiscal Crisis. So far, we discussed variation in the convenience yields driven by variation in the quantity of outstanding bonds, which in turn was driven by variation in countries' fiscal surpluses. The model contains another channel through which the fiscal conditions of countries can affect bond convenience yields. Specifically, the probability of a Eurozone crisis, ϕ_t, could depend on the fiscal condition of the "peripheral" countries in the Eurozone. Recall that the convenience yield is given by:

$$\exp(-\lambda_t(n)) = 1 - \ell_t \frac{(1-\phi_t)\left(\sum_{n=1}^{N} \omega_t(n) q_t(n)^{\rho}\right)^{(1-\theta-\rho)/\rho} \omega_t(n) q_t(n)^{\rho-1} + \phi_t q_t(n)^{-\theta} 1_{\{n=DE\}}}{u'(c_t)}.$$

If a lower government surplus $s_t(n)$ in peripheral country n not only increases the quantity of that country's outstanding bonds $q_t(n)$ but also the probability of a Eurozone crisis ϕ_t, then both effects lower country n's convenience yield relative to that of the German Bund. This additional fiscal crisis channel further magnifies the response of the convenience yield differential, relative to Germany, to fiscal conditions.

Summing Up. This simple model microfounds the positive relationship between the convenience yield on the one hand and both the current surplus and news about future surpluses on the other hand. Interpreted through the lens of the government's intertemporal budget constraint, the mechanism is that higher surpluses in a country indicate higher fiscal capacity and increase the market value of this country's outstanding government debt. Since the union-wide risk-free rate is unaffected, the higher market value must be reflected in higher convenience yields absent default. We extend this argument to an infinite horizon setting in Section 2.3 and to a world with sovereign default risk in Section 2.4. Applied to the context of a currency union where all member countries share the same risk-free rate, news about current or future primary surpluses must be reflected in either the convenience yield or the default spread. In the empirical sections 3 and 4, we will investigate the extent to which an Eurozone country's current surplus and forecast of future surplus affect that country's convenience yield and default spread in the data. But first, we study spillovers of convenience yields to corporate bonds.

2.2 Extension: Spillovers onto Corporate Bonds

Increase in the convenience yields of sovereign bonds due to improving fiscal conditions could spill over to high-quality (investment-grade) corporate bonds. We introduce corporate bonds, which are imperfect substitutes for sovereign bonds at the country level, into the above analysis. The investor's utility function remains as in (1)-(3), but the bond quantity $q_t(n)$ is now a composite of the government bonds, denoted $q_t^G(n)$, and corporate bonds, denoted $q_t^C(n)$:

$$q_t(n) = \left(q_t^G(n)^{\psi} + q_t^C(n)^{\psi}\right)^{1/\psi}.$$

The coefficient ψ governs the extent to which holdings of government bonds and corporate bonds are substitutable in terms of their provision of convenience services. The investor is endowed with a set of bond $q_{t-1}^G(n)$ and $q_{t-1}^C(n)$ going into period t. The time-t and time-$t+1$ budget constraints are straightforward generalizations of (5):

$$c_t + \sum_{n=1}^{N} q_t^G(n) + \sum_{n=1}^{N} q_t^C(n) \leq y_t + \sum_{n=1}^{N} q_{t-1}^G(n) \exp(r_t^G(n)) + \sum_{n=1}^{N} q_{t-1}^C(n) \exp(r_t^C(n))$$
$$c_{t+1} \leq y_{t+1} + \sum_{n=1}^{N} q_t^G(n) \exp(r_{t+1}^G(n)) + \sum_{n=1}^{N} q_t^C(n) \exp(r_{t+1}^C(n))$$

We assume that the amount of outstanding corporate bonds is held fixed: $q_t^C(n) = q_{t-1}^C(n)$.[5]

Other assumptions are similar to the baseline model in the previous section. If the elasticity parameters satisfy $\rho < \psi < 1$, i.e., the government bonds and corporate bonds of the same country are more substitutable than the bonds issued by different countries, then, we obtain the following result characterizing how the convenience yield of corporate bonds $\lambda_t^C(n)$ is related to fiscal conditions:

Proposition 3. *If $\rho < \psi < 1$, then, to a first-order approximation, a higher government surplus $s_t(n)$ in country n increases the convenience yield of corporate bonds $\lambda_t^C(n)$.*

The proof is in Appendix A.4. Intuitively, when the government surplus in country i increases, its government bond becomes scarcer. Given the downward-sloping demand curve for government bonds, the convenience yield of this government bond increases. At the same time, if the high-quality corporate bonds in the same country are good substitutes for the government bond, then, investors will be willing to substitute towards the corporate bond and pay a higher price for it as well. This leads to a higher convenience yield on the corporate bond.

The parameter condition $\rho < \psi < 1$ is sufficient but not necessary. Even when the assumption $\rho < \psi$ is not satisfied, corporate bond convenience yields may be increasing in government surpluses, depending on the values of the other parameters.

2.3 Infinite-horizon Extension with Default-free Debt

The three-period model is useful for illustrating the mechanism through which current and expected future surpluses affect government (and corporate) bond convenience yields. We can generalize the model to an infinite-horizon setting with stochastic fiscal surpluses, at the expense of analytical tractability.

[5] In response to an increase in convenience yields of the sovereign bond, firms may decide to issue more debt to take advantage of the lower yields. In that case, the response will be reflected partly in prices and partly in quantities. We abstract from the supply response for simplicity.

Consider an infinite-horizon setting in which the government of each country n issues nominal euro-denominated debt of different maturities $h = 1, 2, \ldots, H$. Debt is assumed to be default free. Investors have preferences over the entire vector $\mathbf{q}_t$ of government bonds outstanding of all horizons:

$$\sum_t \beta^t (u(c_t) + v_t(\mathbf{q}_t)),$$

where β is the subjective time discount factor. The investors' budget constraint is given by:

$$c_t + \sum_n \sum_{h=1}^{H} q_t^h(n) = y_t + \sum_n \sum_{h=1}^{H} q_{t-1}^h(n) \frac{p_t^{h-1}(n)}{p_{t-1}^h(n)},$$

where $q_t^h(n)$ is the quantity of government debt outstanding of country n with maturity h at the end of period t and $p_t^h(n)$ denotes the price of such bond. The investors' Euler equation for bonds with maturity h is given by:

$$\mathbb{E}_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} \frac{p_{t+1}^{h-1}(n)}{p_t^h(n)} \right] = 1 - \frac{v_t'(q_t^h(n))}{u'(c_t)}. \tag{9}$$

The budget constraint of the government of country n is given by:

$$s_t(n) + \sum_{h=1}^{H} q_t^h(n) = \sum_{h=1}^{H} q_{t-1}^h(n) \frac{p_t^{h-1}(n)}{p_{t-1}^h(n)}.$$

It shows that a higher government surplus $s_t(n)$ today lowers the need to raise additional debt in period t: $q_t^h(n) < q_{t-1}^h(n)$, at least for some tenors h. Given the downward-sloping demand curve for government bonds, i.e., $v_t'(q_t^h(n)) < 0$, this implies that the convenience yield $\lambda_t^h(n)$ must increase, just like in the three-period model.

In this infinite-horizon setting, Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2024, 2025) prove the following expression for the market value of government debt:

$$\sum_{h=1}^{H} q_t^h(n) = \mathbb{E}_t \left[\sum_{j=1}^{\infty} \beta^j \frac{u'(c_{t+j})}{u'(c_t)} s_{t+j}(n) \right] + \mathbb{E}_t \left[\sum_{j=0}^{\infty} \beta^j \frac{u'(c_{t+j})}{u'(c_t)} \sum_{h=1}^{H} q_{t+j}^h(n) \frac{v_{t+j}'(q_{t+j}^h(n))}{u'(c_{t+j})} \right]. \tag{10}$$

This expression arises from iterating forward on the one-period government budget constraint and imposing no-arbitrage conditions on all individual bonds and a transversality condition on the government debt portfolio. In the presence of Euler equation wedges, the market value of outstanding government debt equals the present discounted value of primary surpluses plus the present discounted value of seigniorage revenues. The first term reflects the "fundamental" cash flows, while the second term results from the fact that investors are willing to accept a lower expected return on bonds with convenience yields. Absent default, an increase in the market value of the government bond portfolio must reflect either news of higher current or future primary surpluses or news of higher future seigniorage revenues.

This general relationship reinforces the intuition from our three-period model: the government fiscal condition is closely tied to the market value of its outstanding debt. In a currency union where all member countries share the same risk-free rate, the variation in the market value of a country's government debt must be reflected in its convenience yield, absent fluctuations in the default spread.

2.4 Introducing Default and Variance Decomposition

When capital markets in the Eurozone are integrated, there is a common nominal pricing kernel $M_{t,t+h}$ for all member countries at each horizon h. In this case, only union-wide shocks affect the nominal discount rate $r_t^h = -\frac{1}{h}\log \mathbb{E}_t[M_{t,t+h}]$, whereas idiosyncratic shocks to one particular country do not. Even if risk-sharing between Eurozone countries is incomplete, we assume that investors agree on the price of risk-free bonds denominated in Euro.

We introduce the possibility of sovereign default, denoting by $\chi_{t+1}(n)$ the event of government default at time $t+1$ in country n. If the government defaults at time t, we assume all debt is wiped out with zero recovery.

Sovereign bonds carry a country- and tenor-specific Euler equation wedge, $w_t^h(n)$, which represents how much risk-adjusted return investors are willing to forgo to hold the bonds of country n. The Euler equations for bonds with maturity 1 and h are:

$$\mathbb{E}_t\left[M_{t,t+1}\left(1-\chi_{t+1}(n)\right)\right]\exp(w_t^1(n)) = p_t^1(n),$$
$$\mathbb{E}_t\left[M_{t,t+1}p_{t+1}^{h-1}(n)\left(1-\chi_{t+1}(n)\right)\right]\exp(w_t^h(n)) = p_t^h(n),$$

These Euler equation wedges $w_t^h(n)$ measure how much the marginal investors value the extra safety and liquidity provided by Eurozone sovereign bonds, compared to other bonds that promise identical payoffs. For these investors, the wedges do not represent arbitrage opportunities. In our model, they are given by the marginal utility of bond holdings, as in (9). The expression (10) for the market value of government debt continues to hold in the presence of default.

We can decompose the sovereign bond yield in member country n into a risk-free rate component r_t^h, a default spread component $\delta_t^h(n)$, and a convenience yield component $\lambda_t^h(n)$:

$$y_t^h(n) = -\frac{1}{h}\log p_t^h(n) = r_t^h + \delta_t^h(n) - \lambda_t^h(n). \tag{11}$$

The default spread component captures the risk-neutral expectation of sovereign default for country n's bond:

$$\delta_t^h(n) = -\frac{1}{h}\log \mathbb{E}_t\left[M_{t,t+h}\prod_{j=1}^{h}(1-\chi_{t+j}(n))\right] + \frac{1}{h}\log \mathbb{E}_t[M_{t,t+h}],$$

The convenience yield component captures the wedge between the actual bond yield and the yield of a hypothetical bond with the same default spread but no Euler equation wedges:

$$\lambda_t^h(n) = \frac{1}{h}\log \mathbb{E}_t\left[M_{t,t+h}\prod_{j=1}^{h}(1-\chi_{t+j}(n))\exp(w_{t+j-1}^{h-j+1}(n))\right] - \frac{1}{h}\log \mathbb{E}_t\left[M_{t,t+h}\prod_{j=1}^{h}(1-\chi_{t+j}(n))\right].$$

Aggregation and Variance Decomposition. Next, we consider the entire public debt portfolio of a country n. Let $d_t(n)$ denote the log market value of debt outstanding in country n at the start of period t, which consists of the nominal government debt with various maturities h. Let $q_{t-1}^h(n)$ denote the log book value of debt outstanding with maturity h at the end of period $t-1$. The market value of bonds outstanding can be written in terms of convenience yields and default spreads:

$$\exp(d_t(n)) = \sum_h \exp(q_{t-1}^h(n) - hy_t^h(n)) = \sum_h \exp(q_{t-1}^h(n) - hr_t^h - h\delta_t^h(n) - h\lambda_t^h(n)). \tag{12}$$

If we further assume that each country's government debt portfolio consists of zero-coupon bonds with a single maturity h^n, with $q_{t-1}^{h^n}(n)$ denoting the log book value of debt outstanding at the end of period $t-1$, then (12) becomes:

$$d_t(n) = -h^n\left(r_t^{h^n} + \delta_t^{h^n}(n) - \lambda_t^{h^n}(n)\right) + q_{t-1}^{h^n}(n). \tag{13}$$

This implies that the innovation in the market valuation of debt has to coincide with an innovation in the current risk-free rate, in the current convenience yield, or in the current default risk premium:

$$(\mathbb{E}_t - \mathbb{E}_{t-1})\, d_t(n) = -h^n\,(\mathbb{E}_t - \mathbb{E}_{t-1})\,(r_t^{h^n} + \delta_t^{h^n}(n) - \lambda_t^{h^n}(n)).$$

It follows that the conditional variance of the log market value of debt of country n can be decomposed into a convenience yield, a risk-free rate, and a default risk premium component:

$$\mathrm{Var}_{t-1}\,(d_t(n)) = h^n\left[\mathrm{Cov}_{t-1}\left(\lambda_t^{h^n}(n), d_t(n)\right) - \mathrm{Cov}_{t-1}\left(r_t^{h^n}, d_t(n)\right) - \mathrm{Cov}_{t-1}\left(\delta_t^{h^n}(n), d_t(n)\right)\right].$$

We can further aggregate the debt of all currency union members, and denote this aggregate portfolio by a. We analyze a natural benchmark case in which debt maturities coincide: $h^n = h$ for all country n. The log market value of Eurozone debt equals:

$$d_t(a) = -h(r_t^h + \delta_t^h(a) - \lambda_t^h(a)) + q_{t-1}^h(a).$$

By subtracting the Eurozone level expression from the country-level expression, we obtain the following expression for the deviation $\widehat{d}_t(n)$ of the valuation from the Eurozone level, which differences out the common risk-free rate r_t^h:

$$\begin{aligned}\widehat{d}_t(n) &= d_t(n) - d_t(a) \\ &= -\left((h\delta_t^h(n) - h\delta_t^h(a)) - (h\lambda_t^h(n) - h\lambda_t^h(a))\right) + q_{t-1}^h(n) - q_{t-1}^h(a).\end{aligned}$$

The innovations to $\widehat{d}_t(n)$ measure country-specific fiscal news in country n, because we are comparing the valuation of the debt for country n relative to valuation of the aggregate debt using the same stochastic discount factor.

Define $\widehat{\lambda}_t^h(n) = \lambda_t^h(n) - \lambda_t^h(a)$, and $\widehat{\delta}_t^h(n) = \delta_t^h(n) - \delta_t^h(a)$. News which increases the market value of country n's debt relative to that of the other countries in the monetary union must coincide with an increase in the current convenience yield or a decrease in the current default risk premium:

$$(\mathbb{E}_t - \mathbb{E}_{t-1})\,\widehat{d}_t(n) = h\,(\mathbb{E}_t - \mathbb{E}_{t-1})\left(\widehat{\lambda}_t^h(n) - \widehat{\delta}_t^h(n)\right).$$

The nominal risk-free yield curve cannot adjust to enforce the valuation equation at the country level since all member countries in the Eurozone share the same nominal pricing kernel and nominal risk-free rate. To the extent that country n's default spread does not respond to the country-specific news about the market value of debt, the news has to be reflected in a higher convenience yield for country n.

We derive the following variance decomposition result for the log valuation of country i's in deviation from the Eurozone aggregate level:

Result 1. *In a monetary union with integrated capital markets and equal durations for countries' outstanding debt portfolios, the variation in the log market value as a deviation from the monetary union aggregate is given by a convenience yield component and a default risk component:*

$$Var_{t-1}\left(\widehat{d}_t(n)\right) = h \cdot Cov_{t-1}\left(\widehat{\lambda}_t^h(n), \widehat{d}_t(n)\right) - h \cdot Cov_{t-1}\left(\widehat{\delta}_t^h(n), \widehat{d}_t(n)\right). \tag{14}$$

A positive variance reflects either a positive covariance of the current convenience yield (in deviation from the union-level aggregate) with the market value of debt (in deviation from the union-level aggregate), or a negative covariance of the market value with the default risk premium (in deviation from the union-level aggregate), or a combination of both. Dividing both sides by the conditional variance, we obtain a variance decomposition formula:

$$1 = h\frac{\text{Cov}_{t-1}\left(\widehat{\lambda}_t^h(n), \widehat{d}_t(n)\right)}{\text{Var}_{t-1}\left(\widehat{d}_t(n)\right)} - h\frac{\text{Cov}_{t-1}\left(\widehat{\delta}_t^h(n), \widehat{d}_t(n)\right)}{\text{Var}_{t-1}\left(\widehat{d}_t^i\right)}. \tag{15}$$

The two terms on the right-hand side have interpretations as regression coefficients. In Section 4, we estimate the regression coefficients in the data to assess to what extent the cross-country differences in bond valuations are driven by convenience yields and default spreads.

While the above analysis is silent on the source of news that moves the market value of debt, the previous section connected convenience yields to fiscal news. This source of variation is the focus of our empirical analysis.

3 Convenience Yields in Eurozone Sovereign Bonds

3.1 Data and Measurement

Eq. (11) implies that the bond yield for a given maturity h is determined by the common nominal risk-free rate r_t^h, the default spread $\delta_t^h(n)$, and the convenience yield $\lambda_t^h(n)$. If we compare the bond yields between any other Eurozone country, denoted by n, and Germany, denoted by DE, we can difference out the common nominal risk-free rate, and obtain a measure of the convenience yield differential from bond yields and CDS spreads:

$$\lambda_t^h(n) - \lambda_t^h(DE) \equiv \tilde{\lambda}_t^h(n) = \tilde{\delta}_t^h(n) - \tilde{y}_t^h(n) \equiv \left(\delta_t^h(n) - \delta_t^h(DE)\right) - \left(y_t^h(n) - y_t^h(DE)\right), \tag{16}$$

where the tilde sign denotes the differential between country i and Germany. A higher $\tilde{\lambda}_t(n)$ means country n's sovereign bond has a higher convenience yield relative to German sovereign bond. When the government bond yields and CDS spreads are correctly measured, convenience yield differentials represent deviations from covered interest rate parity.

Our sample is from 2002/07 to 2024/12 and includes Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal, and Spain. We do not include Greece since it defaulted in this sample and was excluded from the sovereign debt market. The tenors in our data include 1, 2, 3, 5, 7, 10, 15, 20, and 30 years. Our preferred tenor is 5 years because the 5-year CDS contracts are the most liquid. We use the CDS spreads from the CR contracts before 2014/09/22 and the CR14 contracts as they become available after 2014/09/22. The government bond yields are par yields from Bloomberg and the CDS spreads are from Markit; both are Euro-denominated. Appendix Figure A.1, Figure A.2 and Figure A.3 report the time series of yields, CDS spreads, and convenience yields for each country and tenor.

3.2 Summary Statistics

Table 1 reports the summary statistics of convenience yield differentials based on 5-year bonds and CDS, which is the most liquid. We split our sample before and after 2008/01/01 because the bond yield differentials, CDS premium differentials, and convenience yield differentials are all very close to zero before 2008 and widen up dramatically in 2008 and beyond.

Table 1: Summary Statistics of Convenience Yield Differentials

Country	Mean	Std Dev	10th Pct	50th Pct	90th Pct	Skewness	Autocorr
Panel (a) 2002–2007							
France	−0.02	0.03	−0.06	−0.02	0.01	−0.36	0.83
Netherlands	−0.03	0.03	−0.06	−0.03	−0.00	−0.92	0.42
Austria	−0.05	0.05	−0.14	−0.04	−0.00	−0.87	0.84
Belgium	−0.04	0.05	−0.12	−0.03	0.00	−0.97	0.88
Finland	−0.06	0.07	−0.18	−0.06	0.01	−0.96	0.86
Italy	−0.02	0.05	−0.08	−0.03	0.04	−0.05	0.82
Ireland	−0.05	0.06	−0.12	−0.03	0.02	−0.59	0.60
Spain	−0.02	0.06	−0.09	−0.02	0.04	−0.92	0.85
Portugal	−0.06	0.06	−0.14	−0.04	−0.00	−1.13	0.84
Average	−0.04	0.05	−0.11	−0.03	0.01	−0.75	0.77
Germany Level	0.22	0.08	0.15	0.21	0.32	1.69	0.85
Panel (b) 2008–2024							
France	−0.12	0.12	−0.29	−0.10	0.01	−0.57	0.71
Netherlands	−0.13	0.09	−0.25	−0.11	−0.04	−0.81	0.77
Austria	−0.17	0.17	−0.39	−0.16	−0.01	−0.12	0.87
Belgium	−0.18	0.20	−0.40	−0.16	0.04	−1.61	0.86
Finland	−0.20	0.13	−0.34	−0.18	−0.07	−1.42	0.83
Italy	−0.34	0.39	−0.72	−0.29	0.09	−1.75	0.83
Ireland	−0.34	0.61	−1.12	−0.17	0.04	−2.65	0.80
Spain	−0.37	0.43	−0.85	−0.26	0.01	−1.99	0.91
Portugal	−0.57	1.08	−1.56	−0.19	0.04	−3.27	0.91
Average	−0.27	0.36	−0.66	−0.18	0.01	−1.58	0.83
Germany Level	0.64	0.25	0.42	0.57	1.02	1.38	0.90

Notes: This table reports the convenience yield differentials $\tilde{\lambda}_t^5(n) = \lambda_t^5(n) - \lambda_t^5(DE)$ with 5-year tenor, annualized, and reported in percentage points. The last row reports the German convenience yield level, using the OIS rate as a proxy for the benchmark risk-free rate. The data are at monthly frequency, 2002/07–2024/12.

On average, the convenience yield differentials against German bonds are negative, which means the German bonds enjoy higher convenience yields than any other countries. The average gap widens from 4 basis points per year before 2008 to 27 basis points thereafter. The convenience yield differentials vary both across countries and across time. For example, France and the Netherlands tend to have higher convenience yields than Italy and Portugal. In the time series, the convenience yield differentials have large standard deviations and tend to be negatively skewed, which means that there are occasions in which the convenience yield gaps between German and other countries' bonds widen sharply. Convenience yield differentials are relatively persistent at monthly frequency. The average autocorrelation is 0.77 before 2008 and 0.83 thereafter.

How large are the convenience yield differentials between each country and Germany relative to the level of each country's convenience yield? This requires an estimate of Germany's convenience yield level. For this purpose, we assume that the Euro OIS zero rate is a good proxy for the benchmark nominal risk-free rate r_t^h that carries no convenience yield. Combined with the CDS rate and the bond yield, we then obtain the convenience yield level $\lambda_t^h(n)$ from (11):

$$\lambda_t^h(n) = r_t^h + \delta_t^h(n) - y_t^h(n).$$

We report the German convenience yield level in the last row of Table 1. Before 2008, the German convenience yield level averaged 22 basis points. This is larger than the average convenience yield differential between other countries and Germany. So, most countries' bonds show positive convenience yields before 2008, with the average country enjoying convenience yield levels close to the German ones. After 2008, the German convenience yield level is 64 basis points on average, which is twice as large as the average convenience yield differential between other countries and Germany. This implies that the average country's convenience yield level is about half of the German convenience yield level.

We also calculate the convenience yield differential for different tenors. Figure A.4 reports the average term structure of convenience yield differentials for each country. For most countries, the term structure is downward-sloping, suggesting that long-term German bonds enjoy relatively higher convenience yield advantages relative to other Eurozone sovereign bonds than short-term German bonds. One exception to this pattern is the Netherlands.[6]

3.3 How Much Variation of Bond Yields Is Due To Convenience Yields?

We consider two ways to decompose the variance of bond yield differential. Applying the expression for yields for country n in (11), subtracting the same expression for Germany, and taking the variance, we obtain a version of the variance decomposition in (14) and (15) at the 5-year maturity:

$$\begin{aligned}\text{Var}\left(\tilde{y}_t^5(n)\right) &= \text{Var}\left(\tilde{\delta}_t^5(n)\right) + \text{Var}\left(\tilde{\lambda}_t^5(n)\right) - 2\text{Cov}\left(\tilde{\delta}_t^5(n), \tilde{\lambda}_t^5(n)\right) \\ &= \text{Cov}\left(\tilde{y}_t^5(n), \tilde{\delta}_t^5(n)\right) - \text{Cov}\left(\tilde{y}_t^5(n), \tilde{\lambda}_t^5(n)\right).\end{aligned}$$

The variance of the bond yield differential is equal to the variance of its default spread, plus the variance of its convenience yield differential, minus two times their covariance. It is also equal to the covariance between the bond yield differential and the default spread minus the covariance between the bond yield differential and the convenience yield differential. Table 2 reports the

[6]We conjecture that this might be related to their pension funds buying the long-term bonds issued by their own government.

Table 2: Variance Decomposition of Convenience Yield Differential

Country	$Std\left(\tilde{y}_t^5(n)\right)$	$\frac{\mathrm{Var}\left(\tilde{\delta}_t^5(n)\right)}{\mathrm{Var}\left(\tilde{y}_t^5(n)\right)}$	$\frac{\mathrm{Var}\left(\tilde{\lambda}_t^5(n)\right)}{\mathrm{Var}\left(\tilde{y}_t^5(n)\right)}$	$\frac{-2\mathrm{Cov}\left(\tilde{\delta}_t^5(n),\tilde{\lambda}_t^5(n)\right)}{\mathrm{Var}\left(\tilde{y}_t^5(n)\right)}$	$\frac{\mathrm{Cov}\left(\tilde{y}_t^5(n),\tilde{\delta}_t^5(n)\right)}{\mathrm{Var}\left(\tilde{y}_t^5(n)\right)}$	$\frac{-\mathrm{Cov}\left(\tilde{y}_t^5(n),\tilde{\lambda}_t^5(n)\right)}{\mathrm{Var}\left(\tilde{y}_t^5(n)\right)}$
Panel (a) 2002–2007						
France	0.03	0.06	1.13	−0.19	−0.04	1.04
Netherlands	0.02	0.08	1.28	−0.36	−0.10	1.10
Austria	0.05	0.07	1.10	−0.17	−0.01	1.01
Belgium	0.05	0.10	0.99	−0.09	0.06	0.94
Finland	0.06	0.06	1.31	−0.37	−0.12	1.12
Italy	0.04	0.42	1.22	−0.64	0.10	0.90
Ireland	0.05	0.13	1.16	−0.28	−0.02	1.02
Spain	0.06	0.16	0.98	−0.15	0.09	0.91
Portugal	0.05	0.13	1.04	−0.18	0.05	0.95
Average	0.05	0.13	1.13	−0.27	0.00	1.00
Panel (b) 2008–2024						
France	0.21	0.65	0.36	−0.01	0.65	0.35
Netherlands	0.13	0.39	0.42	0.19	0.49	0.51
Austria	0.24	0.98	0.52	−0.51	0.73	0.27
Belgium	0.48	0.57	0.16	0.27	0.70	0.30
Finland	0.13	0.27	0.90	−0.17	0.19	0.81
Italy	1.00	0.55	0.15	0.30	0.70	0.30
Ireland	2.10	0.66	0.08	0.25	0.79	0.21
Spain	1.15	0.48	0.14	0.38	0.67	0.33
Portugal	3.50	0.52	0.10	0.39	0.71	0.29
Average	1.00	0.56	0.31	0.12	0.62	0.38

Notes: This figure reports the variance decomposition of bond yield variations into convenience yield differentials and default spreads. We focus on the 5-year tenor only. The yields are annualized and reported in percentage points. The data are at monthly frequency, 2002/07–2024/12.

results from both decomposition methods for the 5-year tenor.

Before 2008, the bond yield differentials are small with a mean standard deviation of 5 basis points per month. The convenience yield component accounts for nearly all of the yield differential variability in both decompositions.

After 2008, the bond yield differentials are much more volatile with a mean standard deviation of 101 basis points. The first method implies that the convenience yield component accounts for 31% of the variation in the yield differential, and its covariance with the default spread accounts for another 12%. The second method implies that the convenience yield component accounts for 38% of the variation in the yield differential, whereas the default spread component accounts for the remaining 62%. Both results suggest that the convenience yield component accounts for a non-trivial fraction of the variation in bond yields.

Appendix Table A.1 repeats this exercise using the monthly changes in the bond yield, convenience yield, and default spread. The two decomposition equations become

$$\begin{aligned}\text{Var}\left(\Delta\tilde{y}_t^5(n)\right) &= \text{Var}\left(\Delta\tilde{\delta}_t^5(n)\right) + \text{Var}\left(\Delta\tilde{\lambda}_t^5(n)\right) - 2\text{Cov}\left(\Delta\tilde{\delta}_t^5(n), \Delta\tilde{\lambda}_t^5(n)\right) \\ &= \text{Cov}\left(\Delta\tilde{y}_t^5(n), \Delta\tilde{\delta}_t^5(n)\right) - \text{Cov}\left(\Delta\tilde{y}_t^5(n), \Delta\tilde{\lambda}_t^5(n)\right).\end{aligned}$$

We find that the change in the convenience yield explains the majority of the variation in the change in the bond yield. For example, under the second method, the convenience yield component $\text{Cov}(\Delta\tilde{y}_t^5(n), \Delta\tilde{\lambda}_t^5(n))$ accounts for 59% (98%) of the variation after 2008 (before 2008), whereas the default spread component $\text{Cov}\left(\Delta\tilde{y}_t^5(n), \Delta\tilde{\delta}_t^5(n)\right)$ accounts for the remaining 41% (2%).

3.4 The Economic Magnitude of Convenience Yields

One way to quantify the economic significance of the convenience yields is to consider their implications for government revenue from bond issuance. We compute each country's revenue loss from having to issue bonds at a convenience yield that is lower than that of German bonds. For each bond issuance, the revenue loss is equal to the product of the issuance amount $I_t^h(n)$, the bond's duration $\tau_t^h(n)$, and the convenience yield differential relative to Germany $\tilde{\lambda}_t^h(n)$:

$$\mathcal{L}_t^h(n) = I_t^h(n) \cdot \tau_t^h(n) \cdot \tilde{\lambda}_t^h(n). \tag{17}$$

If the convenience yield differential is constant across the term structure, a bond with a higher duration will suffer a higher revenue loss.

We obtain data on bond issuance from Bloomberg. We interpolate available convenience yield differentials across the term structure to obtain the convenience yield differential for each bond issuance. Figure A.5 reports the cumulative revenue loss for each issuer. From 2003 to 2024, Ireland, Italy, Portugal and Spain have lost between 3% and 7% of their 2024 GDP due to lower convenience yields relative to Germany. Even for core countries like Austria, France, and the Netherlands, cumulative revenue losses are non-trivial. Aggregated across the nine countries, the additional revenue from the historical bond issuance over the past two decades would have been 4.1% of GDP.

This counterfactual envisions all countries earning the same convenience yield as Germany. As a robustness check, we also compute the counterfactual where all countries can reduce the convenience yield gap with Germany to 20 basis points in each period (or keep their existing convenience yield if and when it is within 20 basis points). This magnitude of 20 basis points is the observed yield differential with Germany observed for AAA-rated supranational debt (European Investment Bank, European Stability Mechanism, European Financial Stability Facility, and European Commission) in 2021, as shown by Bonfanti (2024). We report the implied cumulative revenue loss under this scenario in Appendix Figure A.6. The aggregate gain in bond revenue across the nine countries becomes 2.3% of GDP.

These calculations provide some indication of the potential benefits of deeper fiscal integration in the Eurozone. A more precise calculation would consider the impact of a larger aggregate supply of safe debt on the overall level of the convenience yield. On the one hand, reduced scarcity of safe assets could lower convenience yields (Krishnamurthy and Vissing-Jorgensen, 2012). On the other hand, a larger European safe bond market would enjoy greater liquidity benefits and could reduce the likelihood of a sovereign-banking doom loop where the health of the national banking sector and the national sovereign are intimately tied up (Brunnermeier, Garicano, Lane, Pagano, Reis, Santos, Thesmar, Van Nieuwerburgh, and Vayanos, 2016; Brunnermeier, Langfield, Pagano, Reis, Van Nieuwerburgh, and Vayanos, 2017), raising convenience yields. The net effect of these offsetting forces is hard to gauge.

3.5 Global Flight To Safety

We document that convenience yield differentials do not capture global flight to safety dynamics. German convenience yield levels, and hence the baseline level in all Eurozone convenience yields, do. To see this, we study the relationship between convenience yield levels and convenience yield differentials on the one hand, and two indicators of the global flight to safety on the other hand. These indicators are (i) $\lambda_t^1(US)$, the 1-year U.S. Treasury convenience yield relative to the other G10 countries' government debt, and (ii) VIX_t, the CBOE VIX index. We regress the convenience yield measures on these indicators of flight to safety:

$$\overline{\lambda_t^5(n) - \lambda_t^5(DE)} = \alpha + \beta\lambda_t^1(US) \text{ or } \gamma VIX_t + \varepsilon_t^i, \tag{18}$$

$$\lambda_t^5(DE) = \alpha + \beta\lambda_t^1(US) \text{ or } \gamma VIX_t + \varepsilon_t^i, \tag{19}$$

$$\overline{\lambda_t^5(n)} = \alpha + \beta\lambda_t^1(US) \text{ or } \gamma VIX_t + \varepsilon_t^i. \tag{20}$$

Columns (1) and (4) of Table 3 show that the average convenience yield differential between other Eurozone countries and Germany is unrelated to the flight-to-safety measures. In contrast, columns (2) and (5) show that the German convenience yield level comoves with the flight-to-safety measures. The same is true for the average convenience yield level across Eurozone countries (excluding Germany), as shown in columns (3) and (6). So, while German and other Eurozone countries' convenience yield levels comove with flight-to-safety indicators, this comovement effect differences out once we study the convenience yield differentials between Germany and other Eurozone countries.

In the next section, we show that these convenience yield differentials are related to relative fiscal conditions. This result is consistent with our conceptual framework's implication that conve-

Table 3: Convenience Yield Levels and Differentials and Flight to Safety

	(1) $\lambda_t^5(n) - \lambda_t^5(DE)$	(2) $\lambda_t^5(DE)$	(3) $\lambda_t^5(n)$	(4) $\lambda_t^5(n) - \lambda_t^5(DE)$	(5) $\lambda_t^5(DE)$	(6) $\lambda_t^5(n)$
US Treasury basis (bps)	-0.08	0.87***	0.80***			
	(0.11)	(0.12)	(0.08)			
VIX (%)				-0.22	1.50***	1.31***
				(0.30)	(0.48)	(0.43)
Num. of Obs.	217	217	217	269	269	269
Adj. R^2 (full model)	-0.00	0.25	0.31	0.00	0.19	0.21

Notes: We report results from the regressions (18) to (20). The dependent variables are the average convenience yield differential between Germany and other countries, the Germany convenience yield level, and the average convenience yield level across all countries. The sample is 2002/07–2024/12. We report Newey-West standard errors with 12 lags. *p<0.1; **p<0.05; ***p<0.01.

nience yield differentials adjust to reflect country-specific fiscal shocks within the currency union.

This comparison demonstrates that convenience yield levels and differentials play different roles in a currency union. Like other measures of flight-to-safety, the convenience yield levels increase during global flight-to-safety episodes marked by increases in volatility and larger Treasury bases. In contrast, the convenience yield differentials between member countries within the currency union adjust in response to country-specific fiscal shocks to clear the bond markets. In sum, these two channels are not mutually exclusive.

Furthermore, we document that convenience yield levels are connected through a factor structure. To examine the common movements in countries' convenience yields, we regress each country's convenience yield level on Germany's convenience yield level:

$$\lambda_t^h(n) = \alpha(n) + \beta(n)\lambda_t^h(DE) + \varepsilon_t(n). \tag{21}$$

Table 4 reports the results for the 5-year tenor. When Germany's convenience yield is high, countries like the Netherlands, France, Austria, and Finland tend to have high convenience yields as well, whereas countries like Italy, Spain, and Portugal tend to have low convenience yields. As safe assets, the government bonds issued by the Netherlands and Austria are perceived to be close substitutes for German bonds whereas the debt of periphery countries is perceived to be a poor substitute. None of the β^i coefficient is above 1, which suggests that when Germany's convenience yield is higher, it rises above other countries' convenience yields. In other words, the convenience yield differential $\lambda_t^h(DE) - \lambda_t^h(n)$ should widen with an average coefficient of $1 - \beta(n) > 0$. Moreover, the R^2s are substantial for several countries, suggesting that Germany's convenience yield represents a common factor in the cross-section of convenience yields.

Table 4: Loadings on Convenience Yield Levels

	(1) France	(2) Netherlands	(3) Austria	(4) Belgium	(5) Finland	(6) Italy	(7) Ireland	(8) Spain	(9) Portugal
Germany CY	0.81***	0.79***	0.78***	0.58***	0.66***	0.27***	0.47***	0.27***	−0.95***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.07)	(0.12)	(0.08)	(0.17)
Observations	269	232	269	269	262	269	264	269	269
Adjusted R^2	0.83	0.90	0.68	0.58	0.81	0.06	0.06	0.04	0.10

Notes: This table reports the results of the regression (21) in the time series of each country's 5-year convenience yield. The sample is 2002/07–2024/12. *p<0.1; **p<0.05; ***p<0.01.

4 Convenience Yields and Fiscal Conditions

In this section, we test the relationship between convenience yields and fiscal conditions. Based on the analysis in Section 2.1, our hypothesis is that a country's bond convenience yield is positively related to its current and expected future government surpluses. We obtain the government primary surplus and GDP data from Eurostat. The primary surplus is defined as the general government's tax revenues minus spending excluding spending on debt service.

While the government surplus data are annual from Eurostat, the asset price data are daily. We need to take a stance on when the surplus data become available. According to the Council of the European Union, member states report their government surpluses for year t before April 1 of year $t+1$, and Eurostat releases the data around three weeks after this deadline.[7] Appendix B.3 provides a detailed discussion. As a result, we link the government surplus in year t with the last available yield and CDS data at the end of April in year $t+1$. Aligning the government surplus in year t with the yield and CDS data from March to June of year $t+1$ produces similar results.

4.1 Explaining Cross-Country Variation in Convenience Yield Differentials

We first examine the cross-section by comparing the average convenience yield differentials to the average government deficit-to-GDP (deficit is minus the surplus) or debt-to-GDP ratios across countries. For the cross-sectional tests, we compute the average government surplus-to-GDP ratios and the average convenience yields using only the years in which all countries in our sample have available data for a given tenor to ensure comparability of the averages.

Figure 2 plots these cross-sectional comparisons for the 5-year tenor. On average, Germany has a low government deficit-to-GDP ratio and a low debt-to-GDP ratio, and it earns the highest average convenience yield among the Eurozone countries. In comparison, Portugal has high deficits and high debt, and it earns the lowest convenience yields relative to Germany. Relative

[7] Our yield and CDS data are available until the end of 2024/12. 2024 fiscal data are matched with the last available yield and CDS data in 2024/12 in order to make use of the most recent data.

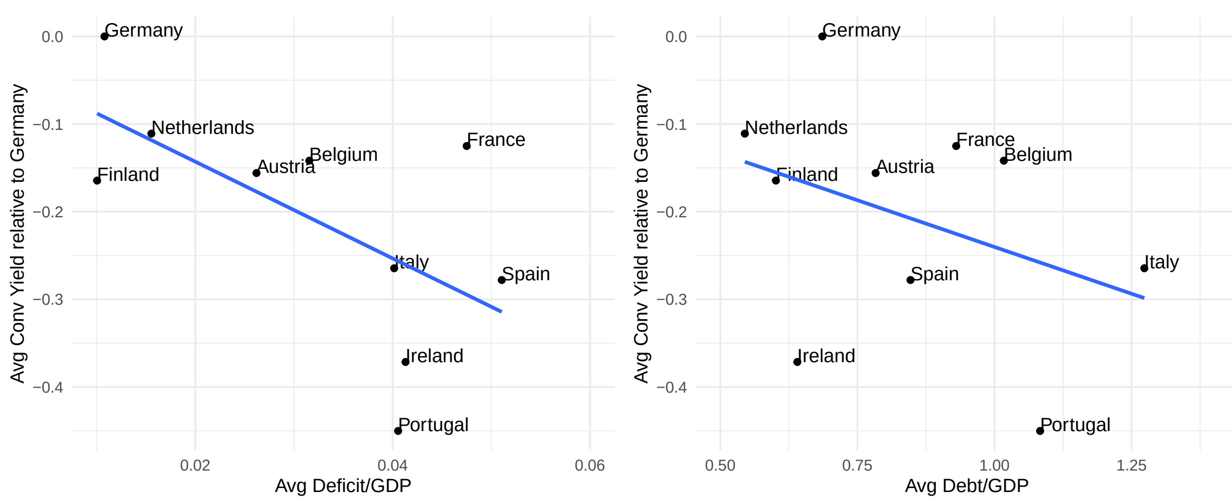
fundamentals play a role in the determination of safe asset demand, as pointed out by He, Krishnamurthy, and Milbradt (2019). A country with stronger relative fiscal fundamentals benefits from more safe asset demand for its sovereign debt.

Table 5 reports these cross-sectional results in regression form:

$$\frac{1}{T}\sum_t \tilde{\lambda}_t^h(n) = \alpha^h + \beta\frac{1}{T}\sum_t \tilde{s}_t(n) + \gamma\frac{1}{T}\sum_t \tilde{d}_t(n) + \varepsilon_t^h(n), \tag{22}$$

where $\tilde{s}_t = s_t(n) - s_t(DE)$ is the government surplus-to-GDP differential between country n and Germany, and $\tilde{d}_t(n)$ is the government debt-to-GDP differential between country n and Germany. We estimate three specifications. In Panel (a), we estimate a panel regression by pooling all tenors and control for tenor fixed effects. The multivariate regression results in Column (3) imply that a one-standard-deviation increase in the average surplus-to-GDP ratio (1.5% in the cross-section) increases the average convenience yield differential by 8.2 basis points. The predicted difference in average 5-year convenience yields between Germany and Italy, based on the difference in their fiscal conditions and the parameter estimates in Column (3), is 19 basis points. In comparison, the observed difference in average convenience yields between Germany and Italy is 26 basis points. A higher debt-to-GDP ratio is significantly negatively associated with convenience yield differentials in a univariate regression (column 2) but is no longer significant when the surplus-to-GDP ratio is included in the regression (column 3).

Figure 2: The Cross-Section of Convenience Yields and Fiscal Status



Notes: The left panel plots the time-series average convenience yield differential against the time-series average primary deficit-to-GDP ratio, and the right panel plots against the time-series average government debt-to-GDP ratio. All convenience yields are for the 5-year tenor. The average is taken over years in which all countries have available data.

Table 5: Average Convenience Yields in the Cross-Section

	(1) $\tilde{\lambda}$	(2) $\tilde{\lambda}$	(3) $\tilde{\lambda}$
	Panel (a) Baseline		
Surplus/GDP	5.71***		5.30***
	(1.00)		(0.64)
Debt/GDP		−0.25**	−0.05
		(0.07)	(0.05)
Num. of Obs.	70	70	70
Adj. R^2 (full model)	0.52	0.36	0.51
Adj. R^2 (proj model)	0.35	0.13	0.35
	Panel (b) Control for Bid-Ask Spread		
Surplus/GDP	5.45***		5.01***
	(0.81)		(0.55)
Debt/GDP		−0.24***	−0.06
		(0.06)	(0.05)
Bid Ask Spread	−0.60	−0.73	−0.60
	(0.65)	(0.73)	(0.66)
Num. of Obs.	69	69	69
Adj. R^2 (full model)	0.55	0.40	0.54
Adj. R^2 (proj model)	0.40	0.21	0.40
	Panel (c) Control for GDP Growth and Inflation		
Surplus/GDP	4.24***		2.32**
	(1.00)		(0.75)
Debt/GDP		−0.31***	−0.20**
		(0.07)	(0.06)
GDP Growth	0.37	−3.24***	−1.99***
	(0.98)	(0.31)	(0.53)
Inflation	15.26***	18.31***	15.39***
	(2.61)	(3.13)	(2.79)
Num. of Obs.	70	70	70
Adj. R^2 (full model)	0.57	0.58	0.59
Adj. R^2 (proj model)	0.42	0.43	0.45

Notes: This table reports results from the regression (22). We take the average of the convenience yield differentials and fiscal variables across time for each country and each tenor. We run the panel regression and control for the tenor fixed effects. The dependent variable is the convenience yield differential relative to Germany, in percentage points. The tenors are 1, 2, 3, 5, 7, 10, 20, and 30 years. *p<0.1; **p<0.05; ***p<0.01.

In Panel (b), we repeat the regressions and additionally control for the bonds' liquidity, as measured by the average bid-ask spread. The bid-ask spread is insignificant when included alongside the surplus-to-GDP ratio, the debt-to-GDP ratio, or both.

In Panel (c), we control for the country-specific average GDP growth and inflation rates. These variables could enter as inputs in a country-specific stochastic discount factor. The SDF may affect sovereign bond prices in the presence of (partial) segmentation in the bond markets. In the presence of such segmentation, the convenience yield would include this compensation for country-specific risk. Alternatively, these variables may partially help to soak up negative redenomination risk, which might be larger for countries with higher GDP growth. We find that both GDP growth and inflation enter significantly, and that the coefficient on the surplus attenuates. However, it remains economically and statistically significant. The coefficient on the debt-to-GDP ratio strengthens in magnitude in the presence of inflation and GDP growth.

4.2 Explaining the Time-Series Variation in Convenience Yield Differentials

Fiscal conditions help explain not only the cross-country variation in average convenience yields but also the variation in convenience yield differentials across time. We investigate how a country's bond yield, convenience yield, and the CDS spread respond when its surplus-to-debt ratio changes.[8] The regression specification is as follows:

$$\tilde{y}_t^h(n) \text{ or } \tilde{\lambda}_t^h(n) \text{ or } \tilde{\delta}_t^h(n) = \alpha(n) + \beta \tilde{s}_t(n) + \varepsilon_t^h(n). \tag{23}$$

We control for the country-level fixed effects $\alpha(n)$, so that the result is unaffected by unconditional differences between countries.

Table 6 reports the panel regression results for the 5-year tenor. As shown in Column (2) of panel (a), higher government surpluses are associated with higher convenience yield differentials in the time series. The point estimate of β is about 5.4, which is very close to the slope coefficient of 5.7 in the cross-sectional regression reported in Table 5. This result suggests that a one-standard-deviation increase in the government surplus/GDP ratio (about 3.8% in the panel) is associated with a 20.6 basis points increase in the convenience yield differential. The effect is estimated precisely; we use Driscoll and Kraay (1998) standard errors for panel settings with time-series and cross-sectional dependence.[9] The adjusted R^2 of 30% is also notable. Column (3) shows that higher government surpluses are also associated with significantly lower default spreads. Both effects combine to lead to lower bond yield differentials when a country's surplus increases (Column 1).

[8]There is a long tradition in macro-economics that considers shocks to the primary surplus, be it to government spending or to taxes (Blanchard and Perotti, 2002; Mertens and Ravn, 2012; Ramey, 2011).

[9]Appendix Table A.8 shows similar results using a feasible generalized least squares estimation method. The point estimate on the surplus/GDP ratio in the convenience yield regression is 4.4 and significant at the 1% level. This compares to a panel regression coefficient of 6.1 estimated on the same sample.

Panel (b) controls for the bonds' bid-ask spreads, to proxy for liquidity effects. The coefficient of interest on the surplus term remains economically and statistically significant. The bid-ask spread is also significantly associated with convenience yields in the time series and the R^2 increases meaningfully. This shows that liquidity and fiscal considerations can co-exist as determinants of the dynamics of convenience yields. Panel (c) controls for the countries' GDP growth and inflation, to proxy for market segmentation effects. GDP growth and inflation do not enter significantly in Column (2) and do not increase the R^2 meaningfully.

Table A.2 presents the results of the time series regression of convenience yield differentials on contemporaneous surplus-to-GDP differentials country by country, allowing sensitivities to differ across countries. The results are significant for Ireland, Italy, and Spain, and borderline significant for Portugal. This shows that our results are not driven by one or to countries.

Table 6: Convenience Yields vs. Fiscal Conditions in the Time-Series

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
	Panel (a): Surplus Alone		
Surplus/GDP	-19.91^{***}	5.37^{**}	-14.55^{***}
	(6.20)	(1.95)	(4.30)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.41	0.32	0.41
Adj. R^2 (proj model)	0.34	0.30	0.32
	Panel (b): Control for Bid-Ask Spread		
Surplus/GDP	-8.68^{***}	2.68^{**}	-6.00^{***}
	(1.31)	(0.98)	(0.76)
Bid Ask Spread	12.18^{***}	-2.91^{***}	9.27^{***}
	(0.59)	(0.58)	(0.32)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.81	0.62	0.81
Adj. R^2 (proj model)	0.79	0.61	0.78
	Panel (c): Control for GDP Growth		
Surplus/GDP	-18.30^{***}	5.03^{**}	-13.27^{***}
	(5.69)	(1.84)	(3.93)
GDP Growth	-7.91	1.56	-6.35
	(5.44)	(1.44)	(4.15)
Inflation	6.39	-1.01	5.38
	(10.58)	(2.67)	(8.14)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.44	0.33	0.44
Adj. R^2 (proj model)	0.37	0.30	0.35

Notes: Estimation results for the panel regression in equation (23). The sample is 2002–2024 at annual frequency using the 5-year tenor. Rates and surplus/GDP ratios are relative to their German counterparts. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.

Returning to our relative variance decomposition in Eq. (15), repeated below for convenience, we can use the change in the surplus-to-GDP ratio as a proxy for fiscal news $\widehat{d}_t(n)$. Based on the estimated coefficients in panel (a) of Table 6, assuming an average duration of debt of $h = 1/0.1991 = 5.02$ years:

$$1 = h\frac{\mathrm{Cov}_{t-1}\left(\widehat{\lambda}_t^h(n), \widehat{d}_t(n)\right)}{\mathrm{Var}_{t-1}\left(\widehat{d}_t(n)\right)} - h\frac{\mathrm{Cov}_{t-1}\left(\widehat{\delta}_t^h(n), \widehat{d}_t(n)\right)}{\mathrm{Var}_{t-1}\left(\widehat{d}_t(n)\right)} = 5.02 \times (0.0537 - (-0.1455)). \tag{24}$$

The convenience yield channel accounts for $0.0537 \times 5.02 = 27\%$ of the variance in fiscal news (debt valuations), while the default risk channel accounts for the remaining 73%. Fiscal news contributes meaningfully to the dynamics of convenience yields.

Appendix B.4 decomposes the variance of convenience yields into a component that is correlated with default spreads and a component that is orthogonal to it. Both components are sizable. We find that most of the covariance between surpluses and convenience yields comes from the component of convenience yields that is correlated with default spreads. This result is expected if the fiscal conditions driver both convenience yields and default spreads.

4.3 The Explanatory Power of Fiscal Forecasts

Proposition 2 suggests that the convenience yield, like any other asset price, is forward-looking. In addition to current fiscal conditions, forecasts of future fiscal conditions should also affect current convenience yields.

For a subsample of Eurozone countries (Germany, France, Italy, the Netherlands, and Spain), we are able to obtain professional forecasts of budget deficits in the current year and in the next year for the period 2002–2020. The data is from Consensus Economics, available monthly, and pertains to the median forecaster.[10] We take the last observation in each quarter; the aggregation at the quarterly level eliminates some additional overlap we would have with monthly data. We normalize the median forecast of the budget deficit by the GDP in the year prior to the year for which the forecast is produced. Our regression equation is:

$$\tilde{y}_t^h(n) \text{ or } \tilde{\lambda}_t^h(n) \text{ or } \tilde{\delta}_t^h(n) = \alpha(n) + \beta\mathbb{E}_t[\tilde{s}_{t+1}(n)] + \varepsilon_t^h(n). \tag{25}$$

Table 7 reports the regression results for five-year bonds. As with the realized surplus, a higher forecasted surplus-to-GDP ratio is associated with a higher convenience yield differential. A 1% point increase in the forecasted government surplus-to-GDP ratio differential for the ongoing cal-

[10] For example, in August 2015, the forecasters were asked to make predictions about the fiscal conditions in the year of 2015 (the current year) and in the year of 2016 (the next year). In September 2015, they were asked the same questions, although the number of remaining months in the current year is one less. We directly use the forecasts made in different months as proxies for the expected government surpluses.

endar year is associated with a 5.6 basis points increase in the convenience yield differential. The coefficient is estimated precisely, using standard errors that account for cross-sectional and time-series dependence. Interestingly, the point estimate of 5.6 in Table 7 obtained with the surplus forecast is close to the 5.4 estimate from Table 6 and the cross-sectional estimate of 5.7 in Table 5.

Table 7: Convenience Yields vs. Fiscal Forecasts in the Time-Series

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
Panel (a): Surplus Forecast Alone			
Surplus Forecast/GDP	-20.92^{***}	5.59^{***}	-15.32^{***}
	(3.81)	(1.83)	(2.48)
Num. of Obs.	234	234	234
Adj. R^2 (full model)	0.36	0.26	0.37
Adj. R^2 (proj model)	0.11	0.08	0.10
Panel (b): Control for Bid-Ask Spread			
Surplus Forecast/GDP	-22.33^{***}	5.97^{***}	-16.36^{***}
	(2.78)	(1.58)	(1.91)
Bid Ask Spread	33.62^{***}	-9.03^{***}	24.59^{***}
	(4.38)	(1.95)	(3.14)
Num. of Obs.	234	234	234
Adj. R^2 (full model)	0.67	0.53	0.64
Adj. R^2 (proj model)	0.54	0.42	0.49
Panel (c): Control for GDP Growth and Inflation Forecasts			
Surplus Forecast/GDP	-22.36^{***}	7.09^{***}	-15.28^{***}
	(5.98)	(2.16)	(4.64)
GDP Growth Forecast	-0.17	0.03	-0.14
	(0.11)	(0.03)	(0.09)
Inflation Forecast	0.46^{**}	-0.15^{*}	0.31^{*}
	(0.23)	(0.08)	(0.17)
Num. of Obs.	234	234	234
Adj. R^2 (full model)	0.47	0.34	0.47
Adj. R^2 (proj model)	0.25	0.17	0.24

Notes: We estimate the regression in equation (25). Regression results are for 2002–2020 at quarterly frequency using the 5-year tenor. The right-hand side is the forecast of current year surplus and other controls. Rates and surplus forecasts are relative to their German counterparts. Rates and surplus forecast/GDP ratios are in percentage points. We report Driscoll and Kraay (1998) standard errors. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Panel (b) controls for the bid-ask spread. The coefficient on the surplus strengthens slightly, and both the surplus and the bid-ask spread enter strongly significantly, and with the predicted sign. Panel (c) controls for the forecasts of GDP growth and inflation from the same Consensus Economics data set from which we obtain the surplus forecast. The coefficient estimates remain similar. The inflation forecast enters weakly significantly in the convenience yield regression, whereas the surplus forecast remains strongly significant and its magnitude strengthens.

Returning to our relative variance decomposition in Eq. (15), the change in the forecasted surplus is a plausible proxy for fiscal news $\widehat{d}_t(n)$. Based on the point estimates in panel (a) of Table 7, if the Eurozone countries have a duration of debt $h = 1/0.2092 = 4.78$ years.

$$1 = h\frac{\mathrm{Cov}_{t-1}\left(\widehat{\lambda}_t^h(n), \widehat{d}_t(n)\right)}{\mathrm{Var}_{t-1}\left(\widehat{d}_t(n)\right)} - h\frac{\mathrm{Cov}_{t-1}\left(\widehat{\delta}_t^h(n), \widehat{d}_t(n)\right)}{\mathrm{Var}_{t-1}\left(\widehat{d}_t(n)\right)} = 4.78 \times (0.0559 - (-0.1532)) \,. \tag{26}$$

When we use fiscal forecast data, the convenience yield channel accounts for $0.0559 \times 4.78 = 27\%$ of the variance in fiscal conditions (debt valuations), while the default risk channel accounts for the remaining 73%. These results based on fiscal forecasts confirm that fiscal news is an important driver of convenience yields.

Appendix Table A.3 repeats these regressions using the forecast of the next year's fiscal and fundamental variables. A 1% point increase in the predicted surplus differential for the following calendar year results in a 4.7 basis point higher convenience yield differential; the effect is estimated precisely.

Table A.4 breaks down the results by country. It finds that the forecast of current calendar year surplus is significantly positively correlated with the convenience yield in each of the countries for which we have data. Two of the four countries also show a precisely estimated link with next year's forecast.

4.4 Impact of ECB Policy on Convenience Yields

During our study period, the European Central Bank pursued an active agenda of unconventional monetary policy, some of which involved the sovereign bond markets. Appendix B.5 provides the institutional details. It shows that the Security Markets Program (SMP1 in May 2010 and SMP2 in August 2011) shrunk the convenience yield differentials of the targeted countries with Germany. Two other programs (OMT in August and September 2012 and PSPP in May 2015) affected bond yield differentials through default spreads rather than convenience yield differentials. Removing the quarters in which the four events took place does not affect the magnitude and significance of the coefficient on the surplus forecast.

4.5 Spill-Overs to Corporate Bond Convenience Yields

Proposition 3 predicts that a higher government surplus in a country also leads to a higher convenience yield for investment-grade corporate bonds issued by firms of the same country. We obtain corporate bond data from Corell, Mota, and Papoutsi (2023), sourced from iBoxx investment-grade EUR corporate credit indices and Markit single-name CDS contracts. Corell, Mota, and Papoutsi (2023) merge corporate bonds and CDS, following Mota (2023), and aggregate the data at country-maturity-rating level using face-value weights. The final series are the corporate CDS spread,

$\delta_t^{C,h}(n)$, the corporate bond yield relative to the maturity-matched EUR AAA Sovereign composite published by the ECB, $\tilde{y}_t^{C,h}(n)$, and the corporate bond convenience yield differential $\tilde{\lambda}_t^{C,h}(n)$, defined by:

$$\tilde{\lambda}_t^{C,h}(n) = \delta_t^{C,h}(n) - \tilde{y}_t^{C,h}(n),$$

which is also measured relative to the maturity-matched EUR AAA Sovereign composite. A higher corporate bond convenience yield differential implies a lower default-adjusted yield, and hence a higher funding advantage for the firm.

Similar to our previous exercise using sovereign bonds, we merge the fiscal data in year t with the corporate convenience yield differentials on the last available day in April of year $t+1$. Our final sample is an unbalanced country-by-year panel from 2009 to 2024, covering the following eight countries: Austria, Belgium, France, Ireland, Italy, Netherlands, Portugal, Spain. We focus on the 3-to-5-year tenor and on bonds rated A- or above.

First, we examine the relationship between the pricing of a country's sovereign bond and that of its corporate bonds. We regress the corporate bond's convenience yield differential on the convenience yield differential of the sovereign bond in the same country:

$$\tilde{\lambda}_t^{C,h}(n) = \alpha(n) + \beta\tilde{\lambda}_t^{h}(n) + \varepsilon_t^h(n). \tag{27}$$

We estimate similar regressions putting the yield differential and CDS spread of corporate bonds on the left-hand side and the sovereign counterparts on the right-hand side.

Panel (a) of Table 8 reports the results. We find that the yield spread, convenience yield, and CDS spread of the corporate bonds are all positively correlated with the corresponding spreads of the sovereign bonds in the same country. In particular, column (2) suggests that when a country's sovereign bond convenience yield increases by 1%, the convenience yield of the corporate bond in the same country tend to increase by 0.4%. In comparison, when a country's sovereign bond CDS spread increases by 1%, the corporate bonds' CDS spread increases by 1.5%. The sensitivity of corporate bond yields to sovereign bond yields is 1.2.

Next, we examine the relationship between the convenience yield differential of corporate bonds and the government surplus. We estimate the following regression:

$$\tilde{\lambda}_t^{C,h}(n) = a_t + \alpha(n) + \beta\tilde{s}_t(n) + \varepsilon_t^h(n). \tag{28}$$

We include time fixed effects a_t to control for time variation in corporate spreads common to all countries. Similarly, we also run the corresponding regression with the bond yield differential or the CDS spread of corporate bonds as the dependent variable.

Panel (b) of Table 8 reports the results. While the results are statistically less significant than our previous results obtained using sovereign bonds, we find that the convenience yield of corporate bonds is positively and significantly correlated with the government surplus in the same country. In particular, Column (2) reports a slope coefficient of 1.7, which implies that a one-standard-deviation increase in the government surplus/GDP ratio (about 3.9%) is associated with a 6.6 basis point increase in the corporate bond's convenience yield. For comparison, the corresponding specification that regresses government bond convenience yield differentials on the surplus/GDP ratio with time fixed effects is 5.4 (std error 1.2), which is about 3 times larger. This shows that the relationship between the fiscal situation and convenience yields of corporate bonds is weaker than the relationship with government convenience yields. This is natural given the safety advantage of government bonds over corporate bonds.

For comparison, Appendix Table A.5 repeats our exercise pooling the 1-to-3-year, 3-to-5-year, and 5-to-10-year tenors, and Appendix Table A.6 estimates the regression for the set of BBB-rated corporate bonds as opposed to bonds rated A- or better. In contrast with the results for corporate bond convenience yields for bonds rated A- or higher, the positive correlation with the surplus disappears in the sample of firms with a broader maturity spectrum and with lower credit rating. This is consistent with the notion that the convenience yields mainly accrue to corporate

Table 8: Spill-Over to Corporate Bond Convenience Yields

Panel (a): Corporate vs. Government Bond Differentials			
	(1) $\tilde{y}^C$	(2) $\tilde{\lambda}^C$	(3) δ^C
Government Yield Diff	1.18^{***} (0.26)		
Government Convenience Yield Diff		0.40^{**} (0.17)	
Government CDS Diff			1.45^{***} (0.29)
Num. of Obs.	84	84	84
Adj. R^2 (full model)	0.86	0.46	0.86
Adj. R^2 (proj model)	0.59	0.09	0.65
Panel (b): Relationship with Government Surplus			
	(1) $\tilde{y}^C$	(2) $\tilde{\lambda}^C$	(3) δ^C
Surplus/GDP	-35.53^{**} (12.35)	1.71^{**} (0.63)	-33.83^{**} (12.08)
Num. of Obs.	84	84	84
Adj. R^2 (full model)	0.86	0.64	0.84
Adj. R^2 (proj model)	0.52	0.01	0.52

Notes: We estimate the regressions in equations (27) and (28). Regression results are for 2009—2024 at annual frequency using the 3-to-5-year tenor. Rates and surplus/GDP ratios are in percentage points. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.

bonds with higher credit ratings, which are better substitute safe assets for government bonds. Instead, these corporate bonds' CDS spreads are significantly negatively correlated with the government surplus-to-GDP ratio, suggesting alternative channels through which government fiscal conditions affect the pricing of riskier corporate bonds.

5 Discussion: CDS Spreads

Our convenience yield measure is constructed from bond yields and CDS spreads. Several measurement issues related to CDS spreads are worth discussing further.

One issue in the CDS market is the bond redenomination risk (Kremens, 2024). There is a small chance that countries in the Eurozone may leave the currency union and redenominate their bonds in a different currency. Depending on the relative value of the new currency, the redenomination may lead to either a capital loss or gain for the bondholders, called positive and negative redenomination risk, respectively. The CDS CR contracts we use in the early part of our sample do not protect against the event of redenomination without default for France, Germany, and Italy, but do pay off for the other countries in our sample. Thus, the positive redenomination risk in the absence of default affects our measure of the convenience yield for these three countries before 2014. However, we think this event is unlikely since countries that redenominate their debt when they exit the Eurozone are more likely to simultaneously default.

Convenience yields may also include negative redenomination risk. Specifically, if the German government were to redenominate its debt back to the Deutsche Mark if Germany leaves the Euro Area on a future date, and the Mark is stronger than the Euro, then the German sovereign bond yield may be lower today to reflect this effect. Moreover, as no German CDS contracts have negative payoff in this event, the valuation manifests itself as a convenience yield on the German bond. Our convenience yield has a broader interpretation that includes the hedging benefit from negative redenomination risk as well as the convenience that arises from the country's fiscal position. Indeed, our theoretical model predicts an amplification of fiscal conditions on convenience yields if poor fiscal conditions increase the likelihood of a currency union break-up. In addition, some of the convenience yield specifications discussed above that controlled for GDP growth may capture some of the negative redenomination risk.

Another issue is that the CDS maturity determines the time length of credit protection, but the premium for this protection may not correspond very closely to a credit spread of a similar maturity bond. If default happens before the 5-year CDS matures, investors will be able to deliver bonds of different maturities into the CDS auction. The payout received by credit protection holders could be larger than the credit loss on the 5-year bond. This issue creates some measurement error in the convenience yields, and our results are subject to this caveat.

Klingler and Lando (2018) argue that CDS premiums for highly-rated sovereigns are influenced by regulatory factors. Particularly, the use of CDS contracts provides regulatory capital relief for dealer banks, which drives up CDS premiums.[11] This force applies to all sovereigns but is stronger for safer sovereigns. Directionally, it results in a measured convenience yield differential relative to Germany that is lower (more negative) than it would be absent this effect. The magnitude of this source of measurement error is not known for every EZ sovereign bond.[12]

During the European debt crisis, there was some legal and financial ambiguity surrounding the question of whether a restructuring like the Greek Private Sector Involvement (PSI) in 2012, would be classified as a "credit event" under ISDA definitions, and thus trigger CDS payouts. The eventual use of Collective Action Clauses (CACs) made the restructuring "coercive" enough to trigger CDS. The delay and uncertainty may have introduced pricing inefficiencies, reduced CDS credibility, and potentially affected the sovereign bond-CDS basis. This ex-ante risk of non-enforceability was arguably highest for Greece, given that its higher and more imminent likelihood of default. For this reason, we did not include Greece in our sample. But we cannot rule out that this risk was still present for other periphery countries, albeit potentially discounted more heavily.

CDS spreads may be sensitive to counterparty risk of the protection seller to the extent that it is correlated with the default risk of the reference entity. While this effect may bias the convenience yield level, it is less clear whether it affects the convenience yield differential vis-à-vis Germany. There is no bias in differentials when there is uniform counterparty risk across issuers or when systemic risk is mutualized via Centralized Counterparty Clearing as noted by Du, Gadgil, Gordy, and Vega (2023).

We use euro-denominated CDS contracts, which are less liquid than dollar-denominated CDS contracts. Appendix Table A.7 shows that our results are robust to using dollar-denominated CDS spread. Differential liquidity due to CDS currency denomination can affect levels of convenience yields in ways that are hard to quantify.

6 Conclusion

We study the convenience yields countries earn on their bond issuance in a currency union. Convenience yields are a major determinant of sovereign bond yield differentials in the Eurozone as

[11]The underlying issue is that dealers engage in derivative transactions with sovereigns and sub-sovereigns, such as interest rate swaps. (Sub-)sovereigns do not post collateral in these transactions, which leaves dealer banks exposed. The credit risk exposure is reflected in the bank's accounts through a credit value adjustment, and has the effect of increasing the banks' risk-weighted assets and capital requirements.

[12]There is a different bank regulatory capital effect that increases measured convenience yield differentials (makes them less negative), thus working in the opposite direction as the CDS effect. Under the Basel regulatory capital framework (Article 114(4) of the EU's Capital Requirements Regulation), any Eurozone (EZ) bank is permitted to assign a 0% risk weight to sovereign bonds issued by any EZ member states, as long as they are denominated and funded in euros. This regulatory capital treatment affects the bond yields, not the CDS spreads, lowering the yields of the weakest sovereigns the most. This regulatory effect of 0% risk weights is a tangible source of differences in $\omega(n)$ in (2) and relates to the literature on haircuts and margins (Ashcraft, Garleanu, and Pedersen, 2011; Garleanu and Pedersen, 2011).

they reflect country-specific shocks. Consistent with our conceptual framework, we show that fiscal shocks are important determinants of convenience yields. Convenience yields, or the lack thereof, imply large fiscal costs for the peripheral countries, which can be mitigated through responsible fiscal stewardship. Our findings speak to the costs and benefits of deepening the fiscal union in the Eurozone.

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Appendix

A Proofs

A.1 Derivation of the First-order Condition

The Lagrangian is:

$$\begin{aligned}\mathcal{L} &= u(c_t) + (1-\phi_t)v_1(\mathbf{q}_t) + \phi_t v_2(\mathbf{q}_t) + \beta u(c_{t+1}) \\ &+ \zeta_t \left[y_t + \sum_{n=1}^{N} q_{t-1}(n)\exp(r_{t-1}(n)) - c_t - \sum_{n=1}^{N} q_t(n) \right] \\ &+ \zeta_{t+1} \left[\sum_{n=1}^{N} q_t(n)\exp(r_t(n)) + y_{t+1} - c_{t+1} \right].\end{aligned}$$

The first order conditions are:

$$\begin{aligned}0 &= u'(c_t) - \zeta_t, \\ 0 &= \beta u'(c_{t+1}) - \zeta_{t+1}, \\ 0 &= (1-\phi_t)\ell_t \left(\sum_{n=1}^{N} \omega_t(n) q_t(n)^{\rho} \right)^{(1-\theta-\rho)/\rho} \omega_t(n) q_t(n)^{\rho-1} + \phi_t \ell_t q_t(n)^{-\theta} 1_{\{n=DE\}} - \zeta_t + \exp(r_{t+1}(n))\zeta_{t+1},\end{aligned}$$

which implies

$$\begin{aligned}\exp(-\lambda_t(n)) &= \beta \frac{u'(c_{t+1})}{u'(c_t)} \exp(r_{t+1}(n)) \\ &= 1 - \ell_t \frac{(1-\phi_t)\left(\sum_{n=1}^{N} \omega_t(n) q_t(n)^{\rho}\right)^{(1-\theta-\rho)/\rho} \omega_t(n) q_t(n)^{\rho-1} + \phi_t q_t(n)^{-\theta} 1_{\{n=DE\}}}{u'(c_t)}.\end{aligned}$$

A.2 Derivation of Proposition 1

Note that when the investor is risk neutral: $u(c_t) = c_t$ and $u'(c_t) = 1$. Define:

$$\Lambda_t(n) \equiv \ell_t \left\{ (1-\phi_t) \left(\sum_{n=1}^{N} \omega_t(n) q_t(n)^{\rho} \right)^{(1-\theta-\rho)/\rho} \omega_t(n) q_t(n)^{\rho-1} + \phi_t q_t(n)^{-\theta} 1_{\{n=DE\}} \right\}.$$

Write the first-orde condition as:

$$1 - \exp(-\lambda_t(n)) = \Lambda_t(n).$$

Denote $\hat{x}_t := x_t - \bar{x}$ as the deviation from steady state for every t-measurable variable x_t. We take a first order Taylor expansion around the steady state on the first order condition.

$$
\begin{aligned}
\exp(-\bar{\lambda}(n))\hat{\lambda}_t(n) = {} & \bar{\Lambda}(n)\frac{\hat{\ell}_t}{\bar{\ell}_t} + (\bar{\Lambda}(n)_{\text{bad}} - \bar{\Lambda}(n)_{\text{normal}})\hat{\phi}_t \\
& + (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} \left(\frac{1-\theta-\rho}{\rho} \frac{\bar{\omega}(n)\bar{q}(n)^{\rho}}{\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho}} + 1 \right) \frac{1}{\bar{\omega}(n)} \hat{\omega}_t(n) \\
& + (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^{\rho}}{\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho}} + (\rho-1) \right] \frac{1}{\bar{q}(n)} \hat{q}_t(n) \\
& - \theta\bar{\phi}\bar{\Lambda}(n)_{\text{bad}} \frac{1}{\bar{q}(n)} \hat{q}_t(n).
\end{aligned}
$$

where

$$
\begin{aligned}
\bar{\Lambda}(n) &:= \bar{\ell} \left\{ (1-\bar{\phi}) \left(\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho} \right)^{(1-\theta-\rho)/\rho} \bar{\omega}(n)\bar{q}(n)^{\rho-1} + \bar{\phi}\bar{q}(n)^{-\theta} 1_{\{n=DE\}} \right\} \\
&= (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} + \bar{\phi}\bar{\Lambda}(n)_{\text{bad}}, \\
\bar{\Lambda}(n)_{\text{normal}} &:= \bar{\ell} \left(\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho} \right)^{(1-\theta-\rho)/\rho} \bar{\omega}(n)\bar{q}(n)^{\rho-1}, \\
\bar{\Lambda}(n)_{\text{bad}} &:= \bar{\ell}\bar{q}(n)^{-\theta} 1_{\{n=DE\}}.
\end{aligned}
$$

Note that $q_t(n) = q_{t-1}(n)\frac{\beta\exp(\lambda_t(n))}{p_{t-1}(n)} - s_t(n)$, hence

$$
\hat{q}_t(n) = q_{t-1}(n)\frac{\beta\exp(\bar{\lambda}(n))}{p_{t-1}(n)}\hat{\lambda}_t(n) - \hat{s}_t(n),
$$

which implies

$$
\begin{aligned}
\exp(-\bar{\lambda}(n))\hat{\lambda}_t(n) = {} & \bar{\Lambda}(n)\frac{\hat{\ell}_t}{\bar{\ell}_t} + (\bar{\Lambda}(n)_{\text{bad}} - \bar{\Lambda}(n)_{\text{normal}})\hat{\phi}_t \\
& + (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} \left(\frac{1-\theta-\rho}{\rho} \frac{\bar{\omega}(n)\bar{q}(n)^{\rho}}{\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho}} + 1 \right) \frac{1}{\bar{\omega}(n)} \hat{\omega}_t(n) \\
& + (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^{\rho}}{\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho}} + (\rho-1) \right] \frac{1}{\bar{q}(n)} q_{t-1}(n)\frac{\beta\exp(\bar{\lambda}(n))}{p_{t-1}(n)}\hat{\lambda}_t(n) \\
& - \theta\bar{\phi}\bar{\Lambda}(n)_{\text{bad}} \frac{1}{\bar{q}(n)} q_{t-1}(n)\frac{\beta\exp(\bar{\lambda}(n))}{p_{t-1}(n)}\hat{\lambda}_t(n) \\
& - (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^{\rho}}{\sum_{n=1}^{N} \bar{\omega}(n)\bar{q}(n)^{\rho}} + (\rho-1) \right] \frac{1}{\bar{q}(n)} \hat{s}_t(n) \\
& + \theta\bar{\phi}\bar{\Lambda}(n)_{\text{bad}} \frac{1}{\bar{q}(n)} \hat{s}_t(n).
\end{aligned}
$$

Assume that $\bar{q}(n) = q_{t-1}(n)$ and $\hat{\ell}_t = \hat{\omega}_t = \hat{\phi}_t = 0$. Also, assume that N is large such that $\frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} \to 0$. Note that $p_{t-1}(n) = \beta\bar{p}(n) = \beta^2 \exp(\bar{\lambda}(n))$. We simplify the result to

$$\begin{aligned}\exp(-\bar{\lambda}(n))\hat{\lambda}_t(n) = (1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}}\frac{\rho-1}{\beta}\hat{\lambda}_t(n) - \bar{\phi}\bar{\Lambda}(n)_{\text{bad}}\frac{\theta}{\beta}\hat{\lambda}_t(n)\\ -(1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}}\frac{\rho-1}{\bar{q}(n)}\hat{s}_t(n) + \bar{\phi}\bar{\Lambda}(n)_{\text{bad}}\frac{\theta}{\bar{q}(n)}\hat{s}_t(n),\end{aligned}$$

i.e.,

$$\lambda_t(n) = \bar{\lambda}(n) + b(s_t(n) - \bar{s}(n)),$$

where

$$b := \frac{(1-\rho)(1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} + \theta\bar{\phi}\bar{\Lambda}(n)_{\text{bad}}}{\beta\exp(-\bar{\lambda}(n)) + (1-\rho)(1-\bar{\phi})\bar{\Lambda}(n)_{\text{normal}} + \theta\bar{\phi}\bar{\Lambda}(n)_{\text{bad}}}\frac{\beta}{\bar{q}(n)} > 0$$

when $\rho < 1$.

A.3 Derivation of Proposition 2

Plugging the result from Proposition 1 into $p_{t-1}(n) = \beta\mathbb{E}_{t-1}[p_t(n)]$ and $p_t(n) = \beta\exp(\lambda_t(n))$, we obtain

$$p_{t-1}(n) = \beta\mathbb{E}_{t-1}[\beta\exp(a + bs_t(n))] = \beta^2\mathbb{E}_{t-1}[\exp(a + bs_t(n))].$$

A.4 Derivation of Proposition 3

Proof. Note that

$$q_t(n) = \left(q_t^C(n)^\psi + q_t^G(n)^\psi\right)^{\frac{1}{\psi}} \tag{A.1}$$

We obtain

$$\exp(-\lambda_t^C(n)) = 1 - \ell_t\left[\phi_t\left(\sum_{n=1}^N \omega_t(n)q_t(n)^\rho\right)^{(1-\theta-\rho)/\rho}\omega_t(n)q_t(n)^{\rho-1} + (1-\phi_t)q_t(n)^{-\theta}1_{\{n=DE\}}\right]q_t(n)^{1-\psi}q_t^C(n)^{\psi-1},$$

$$\exp(-\lambda_t^G(n)) = 1 - \ell_t\left[\phi_t\left(\sum_{n=1}^N \omega_t(n)q_t(n)^\rho\right)^{(1-\theta-\rho)/\rho}\omega_t(n)q_t(n)^{\rho-1} + (1-\phi_t)q_t(n)^{-\theta}1_{\{n=DE\}}\right]q_t(n)^{1-\psi}q_t^G(n)^{\psi-1}.$$

Since $q_t^G(n) = q_{t-1}^G(n)\frac{\beta \exp(\lambda_t^G(n))}{p_{t-1}^G(n)} - s_t(n)$,

$$\hat{q}_t^G(n) = q_{t-1}^G(n)\frac{\beta \exp(\bar{\lambda}^G(n))}{p_{t-1}^G(n)}\hat{\lambda}_t^G(n) - \hat{s}_t(n). \tag{A.2}$$

Note that $q_t^C(n) = q_{t-1}^C(n)$. The first-order expansion of Eq. (A.1) yields

$$\hat{q}_t(n) = \bar{q}(n)^{1-\psi}\bar{q}^G(n)^{\psi-1}\hat{q}_t^G(n). \tag{A.3}$$

The first-order expansion of $\exp(-\lambda_t^G(n))$ implies

$$\begin{aligned}
\exp(-\bar{\lambda}^G(n))\hat{\lambda}_t^G(n) = {} & \bar{\Lambda}^G(n)\frac{\hat{\ell}_t}{\bar{\ell}_t} + (\bar{\Lambda}^G(n)_{\text{normal}} - \bar{\Lambda}^G(n)_{\text{bad}})\hat{\phi}_t \\
& + \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}}\left(\frac{1-\theta-\rho}{\rho}\frac{\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + \frac{1}{\bar{\omega}(n)}\right)\hat{\omega}_t(n) \\
& + \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}}\left[(1-\theta-\rho)\frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho-\psi)\right]\frac{\hat{q}_t(n)}{\bar{q}(n)} \\
& + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)\frac{\hat{q}_t(n)}{\bar{q}(n)} \\
& + (\psi-1)\bar{\Lambda}^G(n)\frac{\hat{q}_t^G(n)}{\bar{q}^G(n)},
\end{aligned} \tag{A.4}$$

where

$$\begin{aligned}
\bar{\Lambda}^G(n) &:= \bar{\ell}\left[\bar{\phi}\left(\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho\right)^{(1-\theta-\rho)/\rho}\bar{\omega}(n)\bar{q}(n)^{\rho-1} + (1-\bar{\phi})\bar{q}(n)^{-\theta}1_{\{n=DE\}}\right]\bar{q}_t(n)^{1-\psi}\bar{q}_t^G(n)^{\psi-1} \\
&= \bar{\phi}\bar{\Lambda}(n)^G_{\text{normal}} + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}, \\
\bar{\Lambda}^G(n)_{\text{normal}} &:= \bar{\ell}\left(\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho\right)^{(1-\theta-\rho)/\rho}\bar{\omega}(n)\bar{q}(n)^{\rho-1}\bar{q}_t(n)^{1-\psi}\bar{q}_t^G(n)^{\psi-1}, \\
\bar{\Lambda}^G(n)_{\text{bad}} &:= \bar{\ell}\bar{q}(n)^{-\theta}1_{\{n=DE\}}\bar{q}_t(n)^{1-\psi}\bar{q}_t^G(n)^{\psi-1}.
\end{aligned}$$

Let $\hat{\ell}_t = \hat{\phi}_t = \hat{\omega}_t = 0$ and plug in $p_{t-1}^G = \beta^2\exp(\bar{\lambda}^G(n))$. Eq. (A.2), (A.3) and (A.4) jointly imply

$$\begin{aligned}
& \exp(-\bar{\lambda}^G(n))\beta\bar{q}^G(n)^{-1}(\hat{s}_t(n) + \hat{q}_t^G(n)) \\
= & \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}}\left[(1-\theta-\rho)\frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho-\psi)\right]\left(\frac{\bar{q}^G(n)}{\bar{q}(n)}\right)^\psi\frac{\hat{q}_t^G(n)}{\bar{q}^G(n)} \\
& + (1-\bar{\phi})\Lambda^G(n)_{\text{bad}}(1-\psi-\theta)\left(\frac{\bar{q}^G(n)}{\bar{q}(n)}\right)^\psi\frac{\hat{q}_t^G(n)}{\bar{q}^G(n)} \\
& + (\psi-1)\Lambda^G(n)\frac{\hat{q}_t^G(n)}{\bar{q}^G(n)},
\end{aligned}$$

i.e.,

$$
\begin{aligned}
\frac{\hat{q}_t^G(n)}{\bar{q}^G(n)} = & \Big\{ (\psi - 1 + \beta)\bar{\Lambda}^G(n) - \beta \\
& + \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho - \psi) \right] \left(\frac{\bar{q}^G(n)}{\bar{q}(n)} \right)^\psi \\
& + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta) \left(\frac{\bar{q}^G(n)}{\bar{q}(n)} \right)^\psi \Big\}^{-1} \\
& \times (1 - \bar{\Lambda}^G(n))\beta \frac{\hat{s}_t(n)}{\bar{q}^G(n)}.
\end{aligned}
$$

From Eq. (A.3)

$$
\begin{aligned}
\frac{\hat{q}_t(n)}{\bar{q}(n)} = & \Bigg\{ \Big[(\psi - 1 + \beta)\bar{\Lambda}^G(n) - \beta \Big] \left(\frac{\bar{q}(n)}{\bar{q}^G(n)} \right)^\psi \\
& + \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho - \psi) \right] \\
& + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta) \Big\}^{-1} \\
& \times (1 - \bar{\Lambda}^G(n))\beta \frac{\hat{s}_t(n)}{\bar{q}^G(n)}.
\end{aligned} \tag{A.5}
$$

Similarly, the first-order expansion of $\exp(-\lambda_t^C(n))$ implies

$$
\begin{aligned}
\exp(-\bar{\lambda}^C(n))\hat{\lambda}_t^C(n) = & \bar{\Lambda}^C(n)\frac{\hat{\ell}_t}{\bar{\ell}_t} + (\bar{\Lambda}^C(n)_{\text{normal}} - \bar{\Lambda}^C(n)_{\text{bad}})\hat{\phi}_t \\
& + \bar{\phi}\bar{\Lambda}^C(n)_{\text{normal}} \left(\frac{1-\theta-\rho}{\rho} \frac{\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + \frac{1}{\bar{\omega}(n)} \right) \hat{\omega}_t(n) \\
& + \bar{\phi}\bar{\Lambda}^C(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho - \psi) \right] \frac{\hat{q}_t(n)}{\bar{q}(n)} \\
& + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)\frac{\hat{q}_t(n)}{\bar{q}(n)} \\
& + (\psi - 1)\bar{\Lambda}^C(n)\frac{\hat{q}_t^C(n)}{\bar{q}^C(n)}.
\end{aligned} \tag{A.6}
$$

Note that $\hat{q}_t^C(n) = 0$. Let $\hat{\ell}_t = \hat{\phi}_t = \hat{\omega}_t = 0$ to obtain

$$
\begin{aligned}
\exp(-\bar{\lambda}^C(n))\hat{\lambda}_t^C(n) = & \bar{\phi}\bar{\Lambda}^C(n)_{\text{normal}} \left[(1-\theta-\rho) \frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho - \psi) \right] \frac{\hat{q}_t(n)}{\bar{q}(n)} \\
& + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)\frac{\hat{q}_t(n)}{\bar{q}(n)}.
\end{aligned}
$$

Substitute out $\hat{q}_t(n)$ by Eq. (A.5) to obtain

$$\hat{\lambda}_t^C(n) = \frac{\beta\bar{\phi}\bar{\Lambda}^C(n)_{\text{normal}}\left[(1-\theta-\rho)\frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho-\psi)\right] + \beta(1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)}{\left[(\psi-1+\beta)\bar{\Lambda}^G(n)-\beta\right]\left(\frac{\bar{q}(n)}{\bar{q}^G(n)}\right)^\psi + \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}}\left[(1-\theta-\rho)\frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} + (\rho-\psi)\right] + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)} \frac{\hat{s}_t(n)}{\bar{q}^G(n)}.$$

Also, assume that N is large such that $\frac{\bar{\omega}(n)\bar{q}(n)^\rho}{\sum_{n=1}^N \bar{\omega}(n)\bar{q}(n)^\rho} \to 0$. Then the expression simplifies to:

$$\hat{\lambda}_t^C(n) = \frac{\beta\bar{\phi}\bar{\Lambda}^C(n)_{\text{normal}}(\rho-\psi) + \beta(1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)}{\left[(\psi-1+\beta)\bar{\Lambda}^G(n)-\beta\right]\left(\frac{\bar{q}(n)}{\bar{q}^G(n)}\right)^\psi + \bar{\phi}\bar{\Lambda}^G(n)_{\text{normal}}(\rho-\psi) + (1-\bar{\phi})\bar{\Lambda}^G(n)_{\text{bad}}(1-\psi-\theta)} \frac{\hat{s}_t(n)}{\bar{q}^G(n)}.$$

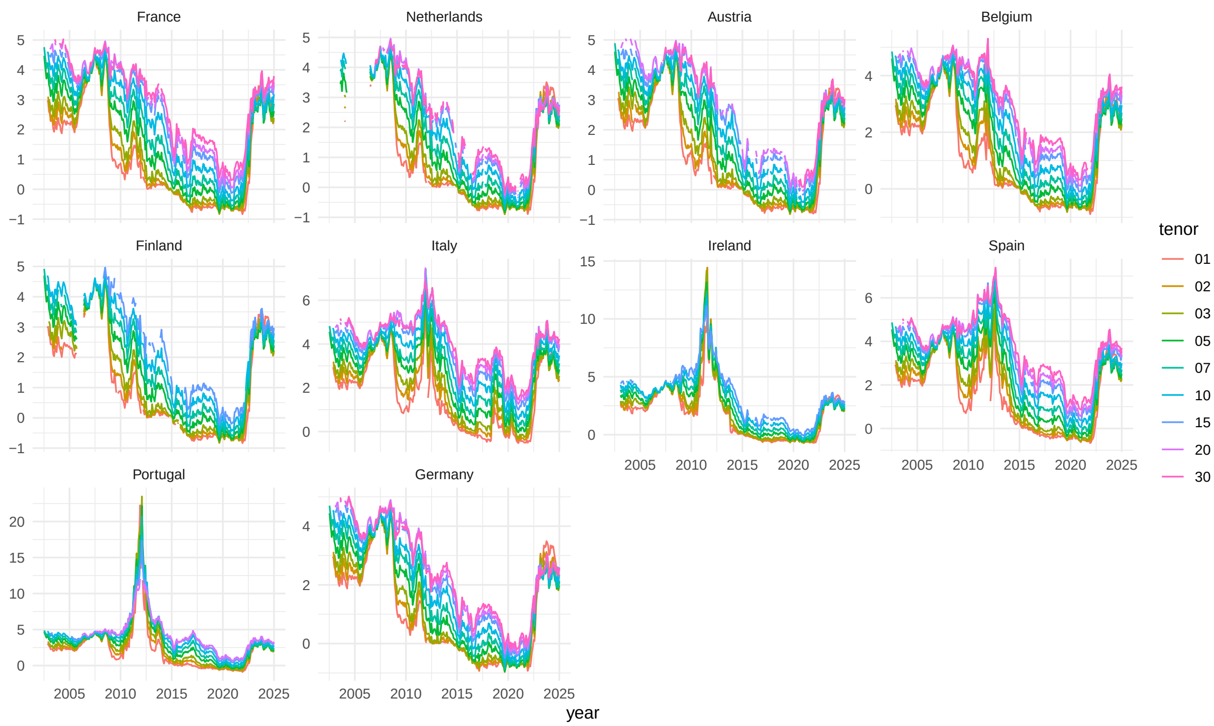
A sufficient condition for the convenience yield on corporate bond $\lambda_t^C(n)$ to be increasing in $s_t(n)$ is if $\psi < 1$, $\rho < \psi$, $1-\theta-\psi < 0$. Corporate bonds and sovereign bonds are imperfect substitutes when $\psi < 0$.

Even when $\rho > \psi$, the convenience yield on corporate bond $\lambda_t^C(n)$ can still be increasing in $s_t(n)$ depending on the other parameter values. □

B Additional Empirical Results

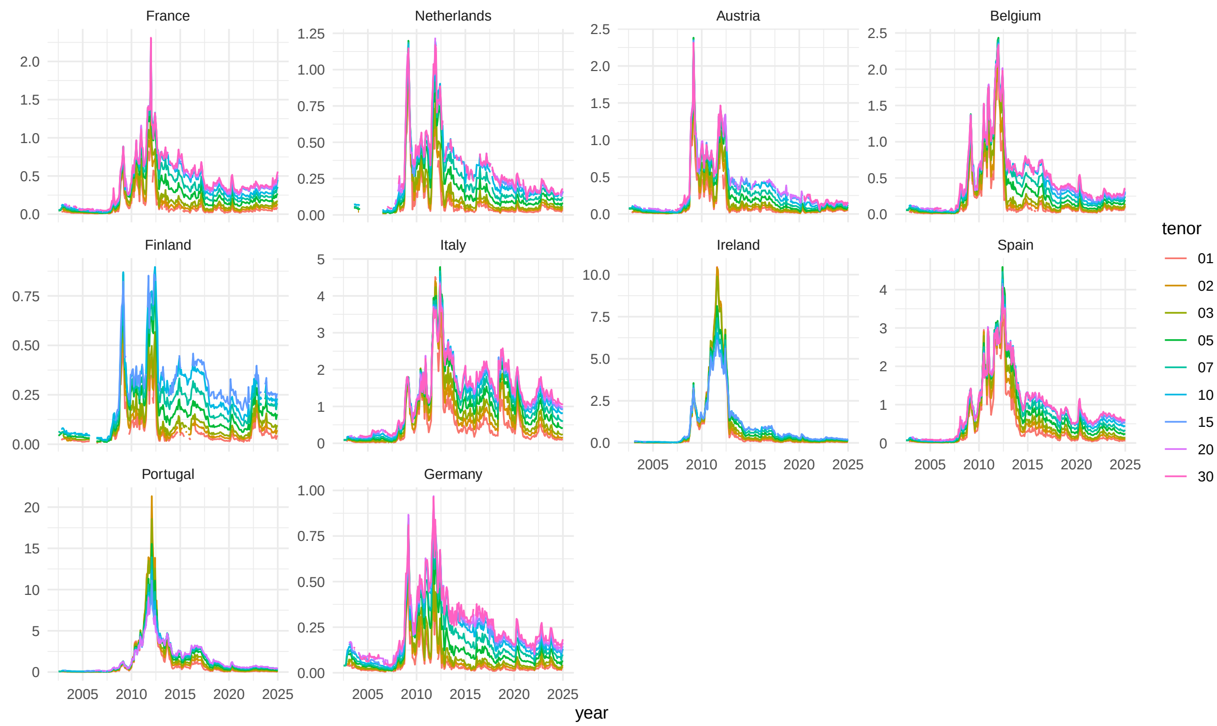
B.1 Additional Graphs and Tables

Figure A.1: The Time Series of Yields



Notes: Sovereign bond yields for the Eurozone countries in our sample; various tenors. The yields are in percentage points.

Figure A.2: The Time Series of CDS Spread

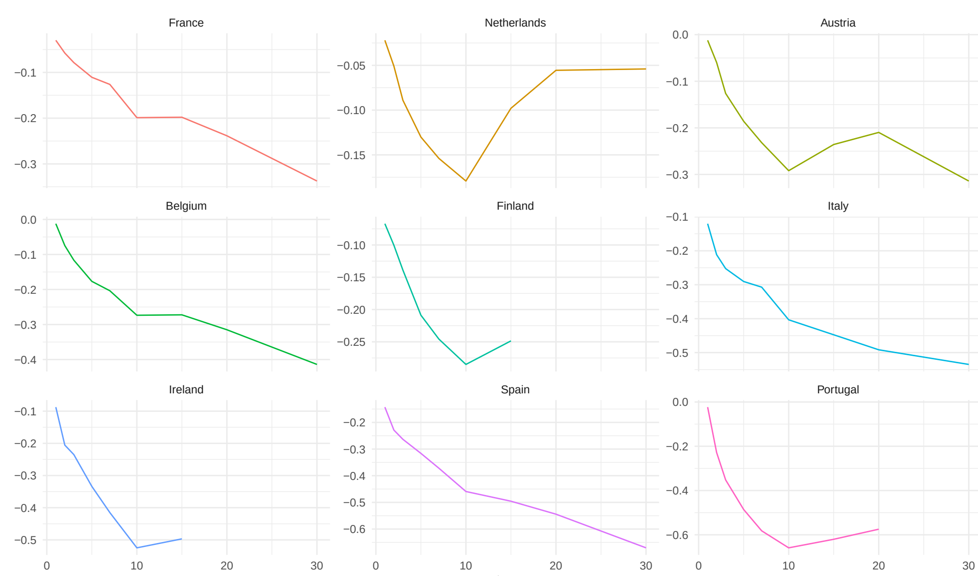


Notes: The CDS spreads are in percentage points.

Figure A.3: The Time Series of Convenience Yield Differentials Across Maturities

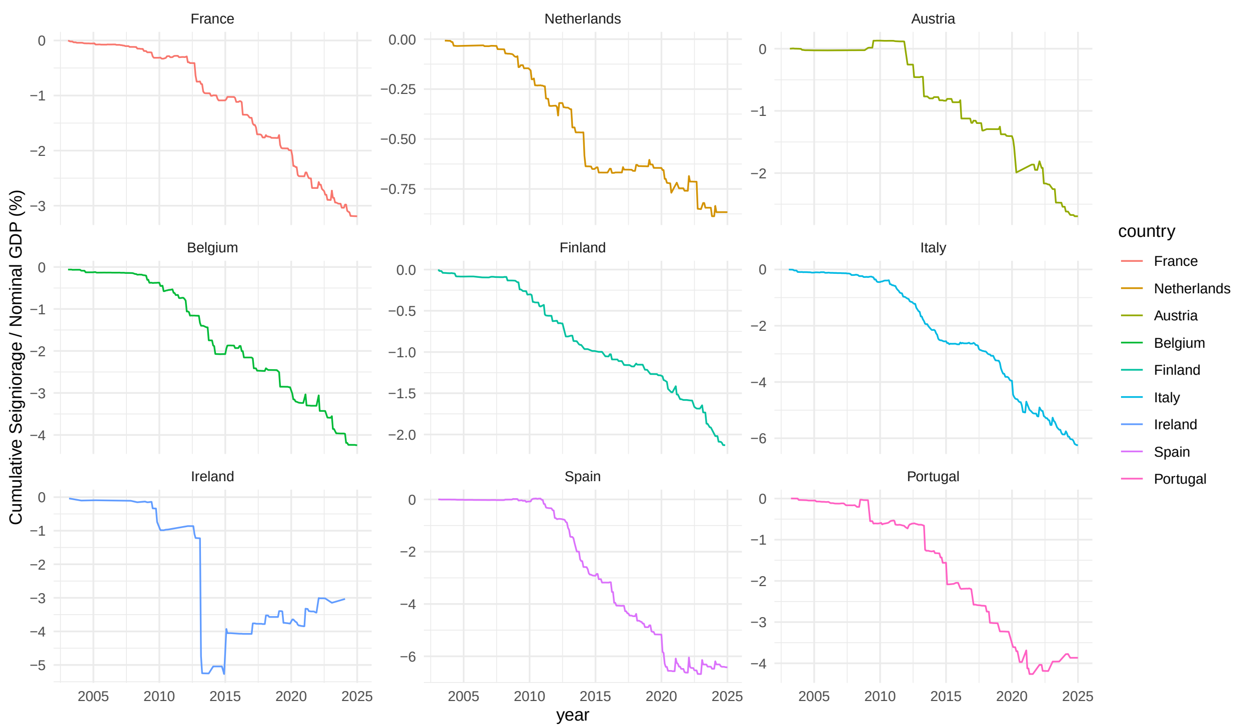
Notes: The convenience yield differentials are expressed relative to Germany and are in percentage points.

Figure A.4: The Term Structure of Average Convenience Yields



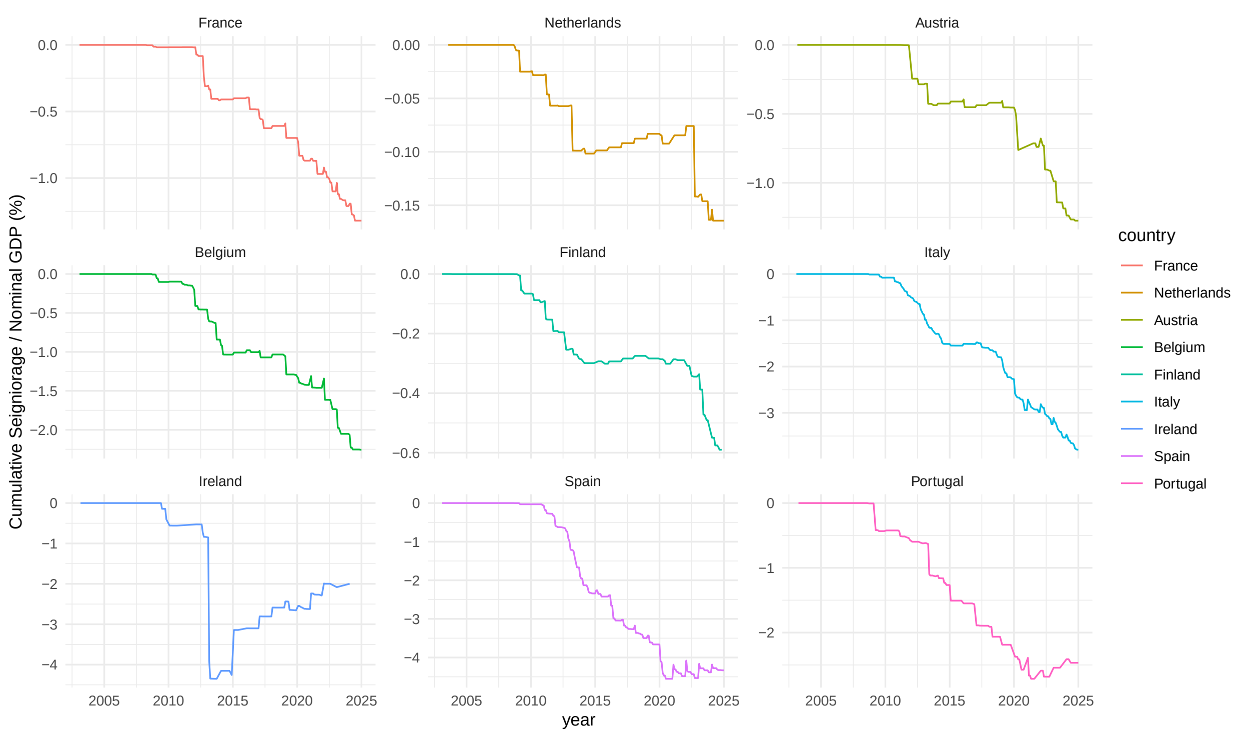
Notes: This figure reports the average convenience yield differentials $\tilde{\lambda}_t^i = \lambda_t^i - \lambda_t^{DE}$ across different tenors. The convenience yield differentials are annualized and reported in percentage points, 2002/07–2024/12.

Figure A.5: Cumulative Loss due to Convenience Yield Differentials



Notes: This figure plots each country's cumulative revenue loss, normalized by the concurrent national GDP.

Figure A.6: Cumulative Loss due to Convenience Yield Differentials, Alternative Scenario



Notes: This figure plots each country's cumulative revenue loss, normalized by the concurrent national GDP. In this alternative scenario, we assume that each country's bond convenience yield can be narrowed to 20 bps with respect to Germany, or remains unchanged if the gap is already lower than 20 bps.

Table A.1: Variance Decomposition of the Change in Convenience Yield Differentials

Country	$Std\left(\Delta\tilde{y}_t^5(n)\right)$	$\frac{\mathrm{Var}\left(\Delta\tilde{\delta}_t^5(n)\right)}{\mathrm{Var}\left(\Delta\tilde{y}_t^5(n)\right)}$	$\frac{\mathrm{Var}\left(\Delta\tilde{\lambda}_t^5(n)\right)}{\mathrm{Var}\left(\Delta\tilde{y}_t^5(n)\right)}$	$\frac{-2\mathrm{Cov}\left(\Delta\tilde{\delta}_t^5(n),\Delta\tilde{\lambda}_t^5(n)\right)}{\mathrm{Var}\left(\Delta\tilde{y}_t^5(n)\right)}$	$\frac{\mathrm{Cov}\left(\Delta\tilde{y}_t^5(n),\Delta\tilde{\delta}_t^5(n)\right)}{\mathrm{Var}\left(\Delta\tilde{y}_t^5(n)\right)}$	$\frac{-\mathrm{Cov}\left(\Delta\tilde{y}_t^5(n),\Delta\tilde{\lambda}_t^5(n)\right)}{\mathrm{Var}\left(\Delta\tilde{y}_t^5(n)\right)}$
Panel (a) 2002–2007						
France	0.01	0.07	1.08	−0.15	−0.00	1.00
Netherlands	0.02	0.06	1.15	−0.21	−0.05	1.05
Austria	0.03	0.07	0.97	−0.04	0.05	0.95
Belgium	0.02	0.14	0.94	−0.08	0.10	0.90
Finland	0.03	0.08	1.14	−0.21	−0.03	1.03
Italy	0.03	0.25	1.09	−0.34	0.08	0.92
Ireland	0.05	0.02	0.99	−0.00	0.01	0.99
Spain	0.03	0.11	1.09	−0.20	0.01	0.99
Portugal	0.02	0.13	1.12	−0.25	0.00	1.00
Average	0.03	0.10	1.06	−0.16	0.02	0.98
Panel (b) 2008–2024						
France	0.07	1.39	1.56	−1.96	0.41	0.59
Netherlands	0.05	0.70	1.35	−1.05	0.17	0.83
Austria	0.09	0.89	0.95	−0.84	0.47	0.53
Belgium	0.14	0.50	0.52	−0.01	0.49	0.51
Finland	0.07	0.24	1.23	−0.47	0.00	1.00
Italy	0.37	0.50	0.36	0.14	0.57	0.43
Ireland	0.53	0.35	0.53	0.12	0.41	0.59
Spain	0.32	0.44	0.33	0.23	0.56	0.44
Portugal	0.92	0.54	0.24	0.23	0.65	0.35
Average	0.28	0.62	0.79	−0.40	0.41	0.59

Notes: This table reports the variance decomposition of bond yield differential changes into convenience yield differential changes and default spread differential changes, all for the five-year tenor. The yields are annualized and reported in percentage points. The data are at the monthly frequency, 2002/07–2024/12.

Table A.2: Convenience Yields vs. Fiscal Conditions in the Time-Series: By Country

Country	Coefficient	*t*-Stats
Austria	1.06	1.18
Belgium	1.04	0.93
Finland	0.27	0.46
France	1.27	0.98
Ireland	7.03	4.27
Italy	5.34	2.60
Netherlands	1.13	0.64
Portugal	10.57	1.64
Spain	3.96	2.56

Notes: We estimate the regression in equation (23) country by country using the 5-year tenor. We report Newey-West standard errors. *p<0.1; **p<0.05; ***p<0.01.

Table A.3: Convenience Yield vs. Fiscal Forecasts in the Time-Series, Using Next Year Forecasts

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
	Panel (a): Surplus Forecast Alone		
Surplus Forecast/GDP	-15.22^{***}	4.68^{***}	-10.54^{**}
	(5.07)	(1.69)	(4.12)
Num. of Obs.	234	234	234
Adj. R^2 (full model)	0.32	0.23	0.32
Adj. R^2 (proj model)	0.04	0.04	0.03
	Panel (b): Control for Bid-Ask Spread		
Surplus Forecast/GDP	-21.48^{***}	6.37^{***}	-15.11^{***}
	(3.99)	(1.70)	(3.20)
Bid Ask Spread	34.95^{***}	-9.45^{***}	25.51^{***}
	(4.62)	(2.02)	(3.30)
Num. of Obs.	234	234	234
Adj. R^2 (full model)	0.65	0.52	0.61
Adj. R^2 (proj model)	0.50	0.40	0.44
	Panel (c): Control for GDP Growth and Inflation Forecasts		
Surplus Forecast/GDP	3.49	1.59	5.08
	(7.85)	(1.56)	(6.79)
GDP Growth Forecast	-0.75^{***}	0.19^{**}	-0.56^{***}
	(0.25)	(0.07)	(0.19)
Inflation Forecast	-0.15	-0.04	-0.19
	(0.17)	(0.06)	(0.14)
Num. of Obs.	234	234	234
Adj. R^2 (full model)	0.54	0.42	0.52
Adj. R^2 (proj model)	0.36	0.28	0.32

Notes: We estimate the regression in equation (25). Regression results are for 2002–2024 at quarterly frequency using the 5-year tenor. The right-hand side is the forecast of next year surplus and other controls. Rates and surplus forecasts are relative to their German counterparts. Rates and surplus-to-GDP ratios are in percentage points. We report Driscoll and Kraay (1998) standard errors. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Table A.4: Convenience Yields vs. Fiscal Forecasts in the Time-Series: By Country

Panel (a): Forecast of Current Year Surplus		
Country	Coefficient	t-Stats
France	1.56	1.96
Italy	6.49	2.89
Netherlands	3.56	2.98
Spain	20.24	2.58
Panel (b): Forecast of Next Year Surplus		
Country	Coefficient	t-Stats
France	0.99	0.91
Italy	4.66	1.46
Netherlands	3.66	3.34
Spain	17.97	2.56

Notes: We estimate the regression in equation (25) country by country for the 5-year tenor. We compute Newey-West standard errors and report associated t-statistics.

Table A.5: Spill-Overs to Corporate Bond Convenience Yields: Combining Tenors

Panel (a): Corporate vs. Sovereign Spreads			
	(1) $\tilde{y}^C$	(2) $\tilde{\lambda}^C$	(3) δ^C
Government Yield Diff	1.03***		
	(0.23)		
Government Convenience Yield Diff		0.29**	
		(0.12)	
Government CDS Diff			1.38***
			(0.36)
Num. of Obs.	248	248	248
Adj. R^2 (full model)	0.79	0.33	0.77
Adj. R^2 (proj model)	0.46	0.06	0.47

Panel (b): Relationship with Government Surplus			
	(1) $\tilde{y}^C$	(2) $\tilde{\lambda}^C$	(3) δ^C
Surplus/GDP	-38.37^{**}	-1.16	-39.53^{**}
	(16.08)	(1.25)	(17.09)
Num. of Obs.	248	248	248
Adj. R^2 (full model)	0.83	0.55	0.79
Adj. R^2 (proj model)	0.46	0.00	0.44

Notes: We estimate the regressions in equations (27) and (28). Regression results are for 2009—2024 at annual frequency using the 1-to-3-year, 3-to-5-year, and 5-to-10-year tenors. We include country-by-tenor fixed effects. Rates and surplus/GDP ratios are in percentage points. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.

Table A.6: Spill-Over to Corporate Bond Convenience Yields, BBB Bonds

Panel (a): Corporate vs. Sovereign Spreads

	(1) $\tilde{y}^C$	(2) $\tilde{\lambda}^C$	(3) δ^C
Government Yield Diff	1.18^{***}		
	(0.26)		
Government Convenience Yield Diff		0.40^{**}	
		(0.17)	
Government CDS Diff			1.45^{***}
			(0.29)
Num. of Obs.	84	84	84
Adj. R^2 (full model)	0.86	0.46	0.86
Adj. R^2 (proj model)	0.59	0.09	0.65

Panel (b): Relationship with Government Surplus

	(1) $\tilde{y}^C$	(2) $\tilde{\lambda}^C$	(3) δ^C
Surplus/GDP	-31.24^{**}	-0.91	-32.15^{**}
	(13.66)	(1.92)	(11.86)
Num. of Obs.	84	84	84
Adj. R^2 (full model)	0.77	0.40	0.76
Adj. R^2 (proj model)	0.33	-0.01	0.40

Notes: We estimate the regressions in equations (27) and (28). Regression results are for 2009—2024 at annual frequency using the 3-to-5-year tenor. Rates and surplus/GDP ratios are in percentage points. We report Driscoll and Kraay (1998) standard errors. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Table A.7: Convenience Yields vs. Fiscal Conditions in the Time-Series, Using Dollar CDS

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
	Panel (a): Surplus Alone		
Surplus/GDP	-19.91^{***}	4.09^{**}	-15.83^{***}
	(6.20)	(1.76)	(4.51)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.41	0.25	0.43
Adj. R^2 (proj model)	0.34	0.23	0.33
	Panel (b): Control for Bid-Ask Spread		
Surplus/GDP	-8.68^{***}	1.71^{*}	-6.97^{***}
	(1.31)	(0.86)	(0.77)
Bid Ask Spread	12.18^{***}	-2.58^{***}	9.60^{***}
	(0.59)	(0.53)	(0.29)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.81	0.56	0.79
Adj. R^2 (proj model)	0.79	0.55	0.76
	Panel (c): Control for GDP Growth		
Surplus/GDP	-18.30^{***}	3.92^{**}	-14.39^{***}
	(5.69)	(1.75)	(4.04)
GDP Growth	-7.91	1.07	-6.84
	(5.44)	(1.00)	(4.66)
Inflation	6.39	-1.40	4.99
	(10.58)	(2.22)	(8.78)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.44	0.25	0.45
Adj. R^2 (proj model)	0.37	0.23	0.36

Notes: Estimation results for the panel regression in equation (23). The sample is 2002–2024 at annual frequency using the 5-year tenor. Rates and surplus/GDP ratios are relative to their German counterparts. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.

B.2 Generalized Least Squares

We implement a feasible GLS procedure. We write our regression as:

$$y_{it} = X_{it}\beta + \varepsilon_{it} \tag{A.7}$$

with $\mathbb{E}[\varepsilon\varepsilon'] = \Omega$. Define P such that $PP' = \Omega$, we can rewrite our regression as

$$y^*_{it} = X^*_{it}\beta + \varepsilon^*_{it} \tag{A.8}$$

where $y^* = P^{-1}y$, $X^* = P^{-1}X$, and $\varepsilon^* = P^{-1}\varepsilon$. Since ε^* is homoskedastic and free of serial correlation, we can estimate β in (A.8) using OLS.

We build the covariance matrix Ω to accommodate the following features of the data: (1) heteroskedastic residuals with cross-sectional correlations, and (2) uniform AR(1) coefficient to allow for autocorrelation within each country's time series. We implement the standard two-step procedure, which estimates the covariance matrix Ω from OLS residuals in the first step, and uses this matrix to run the feasible GLS in the second step.

Constructing the Ω and P matrices based on this covariance matrix, we estimate the GLS regression in Table A.8 with the realized surplus/GDP ratio as the independent variable and Table A.9 the surplus forecast/GDP ratio as the independent variable. Since the feasible GLS estimation requires a balanced panel, we lose a few observations early in the sample. For comparison, we repeat the panel estimation with Driscoll-Kraay standard errors on the same sample in panel (b) of each table. In both cases, we find that the GLS estimate is an economically and significant predictor of convenience yields.

Table A.8: Convenience Yields vs. Fiscal Conditions in the Time-Series: GLS

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
	Panel (a): GLS		
Surplus/GDP	-18.95^{***}	4.41^{***}	-13.18^{***}
	(0.99)	(0.50)	(0.59)
Num. of Obs.	171	171	171
	Panel (b): OLS Driscoll-Kraay with Same Sample		
Surplus/GDP	-22.99^{***}	6.14^{**}	-16.85^{***}
	(6.47)	(2.20)	(4.33)
Num. of Obs.	171	171	171

Notes: We estimate the regression in equation (23) using a generalized least squares. Regression results are for 2007—2024 at quarterly frequency using the 5-year tenor.

Table A.9: Convenience Yields vs. Fiscal Forecasts in the Time-Series: GLS

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
	Panel (a): GLS		
Surplus Forecast/GDP	-2.74	3.04^{**}	-1.36
	(2.22)	(1.34)	(1.35)
Num. of Obs.	176	176	176
	Panel (b): OLS Driscoll-Kraay with Same Sample		
Surplus Forecast/GDP	-16.09^{**}	7.42^{**}	-8.67^{*}
	(6.88)	(3.07)	(4.86)
Num. of Obs.	176	176	176

Notes: We estimate the regression in equation (25) using a generalized least squares. Regression results are for 2010—2024 at quarterly frequency using the 5-year tenor.

B.3 Timing of Fiscal Data Release

The Council of the European Union provides clear guidance on when Eurozone countries make their fiscal data publicly available. Council Regulation (EC) No 479/2009 of 25 May 2009, which covers the protocol on the excessive deficit procedure annexed to the Treaty establishing the European Community, states:[13]

> *Article 3*
>
> *1. Member States shall report to the Commission (Eurostat) their planned and actual government deficits and levels of government debt twice a year, the first time before 1 April of the current year (year n) and the second time before 1 October of year n.*
>
> *Member States shall inform the Commission (Eurostat) which national authorities are responsible for the excessive deficit procedure reporting.*
>
> *2. Before 1 April of year n, Member States shall: (a) report to the Commission (Eurostat) their planned government deficit for year n, an up-to-date estimate of their actual government deficit for year n-1 and their actual government deficits for years n2, n-3 and n-4.*

Consistent with this regulation, we also find the following statement from the commission staff working document, which reports to the European Parliament and the Council on the quality of fiscal data reported by Member States in 2022:[14]

> *2.1.1. Timeliness*
>
> *Member States are required to report their actual and planned EDP data to Eurostat twice a year, before 1 April and before 1 October.*
>
> *In 2022, EDP reporting covered the 2018-2022 period; the figures for 2022 are those planned by the national authorities, while the 2018-2021 figures are actual data6.*
>
> *Under Article 8(1) of Regulation (EC) No 479/2009, Eurostat assesses the actual data, but not the planned data.*
>
> *In 2022, all 27 Member States met both deadlines for reporting their actual and the planned EDP data.*

Finally, we obtain our fiscal data from Eurostat, which has the following statement in its metadata file:[15]

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[13] This document can be found at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009R0479-20140901

[14] This document can be found at https://ec.europa.eu/eurostat/documents/1015035/2041369/Staff+working+document+reporting+to+the+European+Parliament+and+the+Council+on+the+quality+of+fiscal+data+reported+by+MS+in+2022.pdf/ee638f18-d12e-6215-74e8-bb3cf05837e0?t=1681915327300

[15] This document can be found at https://ec.europa.eu/eurostat/cache/metadata/en/gov_10dd_esms.htm

14. Timeliness and punctuality

14.1. Timeliness

Council Regulation 479/2009 requires that Member States report EDP government deficit and debt data to Eurostat twice per year: before 1 April and before 1 October. Data is published around three weeks after the transmission deadline as announced in the release calendar.

14.2. Punctuality

Member States normally meet the deadlines.

We also confirm this date by checking Eurostat's "release calendar," which announces the fiscal data release around April 21 of each year.

These statements suggest that April (the end of April according to our timing convention) would be the earliest time when the fiscal deficits of the past year become available. As such, in our empirical exercise, we merge the monthly asset price data in April (as opposed to June in the last submission) of year $t + 1$ with the annual fiscal data to reflect the timing of the fiscal data release.

B.4 Component of Convenience Yields Orthogonal to Default Spreads

In Table A.10 we estimate a panel regression of convenience yield differentials on CDS spread differentials. As expected under the null hypothesis of fiscal drivers of both convenience yields and default spreads, the two series are negatively correlated with each other in the full sample (column 3) as well as in the 2008–2024 subsample (column 2) where most of the action in convenience yields and default spreads is concentrated. In the earlier subsample, with much less variability in yields, the correlation is positive but weaker (R^2 is much lower).

Table A.10: Convenience Yield Differential vs. CDS Spread Differential

	(1)	(2)	(3)	(4)	(5)	(6)
	Level Regression			Change Regression		
	2002–2007	2008–2024	Full Sample	2002–2007	2008–2024	Full Sample
CDS Spread Diff	0.92^{**}	-0.31^{***}	-0.31^{***}			
	(0.39)	(0.04)	(0.03)			
ΔCDS Spread Diff				0.72^{***}	-0.18^{***}	-0.18^{***}
				(0.25)	(0.06)	(0.06)
Num. of Obs.	536	1836	2372	525	1836	2361
Adj. R^2 (full model)	0.16	0.56	0.58	0.03	0.04	0.04
Adj. R^2 (proj model)	0.10	0.53	0.55	0.04	0.05	0.05

Notes: Estimation results for the panel regression of convenience yield differential on the CDS spread differential. The sample is 2002/07–2024/12 at annual frequency using the 5-year tenor. Rates are differenced by their German counterparts. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.

If we assign all of the comovement between the convenience yield and the CDS spread to the CDS spread, the convenience yield accounts for 94% of the variation in Eurozone bond yields in the 2002–2007 period and 28% in the 2008–2024 period. If instead, we assign all of the comovement to the convenience yield, convenience yields account for 89% of the variation in yields in the earlier period and 57% in the later period. Table A.11 summarizes these two alternative variance decompositions (rows 2 and 3) and compares them to the benchmark decomposition (row 1). If we do this variance decomposition in first differences, where we assign the common comovement makes less of a difference, with the convenience yield accounting for between 51% and 61% of the variation in yield changes in the 2008–2024 period.

Finally, we ask whether the relationship between the surplus and the convenience yield comes from the component of the convenience yield that is correlated with the default spread or from the component that is orthogonal to the default spread. We regress the convenience yield differential on the CDS spread differential, controlling for the country fixed effects. We collect the residual and compute the component of the convenience yield differential that is explained by the CDS differential. Then, we repeat our regression of the convenience yield differential (or one of its

Table A.11: Variance Decomposition of Convenience Yield Differential

Panel (a) 2002–2007						
Country	$Sd(\tilde{y}_t^i)$	$\frac{\text{Var}(\tilde{\delta}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{\text{Var}(\tilde{\lambda}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{-2\text{Cov}(\tilde{\delta}_t^i,\tilde{\lambda}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{\text{Cov}(\tilde{y}_t^i,\tilde{\delta}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{-\text{Cov}(\tilde{y}_t^i,\tilde{\lambda}_t^i)}{\text{Var}(\tilde{y}_t^i)}$
Average, Baseline in the Paper	0.05	0.13	1.13	−0.27	0.00	1.00
Assign All Comovement to CDS Spread	0.05	0.06	0.94	−0.00	0.06	0.94
Assign All Comovement to Conv Yield	0.05	0.11	0.89	−0.00	0.11	0.89
Panel (b) 2008–2024						
Country	$Sd(\tilde{y}_t^i)$	$\frac{\text{Var}(\tilde{\delta}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{\text{Var}(\tilde{\lambda}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{-2\text{Cov}(\tilde{\delta}_t^i,\tilde{\lambda}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{\text{Cov}(\tilde{y}_t^i,\tilde{\delta}_t^i)}{\text{Var}(\tilde{y}_t^i)}$	$\frac{-\text{Cov}(\tilde{y}_t^i,\tilde{\lambda}_t^i)}{\text{Var}(\tilde{y}_t^i)}$
Average	1.00	0.56	0.31	0.12	0.62	0.38
Assign All Comovement to CDS Spread	1.00	0.72	0.28	0.00	0.72	0.28
Assign All Comovement to Conv Yield	1.00	0.43	0.57	0.00	0.43	0.57

Notes: This figure reports the variance decomposition of bond yield variations into convenience yield differentials and default spreads. We focus on the 5-year tenor only. The yields are annualized and reported in percentage points. The data are at monthly frequency, 2002/07–2024/12.

components) on the surplus/GDP ratio differential:

$$\tilde{\lambda}_t^i = \alpha_i + \beta \tilde{s}_t^i + \varepsilon_t^i.$$

Table A.12 shows that the surplus/GDP ratio has a much stronger explanatory power for the component of the convenience yield differential that is correlated with the CDS differential than with the orthogonal component. There is no significant relationship between the surplus and the orthogonal component. This result suggests that the fiscal conditions drive a common component in the CDS spread and the convenience yield.

Table A.12: Response of Convenience Yields and Its Components

	(1) $\tilde{\lambda}$	(2) Orthogonal to CDS	(3) Common with CDS
Surplus/GDP	5.37**	0.92	4.45***
	(1.95)	(0.77)	(1.31)
Num. of Obs.	203	203	203
Adj. R^2 (full model)	0.32	−0.02	0.37
Adj. R^2 (proj model)	0.30	0.02	0.32

Notes: The sample is 2002–2024 at annual frequency using the 5-year tenor. Convenience yields are relative to their German counterparts. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.

B.5 ECB Announcements

The ECB undertook a series of unconventional monetary policy operations in 2008-09 that did not involve sovereign debt.[16] Prior to 2015, quantitative easing (QE) in the form of ECB purchases of securities did not involve government bonds, but rather took the form of a covered bond purchase program (CBPP)[17] The CBPP was relaunched in October 2014,[18], followed by an asset-backed securities purchase program (ABSPP) in November 2014,[19] and augmented with a corporate sector purchase program (CSPP) in June 2016,[20] It is only in March 2015 that a QE program with public sector debt was launched.[21]

During the Eurozone debt crisis, the ECB announced the Securities Markets Program (SMP) on May 9, 2010 in order to address problems with the monetary policy transmission mechanism and price stability. The SMP is not a traditional QE program since all purchases were sterilized, so that they did not impact the money supply or M3 (the broad money aggregate of the euro area). The explicit goal was not to lower interest rates, but rather restore the functioning of sovereign bond markets. On May 10, 2010, in a first round (SMP1), bonds of Greece, Ireland, and Portugal were bought by the national central banks according to their capital key. On August 7, 2011, the SMP was relaunched with additional purchases of Irish and Portuguese bonds and first-time purchases of Italian and Spanish bonds while discontinuing purchases from Greece. The program's end was announced on September 6, 2012, when the SMP program was replaced by the Outright Monetary Transactions (OMT) program. Studies by ECB economists Eser and Schwaab (2016) and Ghysels, Idier, Manganelli, and Vergote (2017) use high-frequency data on SMP purchases and sovereign bond quotes and find that the SMP was effective at reducing yields on government bonds in the countries under the program. They find that the SMP announcement had an immediate impact

[16]From August 2008 until July 2012, there was a fixed-rate full allotment policy in which the ECB provided a collateralized lending facility to Eurozone banks. There were additional bank liquidity facilities in the form of 6-month and 12-month LTRO operations in both 2009 and 2011. In addition, there were dollar swap lines with the U.S. Federal Reserve in both 2008 and 2011.

[17]The first program was announced in May 2009 (CBPP1) and relaunched in November 2011 (CBPP2).

[18]Between October 2014 and December 2018, the Eurosystem conducted net purchases of covered bonds under a third covered bond purchase program (CBPP3). The net purchases under CBPP3 were restarted in November 2019 and continued until June 2022. Between July 2022 and February 2023, the covered bond portfolio was held constant, and from March 2023, the portfolio began to roll off.

[19]Between November 2014 and December 2018, the Eurosystem conducted net purchases under the ABSPP. From January until October 2019, the principal got reinvested. In November 2019, net purchases under the ABSPP restarted and continued until June 2022. Between July 2022 and February 2023, principal was reinvested, from March 2023, only partial reinvestment took place, and from July 2023, all ABSPP reinvestments stopped.

[20]Between June 2016 and December 2018, the Eurosystem conducted net purchases of corporate bonds (CSPP). from January to October 2019, the principal was reinvested. From November 2019, net purchases restarted until June 2022. Between July 2022 and February 2023, principal was reinvested, from March 2023, only partial reinvestment took place, and from July 2023, all CSPP reinvestments stopped.

[21]The public sector securities purchase program (PSPP) was launched on March 9, 2015 and ran until December 19, 2018. From January to October 2019 the Eurosystem only reinvested the principal payments. Purchases of securities under the PSPP were then restarted on 1 November 2019 and continued until the end of June 2022. Between July 2022 and February 2023 PSPP holdings were reinvested. From March 2023 the Eurosystem only partially reinvested the principal payments, and as of July 2023 the Eurosystem discontinued all PSPP reinvestments.

on government bond spreads, noting that spreads on 10-year Greek government bonds fell by more than 400 basis points on May 9, 2010 (the day the program was formally announced), while spreads on Italian and Spanish bonds fell by almost 100 basis points on August 8, 2011, after the ECB announced SMP2.

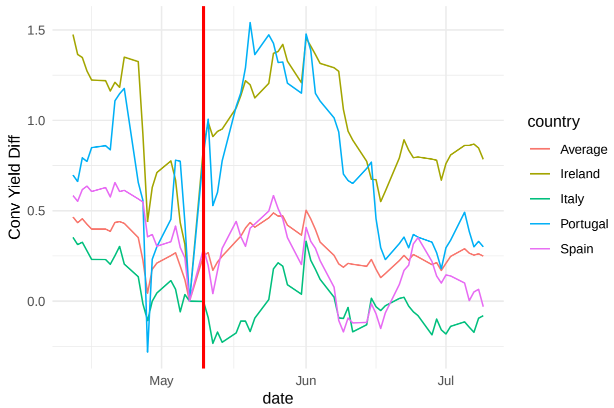
Turning to the OMT program, first announced on August 2, 2012 with further specifics on September 6, 2012 (when it formally replaced the SMP), its goal was to address spatial fragmentation in financial market conditions. It permitted the outright purchase of Eurozone government bonds in secondary markets under a series of conditions. Like with the SMP, the purchases were to be sterilized. However, the program had severe policy conditionality and the conditions were not met for any country. Hence the program was never actually deployed between 2012 through 2014. However, Altavilla, Giannone, and Lenza (2018) find that the *announcement* of the OMT program led to a decline in Italian and Spanish 2-year bond yields of 1.75 and 2.09 percent, respectively.

First, we plot the responses of the convenience yield differentials between different countries and Germany around these four ECB announcements. Figure A.7 shows evidence for rising convenience yield differentials after the first three ECB announcements in the 2010-2012 period, but not for the PSPP in 2015. The effects are stronger for Portugal and Ireland in SMP1, which makes sense since they were the target of that policy. The overall effects are largest for the SMP2 and OMT announcements, and larger for Ireland and Portugal than for Italy and Spain. In both events, there are pre-trends for Ireland so that a strict causal interpretation is difficult.

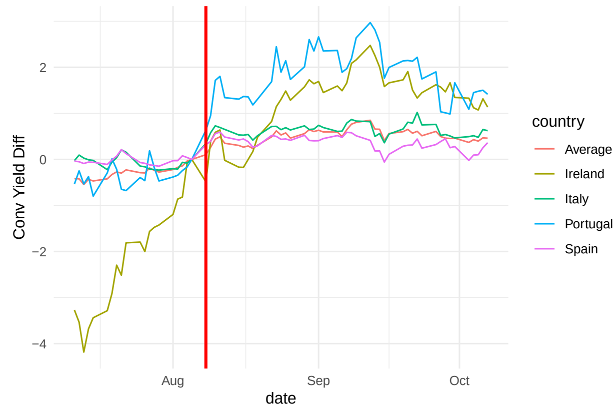
Second, we estimate the relationship between bond yield, convenience yield, and default spread differentials and the four events using our usual monthly regressions. We include the lagged dependent variable to focus better on the news in the announcements. The SMP1 indicator is 1 for Ireland and Portugal in May 2010 and zero otherwise, the SMP2 indicator variable is 1 for Ireland, Portugal, Spain, and Italy in August 2011 and zero otherwise, the OMT indicator is 1 in August and September 2012 for all Eurozone countries and zero otherwise, and the PSPP indicator is 1 in March 2015 for all Eurozone countries and zero otherwise. Table A.13 shows that all four announcements lowered the bond yields. However, only SMP1 and SMP2 raised the bonds' convenience yields relative to the German bond's, whereas OMT and PSPP reduced their CDS spreads. By narrowing convenience yield differentials, SMP1 and SMP2 shrink bond yield differentials. The OMT and PSPP indicators have no effect on convenience yield differentials but shrink yield differentials by shrinking default spread differentials. Strict causal interpretations of these results are difficult since the policy indicator variable effects can also pick up country-specific macroeconomic conditions.

Finally, in Table A.14, we repeat the regression in Table 7, but remove the quarters that coincide with the ECB announcements. This analysis drops the observations for Ireland and Portugal for the dependent variables in 2010Q2, 2011Q3, 2012Q3, and 2015Q1, for Spain and Italy in 2011Q3, 2012Q3, and 2015Q1, and for all Eurozone countries in 2012Q3 and 2015Q1. The positive relation-

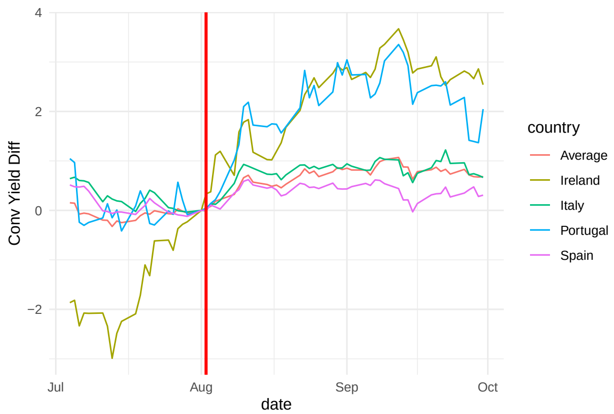
Figure A.7: The Effects of ECB Announcements



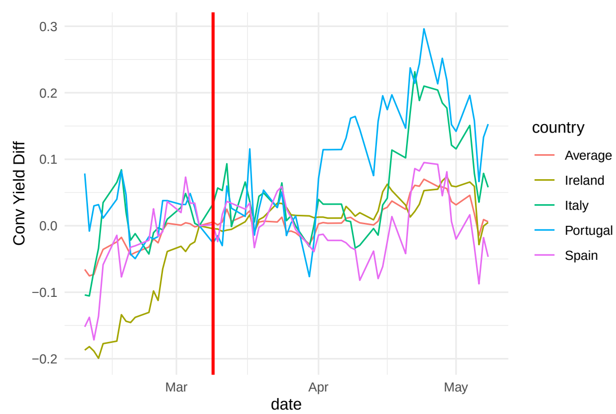
SMP1



SMP2



OMT



PSPP

Notes: We report the convenience yield differentials between different countries and Germany around the 4 ECB announcements. The average country reflects the average of non-Germany countries in our sample.

ship between the fiscal forecasts and the bond convenience yields remain robust.

Table A.13: Response of Bond Yields, Convenience Yields and CDS Spreads to ECB Announcements

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
SMP1	-0.32^{***}	0.67^{***}	0.37^{***}
	(0.07)	(0.02)	(0.05)
SMP2	-1.87^{***}	1.69^{***}	-0.04
	(0.26)	(0.08)	(0.14)
OMT	-0.44^{***}	-0.05	-0.44^{***}
	(0.10)	(0.05)	(0.07)
PSPP	-0.02^{**}	0.00	-0.03^{***}
	(0.01)	(0.01)	(0.01)
Lag Dependent Variable	0.98^{***}	0.92^{***}	0.98^{***}
	(0.04)	(0.04)	(0.03)
Num. of Obs.	2363	2363	2363
Adj. R^2 (full model)	0.95	0.83	0.95
Adj. R^2 (proj model)	0.94	0.82	0.95

Notes: The sample is 2002–2024 at monthly frequency using the 5-year tenor. Rates are differenced by their German counterparts. We report Driscoll and Kraay (1998) standard errors. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Table A.14: Convenience Yields vs. Fiscal Forecasts in the Time-Series: Removing Observations with ECB Announcements

	(1) $\tilde{y}$	(2) $\tilde{\lambda}$	(3) $\tilde{\delta}$
	Panel (a): Surplus Forecast Alone		
Surplus Forecast/GDP	-20.88^{***}	5.55^{***}	-15.34^{***}
	(3.72)	(1.77)	(2.48)
Num. of Obs.	226	226	226
Adj. R^2 (full model)	0.37	0.27	0.36
Adj. R^2 (proj model)	0.12	0.09	0.10
	Panel (b): Control for Bid-Ask Spread		
Surplus Forecast/GDP	-22.67^{***}	5.98^{***}	-16.69^{***}
	(2.75)	(1.59)	(1.86)
Bid Ask Spread	32.89^{***}	-8.03^{***}	24.86^{***}
	(4.86)	(1.54)	(3.71)
Num. of Obs.	226	226	226
Adj. R^2 (full model)	0.66	0.50	0.63
Adj. R^2 (proj model)	0.52	0.37	0.47
	Panel (c): Control for GDP Growth and Inflation Forecasts		
Surplus Forecast/GDP	-22.17^{***}	6.89^{***}	-15.29^{***}
	(5.75)	(2.13)	(4.55)
GDP Growth Forecast	-0.16	0.02	-0.14
	(0.11)	(0.02)	(0.09)
Inflation Forecast	0.41^{*}	-0.12^{*}	0.29^{*}
	(0.22)	(0.07)	(0.17)
Num. of Obs.	226	226	226
Adj. R^2 (full model)	0.45	0.32	0.45
Adj. R^2 (proj model)	0.23	0.16	0.22

Notes: We estimate the regression in equation (25). Regression results are for 2002–2024 at quarterly frequency using the 5-year tenor. We remove the quarter-country observations which coincided with the ECB announcements. The right-hand side is the forecast of current year surplus and other controls. Rates and surplus forecasts are relative to their German counterparts. Rates and surplus/GDP ratios are in percentage points. We report Driscoll and Kraay (1998) standard errors. *p<0.1; **p<0.05; ***p<0.01.