

Liquidity and resilience in the core European sovereign bond markets

March 2024



Executive summary

In 2023, in response to a request from members, ICMA created a Bond Market Liquidity Taskforce (BMLT) to take a deep dive into bond market microstructures and liquidity conditions with a view to identifying potential vulnerabilities and providing recommendations to increase resilience. The analysis is based on both quantitative and qualitative data. This first phase of the BMLT's work focuses on core European sovereign bond markets: Germany, France, Italy, Spain, and the UK.

The key findings of the research are:

- Liquidity in the core European bond markets is generally good, as defined by the ability to execute larger than average transactions, relatively quickly, without significantly moving the market.
- However, in recent years liquidity has become much more sensitive to both episodes of unexpected volatility and regulatory reporting dates (ie year-end and some quarter-ends).
- This can be roundly attributed to the combination of a significant increase in the outstanding stock of government debt while primary dealer balance sheets and appetite for risk, on aggregate, have reduced markedly.
- Applying modelling on historical bid-ask spreads, it becomes clear that at certain points these widen significantly, and this cannot be explained by volatility alone. Rather, volatility is the catalyst for a discernible retreat from liquidity provision.
- Furthermore, the speed at which markets become volatile (the 'volatility of volatility') has increased, possibly aided by greater transparency and more dependence on e-trading and automation.
- Repo markets function well, even in times of heightened stress, but are also subject to sharp drops in liquidity around reporting dates.
- Liquidity in the sovereign bond futures markets is generally good, although limited to a few contracts, and again prone to a rapid thinning and widening of prices in times of stress.
- Market participants accept that episodic heightened volatility, with rapid evaporation of liquidity, and a sharp repricing of risk, is the new normal.
- Participants also believe that central banks will be required to intervene in bond markets more frequently and systematically to restore stability.
- The consistent recommendation from market participants, both sell side and buy side, to make sovereign bond markets more resilient, is that policy makers and regulators should review the design and calibration of prudential regulation as it applies to primary dealers. They suggest that there is a trade-off between high levels of bank capitalization and liquidity and bond market resilience.

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Liquidity and resilience in the core European sovereign bond markets

Part One



Why this report

At a meeting of ICMA's Committee of the Regional Representatives (CRR) in December 2022, it was suggested that ICMA leverage its various initiatives related to fixed income market structure and liquidity to take a more holistic market view, looking also at the inter-dependencies of different markets, to identify potential risks and vulnerabilities. This would include an analysis of the impacts and interplay of prudential, market, and fund regulation. This multi-dimensional perspective is intended to inform recommendations to improve overall market resilience and liquidity.

In response to the suggestion, ICMA proposed to create and mobilise a Bond Market Liquidity Taskforce ("the Taskforce") to drive this initiative. The Taskforce is made up of interested ICMA members, representing sovereign, corporate, short-term, or repo markets, including sell side, buy side, and relevant financial market infrastructures.

ICMA established a small advisory group of members in early 2023 to discuss and agree the potential approach for the work and how the Taskforce could best be formed and mobilised.

Following the first meeting of the Taskforce in April 2023 and a subsequent "open-to-all" call with a broader audience of members in May 2022, it was agreed that the Taskforce should approach its work in phases, addressing different bond market segments sequentially. The first phase of the Taskforce's work ("Phase 1") focuses on core European sovereign bond markets, identified as being those of Germany, France, Italy, Spain, and the UK.

The approach

A three-step approach was outlined for the initiative.

In the first step, the ICMA secretariat would conduct desk-based research on the structure of each of the five bond markets, including extensive data gathering and quantitative analysis to identify any trends or patterns. This could also help to identify any historical observations, either idiosyncratic or structural, where markets may have become dislocated or broken down. The full background research and data analysis can be found in Section one of Part two of the report.

In the second step, as an extension of the data analysis, the ICMA secretariat used machine learning to identify distinct phases in the underlying markets in relation to other observable markets and data points (clustering), as well as modelling for bid-ask spreads (often used as a proxy for liquidity) for the main on-the-run bonds for the five sovereign markets. The aim of the latter was to adjust for volatility and other factors that drive bid-ask spreads in order to isolate any historical evidence of "illiquidity premia". The machine learning based analysis and modelling can be found in Section two of Part two.

The research, data, and analysis were shared with the Taskforce for review and feedback,

In the third step, the secretariat reached out to members active in some or all of the relevant markets, both sell- and buy-side, to conduct semi-structured interviews. The objective of the interviews was to confirm and complement the quantitative analysis with a qualitative overlay, to help explain the key observations and conclusions drawn from the data, as well as to help formulate meaningful recommendations to help improve market resilience.

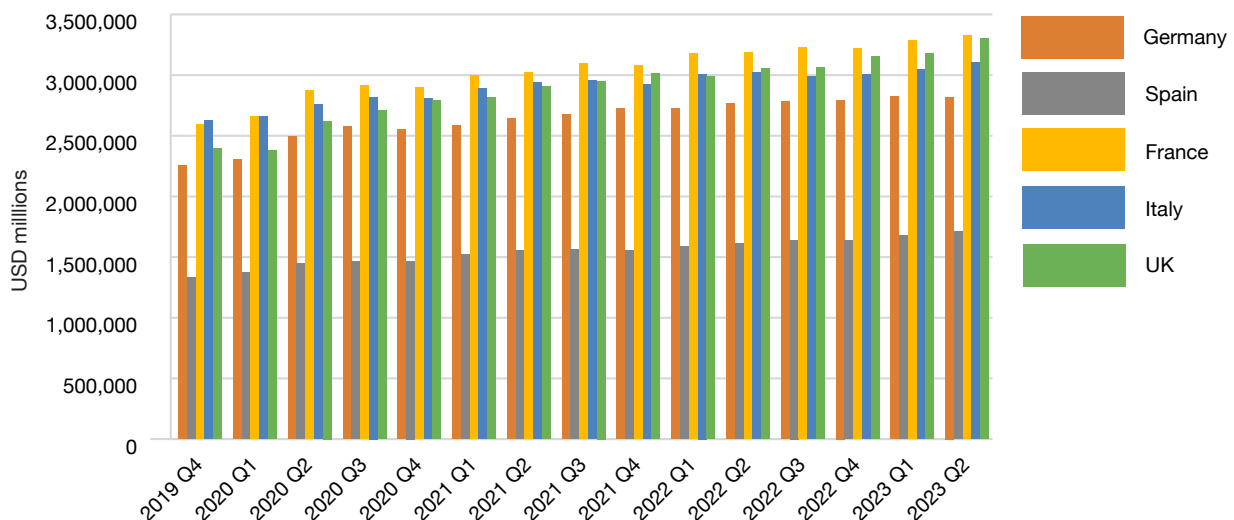
The core European sovereign bond markets

The Taskforce identifies the core European sovereign bond markets as those of Germany, France, Italy, Spain, and the UK. These are by far the largest individual European sovereign bond markets, with a combined notional outstanding value of \$14.3tn as of Q2 2023 (see Figure 1). Together they account for more than 78% of the total notional outstanding EU27+1 sovereign bond markets. Furthermore, in terms of secondary market trading volumes, they represent 88% of total EU27+1 traded value (see Figure 2).¹

As well as in absolute and relative size, these markets are also structurally distinct from other European sovereign bond markets, with active exchange-traded futures markets, extensive Primary Dealer networks, well-defined yield curves, covering multiple tenors with large on-the-run and off-the-run issues, and a deep and diverse investor base (Belgium and the Netherlands are also well developed, but exhibit smaller markets). Furthermore, these markets are often used as both pricing reference points and hedges for other, smaller, European sovereign bond markets, as well as EUR and GBP corporate bonds markets.

Essentially, any vulnerabilities in these markets will have implications that will reverberate across European bond markets more broadly.

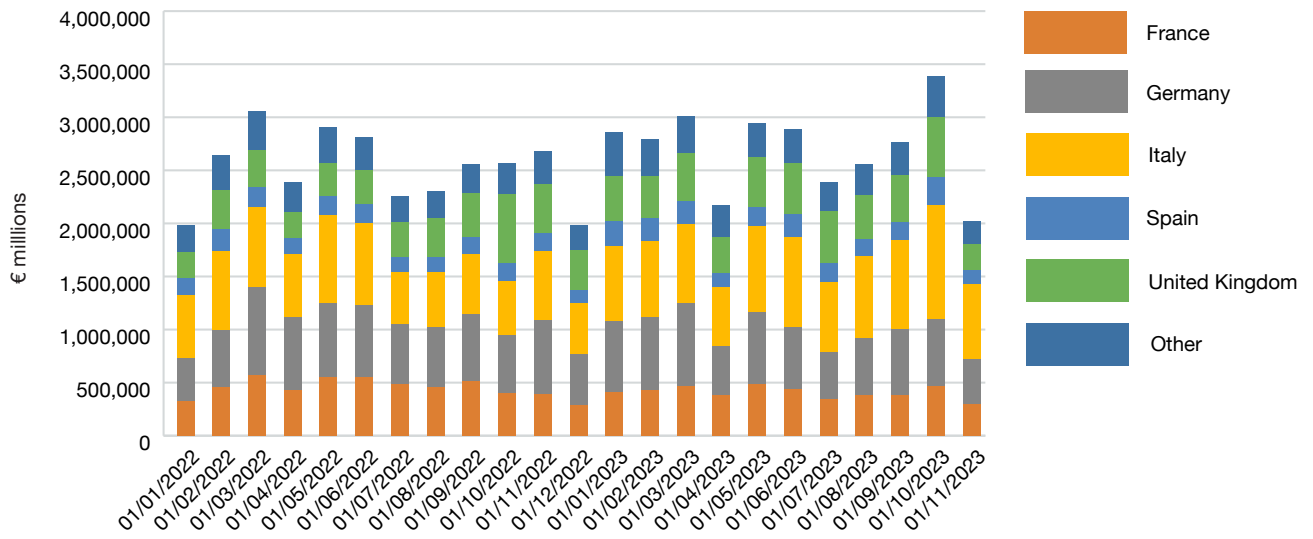
Figure 1: Quarterly time series of outstanding core European sovereign bond markets



Source: ICMA analysis using UK ONS and Eurostat data

1. Based on MIFIR data collated using Propellant software, covering the period January 2022 through June 2023.

Figure 2: EU 27+1 sovereign bond markets: monthly traded volumes



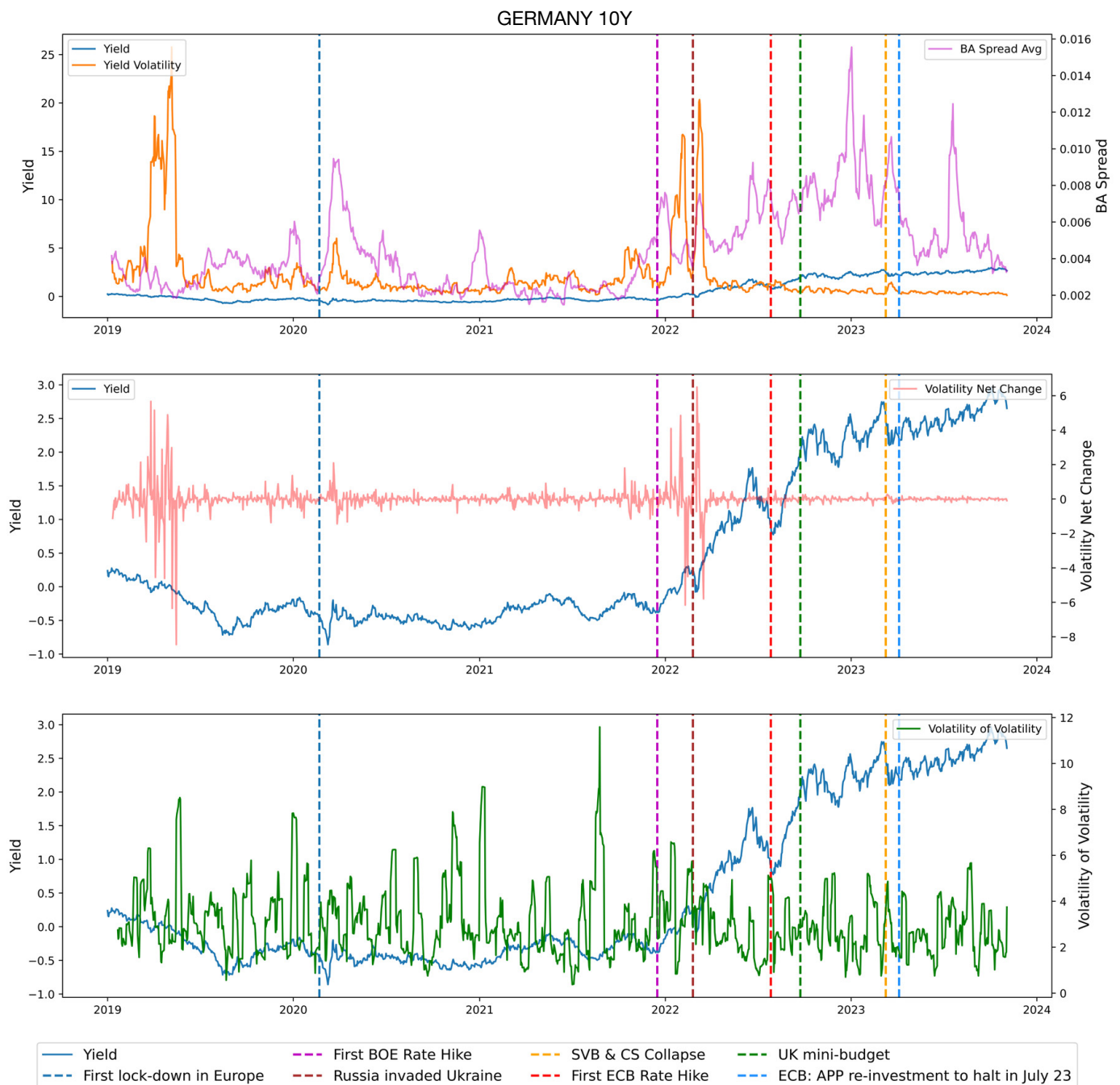
Source: ICMA analysis using MiFIR data collated using Propellant software

An anatomy of liquidity

In its [2016 report](#) on the European corporate bond market, ICMA settled upon the following definition for liquidity: the ability to execute buy or sell orders, when you want, in the size you want, without causing a significant impact on the market price (ICMA 2016). This essentially captures the three dimensions of liquidity outlined by Kyle (1985) and Harris (2003): cost, depth, and time. This largely qualitative view is shared by Taskforce members.

The challenge, of course, is translating this definition into a quantifiable metric. In our analysis we have tried to identify liquidity patterns using a number of metrics, including sharp moves in bond yields, yield volatility (seven days), volatility of volatility, and bid-ask spreads. When we view the core markets along these parameters, we identify clear episodes where liquidity appears to become stretched, as illustrated in Figures 3 and 4.

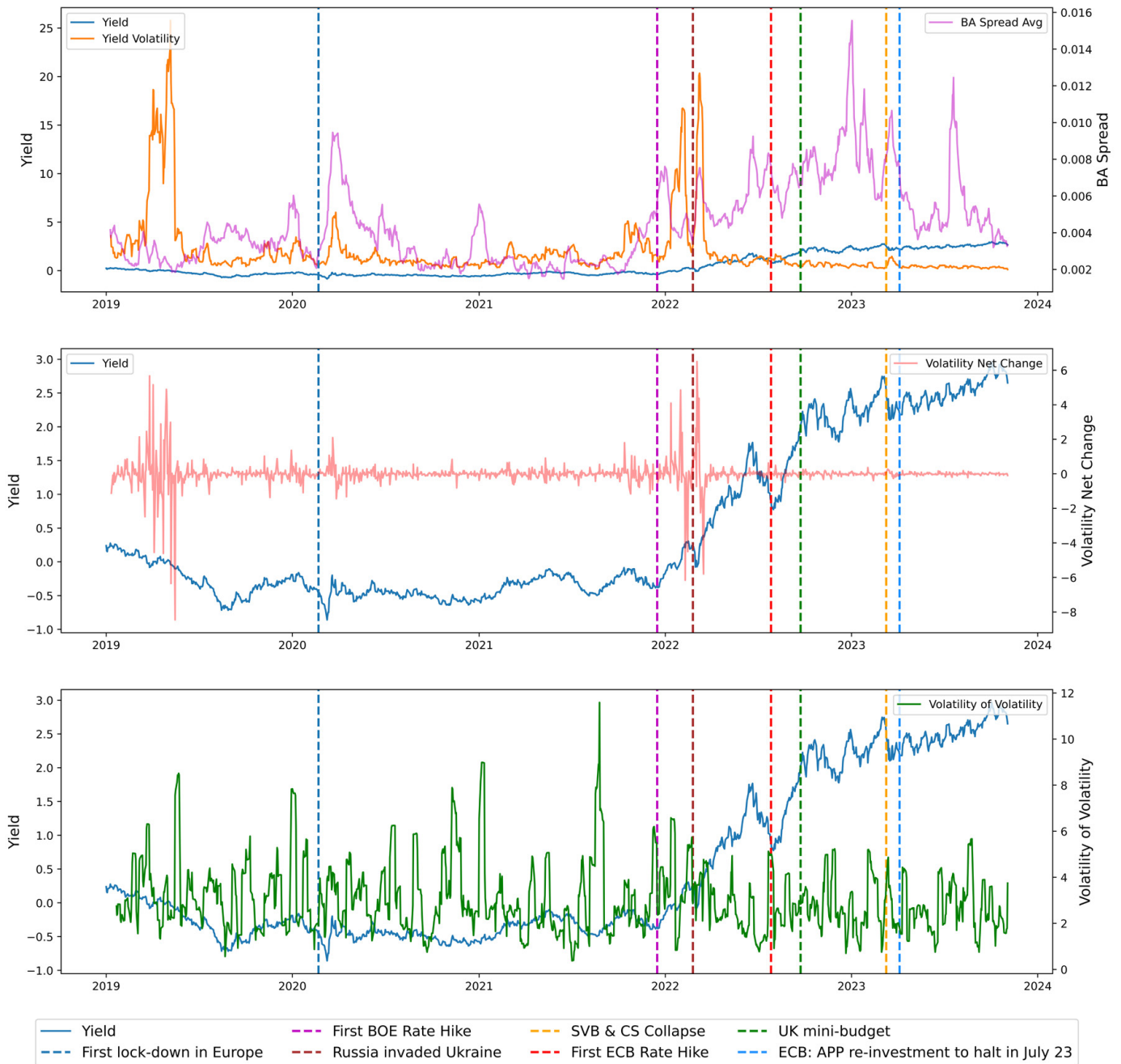
Figure 3: German 10yr on-the-run liquidity analysis



Source: ICMA analysis using Bloomberg data

Figure 4: UK 10yr on-the-run liquidity analysis

UK 10Y



Source: ICMA analysis using Bloomberg data

What we observe from the data are specific events around which liquidity appears to become stretched, with some or all of the following features: sharp upticks in bond yields, increased volatility, increased volatility of volatility, and wider bid-ask spreads. In recent years, these events are: the first lock-down in response to the COVID-19 pandemic, the start of the hiking cycles in the UK and Eurozone, the Russian invasion of Ukraine, the collapse of Silicon Valley Bank, and the September 2022 UK mini-budget.

In addition, we observe notable dislocations at calendar year-end and over some quarter-ends.

Modelling for bid-ask spreads

An important point flagged during the interview process is that an increase in volatility does not in itself imply a drop in liquidity. It may become relatively more expensive to transact during times of heightened volatility, but it should not necessarily become more difficult. In bond markets, which are structurally distinct from equity markets, liquidity is primarily provided by intermediating market-makers, mainly Primary Dealers in the case of sovereign bond markets, who take the other side of investor trades, employing balance sheet and assuming risk. The difference between where they will buy and where they are prepared to sell (particularly where they do not hold a matching opposite position) will be determined by a number of factors, including the cost of capital of holding the position, any expected hedging and funding costs, the expected time to trade out of the position, and, most importantly, volatility. Changes in bid-ask spreads therefore generally reflect changes in market volatility, rather than liquidity. In fact, some analysis undertaken on bond market liquidity has been guilty of conflating liquidity with volatility.

To account for this, we used a series of data points, spanning five years, which also included various volatility measures, to model for bid-ask spreads (BA) for both 2yr and 10yr on-the-runs for the five issuers. A detailed explanation of methodology and results can be found in the Machine Learning section in Part two.

Depending on the underlying bond, we are able to explain successfully between 29% and 72% of the observed bid-ask spread. We then use the difference between the observed spread and predicted spread as a measure of illiquidity, or “liquidity premium”: effectively the additional cost to investors to source liquidity.

What we observe is that at times of heightened volatility, or at year-end or certain quarter-ends, bid-ask spreads widen by notably more than can be explained by our models, suggesting a deterioration in liquidity that can be expressed as a quantifiable cost to investors. Our observations show that this liquidity premium varies with issuer (with a maximum of 1.25 basis point (bp) for 10yr UK and 4bp for 10yr Italy), and with shorter maturities being impacted more in terms of bp cost (with a maximum of 10bp for 2yr Spain and 25bp for 2yr France), but broadly similar when adjusted for duration, ranging from around x2.5 to x8 the normal bid-ask spread.

Some of the results are illustrated in Figures 5 to 8, with the full results found in Part two.

Figure 5: 10yr UK liquidity premium

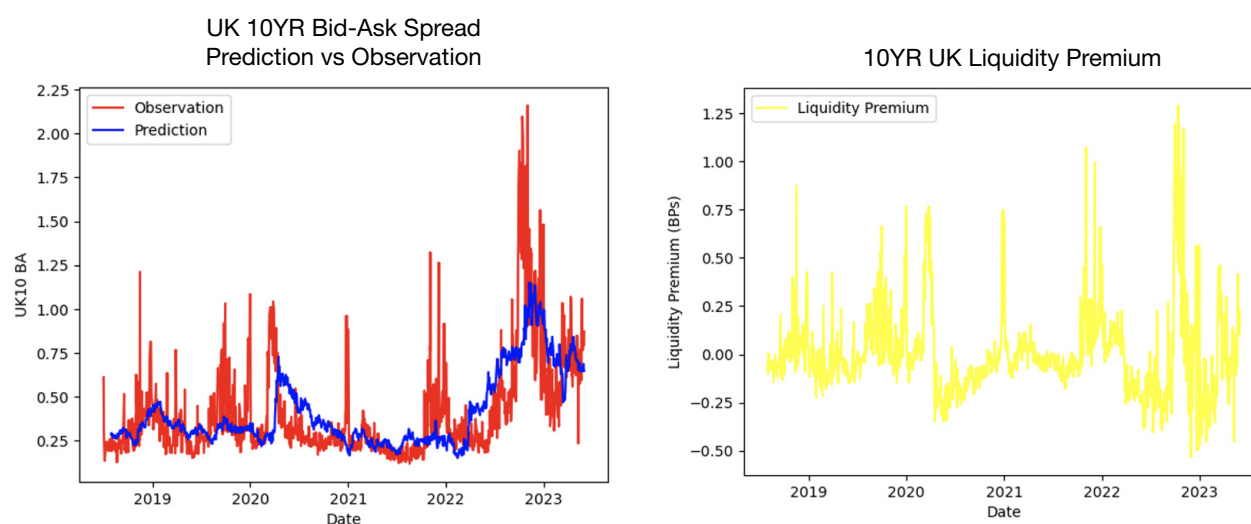


Figure 6: 10yr Italy liquidity premium

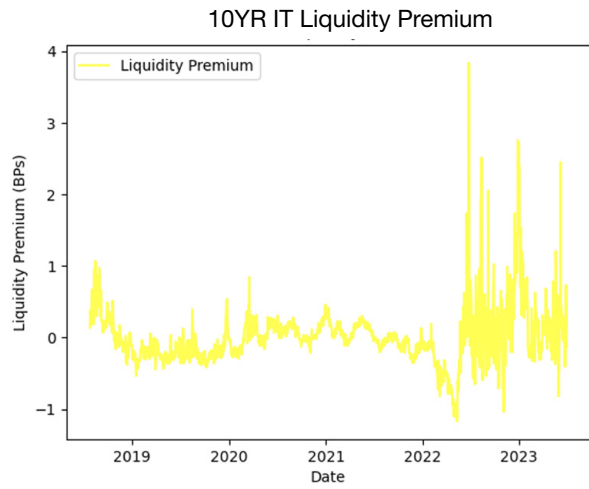
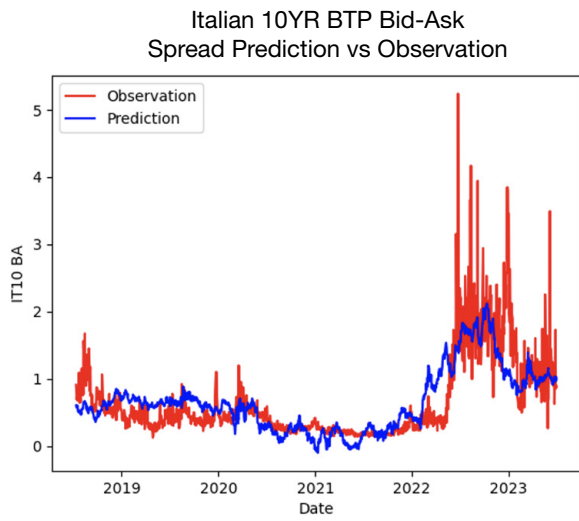


Figure 7: 2yr Spain liquidity premium

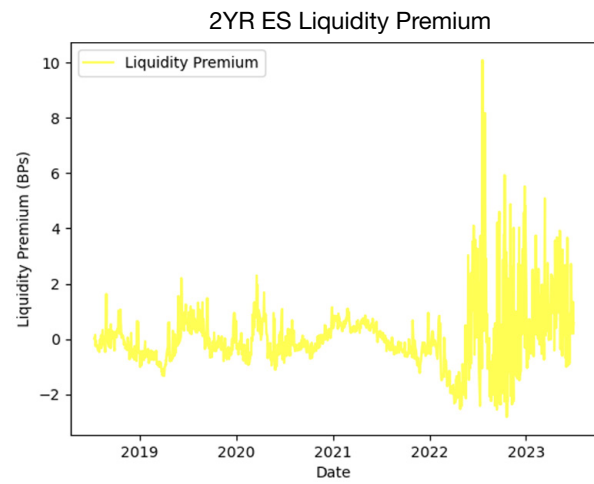
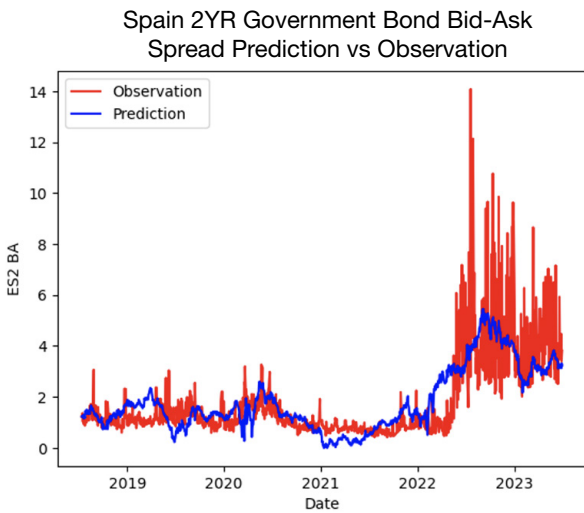
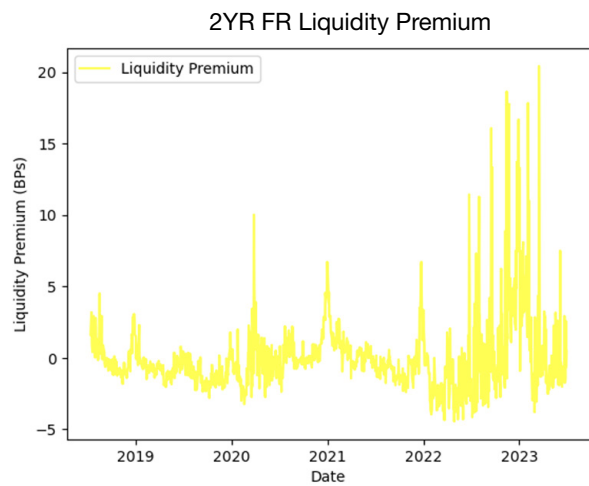
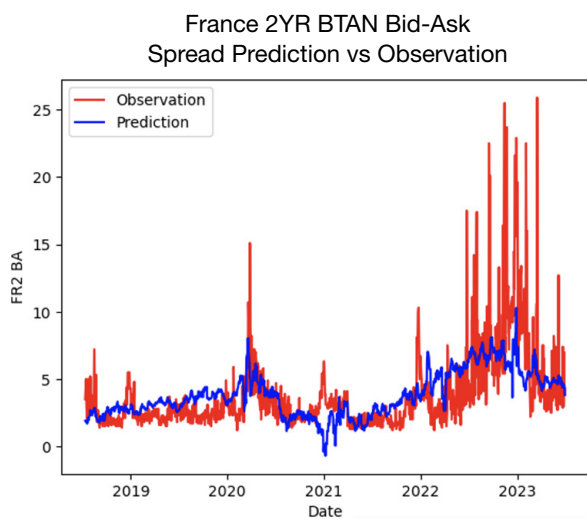


Figure 8: 2yr France illiquidity premia



Participant views

Interviewees confirm that liquidity conditions across the core markets, for the most part, are generally good. Bid-ask spreads are relatively tight,² and do not widen by much for larger sizes, and it is possible to trade large blocks of bonds (100-200mn clips) without moving the market significantly. Supported by a deep futures markets and an active repo market, recycling risk for dealers is usually manageable, even if it may take some time to trade out of larger positions.

However, participants also confirm what we observe in the data, that there are certain stress points, usually triggered by an event, when the core sovereign bond markets become extremely challenging and highly illiquid. This is largely attributed to the fact that dealer balance sheets, on aggregate, have become smaller over the past ten-to-fifteen years, while the underlying market has become notably bigger.³ Interviewees also point to a reduction in the appetite for risk among many dealers, particularly as volatility spikes and client orders become largely one-directional. In such circumstances, some desks are under pressure to cut positions, which can add to the market pressure.

In these scenarios, with some dealers stepping aside, liquidity provision also becomes more concentrated, with the larger global banks best placed to internalise and manage risk across multiple product desks and to recycle positions through their vast franchises. The buy-side observation, however, is that client differentiation also becomes a part of this process, as dealer banks are forced to prioritise scarce balance sheet and constrained risk limits for their more valuable clients. From an investor viewpoint, the largest may be subject to wider bid-ask spreads, while the smallest will struggle to find any price. Interviewees explain that this is when the dealer-investor “partnership” become important, and which is based on business flows across the broader range of activities and services provided by the dealer bank.

One interviewee noted that this characteristic of bond market liquidity was not always the case, and that prices were wide even during the 2008 global financial crisis, but it was still possible to transact. In recent years, at points of heightened stress, liquidity has not only become expensive, but for many buy-sides it has become binary. The ability to ride this storm largely depends on the type of fund, and whether they are able to retreat to the sidelines until the dust has settled, or if they are subject to sizeable investor redemptions or spiraling margin calls on related derivatives positions.

2. The data suggests median bid-ask spreads for all core markets to be less than 0.5bp for 10yrs and less than 1.5bp for 2yrs.

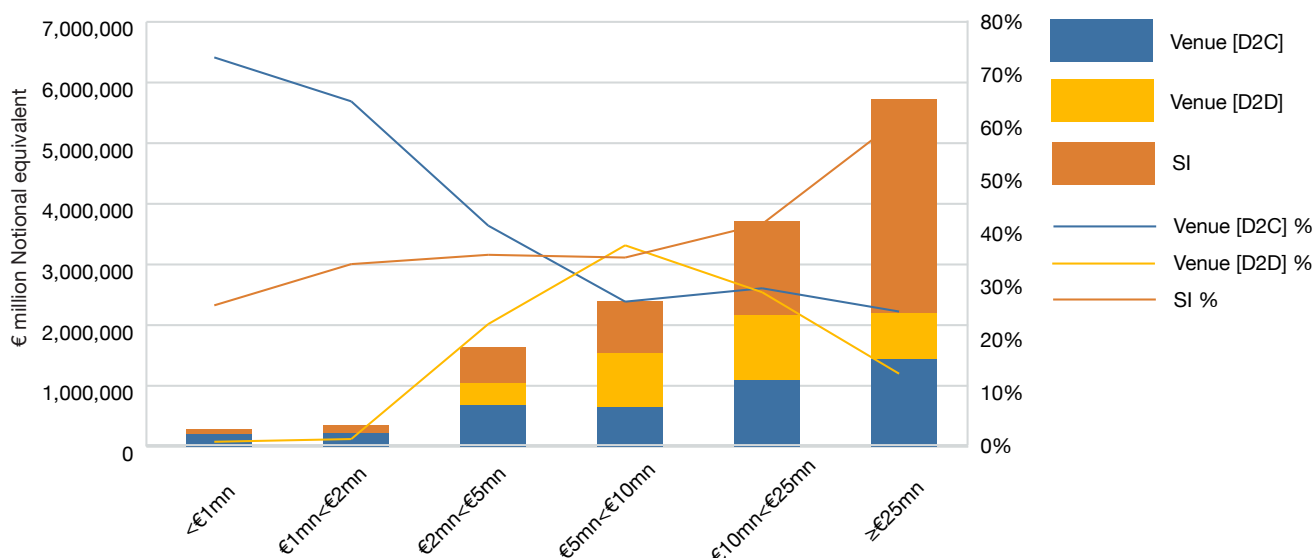
3. The combined notional amount of outstanding issuance of the five markets grew by 27.2% from the end of 2019 to June 2023 alone. See Figure 1.

E-trading

All interviewees confirmed an increasing reliance on e-trading and the use of electronic platforms for requesting quotes and execution in the core sovereign bond markets, particularly for smaller sizes (generally considered to be sub 10mn). Not only has this enhanced efficiencies from a transacting and settlement perspective, but due to the increasing use of algorithmic models (or “algos”) by market-makers and other liquidity providers, this has also improved pricing, both in terms of speed (often seconds to respond to a request-for-quote, or “RFQ”) but also competitiveness, with “mid” (somewhere near the middle of the bid-ask spread) often achievable. One buy-side firm stated that where they had several contingent orders, such as switches (swapping a position in one bond with that in another) or curve trades (taking a position in shorter maturity bond and the opposite position in a delta-weighted amount of a longer maturity bond), whereas historically this would have been quoted by a dealer as package, it is now more efficient to execute the legs separately, at least when working smaller sized orders.

The increased use of e-trading and algos, which is also mirrored by automated rules-based order routing by buy-sides, can also be observed in the data. ICMA’s European Bond Market Data report,⁴ which consolidates and analyses MiFIR reported data, reveals a significant bias toward on-venue trading for smaller ticket sizes, which reverses with larger trades, and a notable decrease in average ticket sizes for sovereign bonds. In the case of the latter trend, we also observe an increase in transaction count, with overall volumes remaining relatively steady over time. These patterns can be seen respectively in Figures 9 and 10. One participant explained this observation as the difference between trading “social size” clips, which have relatively limited impact on dealers’ balance sheets or risk profile, and where information leakage will not move the market; and larger trades, where it is better to go directly to one or two liquidity providers who are likely to show a competitive price, or may even be axed⁵ the other way, without alerting the market. They added that trading blocks of securities this way is currently the most efficient way of achieving best execution, but if liquidity were to become more challenged they would consider splitting orders into smaller “social” clips.

Figure 9: EU sovereign bond trade distribution channels by trade size

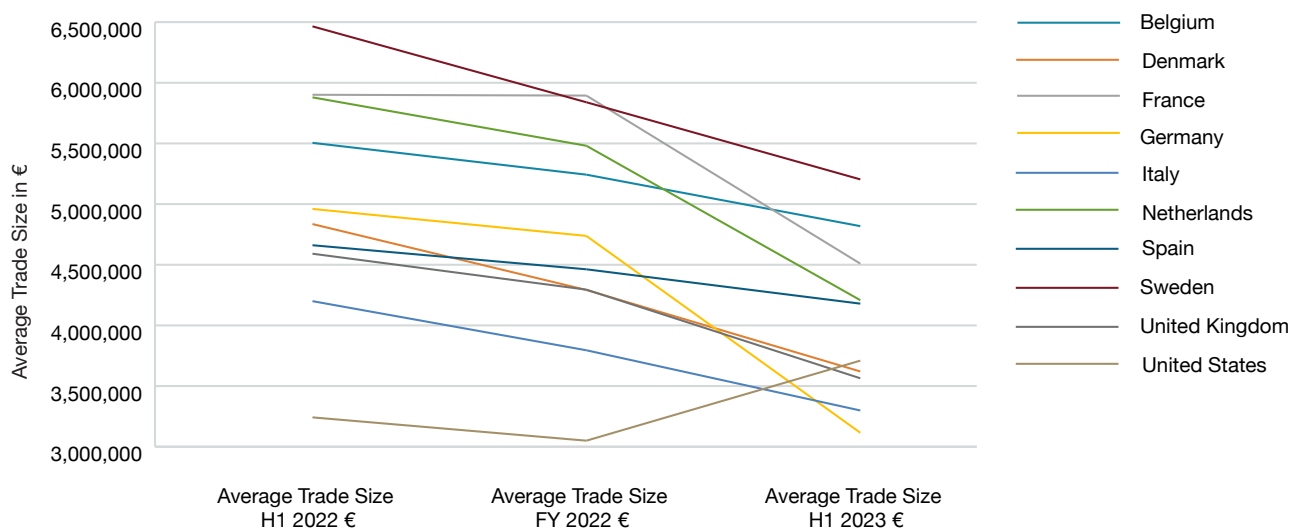


Source: ICMA analysis using MiFIR data sourced used Propellant software

4. See: [European Secondary Bond Market Data: H1 2023](#), ICMA Secondary Market Practices Committee, October 2023

5. Axes are positions held on dealers’ books that they are looking to unwind, or specific interests to buy or sell a bond. Being aware of dealers’ axes is a key source of liquidity, allowing investors to achieve prices at “mid” (ie between the bid-ask spread) and the ability to execute in larger than normal sizes.

Figure 10: European traded sovereign bond average trade sizes



Interviewees verify these observations, attributing both to the greater use of algos and automated order flow. Using algos to price and automate the execution of smaller transactions is more efficient for dealers, and, as a corollary of this, buy-sides splitting trade orders into smaller “child orders” can be more effective than executing in block size. Some dealers note that automating the more liquid, commoditised, and less profitable, transaction flow allows them to spend more time focusing on facilitating the larger, less liquid, and more lucrative client needs. One interviewee described this as being as much an advisory role on execution optimisation, as an enabling risk transfer. A number of participants talked about dealer-client “partnerships”. This is very much what we see in Figure 9.

“Fake liquidity”

As much as e-trading and automation delivers significant efficiencies, and possibly even enhanced liquidity, at the smaller, more commoditised end of the transaction spectrum, some interviewees also highlight potential imbedded vulnerabilities. They point out that pre- and post-trade data generated on platforms become points of reference for pricing larger trades. In stable markets, this is helpful. In stressed markets, the impulse response of many liquidity providers is to switch their algos off, leaving the market blind, particularly from the perspective of pre-trade transparency, which is widely considered to be more valuable than post-trade transparency. One interviewee described venue-based pre-trade transparency as “fake liquidity”, since it is there under normal conditions, but quickly evaporates in times of stress, potentially exacerbating market moves and fueling volatility.

Futures markets

Deep and liquid bond futures markets are not only a byproduct of deep and liquid sovereign bond markets, but also help to reinforce depth and price efficiency. Standardised,⁶ exchange-traded bond futures contracts, which usually roll on a quarterly basis, allow for delivery at expiry of a similar maturity cash bond from a pre-defined basket. The futures price will usually closely follow that of one bond in the basket, the so-called “cheapest to deliver” bond (or CTD), which is the bond with the cheapest implied repo rate from the perspective of buying the bond, selling the future, and making delivery.⁷ Built into this price is the optionality of a different bond in the basket becoming the CTD, which is a function of both the make up of the basket and yield volatility and is essentially a discount to the implied CTD price (buyers of the future are effectively compensated for “selling” the delivery option to the sellers of futures).

Futures are highly efficient off-balance sheet hedges for sovereign bond exposures, as well as a leveraged alternative to the underlying market. In many ways they achieve what the cash bond market cannot, providing a highly liquid, standardised, exchange-traded instrument with full pre- and post-trade transparency. Some buy-side interviewees explained that futures (as well as interest rate swaps) provide an effective alternative to cash bonds when constructing portfolios.

All of the five core European sovereign bond markets have developed futures markets, in some cases representing different points on the curve.

In terms of traded volumes, open interest, and market depth, the German futures contracts are by far the most liquid, with a total combined daily average volume of €192bn notional equivalent,⁸ and the 10yr Bund contract daily average equivalent to €77bn alone, compared with an average daily traded notional value of €29bn in the underlying German sovereign bond market.

With respect to other contracts, the daily notional value is less than that of the underlying market, with the French 10yr contract averaging €18.6bn vs cash volumes of €21.2bn, the Italian 10yr contract averaging €15.6bn vs cash volumes of €30.7bn, and the 10yr UK contract averaging £14.3bn notional equivalent vs cash volumes of £18.5bn.

Interviewees also report that for the most part, in the main contracts,⁹ liquidity is very good, particularly in the three main German contracts, where it is usually possible to execute lots of 500 to 1,000¹⁰ without having a major impact on price. The 10yr France (“OAT”) contract, the 10yr Italian (“BTP”), and the 10yr UK (“Gilt”) contract are, reportedly, similarly liquid. This is also reflected in the data with respect to daily trading volumes and open interest (see Figure 11).

6. A futures contract will represent a “notional” bond, rather than an actual bond, with a specified coupon and maturity date.

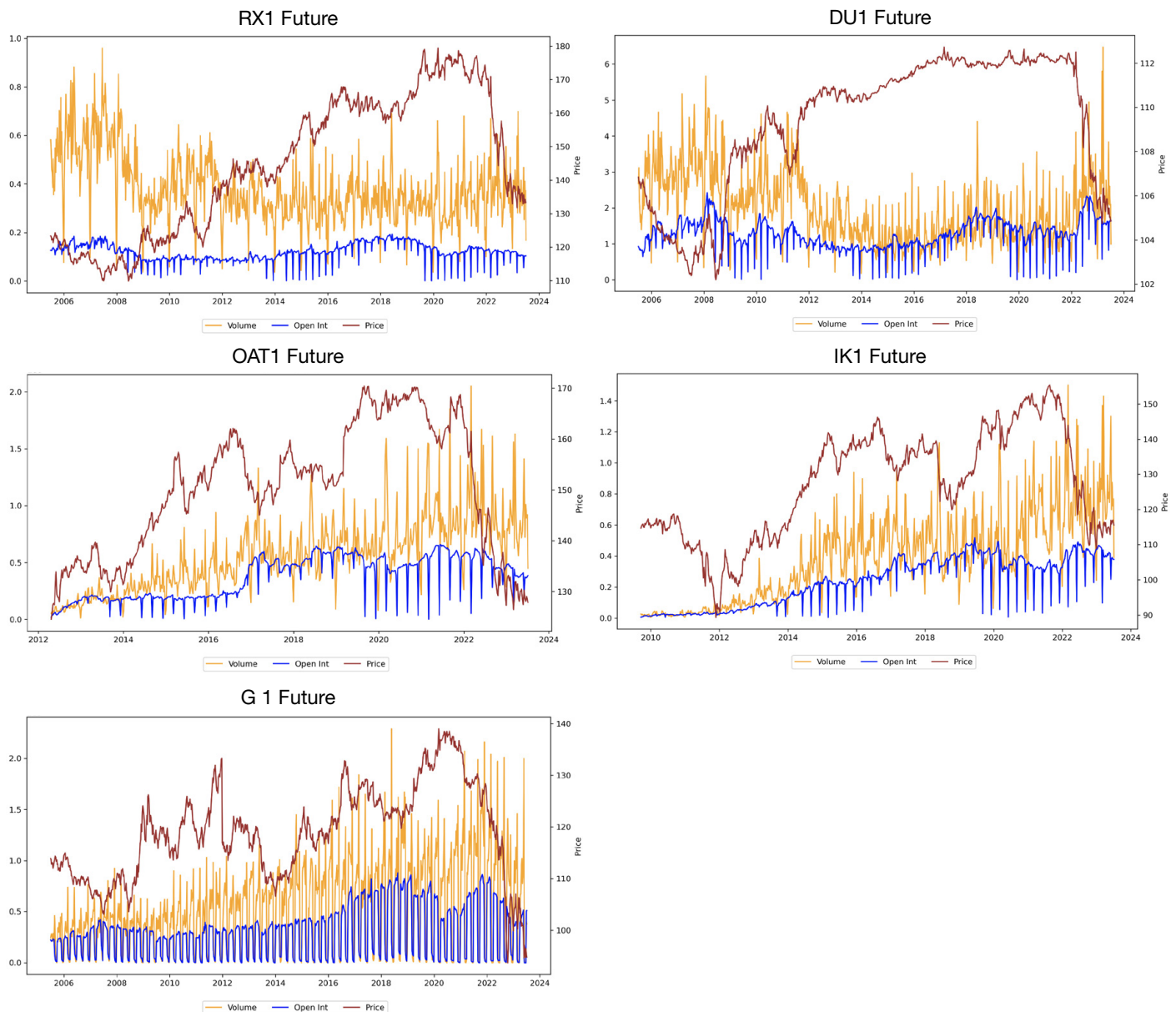
7. Known as “cash-and-carry” basis, this is effectively a synthetic repo exposure.

8. Based on the period January 2022 through June 2023.

9. This is the 10yr “Bund”, the 5yr “Bobl”, and the 2yr “Schatz”.

10. The equivalent of 50mn to 100mn notional value.

Figure 11: Active European sovereign bond futures contracts



However, a number of existing contracts see little-to-no activity, including the 10yr Spanish (“Bonos”) contract, the 5yr France contract, the 5yr Italy contract, and the 2yr short-Gilt contract (see Figure 12).

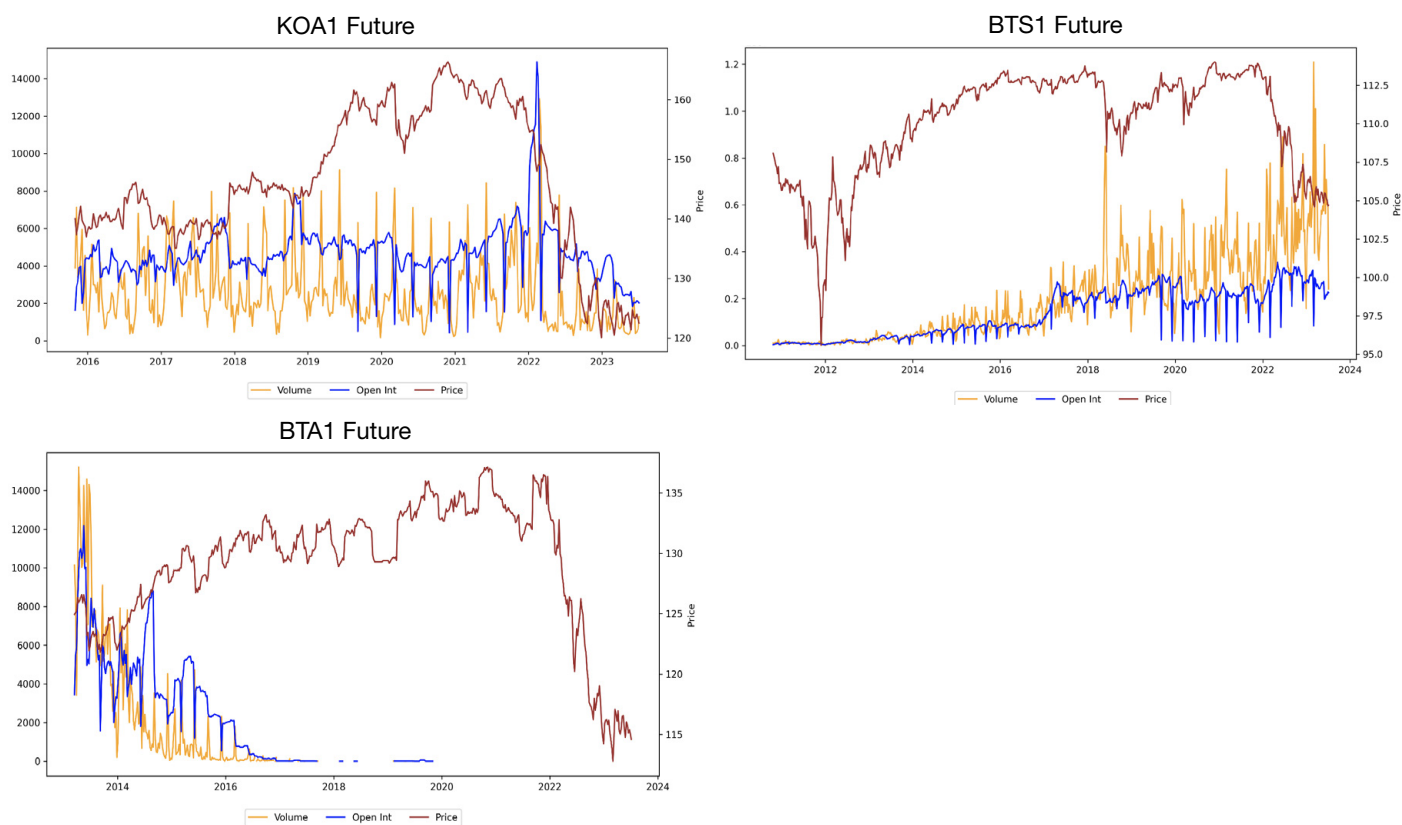
While having too many available contracts runs the risk of fragmenting and also diluting liquidity, interviewees highlight some challenges associated with limited choice. One is curve risk created by maturity mismatches between the maturity of the underlying the bond exposure and that of the notional contract. This is compounded by convexity considerations as a result of relatively high legacy coupons on notional contracts and very low (even zero) coupons on the underlying bonds. In the case of Gilts, it was flagged that historically shorter maturities could be hedged effectively using short-sterling strips,¹¹ but that following the demise of LIBOR, the replacement SONIA contracts¹² are not as liquid.

The second is credit risk, particularly in the case of Italy, where a deeper Bonos futures market would provide the ability to hedge not only BTP interest rate exposure, but also the associated credit risk with a closer fit than using, say, Bund or OAT futures.

11. Short-sterling were a cash-settled contract based on the 3 month sterling LIBOR fixed rate. Interest rate exposures could be hedged by using “strips” of contracts across different settlement dates to match the term of the exposure.

12. Following the cessation of LIBOR, short-sterling contracts were superseded by 3 month SONIA contracts, which settle on the historical compounded Sterling Overnight Index Average.

Figure 12: Inactive European sovereign bond futures contracts



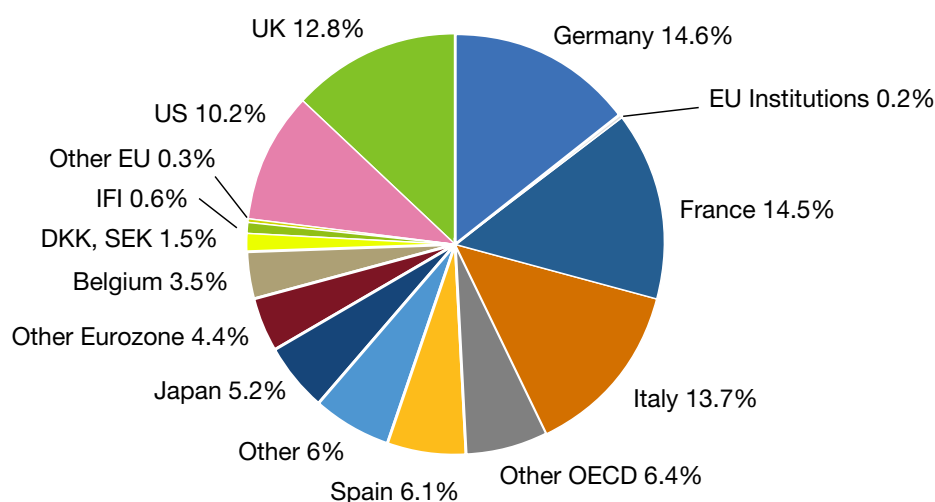
An additional futures-related challenge identified by some interviewees is more structural and concerns the rate at which bond yields have seen a sharp spike in optionality during the past 12 to 18 months (that is a higher probability of a CTD switch) thereby un-anchoring contracts from the CTD and making the spread between futures and cash bonds (the basis) less predictable and so a less perfect hedge or substitute.

However, perhaps the biggest concern raised by participants is that, similar to the underlying cash market, in times of stress the futures markets can become extremely illiquid and highly volatile, characterised by a thinning of order depth and “gapping” between prints (rather than moving a tick at a time). This is also attributed to algos being switched off, which provide a lot of the smaller order flow, thus supporting price discovery for larger trades. As liquidity thins in futures, so it becomes more difficult for dealers to price and hedge client orders in sovereign bonds, driving bid-ask spreads even wider and reducing their appetite for risk.

The repo market

The most recent ICMA European Repo Market Survey, which maps the market as of December 2022,¹³ puts the size of the market at €10.4tn. This is a 31% increase since December 2019, and almost a 63% growth from December 2008. In terms of the underlying collateral, the five core sovereign bond markets constitute 63% of the total (see Figure 13). Adjusting for non-EU 27+1 issuance, this constitutes more than 90% of the total collateral underpinning repo transactions, perhaps unsurprisingly almost exactly mirroring the relative proportion of outstanding issuance.

Figure 13: Collateral distribution of outstanding repo transactions in the European market at June 2023



Source: ICMA Repo Survey

In terms of repo market activity, we have similarly seen healthy growth in daily traded volumes, as measured in the interbank market (see Figure 14), and interviewees confirm a deep and liquid market, particularly for the big five European sovereign issuers. This is notable even during times of stress, such as the invasion of Ukraine and the SVB collapse, where the market has been able to absorb large inflows into very short-dated repo, with relatively low volatility. This was also evident during the COVID-19 market turmoil, albeit with greater dealer concentration.¹⁴ One participant noted that even during the 2008 GFC the European repo market functioned well.

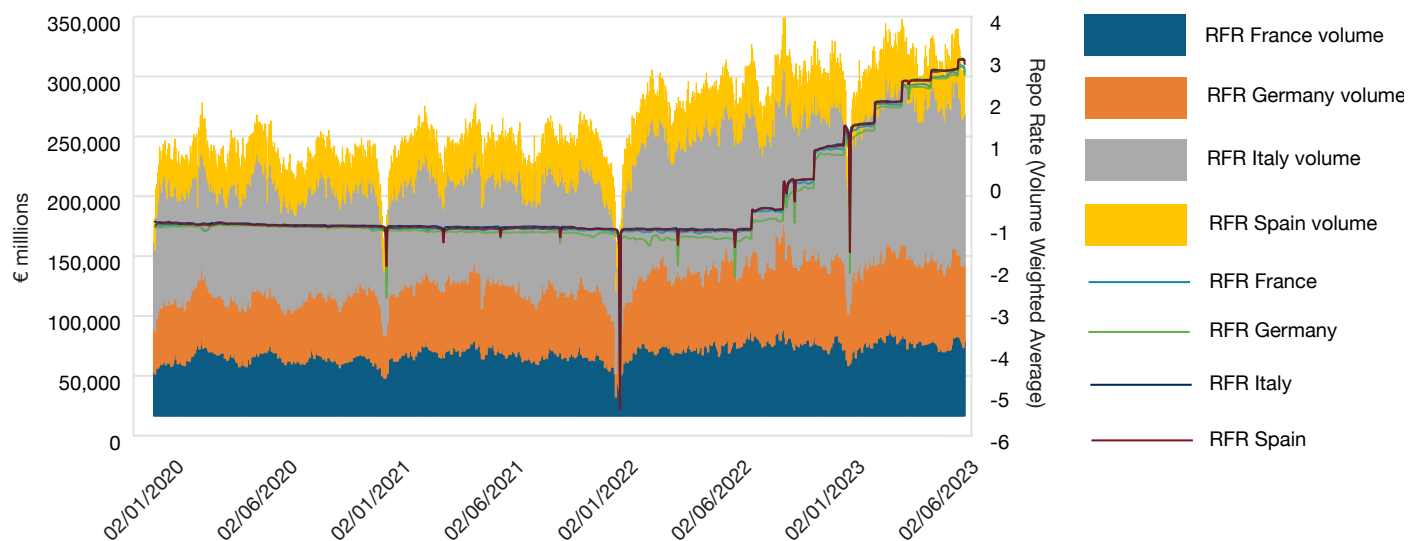
However, as observed in the data, well documented in the literature, such as ICMA's annual analyses,¹⁵ and confirmed by interviewees, where the European repo market, or at least the euro repo market does not function well is over calendar year-end and certain quarter-ends. This is the direct consequence of regulatory reporting requirements, forcing intermediary banks to reduce balance sheet exposure. When it comes to managing bank balance sheets, repo is often the easiest exposure to manage, while also being among the worst returns on capital from a trading perspective.

13. See: [The International Capital Market Association European Repo Market Survey, No 44, Conducted December 2022](#), March 2023

14. See: [The European repo market and the COVID-19 crisis](#), ICMA ERCC, April 2020

15. For example, see: [The European repo market at 2022 year-end](#), ICMA ERCC, January 2023

Figure 14: Repo Funds Rate daily volumes and rates: DE, FR, IT, ES



Source: ICMA analysis using CME RFR data

In the case of quarter-ends, EU regulated banks regularly shrink balance sheets, temporarily, to meet (usually self-imposed) Liquidity Capital Ratios (LCR). Depending on market positioning, and the amount of leverage in the system, this can feed through into the underlying bond market, reducing liquidity and widening bid-ask spreads; which is what we observe in the data.

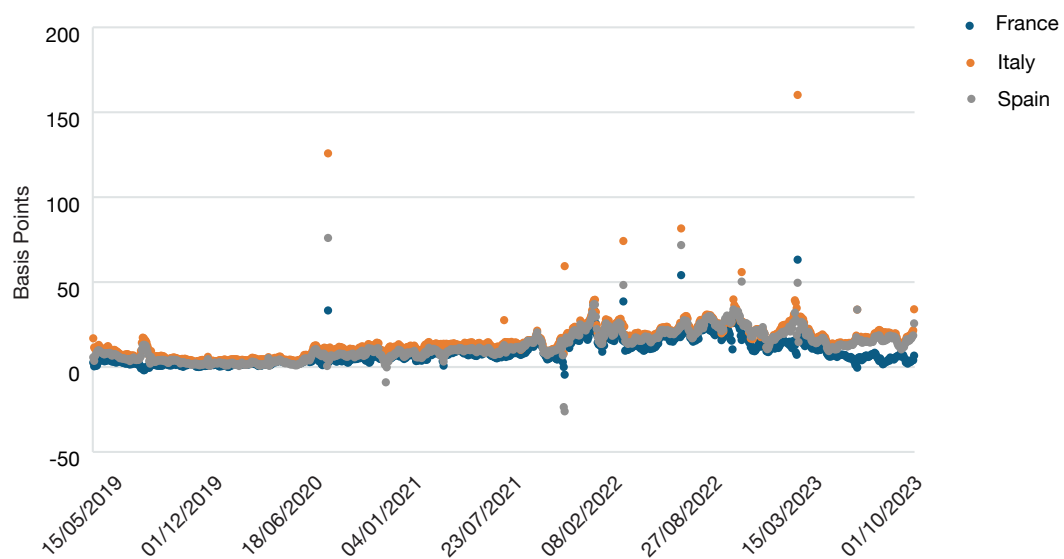
At calendar year-end, this effect is compounded not only by European banks' LCR reporting, but more widely by the largest globally systemically important banks managing their balance sheets down to optimise their snapshot GSIB scores, which affects their capital requirements for the next twelve months. The picture is further complicated by a number of jurisdictions applying bank levies, also based on year-end balance sheet snapshots. Add to this mix, as we have seen in recent years, a combination of excess reserves and a degree of collateral scarcity (the result of central bank asset purchases), and year-end for euro denominated repo markets is characterised by significant deleveraging and wild price dislocations (see Figure 15). The impact for underlying sovereign bond markets, as observed in the data, is a reduction in trading activity and a sizeable widening of bid-ask spreads commensurate with that seen in any crisis.

Some buy-side interviewees point to restrictive regulation that limits their ability to access the repo market, noting that this could be a useful liquidity management tool, particularly in times of volatility, enabling them to manage margin calls on derivatives exposures or to meet redemptions without the procyclical impacts of selling holdings into a thin market.

A further observation noted during some buy-side interviews is the lack of price transparency in the repo market, compared to that in the underlying market. While in some respects it is difficult to compare repo rates as they also contain an element of counterparty-specific balance sheet footprint, knowing where "specials"¹⁶ are trading would provide useful intelligence with respect to price formation in the underlying bond.

16. A "special" is a bond that is trading expensively on repo (ie a lower repo rate) relative to general collateral (ie the generic secured funding rate for the class of bond).

Figure 15: Repo Funds Rate spread to Germany RFR



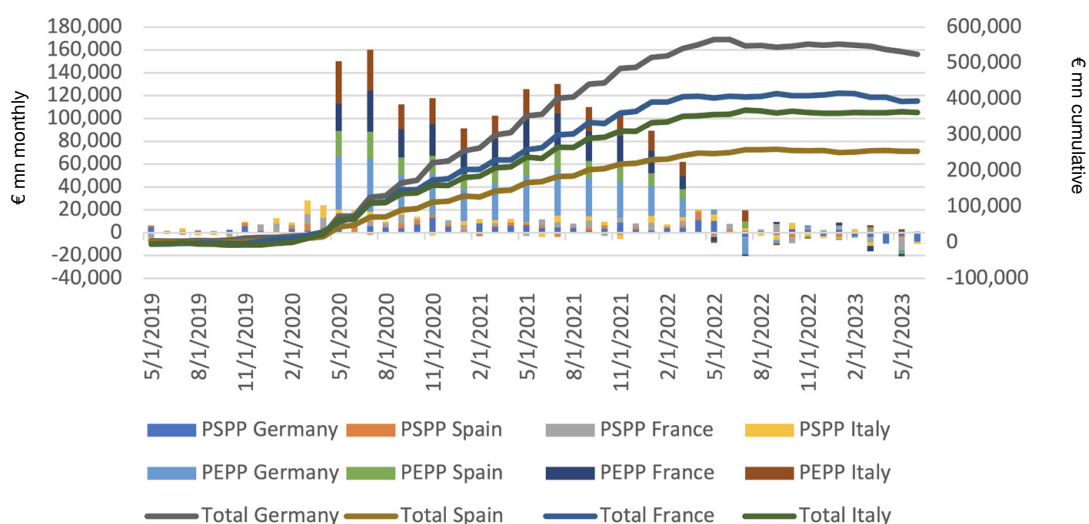
Source: ICMA analysis using CME RFR data

Central bank purchases

Interviewees cite monetary policy, in particular central bank asset purchase programme, as one of the key considerations in any attempt to analyse sovereign bond market liquidity. As they point out, it was the relaunch and expansion of asset purchases that helped to stabilise markets after the COVID-19 crisis of early 2020. Since then, and until the end of 2021 in the case of the UK, and July 2022 in the case of the ECB, the respective central banks became by far the largest single buyer of government bonds. Figure 16 shows the monthly and cumulative net purchases of the four core euro sovereign bond markets under the Public Sector Purchases Programme (PSPP) and the Pandemic Emergency Purchases Programme (PEPP). By July 2022, the ECB and respective NCBs held a total of €3.142tn notional of the bonds of the big four issuers, or around 31% of the total outstanding issuance, which is difficult to ignore (see Figure 16).

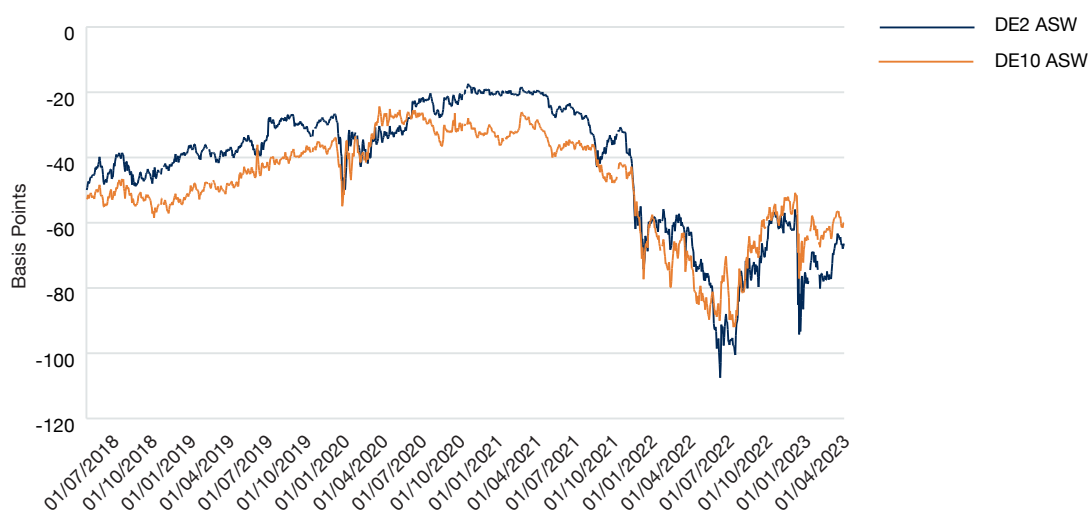
While interviewees suggest that these purchase programmes were largely responsible for richening sovereign bond swap spreads (see Figure 17), increasing repo specialness for certain bonds (and most bonds in the case of Germany), the overarching result was to contain volatility, and to support liquidity more broadly with the reassurance for dealers of a perennial buyer, where size was often a more important consideration than price.

Figure 16: ECB purchases of core EUR sovereign bonds under the PSPP and PEPP



Source: ICMA analysis using ECB data

Figure 17: Bund and Schatz swap spreads



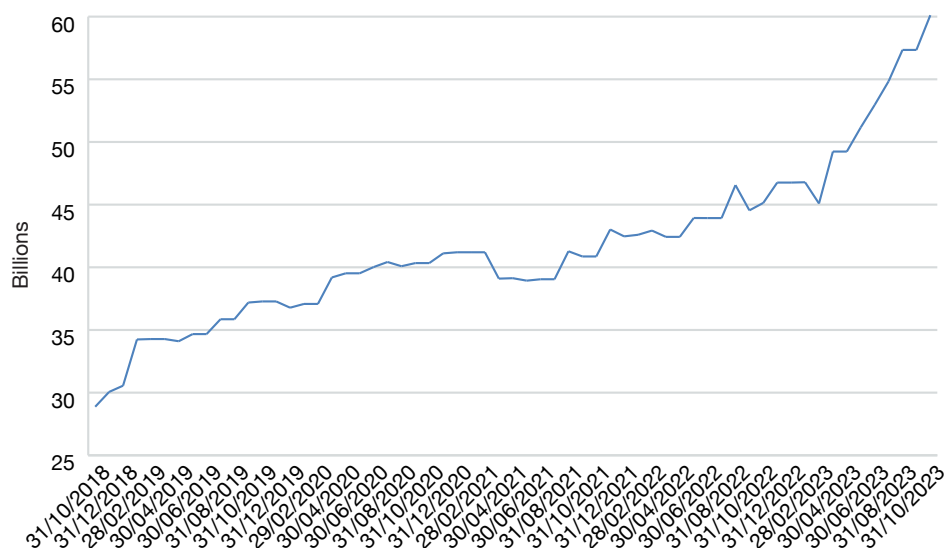
Source: ICMA analysis using Bloomberg data

Alternative liquidity providers

Another discussion point raised by some interviewees is the impact of other, non traditional liquidity providers. Very much linked to the observations and views on algo trading is the growth of sovereign bond exchange traded funds (ETFs), where the creation and redemption process is reliant on the ability of the authorised participant (AP) or market-maker to sell or buy quickly, and efficiently, proxy baskets of bonds, usually in relatively small clip sizes. Here auto-quoting and execution plays a critical role. The corollary to this is the generation of additional two-way flows, close to mid-market, in the underlying bonds, which could be viewed as adding to overall liquidity.

However, while the European sovereign bond ETF market has seen rapid growth in recent years, it is noted that in terms of assets under management (AUM), this remains relatively insignificant when compared to the size of the underlying sovereign bond market (see Figure 18).

Figure 18: EUR sovereign bond ETF total assets



Source: ICMA analysis using Bloomberg data

Of more significance, particularly to some interviewees, is the role of hedge funds, in particular relative value (RV) funds that utilise leverage to enter into short-term strategies to exploit potential price opportunities between different sovereign bonds and instruments. Participants also note a resurgence in hedge fund activity since the end of interest rate compression and with this an increase in volatility, both of which provide more opportunities for RV based trading.

Views on the contribution of hedge funds to market liquidity and resilience are mixed. On the one hand they provide new and active flows, often contrary in direction to more passive, real money orders, that otherwise would probably not exist in the absence of bank “prop” desks. There is also the argument that they ensure price efficiency, by arbitraging-out any price anomalies that exist in the market. However, as some interviewees were keen to point out, unlike Primary Dealers, they have no commitment, nor incentive, to stay active when markets become too volatile or stressed. They are often the first to pull-out when the going gets tough, often adding to the volatility as they deleverage and unwind.

One participant queried why hedge funds, given their relative systemic importance, are not subject to same regulatory oversight, as well as capital and liquidity requirements, as banks. They further suggested that the attempt by regulators to restrain hedge fund activity indirectly by imposing a blunt Leverage Ratio on banks is inefficient, and largely ineffective. Another interviewee touched on a more moral quandary related to the provision of liquidity by hedge funds, citing the fall 2022 UK gilt crisis as the single biggest transfer of wealth in the history of financial markets, when in a matter of days billions of pounds were effectively channelled out of UK pension funds into the P&Ls of US owned hedge funds.¹⁷ However, they also concede that this was largely due to the actions of the UK government at the time and noting that hedge funds were conducting their normal business activities.

17. See also: [An anatomy of the 2022 gilt market crisis](#), Pinter, G., Bank of England Staff Working Paper No. 1,019, March 2023

Clearing

In an attempt to probe interviewees for suggestions to improve core bond market liquidity and resilience, we floated the idea of mandatory clearing, which, at the time of the interviews, was being proposed by the SEC for the US Treasury market.¹⁸ While some interviewees pointed to the benefit of increased access to clearing for buy-sides in the repo market, enabling more netting opportunities for intermediating dealer banks, none were convinced that this would have a positive impact from the perspective of outright bonds. Unlike in the case of repo, central clearing for outright transactions creates additional cost with more limited benefits in terms of netting opportunities.

Furthermore, some raised concern, both from a repo and outright perspective, that mandating clearing could not only result in greater costs for clients, particularly in times of volatility where margin requirements are likely to rise, but it could prove to be countercyclical. The UK mini-budget gilt crisis was held up as an example of where spiraling margin calls, in this instance with respect to swap positions, leads to the selling of bonds (usually high-quality liquid assets) to raise variation margin (VM), which in turn pushes up swap yields, which triggers further margin calls.

This theme also ties in with other discussions about margin more generally, including for non-cleared derivatives, and whether a structural dependence on cash VM is actually an accelerator of market stress. Some interviewees felt that there is a solid case for using non-cash collateral for VM, and which might help both to slow down and dampen some of the extreme moves we are experiencing in sovereign bond markets.

18. See: [SEC Proposes Rules to Improve Risk Management in Clearance and Settlement and to Facilitate Additional Central Clearing for the U.S. Treasury Market](#), September 2022

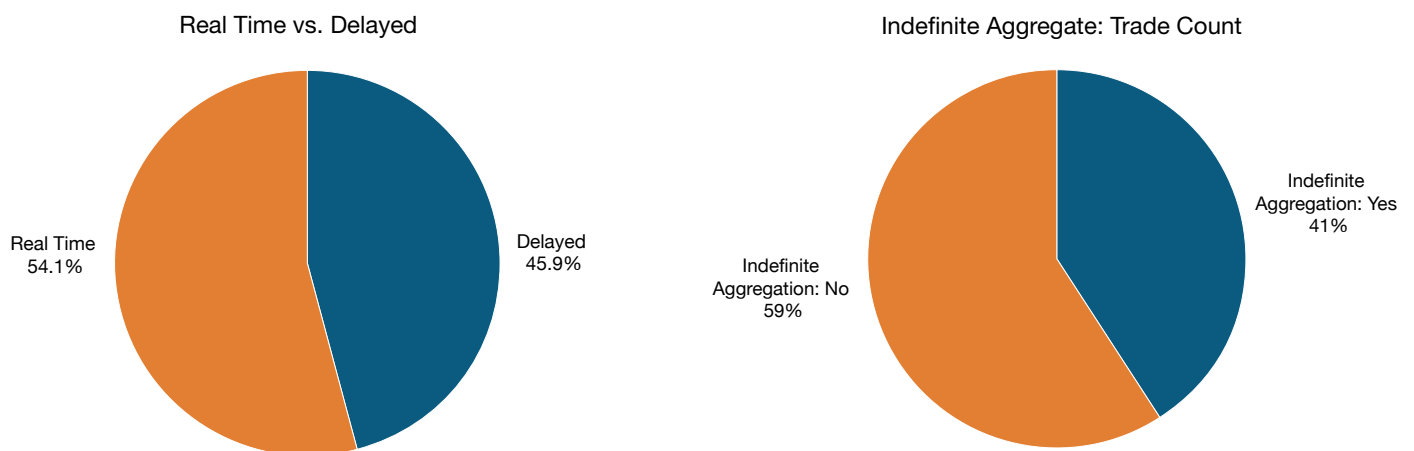
Transparency

The role of transparency in supporting market liquidity and resilience was another theme explored in the interviews. Visibility of what is happening in the market, including prices and volumes is essential for ensuring efficiency, as well as creating confidence for market participants, whether liquidity providers or takers. Pre-trade and real-time post-trade transparency helps with price discovery, while delayed (historical) post-trade data is useful for transaction cost analysis (TCA), which helps investors to measure the efficiency of their trade executions, as well as being essential for market analytics and quantitative research. This is further used for training and testing algos, thereby underpinning market automation.

What is the right amount of transparency, particularly with respect to post-trade, is a hotly debated topic in the context of bond markets, which are structurally different to equity markets, and where liquidity is largely contingent on the ability and willingness of market makers (in this case Primary Dealers) to make prices and assume risk. When market makers take positions onto their books, they remain exposed to market risk until they are able to unwind the position, whether with another client or clients, or back into the street. In the case of core sovereign bonds, they can hedge their interest rate risk, say by using futures, but they remain exposed to the idiosyncratic risk related to the specific bond in which they hold the position. If the market is able to deduce that a dealer is holding a large position, or one that is difficult to unwind, it will adjust the price for the relevant bond in anticipation of the attempted unwind. This, of course, is to the detriment of the dealer, who will potentially have to unwind the position at a loss. Which raises the question as to what prints should be made available to the market, and when? A further consideration is how much information is loaded into the price alone, and even if only this is made available (so called “volume masking”), will it still have the same impact as publishing all the details?¹⁹

Despite the absence of a consolidated tape in Europe, interviewees believe that transparency in the core sovereign bond markets is relatively good, while some feel that it could be better. While most visibility of the market is derived commercially from trading venues and other data sources, EU and UK regulation, under MIFIR and MiFID II, does provide for public transparency across a network of Approved Publication Arrangements (APAs) and venues. While it takes some effort to consolidate this information, ICMA estimates that 54% of all transactions in the five core sovereign bond markets are reported publicly (price and size) within 15 minutes of execution (See Figure 19). With the introduction of a consolidated tape in the next few years, the expectation is not only that post-trade transparency will become more accessible and centralised, but that even more transactions will be visible in “real time”; something broadly welcomed as an important and beneficial market development by market participants.

Figure 19: Core European sovereign bond market post-trade transparency



Source: ICMA analysis using MIFID II/R data consolidated with Propellant software

19. The relationship between transparency and liquidity is explored further in the ICMA Discussion Paper, [Transparency and Liquidity in the European bond markets](#), September 2020.

The question debated by market participants and regulators, and discussed with interviewees, is how much real time information should be made publicly available, and what should be deferred, and for how long?

Under the current regulation, deferred sovereign bond post-trade data is published on a weekly basis in aggregate form, which is then disaggregated after four weeks. However, national competent authorities (NCAs) have the discretion to elect that the deferred post-trade data for their respective sovereign bond markets remain in aggregated form indefinitely. ICMA estimates that 59% of transactions and 69% of the total traded volumes in the five core markets are subject to indefinite aggregation (see Figure 19).

Following the MiFIR and MIFID II Review, indefinite aggregation of sovereign bond trades will cease, with all deferred trades being disaggregated within six months. Interviewees, particularly those representing the buy-side, question the limited value of aggregated post-trade data, as well as the value of six-month old, disaggregated information. Some suggest that sovereign bond trades should be subject to the same revised deferral regime as corporate bonds, with a maximum delay of four weeks before hitting the tape. Views on this vary among sell-sides, who rely on a degree of information asymmetry to take on large risk positions from their clients, although it is difficult to find consensus on the optimal deferral calibration, which to a large extent depends on the actual trade and resulting exposure in question.

Ultimately it will be for ESMA to calibrate the transparency regime, and some suggest that they begin conservatively with a view to increasing the number of transactions published in real time gradually, while also monitoring the market impact, with a view eventually to reaching the transparency “sweet spot”. However, some note that so long as NCA’s retain discretion, their instinct, perhaps understandably, will be to protect their Primary Dealers with a high degree of information asymmetry.

The outlook

Looking forward, the general view of interviewees is that we have entered a new era for sovereign bond markets, where event-triggered episodes of heightened volatility and illiquidity should be expected on a relatively regular basis. The unwind of central bank asset purchases, while ultimately healthy for liquidity more broadly, will likely add to volatility and market sensitivity in the near term. This will also increase overall supply, while dealer balance sheets are set to become even more constrained with the roll-out of Basel 3.5, which may also see a retreat of some traditional liquidity providers. All of this makes central bank interventions to stabilise markets increasingly inevitable and less extraordinary.

As one interviewee pointed out, it is difficult to compare what we have experienced since 2008 with any other period in the history of sovereign bond markets, and at some point, long into the future, the period of 2008-23+ will probably be one of the most studied chapters in financial market history.

Recommendations

Interviewees were asked to provide recommendations that could help improve market resilience, and to support better liquidity during times of heightened volatility or market stress. The closest that participants came to a consensus view was the suggestion that policy makers and regulators need to review the prudential rules that are applied to banks that act as primary liquidity providers in sovereign bond markets, with a view to recalibrating in order to allow dealers to fulfill their function. This would apply not only to underlying bond exposures, but also to related hedges and repo exposures, particularly when viewed in combination. This should be assessed from the perspective of sovereign bond market liquidity and stability as being social goods. Increased sovereign bond issuance and the expected launch of active quantitative tightening will only give more importance to the provision of secondary market liquidity and the ability to neutralise market volatility. If banks cannot provide this critical function, particularly in times of stress, then that responsibility will have to fall on central banks.

A number of other suggestions were offered, which do not necessarily represent a consensus, but each of which perhaps warrants further exploration and consideration:

- Regulators should give consideration to the role and primacy of Primary Dealers when drafting regulation.
- There should be the same focus by regulators on sovereign bond transparency as there is on the corporate bond market.
- Various balance sheet-based reporting requirements and levies should be determined using average measures rather than one-off snapshots.
- Hedge funds should be subject to same prudential requirements as banks.
- UCITS and Money Market Fund regulations should afford greater access to the repo market as a tool to manage liquidity risk.
- Non-cash collateral should be encouraged as an acceptable alternative to cash collateral in the case of variation margin, both for cleared and uncleared trades.

Liquidity and resilience in the core European sovereign bond markets

Part Two



Part Two – Liquidity and market structure in the top 5 European sovereign debt markets

The aim of this paper is to explore both from a qualitative and quantitative perspective liquidity in the top 5 European sovereign debt markets.

The first section of this part two analyses the structure of the market. We begin with primary dealers' requirements in both primary and secondary markets, distribution of holders, statistics on issuance and yield analysis (with comparison to volumes, ratings and volatility).²⁰

A common obligation for primary dealers amongst all markets, is to bid a minimum amount for all issuances. This is summarised below in table 1, and full information is provided for each country in the following chapters. In addition to bid obligations in the primary market, primary dealers' obligations extend to secondary markets too, summarised as per table 2.

Table 1 – Primary markets obligations

Country	Bid obligation	Current number of dealers
France	2%	15
Germany	0.05%	32
Italy	3%	19
Spain	3%	21
UK	2%	17

Table 2 – Secondary markets obligations

Country	Bid Ask quotation on continuous basis	Minimum share in secondary trading volumes
France	✓	2%
Germany		No requirements listed
Italy	✓	Evaluated via quotation quality index (QQI). Full information in relevant chapter.
Spain	✓	Not specified
UK	✓	2%

Debt holders' statistics, are redacted by individual DMOs. This leads to variations in the classification of the holders, and classifications label. Investor structure for each country is fully detailed in each country chapter. It is noticeable, despite differences in classification, that central banks currently hold the majority share in most markets.

43% of German sovereign debt is held by the Eurosystem, Banca d'Italia owns over a quarter of Italian debt, whilst Bank of Spain and the Bank of England own more than a third of their relative country's debt.

Table 3 provides a summary of the quarterly issuances from Q1 2013 to Q1 2023, while comprehensive details regarding the distribution of tenors is provided in each country specific chapter. The same figures in dollar terms are instead provided in table 4. With these statistics it is possible to calculate an average value per issuance which is shown in table 5.

²⁰. Notice that volatility is calculated as a simple standard deviation of absolute yield returns annualised.

Table 3 – Number of issuances

Country	Average issuance	Minimum Issuance	Maximum issuance
France	66	40	108
Germany	46	24	85
Italy	29	10	88
Spain	18	5	56
UK	18	13	27

Table 4 – Value of issuances

Country	Average USD Bn quarterly issuance	Minimum USD Bn quarterly issuance	Maximum USD Bn quarterly issuance
France	179.2	75.35	392.39
Germany	108.75	30.06	267.04
Italy	131.60	75.36	215.30
Spain	68.62	20.23	153.60
UK	130.47	40.09	317.86

Table 5 – Average value per issuance

Country	Average value per issuance in USD Bn
France	2.72
Germany	2.36
Italy	4.54
Spain	3.81
UK	7.24

From a secondary market perspective, we examine traded volumes for the period Jan 2022 to May 2023. On a weekly basis, German debt is the most traded in terms of notional, followed by Italy and France. Italian debt, however, has the biggest average of weekly trades (number of trades), followed by Germany and the UK. This is summarised in table 6 and 7 below. The notional in the below table is expressed in EUR M, except for the UK where GBP M is used.

Table 6 – Traded volumes

Country	Average weekly volume	Minimum weekly volume	Maximum weekly volume
France	99,402.4	33,487.3	156,956.5
Germany	143,731.1	50,277.7	304,633.1
Italy	134,100.0	49,089.0	190,067.9
Spain	38,525.8	14,351.2	68,645.2
UK	74,350.1	31,533.6	165,608.6

Table 7 – Trade count

Country	Average weekly count of trades	Minimum weekly count of trades	Maximum weekly count of trades
France	10,461	5,928	15,309
Germany	19,704	9,411	31,362
Italy	30,528	16,244	73,498
Spain	6,554	3,252	9,893
UK	13,647	7,171	25,991

Figure 20: EUR Core Sovereign Bond Weekly Traded Volumes

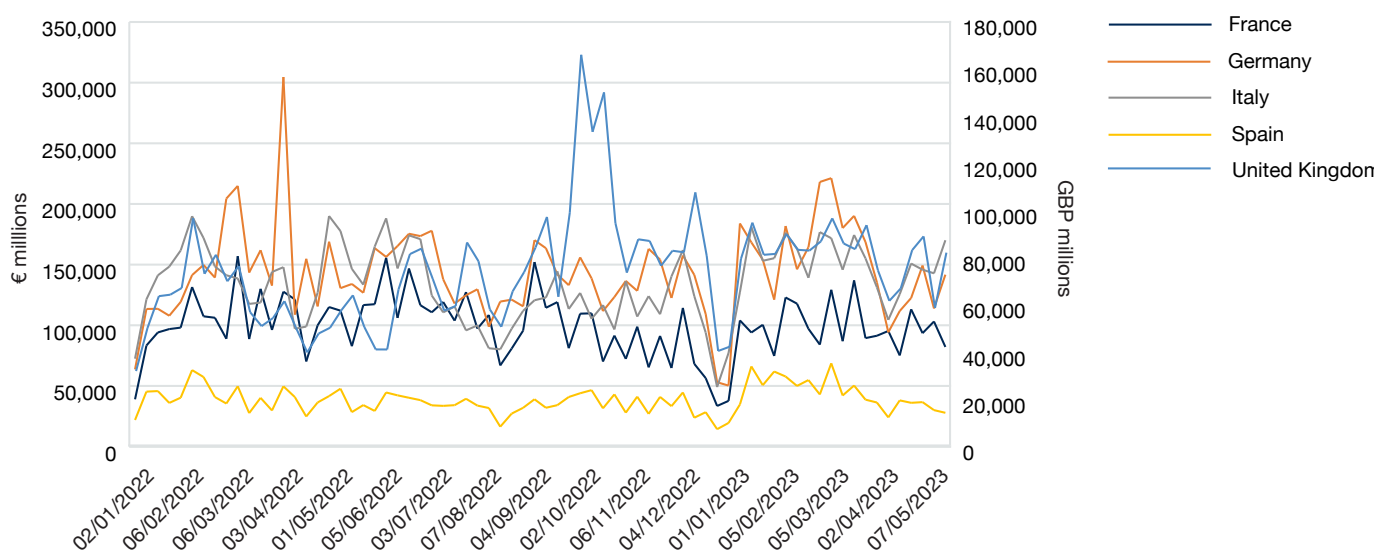


Figure 21: EUR Core Sovereign Bond Weekly Trade Count

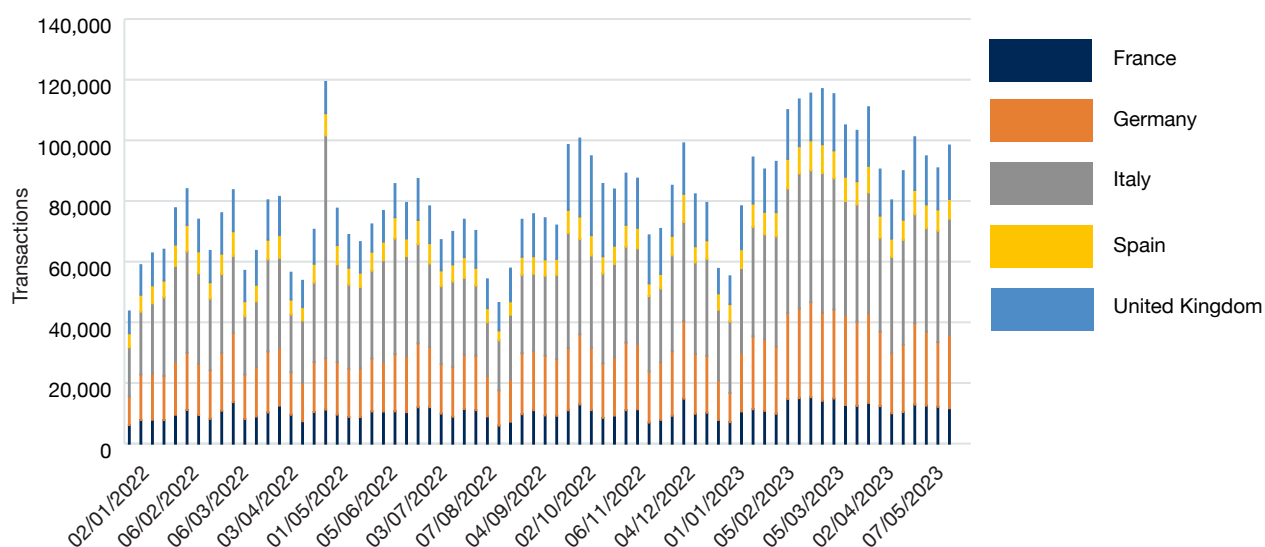
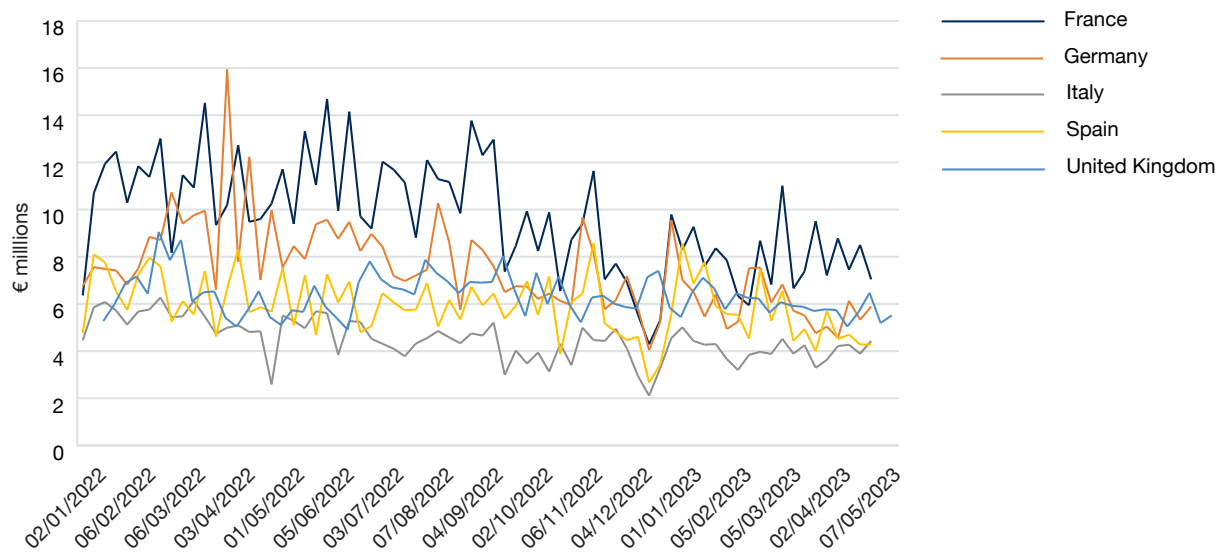


Figure 22: EUR Core Sovereign Bond Average Trade Size



The second section of part two, analyses liquidity from a quantitative perspective. The paper initially focuses on repo. Based on volumes and several spreads, the paper tries to establish whether and how collateral scarcity and excess cash impact the markets. We notice how central bank balance sheets fluctuations have an impact on repo rates, as well as confirming existing literature findings on volumes reductions during quarter/year ends.

Thereafter the paper uses bid-ask spread as a proxy for liquidity. A correlation analysis with volumes shows a negative correlation. To understand this phenomenon further, we model BA spreads with market variables, and obtained, on average, R-Squared > 0.5.

To further understand where the model fails to explain the phenomenon, we look at the difference between observed values and this paper predictions. We define this as the BA spread premium (the unexplained part of our model). The full models are available in the relevant chapter, we notice however, that the premium increases in specific periods that corresponds to periods of market shocks (i.e., COVID Outbreak, Russian invasion of Ukraine, SVB collapse).

The analysis of this paper is done by ICMA using Bloomberg, Propellant and CME data.

Liquidity and resilience in the core European sovereign bond markets

Part Two – Section one



France

List of primary dealers

On 13/12/21 AFT (Agence France Tresor), published the list of mandated primary dealers (SVT - Spécialistes en valeurs du Trésor) for 2022/2024.²¹

Bank Of America Securities	HSBC
Barclays	JP Morgan
BNP Paribas	Morgan Stanley
Citi	Natixis
Commerzbank	Natwest Markets
Crédit Agricole	Nomura
Deutsche Bank	Société Générale
Goldman Sachs	

Requisites for primary dealers are mainly three, summarised as below. Full details are available as per source number 22²².

- Participation of at least 2% to all auctions.
- Secondary market participation.
- Pass an “AFT relationship assessment”.

Requirements to support secondary

AFT, requires SVTs to: “ensure the liquidity of the secondary market in French Treasury securities and uphold their status as one of the euro area’s most liquid securities”²².

The full list of duties governing the relationship between ADT and SVT is set as per source number 22.

In summary:

- Each SVB to provide a buy and sell price on continues basis for French Treasury Securities (BTF, OAT, IL-OAT and strips).
- Preserve liquidity by avoiding implanting strategies known to negatively impact market functions.
- A minimum of 2% share in secondary trading volumes.

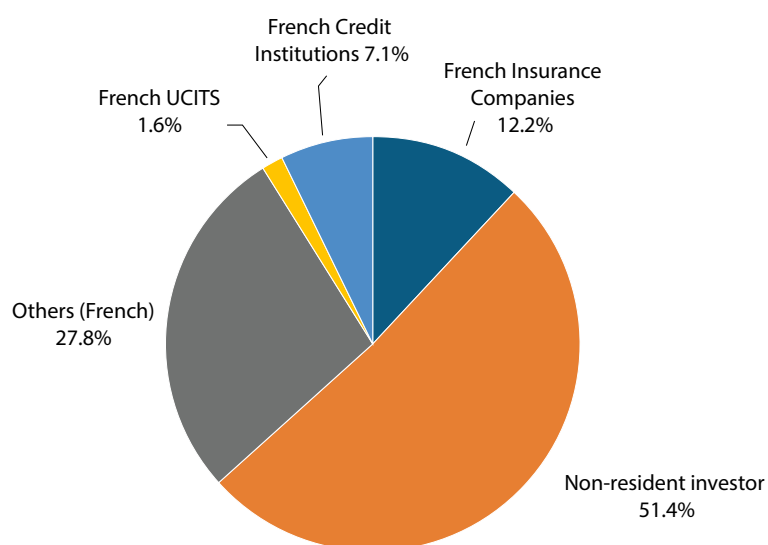
21. <https://www.aft.gouv.fr/en/node/54>

22. https://www.aft.gouv.fr/files/medias-aft/1_AFT/2.Partenaires/2.2_SVT/AFT_Charter%20SVT%202022_EN.pdf

Main investor types²³

	%
French Insurance Companies	12.2
Non-Resident Investors	51.4
Others (French)	27.8
French UCITS	1.6
French Credit Institutions	7.1

Figure 23: Share of French Government Securities Q1 2023



23. https://www.aft.gouv.fr/files/medias-aft/7_Publications/7.2_BM/397_Monthly%20bulletin%20June%202023.pdf

Issuance by tenor

Figure 24: Issuance Count per Quarter for FR

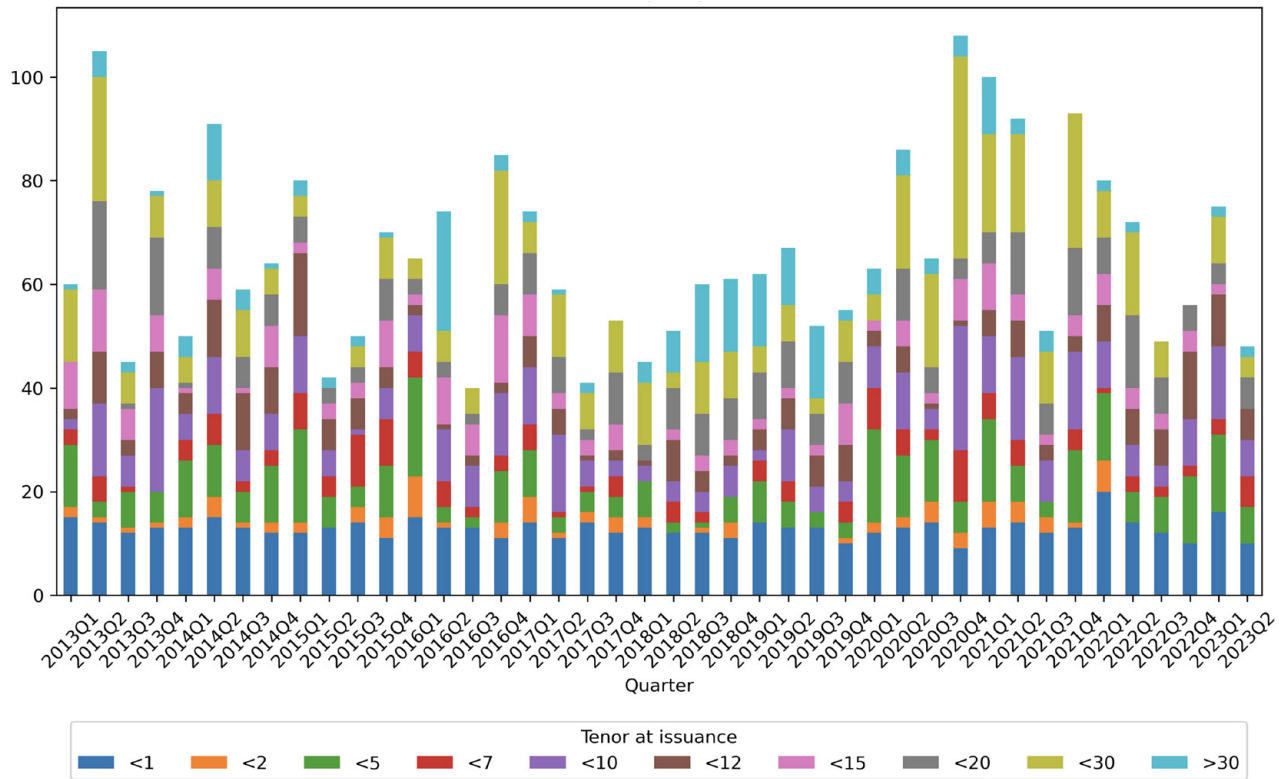
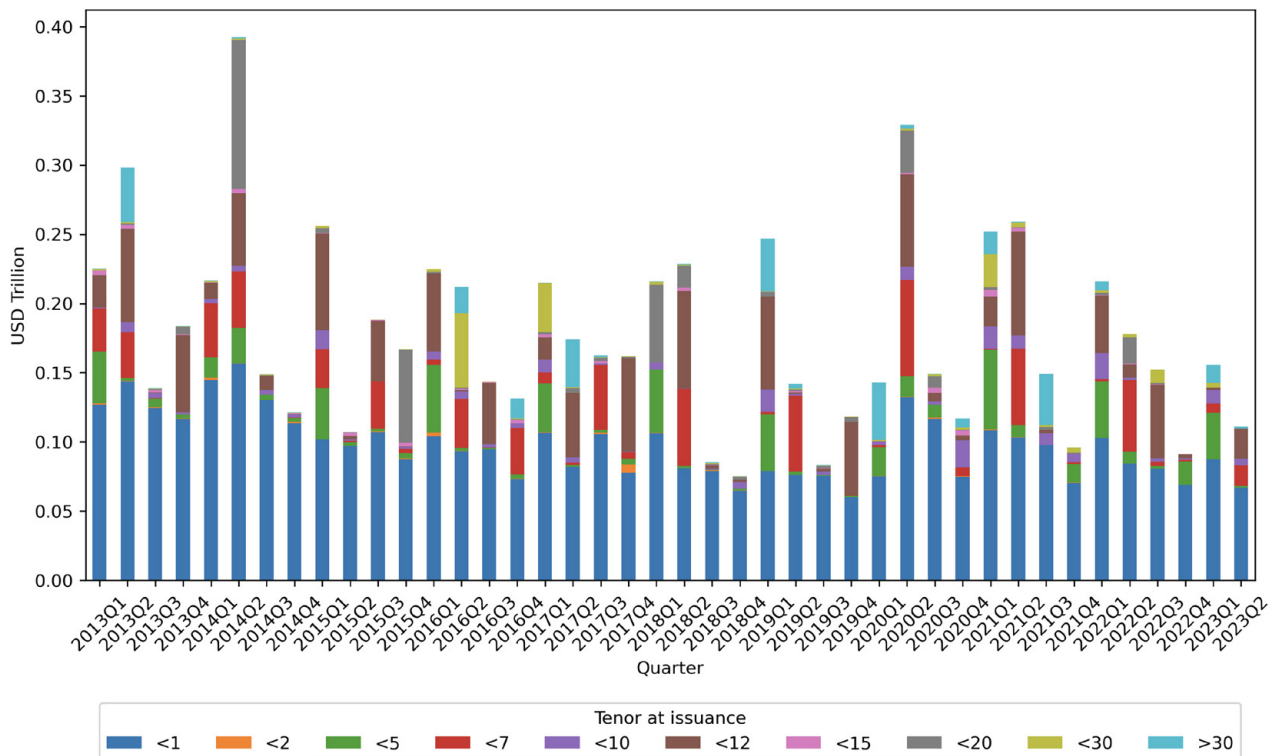


Figure 25: Issuance Amount per Quarter for FR



Tap issuance

Figure 26: Tap Issuance Count per Quarter for FR

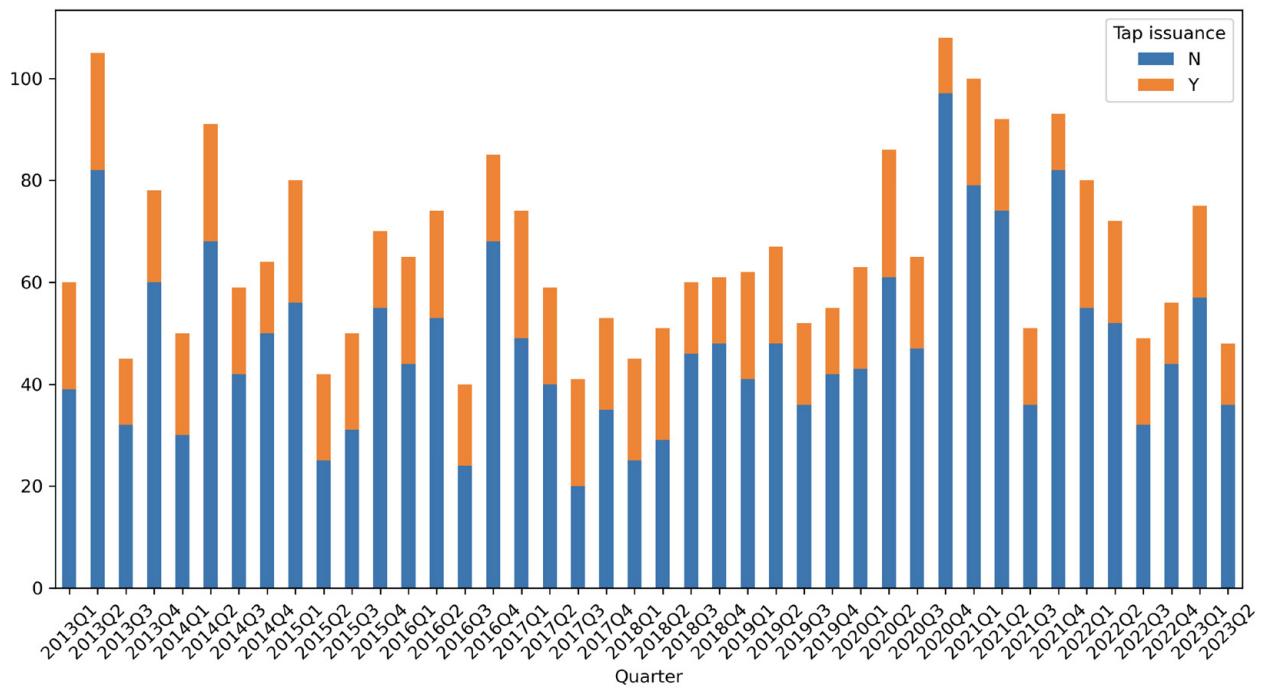
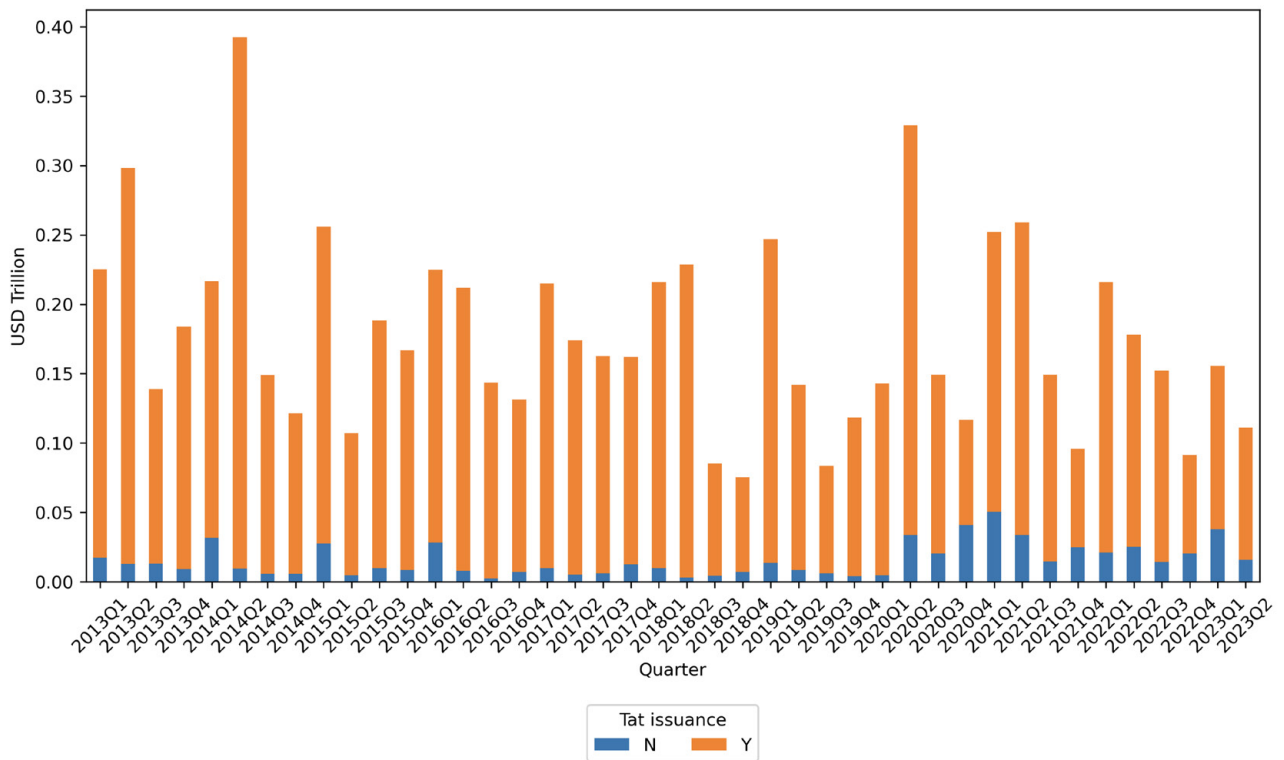


Figure 27: Tap Issuance Amount per Quarter for FR



Yields, Volatility, Volumes and Swap-Spreads

French 2Y shows several clusters of volatility spikes. The first ones happen between 2008 and 2013, in line with events in that period. The spike in 2022 can be attributed to interest rate hike expectations. Fitch downgrades (indicated by the red arrow) do not seem to correlate with any volatility cluster.

The 10Y tenor follows similar patterns but seems more volatile on average, despite not reaching levels as high as the 2 years.

The K-means analysis clearly shows a pre and post pandemic cluster (cluster 2) following a stable trend, which is only interrupted by the outbreak of COVID in March 2020 (cluster 4). Rate hike expectations are depicted in cluster 3 and 5 for both tenors.

In terms of aggregated volumes, we observe a break below the 18 months two standard deviation only during the last week of December 2022.

Figure 28

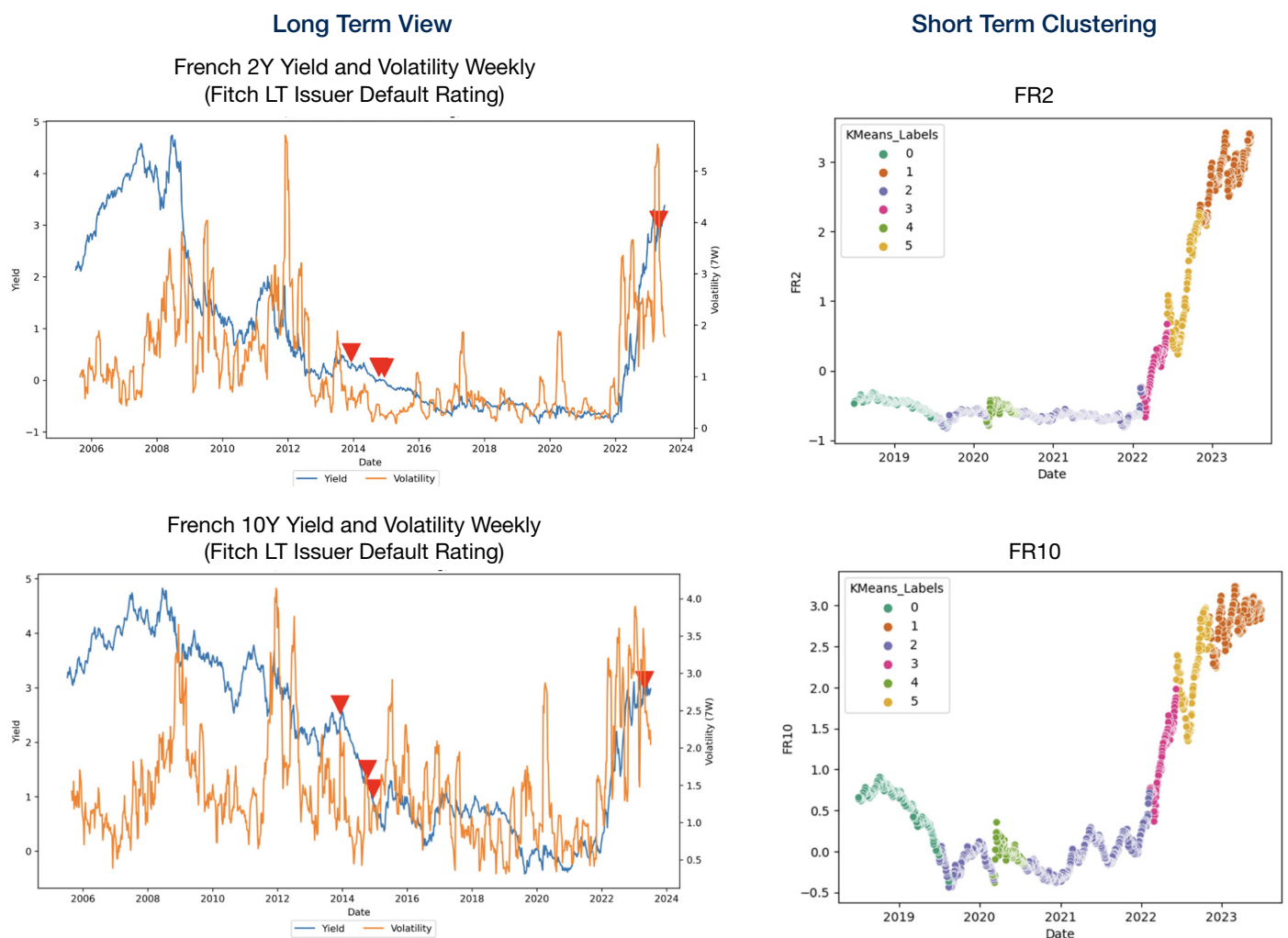


Figure 29: France Government Bond Weekly Traded Volumes

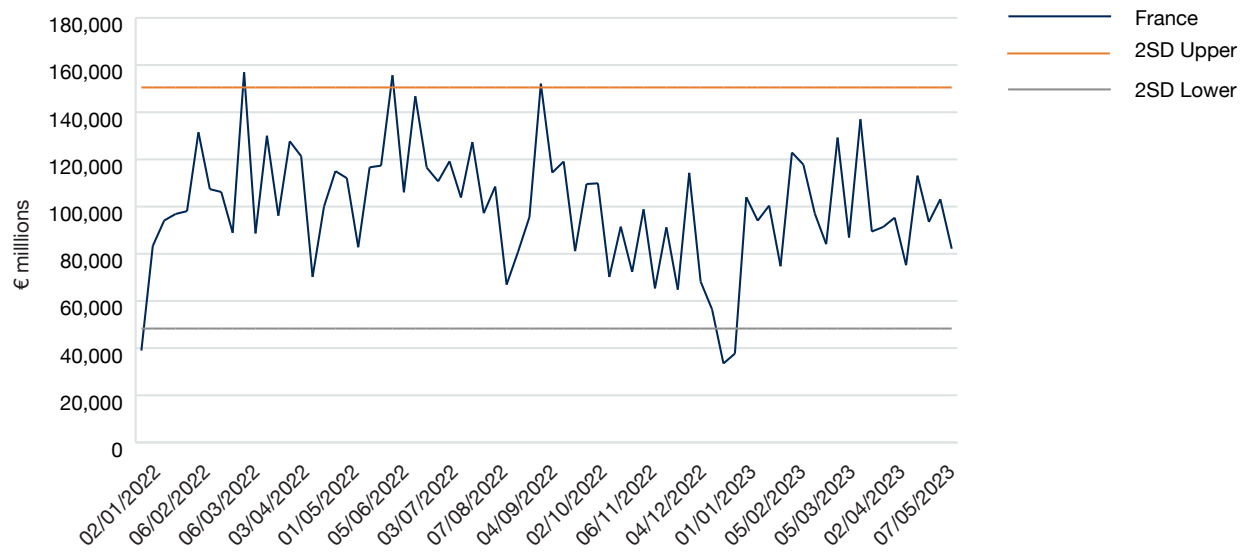
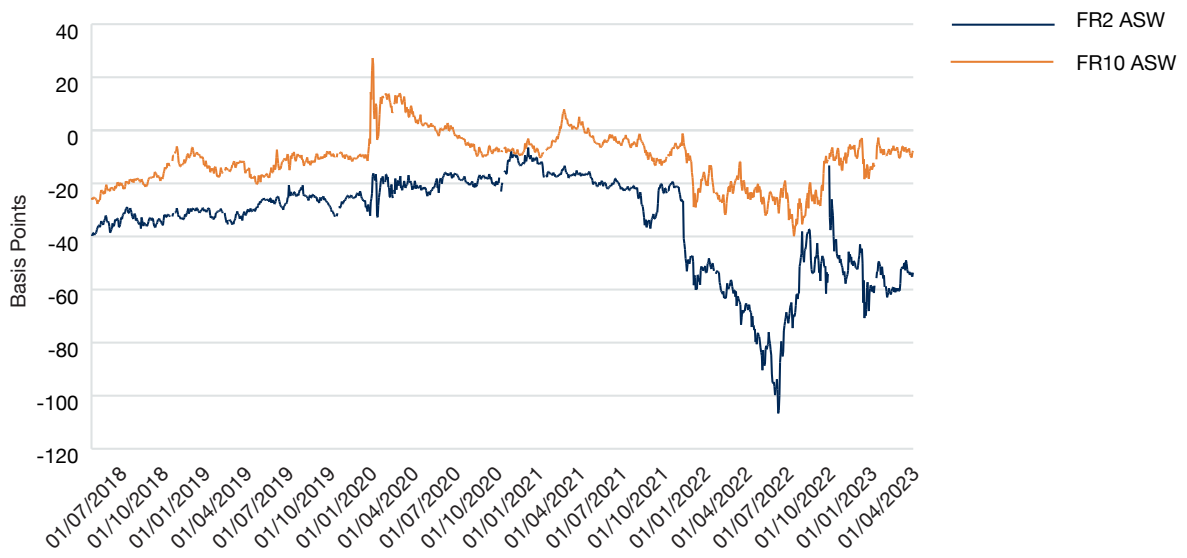


Figure 30: France Swap-Spread



Futures

Available Futures	Exchange	Bloomberg Ticker
Euro-OAT Future	Eurex	OAT
MidTerm Euro-OAT	Eurex	BTA

Figure 31: OAT1 Future

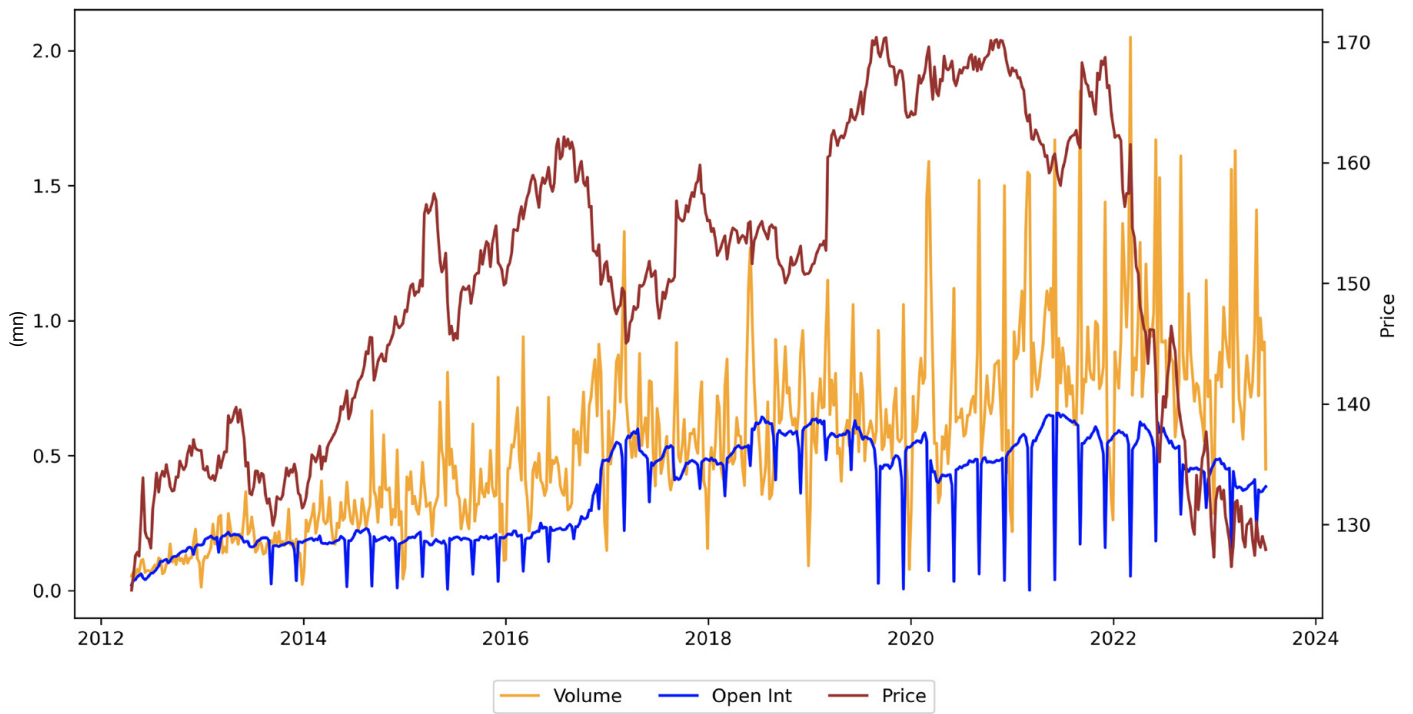
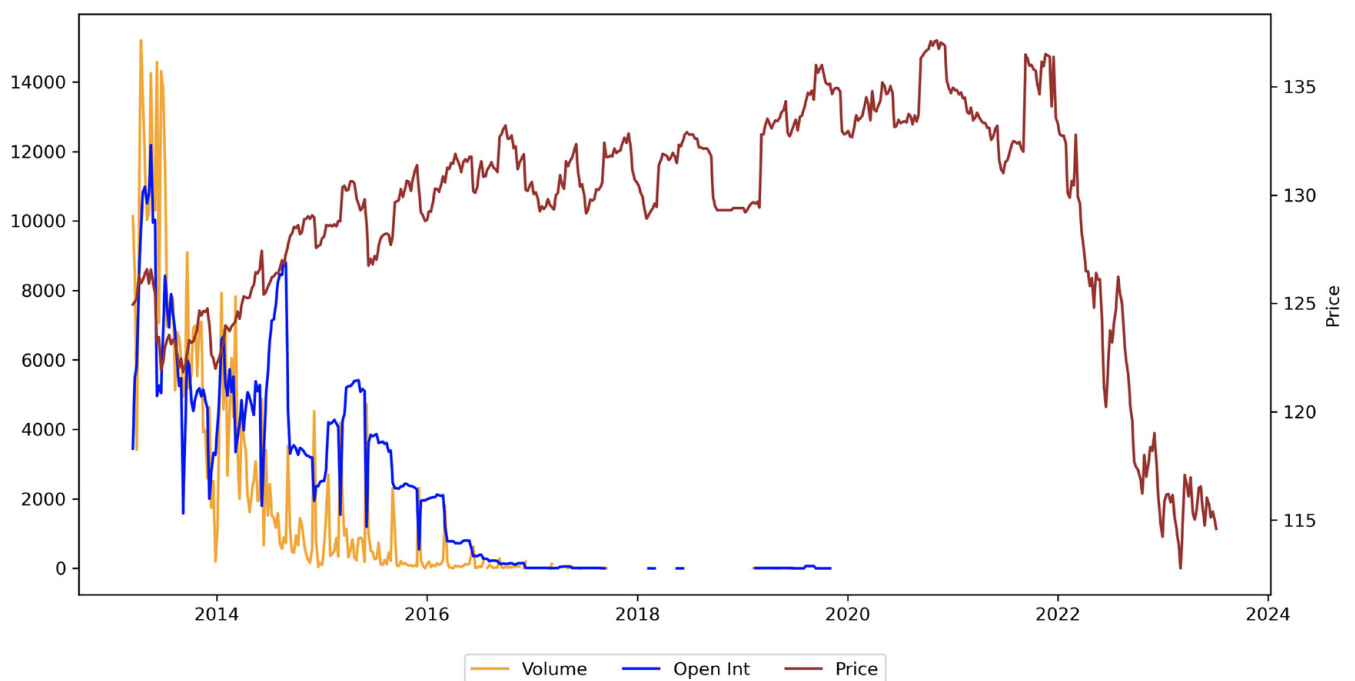


Figure 32: BTA1 Future



Germany

List of primary dealers

The current primary dealers (or Bund Issues Auction Group, BIAG) for the German federal government are listed as follows. The requirements to join the BIAG are summarised as below, full information as per source number 24²⁴:

- Registered office in EU, EEA or Switzerland.
- *“underwrite at least 0.05% of the total issue amounts allocated in the tenders in a calendar year, weighted according to maturity”.*

Current members of the BIAG are:

J.P. Morgan	Société Générale S.A.
BNP Paribas S.A.	Intesa Sanpaolo S.p.A.
Barclays Bank Ireland PLC	UniCredit Bank AG
Deutsche Bank AG	DekaBank
Commerzbank AG	Landesbank Hessen-Thüringen
Bank of America	Mizuho Securities Europe GmbH
Crédit Agricole CIB	Natixis
Citigroup Global Markets Europe AG	Norddeutsche Landesbank
HSBC Continental Europe	Landesbank Baden-Württemberg
Goldman Sachs Bank Europe SE	UBS Europe SE
Nomura Financial Products Europe GmbH	Nordea Bank Abp
Morgan Stanley Europe SE	Coöperatieve Rabobank U.A.
NatWest Markets N.V.	Jefferies GmbH
DZ Bank AG	ODDO BHF SE
Danske Bank A/S	Bayerische Landesbank
Abn Amro Bank N.V.	Scotiabank (Ireland) Designated Activity Company

Requirements to support secondary

The list of BIAG will update every six month, based on their auctions value²⁴. However no specific requirements are listed for secondary market support²⁵.

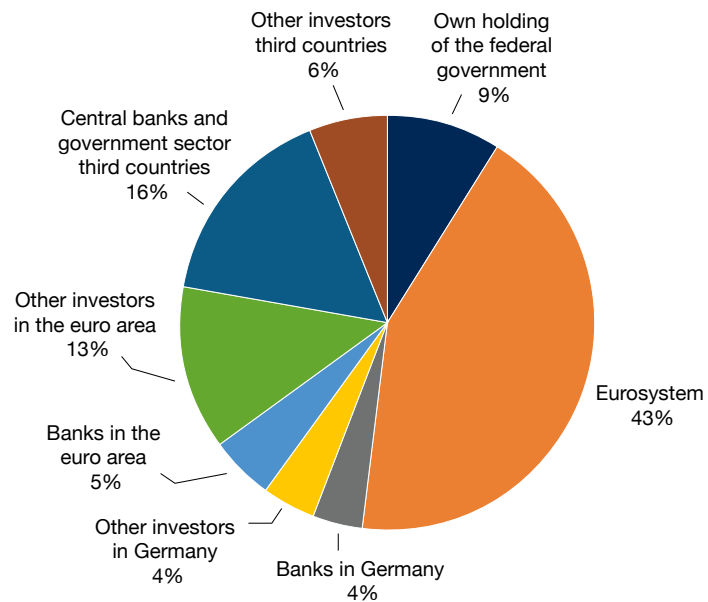
24. <https://www.deutsche-finanzagentur.de/en/federal-securities/issuances/bund-issues-auction-group>

25. <https://www.deutsche-finanzagentur.de/en/federal-securities/trading/secondary-market>

Main investor types²⁶

	%
Own holding of the federal government	9
Eurosystem	43
Banks in Germany	4
Other investors in Germany	4
Banks in the euro area	5
Other investors in the euro area	13
Central banks and government sector third countries	16
Other investors third countries	6

Figure 33: Share of German Government Securities Q2 2022



26. <https://www.deutsche-finanzagentur.de/en/federal-funding/government-as-issuer/investor-structure>

Issuance by tenor

Figure 34: Issuance Count per Quarter for DE

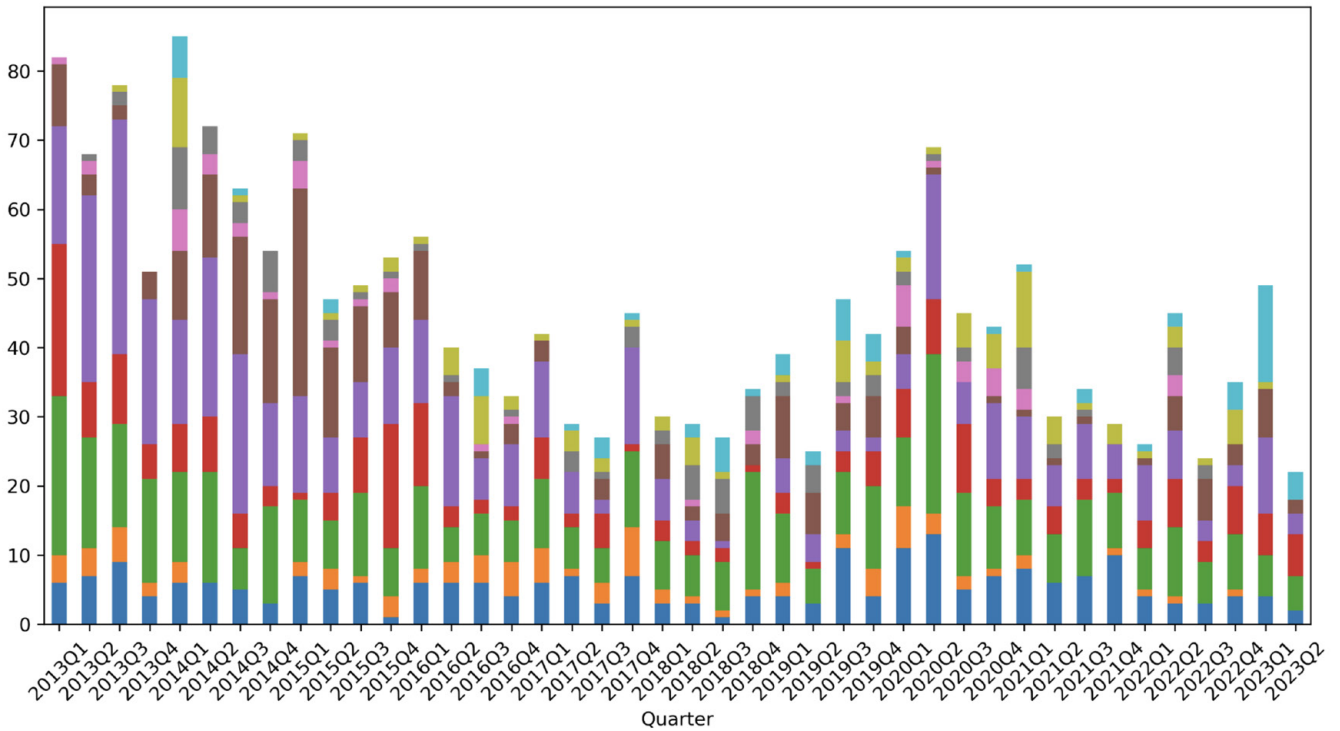
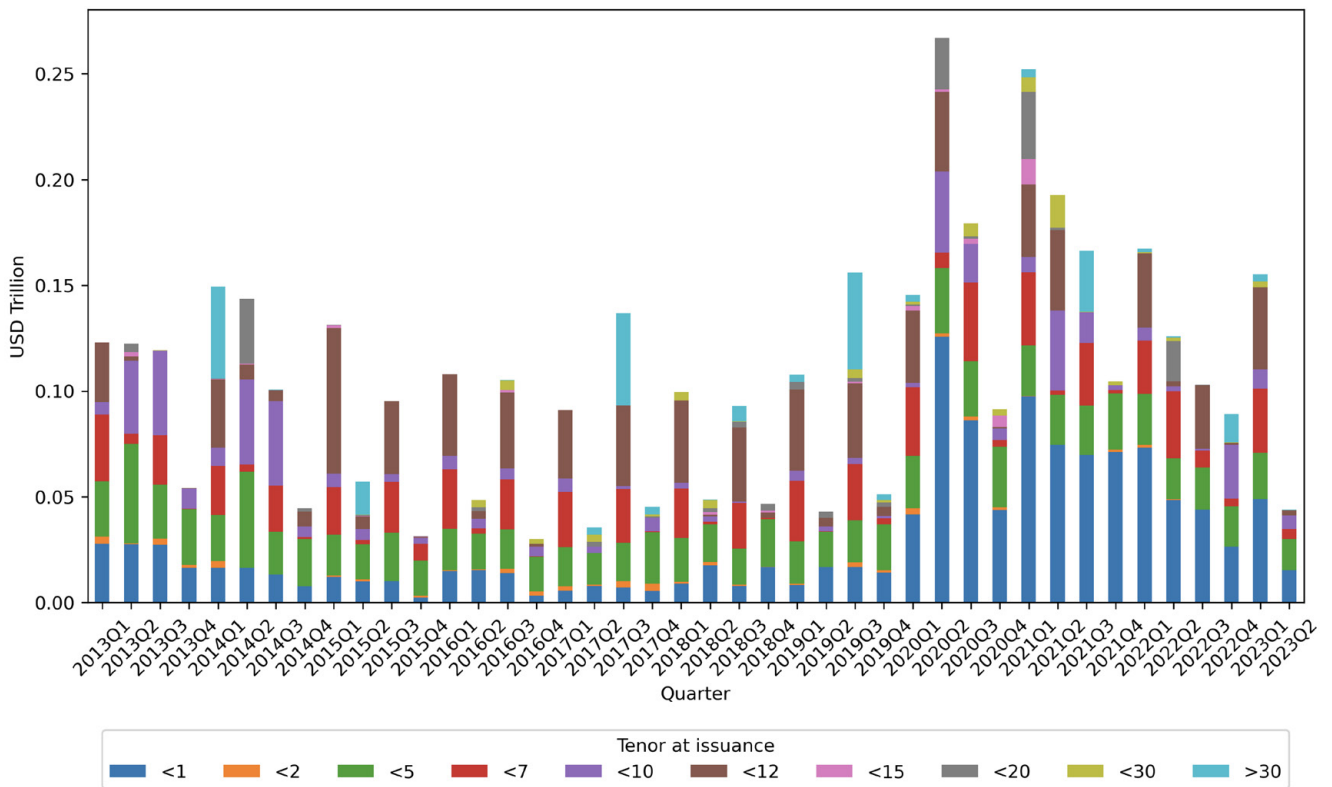


Figure 35: Issuance Amount per Quarter for DE



Tap issuance

Figure 36: Tap Issuance Count per Quarter for DE

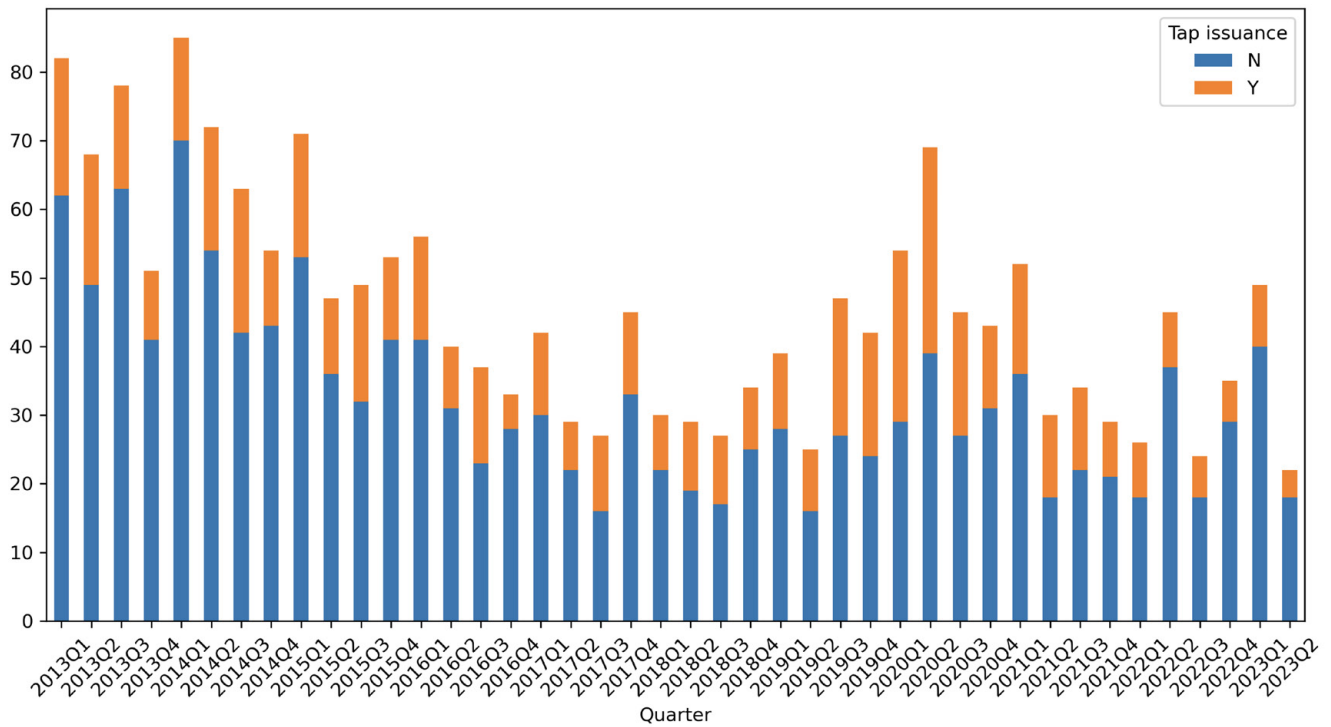
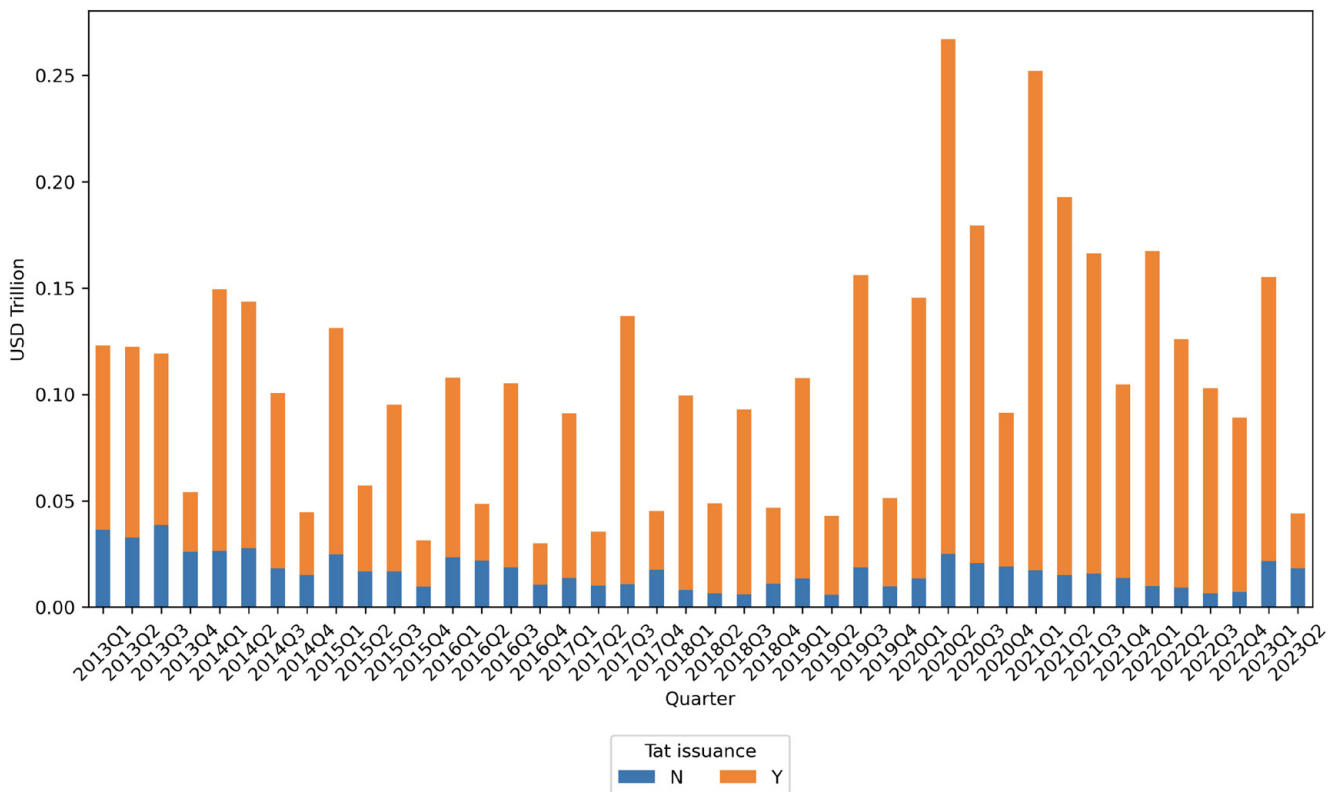


Figure 37: Tap Issuance Amount per Quarter for DE



Yields, Volatility, Volumes and Swap-Spreads

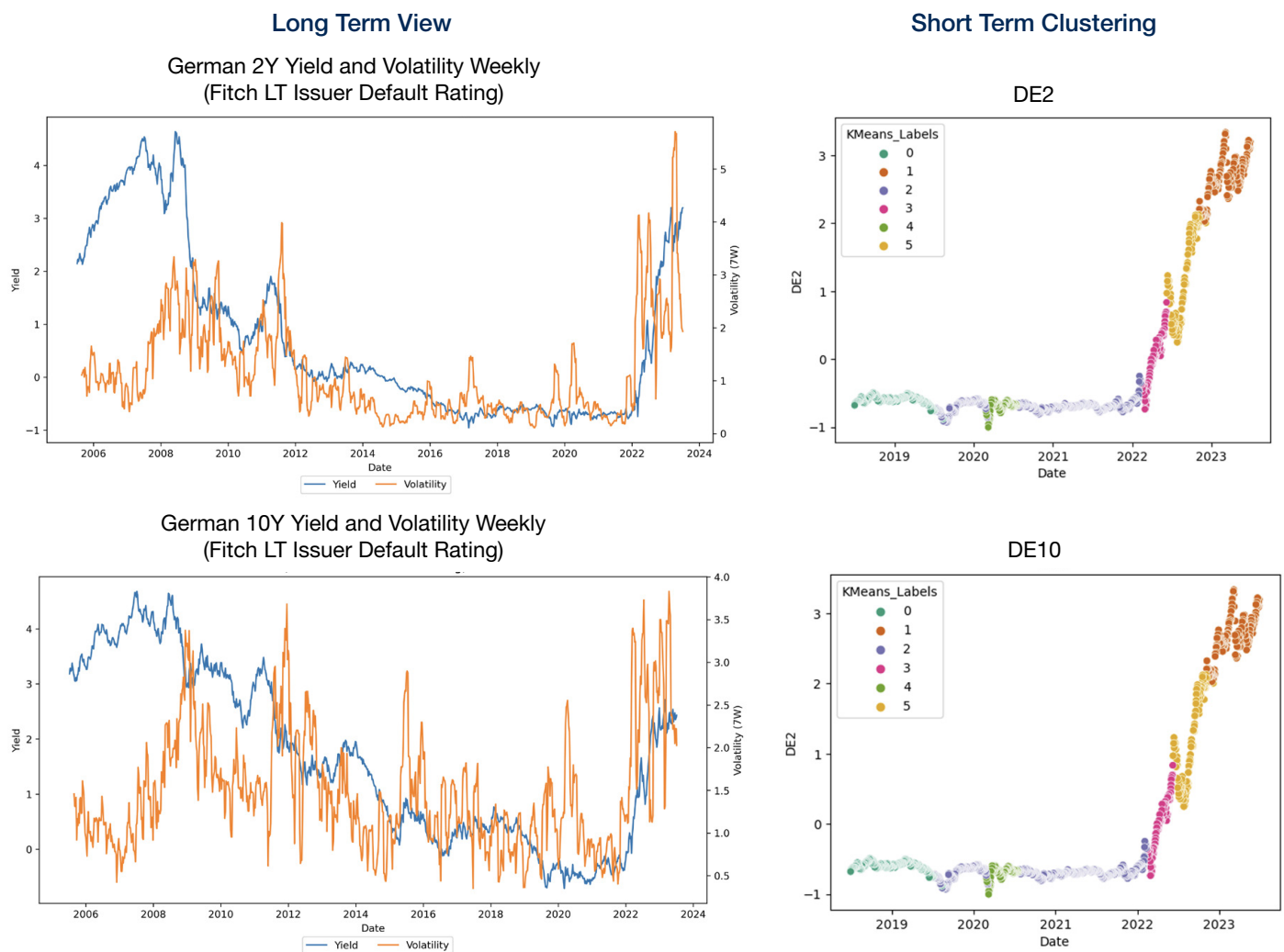
German yields and volatility follow similar patterns compared to the French.

The 2Y tenor has a relatively low volatility from the period 2013 to 2022, while the 10Y tenor instead has low levels of volatility from 2016 to 2020. The same period sees German yields entering negative territory. This can be attributed to Germany being considered by investors as a safe haven in Europe, amid Brexit tension in the UK²⁷. During the same period, German equity markets underperformed. Key events for that quarter:

- Volkswagen's announcement of buy backs/ compensation following the emissions scandal.
- Commerzbank job cut announcements.
- Deutsche Bank 50% stock drop, amid possible 14 USD billion fine over mis-selling MBS²⁸.

In terms of volume, German debt, as per French volumes, temporarily fell below the 2 standard deviation value in the last week of December 2022.

Figure 38



27. <https://www.nytimes.com/2016/07/14/business/dealbook/germany-bonds-negative-yield.html>

28. <https://www.reuters.com/article/eurozone-bonds-idUSL8N1C31UA>

Figure 39: Germany Government Bond Weekly Traded Volumes

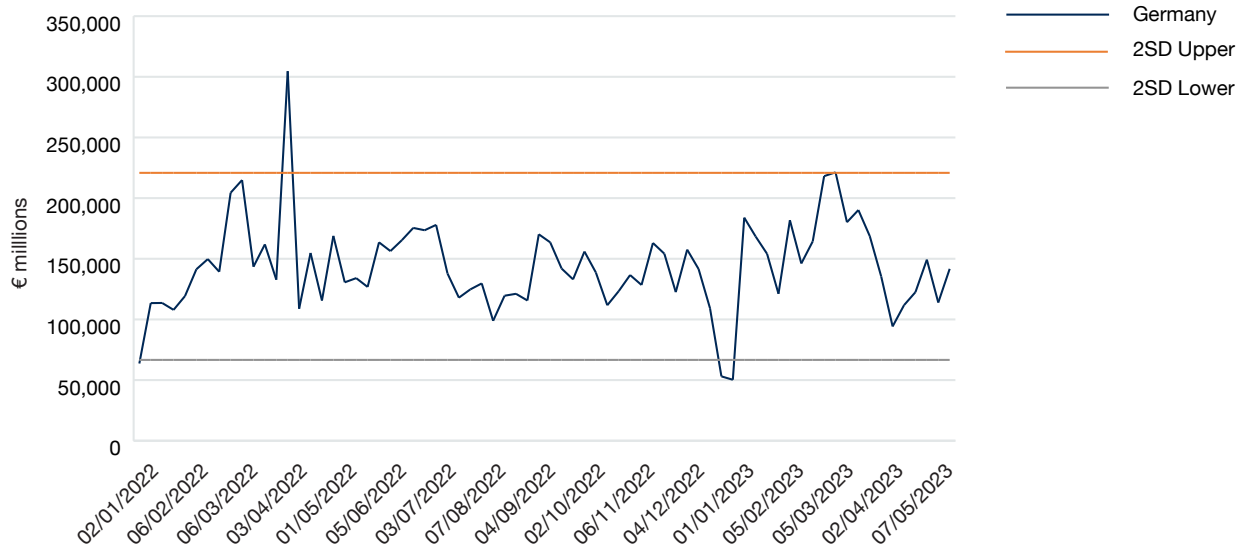
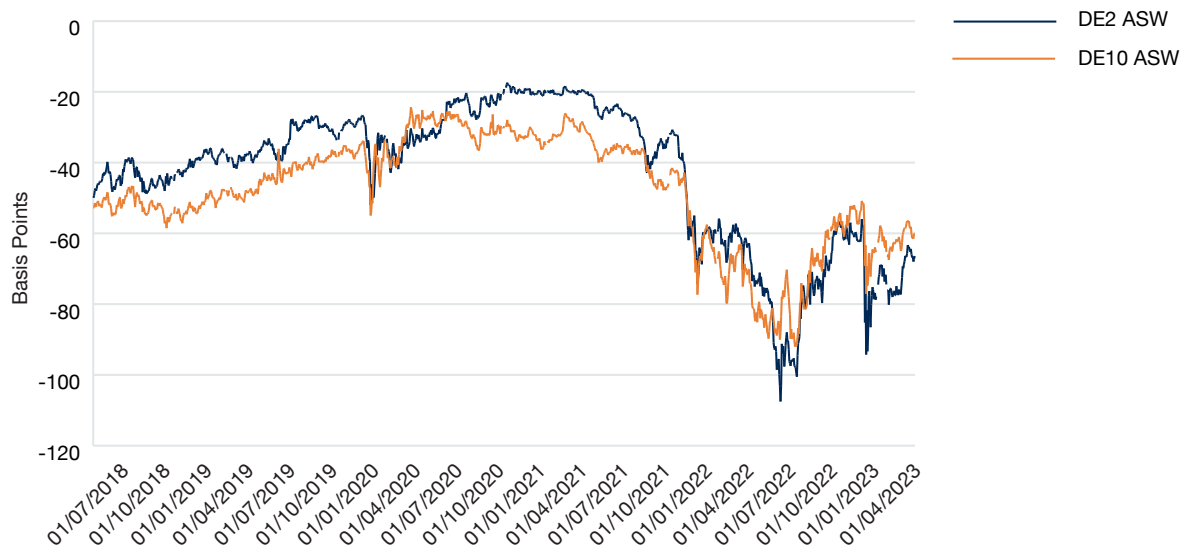


Figure 40: Germany Swap-Spread



Futures

Available Futures	Exchange	Bloomberg Ticker
EURO-BUXL 30Y BND	Eurex	UB
EURO-BUND FUTURE	Eurex	RX
EURO-BOBL FUTURE	Eurex	OE
EURO-SCHATZ FUT	Eurex	DU

Figure 41: RX1 Future

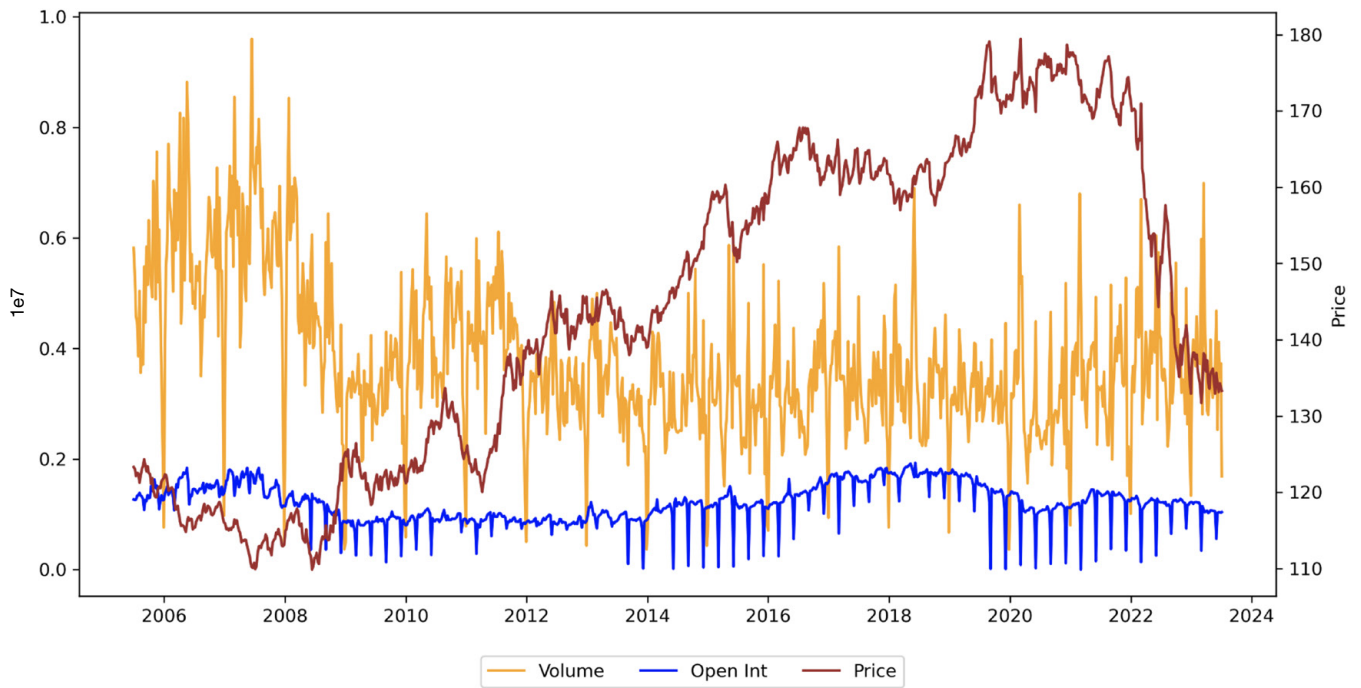
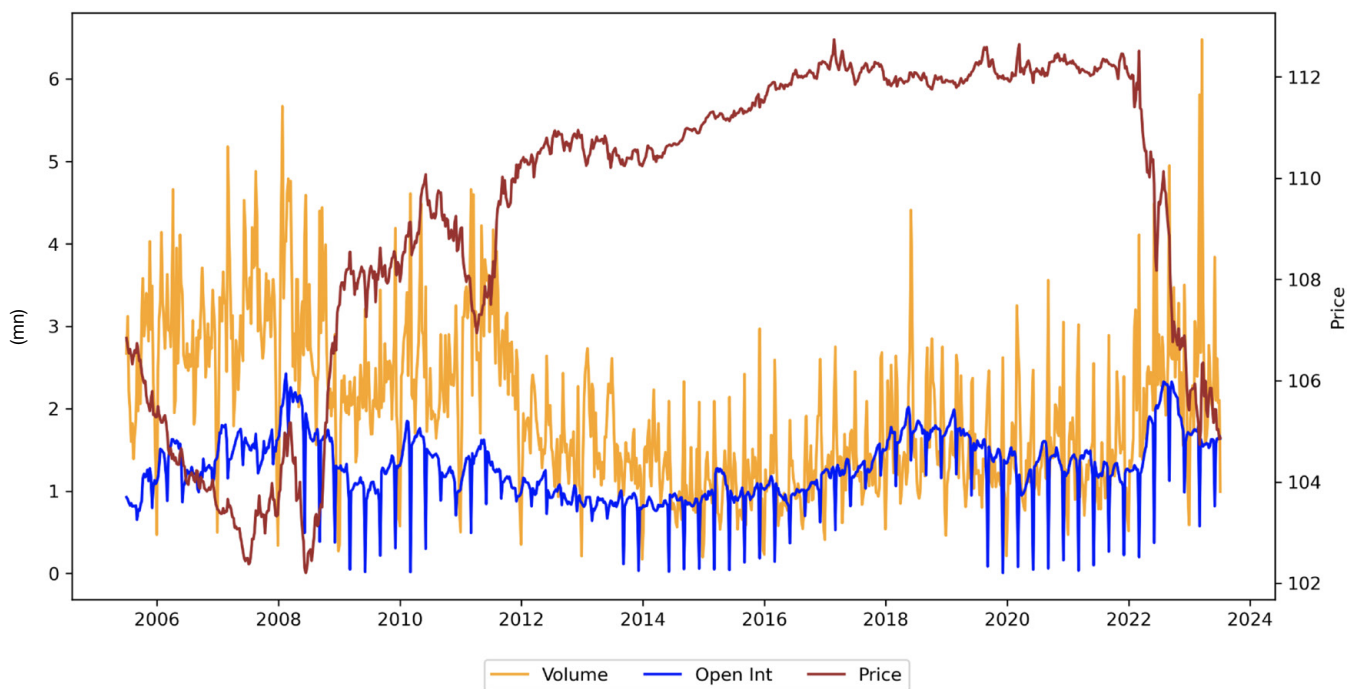


Figure 42: DU1 Future



Italy

List of primary dealers

Requirements to become a primary dealer for Italian debt are summarised as below. These are set as per Decree no. 993039 of November 11th, 2011. "*Selection and Evaluation of Specialists in Government Bonds (Specialists Decree)*". Full information as per source number 29²⁹.

- "*have operated for at least five months, as market makers on Italian Government bonds*"
- "*be in possession of a net regulatory capital equal to at least 50,000,000.00 euros.*"
- "*Subscription of a share of Italian Government bonds placed through auctions, of no less than 3%*"

Current primary dealers are³⁰:

Deutsche Bank A.G.	Crédit Agricole Corp. Inv. Bank
BNP Paribas	Goldman Sachs Bank Europe SE
Barclays Bank Ireland PLC	HSBC Continental Europe
Intesa Sanpaolo S.p.A	Mizuho Securities Europe GmbH
J.P. Morgan SE	Morgan Stanley Europe SE
Monte dei Paschi di Siena	NatWest Markets N.V.
Banco Bilbao Vizcaya Argentaria S.A.	Nomura Financial Products Europe GmbH
Banco Santander S.A.	Société Générale Inv. Banking
BofA Securities Europe S.A.	Unicredit SPA
Citibank Europe Plc	

Requirements to support secondary

In order to be considered a primary dealer, candidates, in addition to the requirements set above, would also be evaluated on secondary markets performances. The evaluation is based on:

- Quotation
- Traded Volumes
- Repo volumes

The full methodology is detailed in Title 3 of Decree no. 111944 as of 20 of December 2019, "*Evaluation Criteria of Specialists in Government bonds (Primary Dealers) Year 2020 (Specialists Evaluation Criteria Decree)*".³¹

29. https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_en/debito_publico/specialisti_titoli_di_stato/Specialists_Decree_-_Selection_and_Evaluation_of_Government_bond_Specialists.pdf

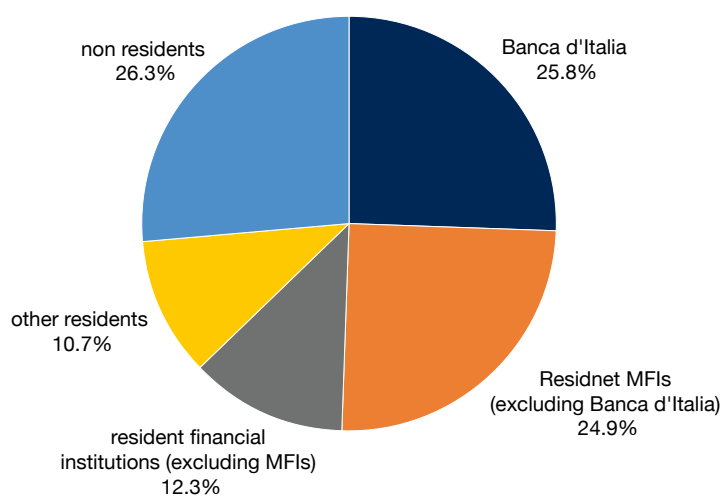
30. https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_en/debito_publico/graduatoria_specialisti/graduatoria/Ranking-of-the-Specialists-in-Government-Bonds-Year-2022.pdf

31. https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_en/debito_publico/specialisti_titoli_di_stato/Specialists_evaluation_criteria_-_year_2020.pdf

Main investor types³²

	%
Banca d'Italia	25.8
Resident MFIs (excluding Banca d'Italia)	24.9
Resident financial institutions (excluding MFIs)	12.3
Other residents	10.7
Non residents	26.3

Figure 43: Share of Italian Government Debt - March 2023



32. https://www.bancaditalia.it/pubblicazioni/finanza-pubblica/2023-finanza-pubblica/en_statistiche_FPI_20230615.pdf?language_id=1

Issuance by tenor

Figure 44: Issuance Count per Quarter for IT

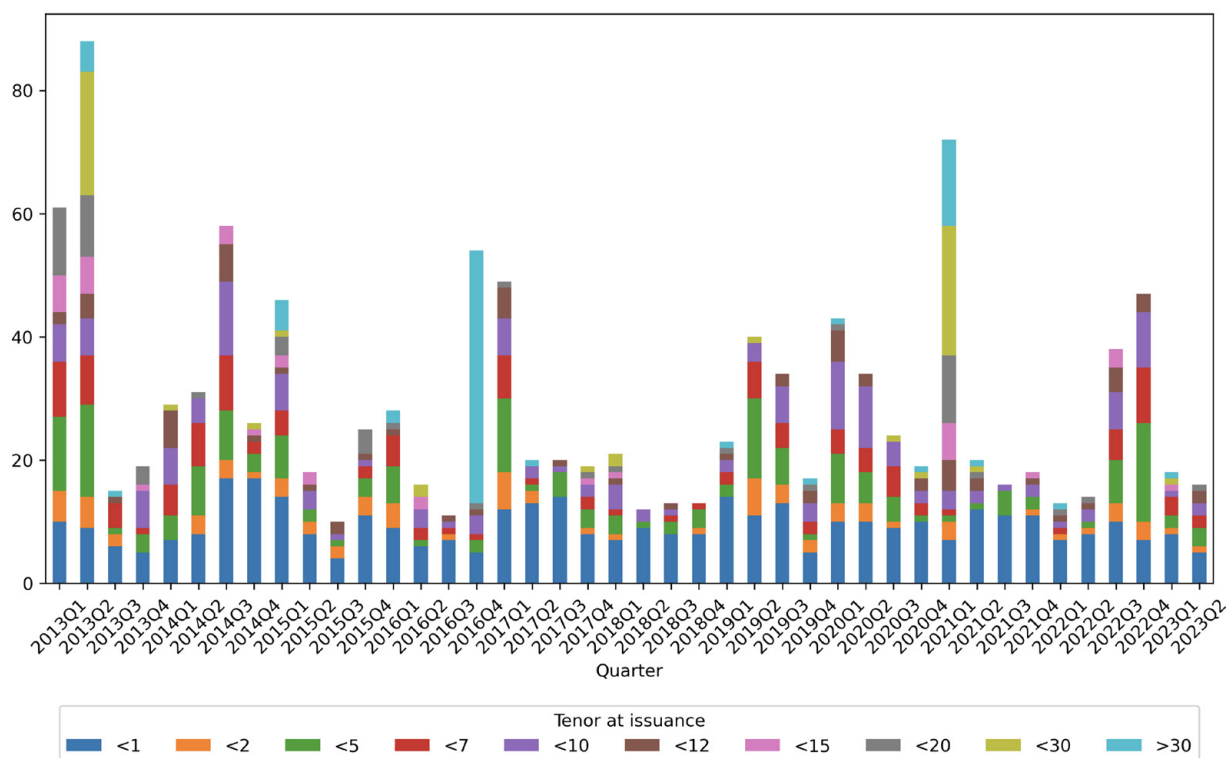
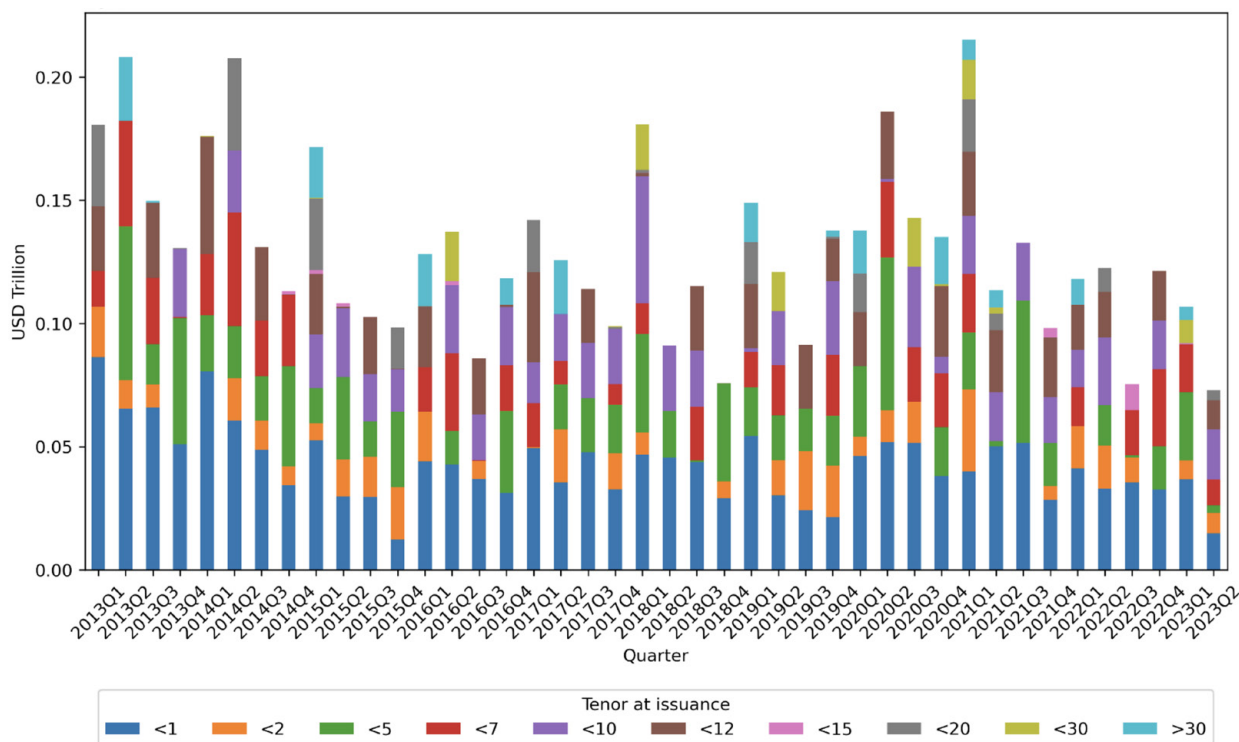


Figure 45: Issuance Amount per Quarter for IT



Tap issuance

Figure 46: Tap Issuance Count per Quarter for IT

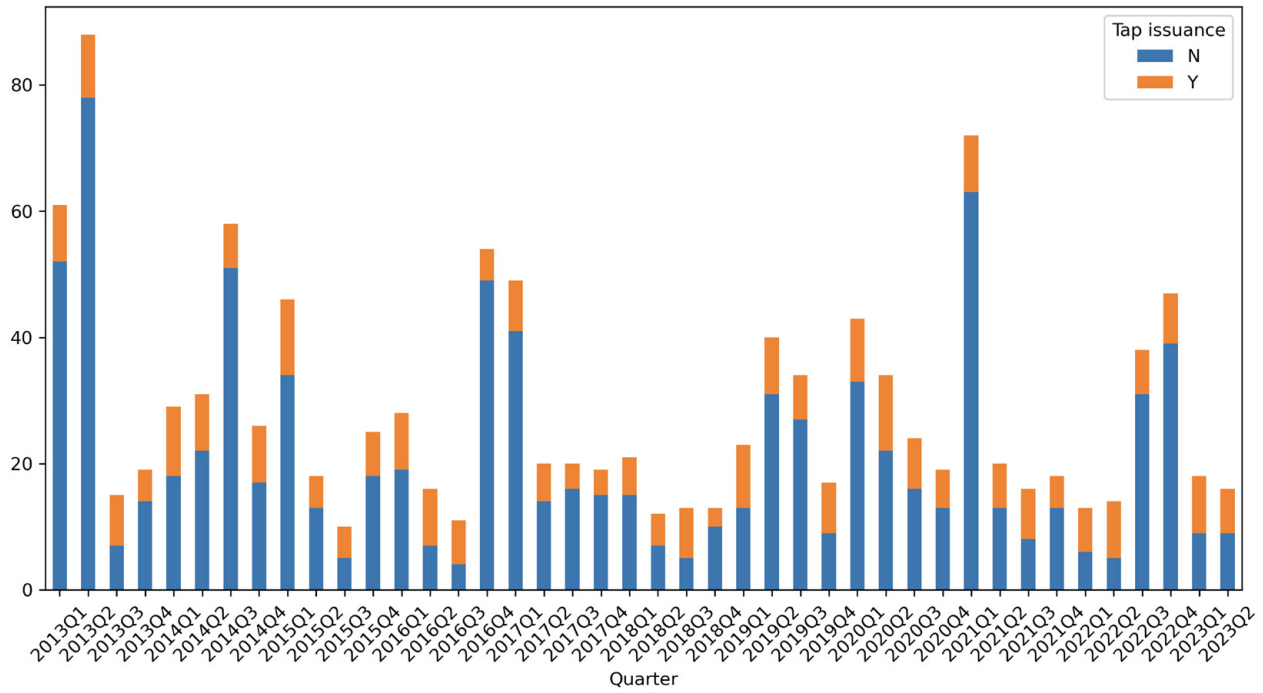
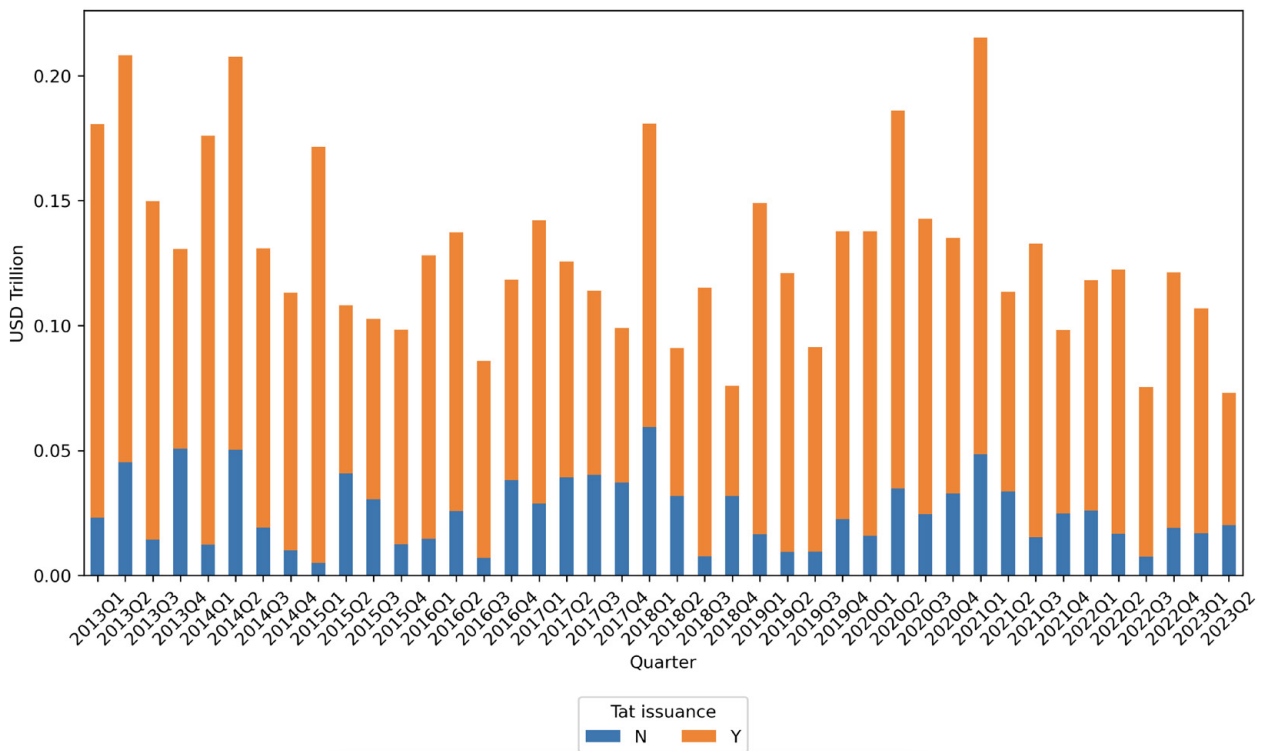


Figure 47: Tap Issuance Amount per Quarter for IT



Yields, Volatility, Volumes and Swap-Spreads

Italian debt, both 2Y and 10Y, showed higher levels of volatility in the post 2008 era compared to neighboring France and Germany. This is also accompanied by a series of downgrades. French and German debt showed relative low volatility during the period 2014-2020. This period of relative low volatility seems to cease in Italy in 2018. Cluster number 4, which we attribute to COVID outbreak, seems steeper compared to Germany and France. Trading volumes have the same common trend in December 2022, with volumes falling below the 2 standard deviation value.

Figure 48

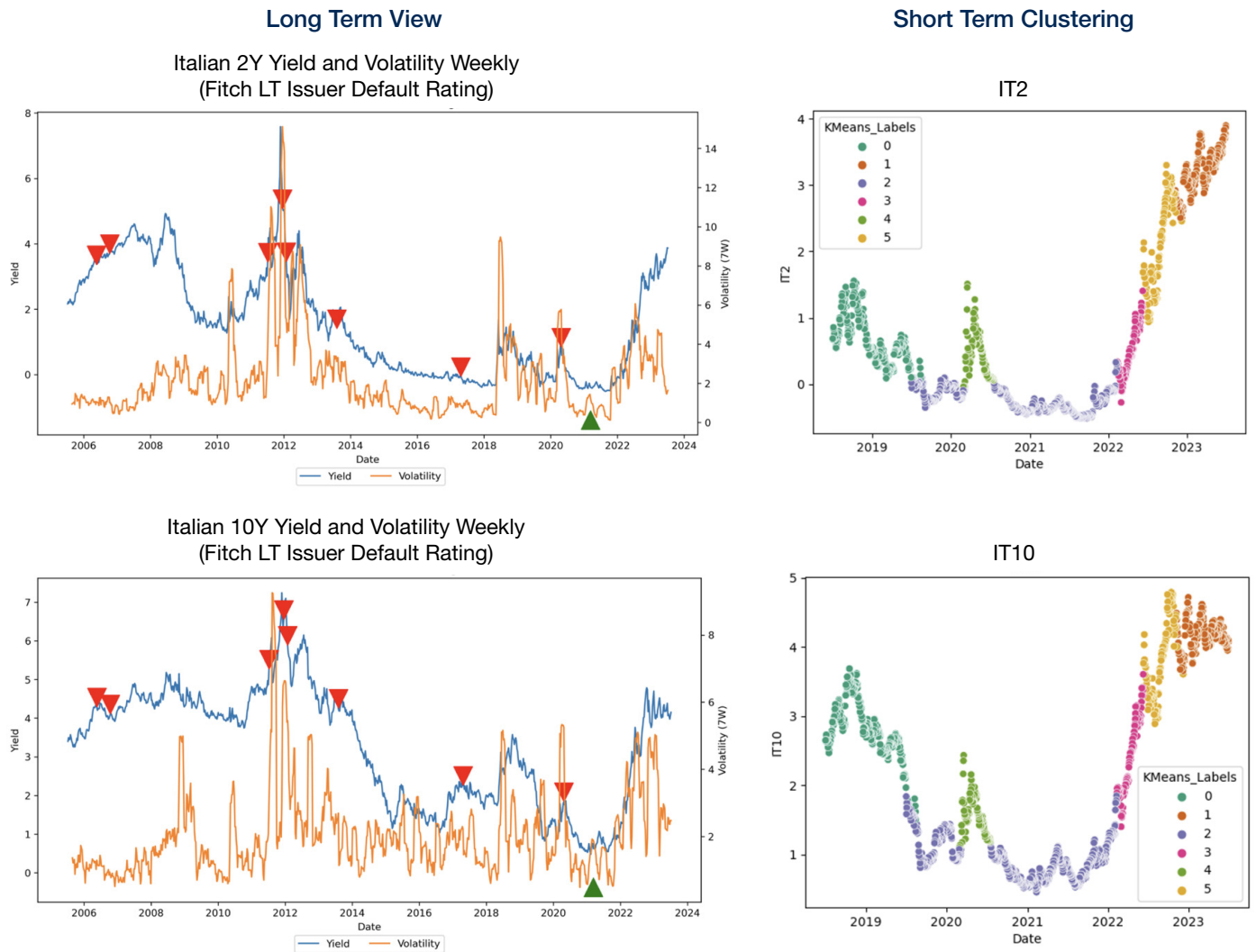


Figure 49: Italy Government Bond Weekly Traded Volumes

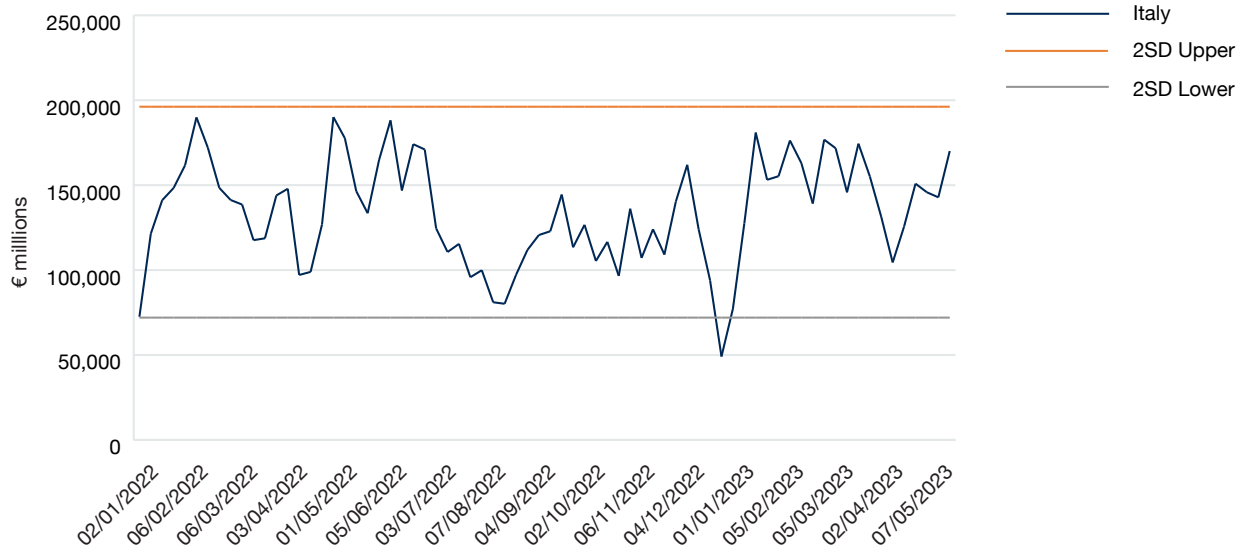
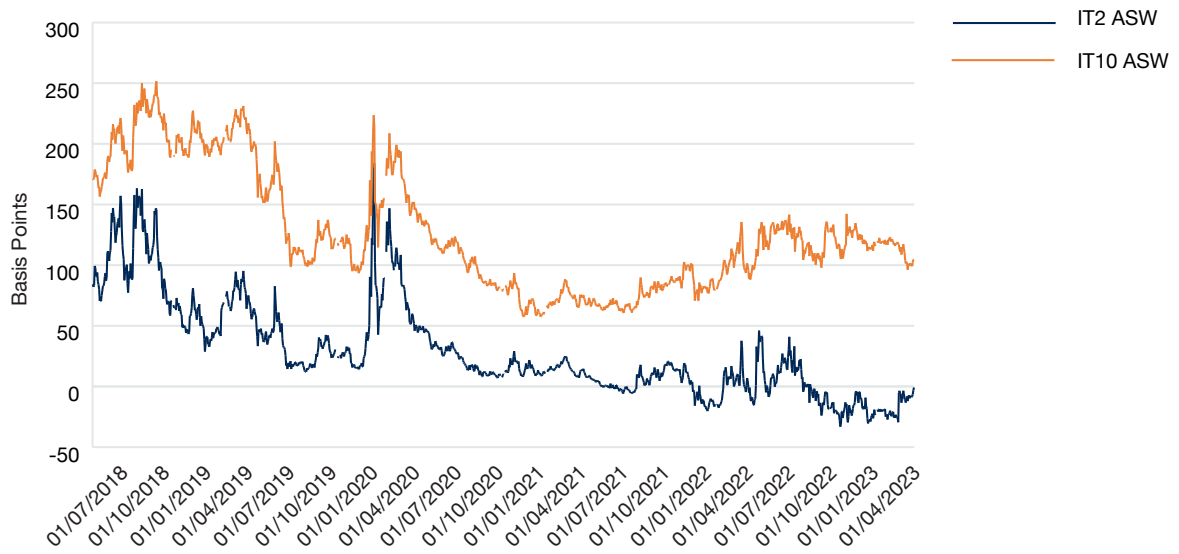


Figure 50: Italy Swap-Spread



Futures

Available Futures	Exchange	Bloomberg Ticker
Euro-BTP Future	Eurex	IK
Short Euro-BTP Future	Eurex	BTS

Figure 51: IK1 Future

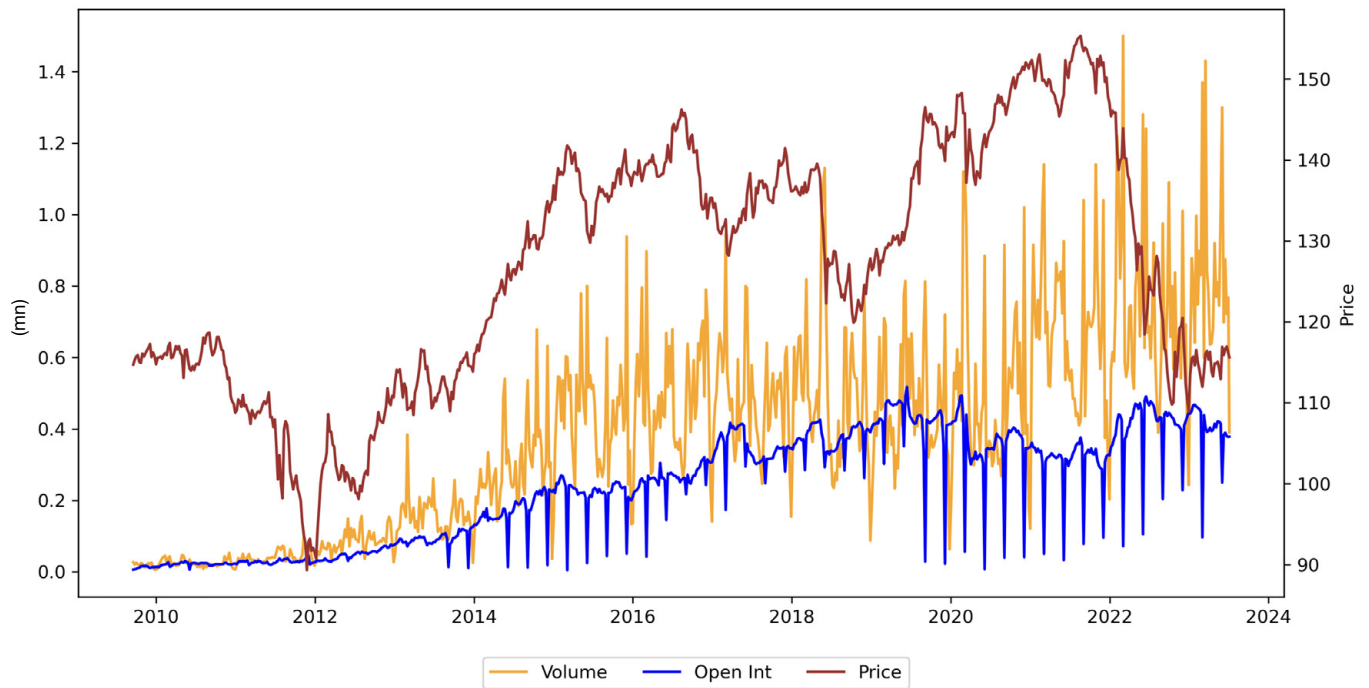
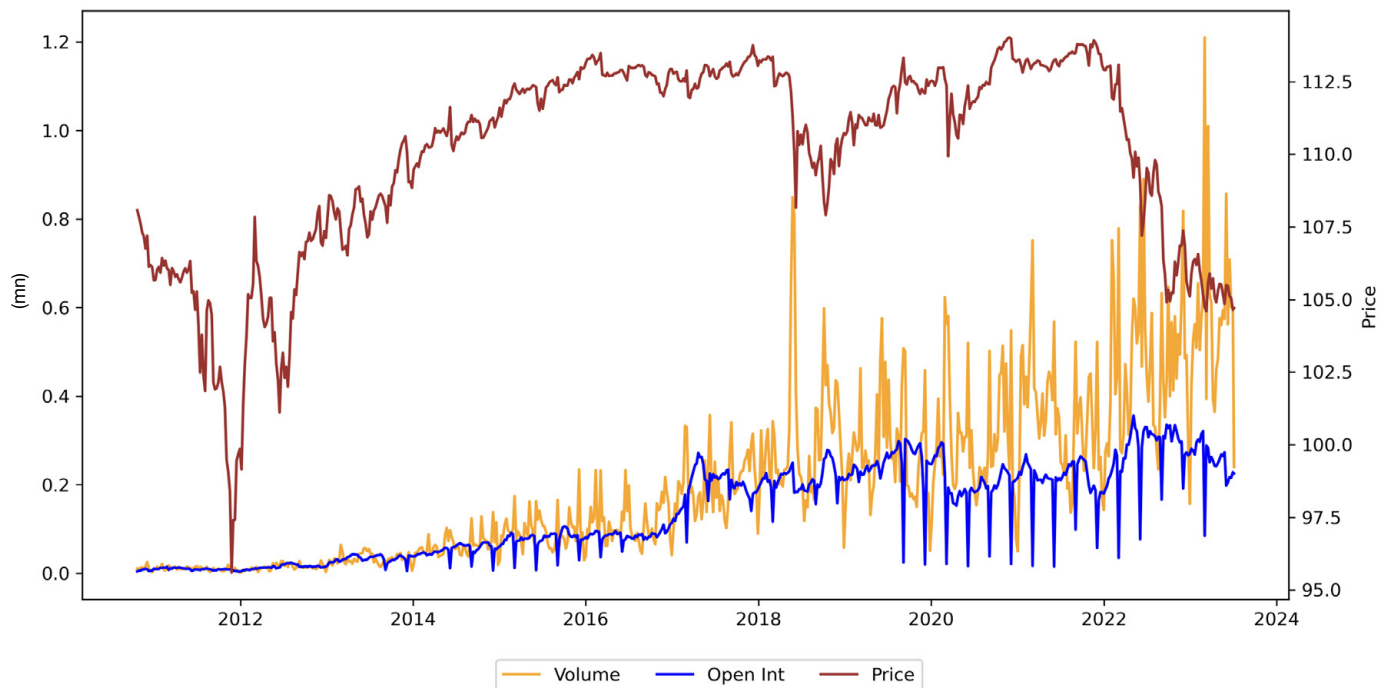


Figure 52: BTS1 Future



Spain

List of primary dealers

Spain currently divides its primary dealers (or Market Makers) in two groups³³:

Market makers in Treasury Bills

Market makers in Government Bonds

At the moment both groups are represented by the same players, and obligations are the same for both groups. Each primary dealer must participate to auctions and *“present at each auction requests to a minimum value of three per cent of the amount sold by the General Secretariat of the Treasury and International Finance for each type of Treasury Bill”*^{34 35}.

The list for both groups is as below^{36 37}:

Banco Bilbao Vizcaya Argentaria, S.A.	Credit Agricole Corporate And Investment Bank
Banco Cooperativo Español, S.A.	Deutsche Bank, A.G.
Banco Santander, S.A.	Goldman Sachs Bank Europe Se
Bankinter, S.A	HSBC Continental Europe
Barclays Bank Ireland Plc.	J.P. Morgan Se
BNP Paribas ,S.A	Morgan Stanley Europe Se
Caixabank, S.A.	Natixis
Cecabank, S.A.	Nomura Financial Products Europe Gmbh
Citibank Europe Plc	Société Générale
Commerzbank A.G.	

Requirements to support secondary

Primary Dealers are to *“guarantee the liquidity of the secondary market, by quoting at a maximum bid/ask spread set out by the General Secretariat of the Treasury and International Finance”*³⁸.

New reforms to introduce a second figure of “Market Member” are currently awaiting approval in Spain³⁹.

“Market Members shall be those entities empowered to purchase and sell securities in the Public Debt Book-Entry Market, on their own or others’ behalf, under the terms allowed by their legal regime”.

*“Secondary market trades are conducted through three systems (the first two reserved exclusively for market members)”*⁴⁰:

1. First Tier, *“in which only Public Debt members can participate. Trading is electronically conducted without knowledge of the counterparty identity (hence the term “blind”)*”.

33. <https://www.tesoro.es/en/deuda-publica/mercado/participantes/creadores-de-mercado/que-es-un-creador-de-mercado>

34. <https://www.tesoro.es/en/deuda-publica/mercado/participantes/creadores-de-mercado/creadores-de-mercado-de-letras-del-tesoro/obligaciones-del-creador-de-mercado-de-letras>

35. <https://www.tesoro.es/en/deuda-publica/mercado/participantes/creadores-de-mercado/creadores-de-mercado-de-bonos-y-obligaciones-del-estado/obligaciones-del-creador-de-mercado-de-bonos-y-obligaciones>

36. <https://www.tesoro.es/en/deuda-publica/mercado/participantes/creadores-de-mercado/creadores-de-mercado-de-letras-del-tesoro/creadores-de-mercado-de-letras>

37. <https://www.tesoro.es/en/deuda-publica/mercado/participantes/creadores-de-mercado/creadores-de-mercado-de-bonos-y-obligaciones-del-estado/creadores-de-mercado-de-bonos-y-obligaciones>

38. <https://www.tesoro.es/en/deuda-publica/mercado/participantes/creadores-de-mercado/creadores-de-mercado-de-letras-del-tesoro/obligaciones-del-creador-de-mercado-de-letras>

39. <https://www.tesoro.es/en/Deuda-Publica/Mercado/Participantes/miembros-mercado>

40. <https://www.tesoro.es/en/deuda-publica/mercado/mercado-secundario/ambitos-de-negociacion>

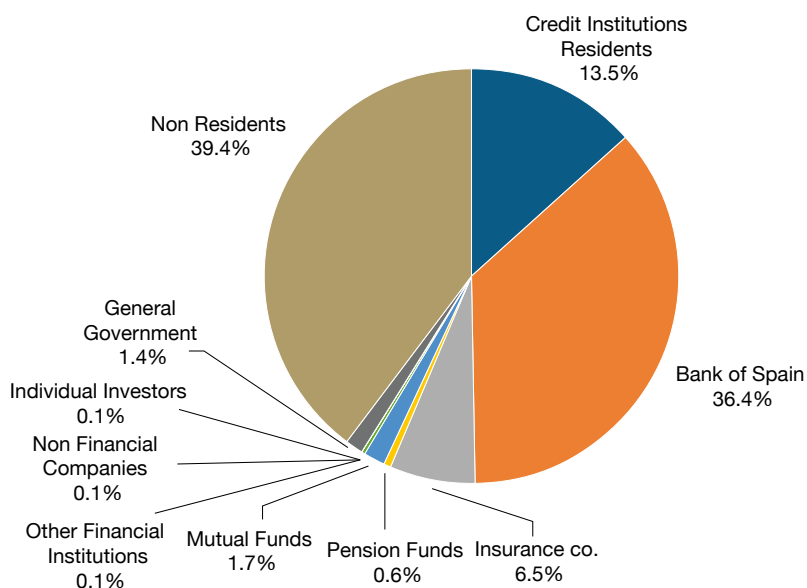
2. Second Tier, Supported by Bank of Spain Settlement Service, *“Operations can be entity-to-entity or through a broker. In the second case, the broker matches the operation and notifies each party of its counterparty -who is identified under this system”.*
3. *“The third and last trading system comprises transactions between Management Institutions and their clients”.*

Full information as per source 40.

Main investor types⁴¹

	%
Credit institutions residents	13.5
Bank of Spain	36.4
Insurance co.	6.5
Pension funds	0.6
Mutual funds	1.7
Other financial institutions	0.1
Non financial companies	0.1
Individual investors	0.1
General government	1.4
Non residents	39.4

Figure 53: Share of Spanish Government Debt - Dec 2022



41. <https://www.tesoro.es/en/deuda-publica/historico-de-estadisticas/Government-Debt-by-holders-2002-2017>

Issuance by tenor

Figure 54: Issuance Count per Quarter for ES

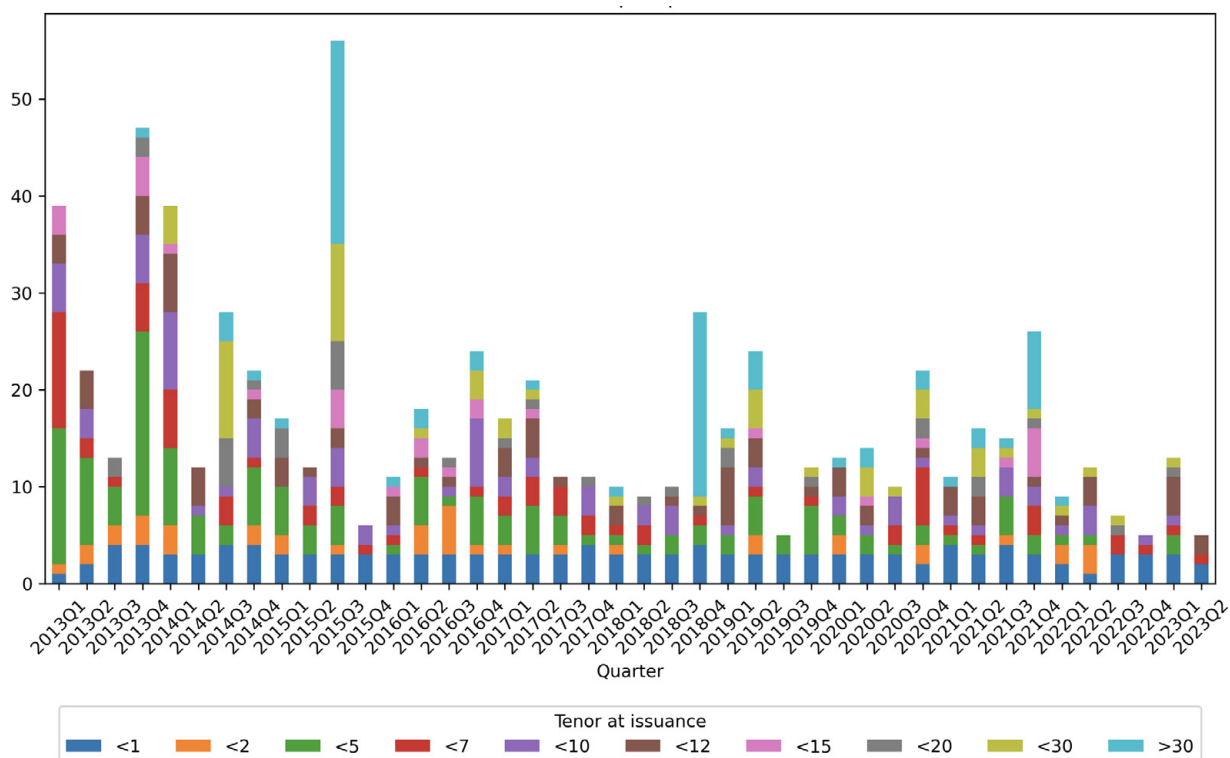
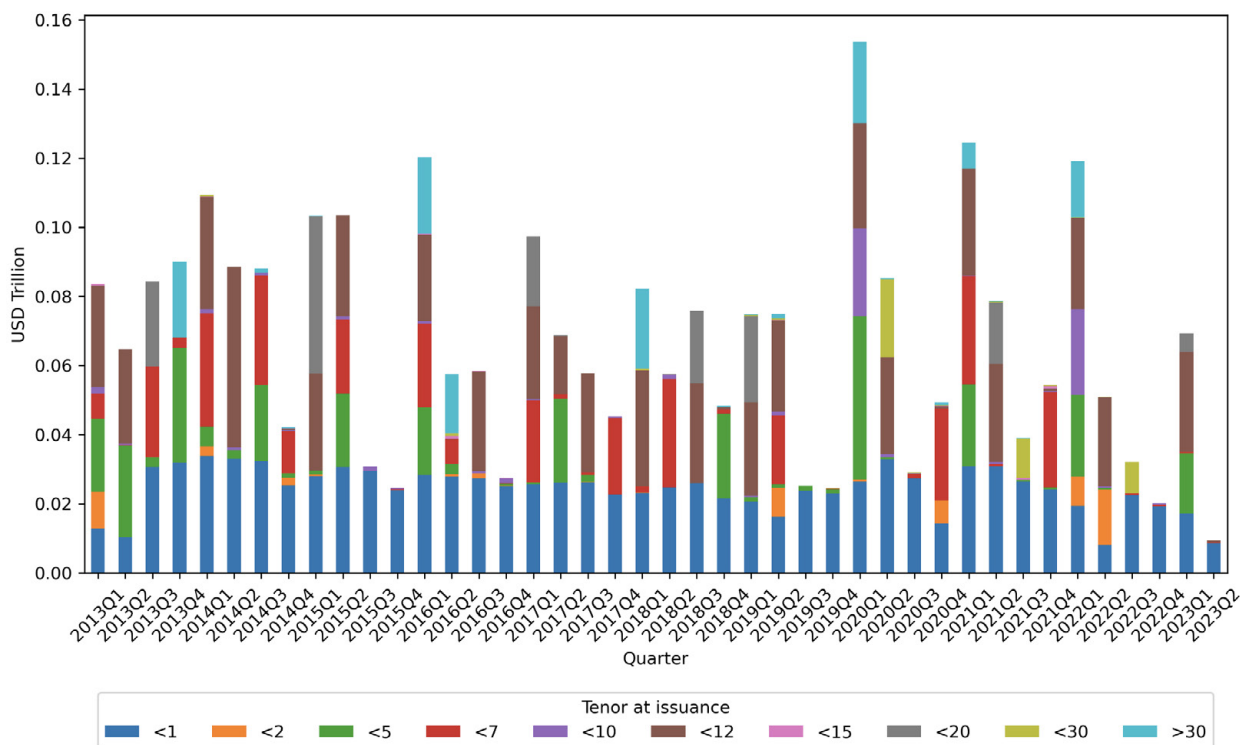


Figure 55: Issuance Amount per Quarter for ES



Tap issuance

Figure 56: Tap Issuance Count per Quarter for ES

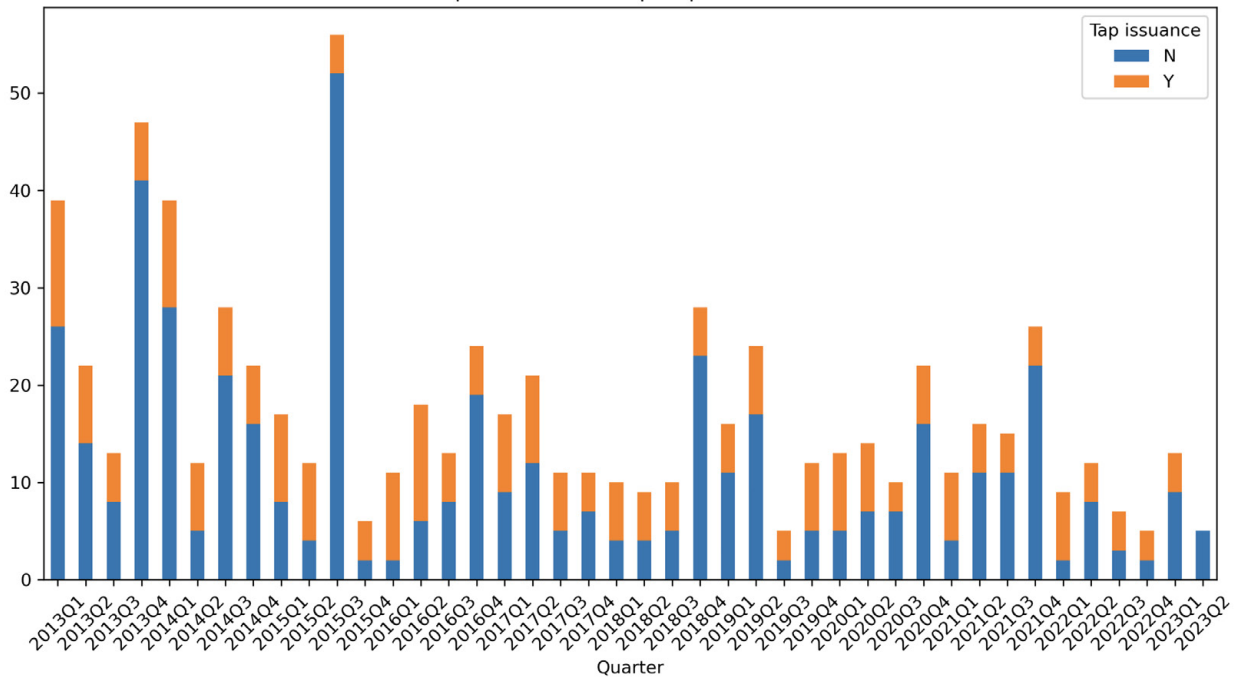
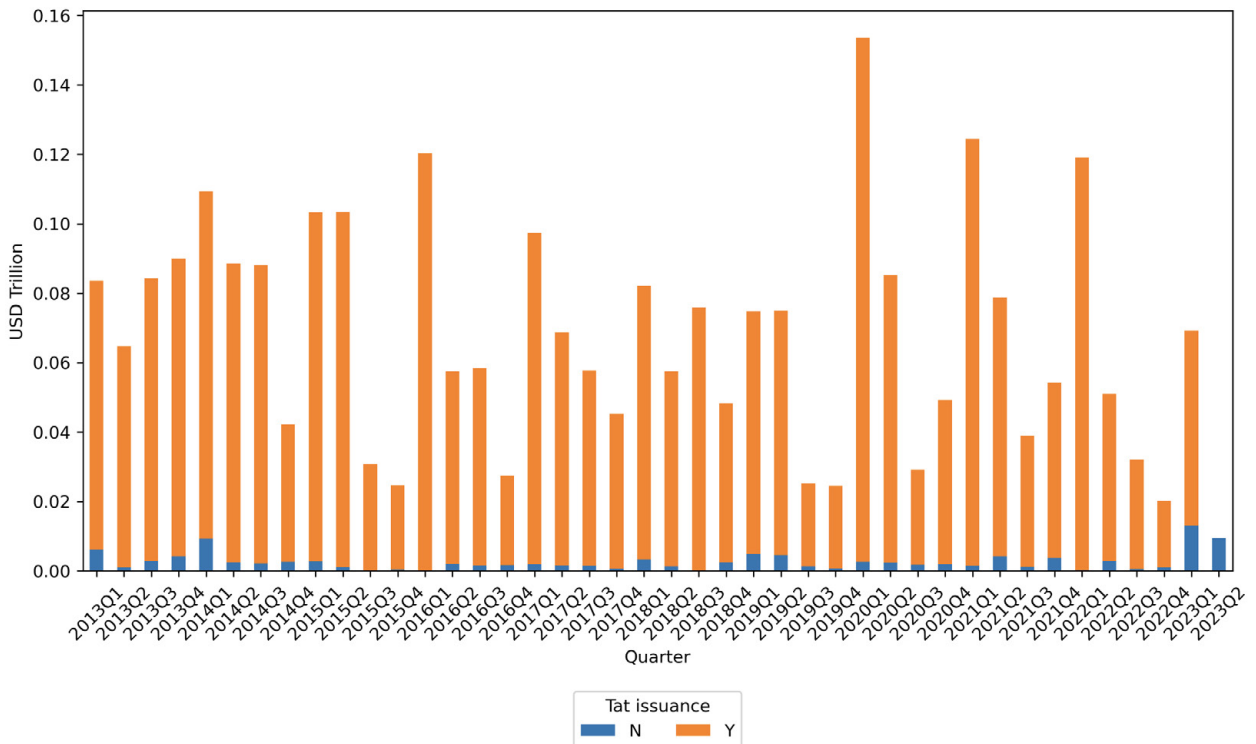


Figure 57: Tap Issuance Amount per Quarter for ES



Yields, Volatility, Volumes and Swap-Spreads

Spanish trends in volatility resemble closely the German and French trends, however, with a greater magnitude. In terms of volumes, Spain experienced low levels in December 2022 similar to the rest of the countries mentioned in this paper.

Figure 58

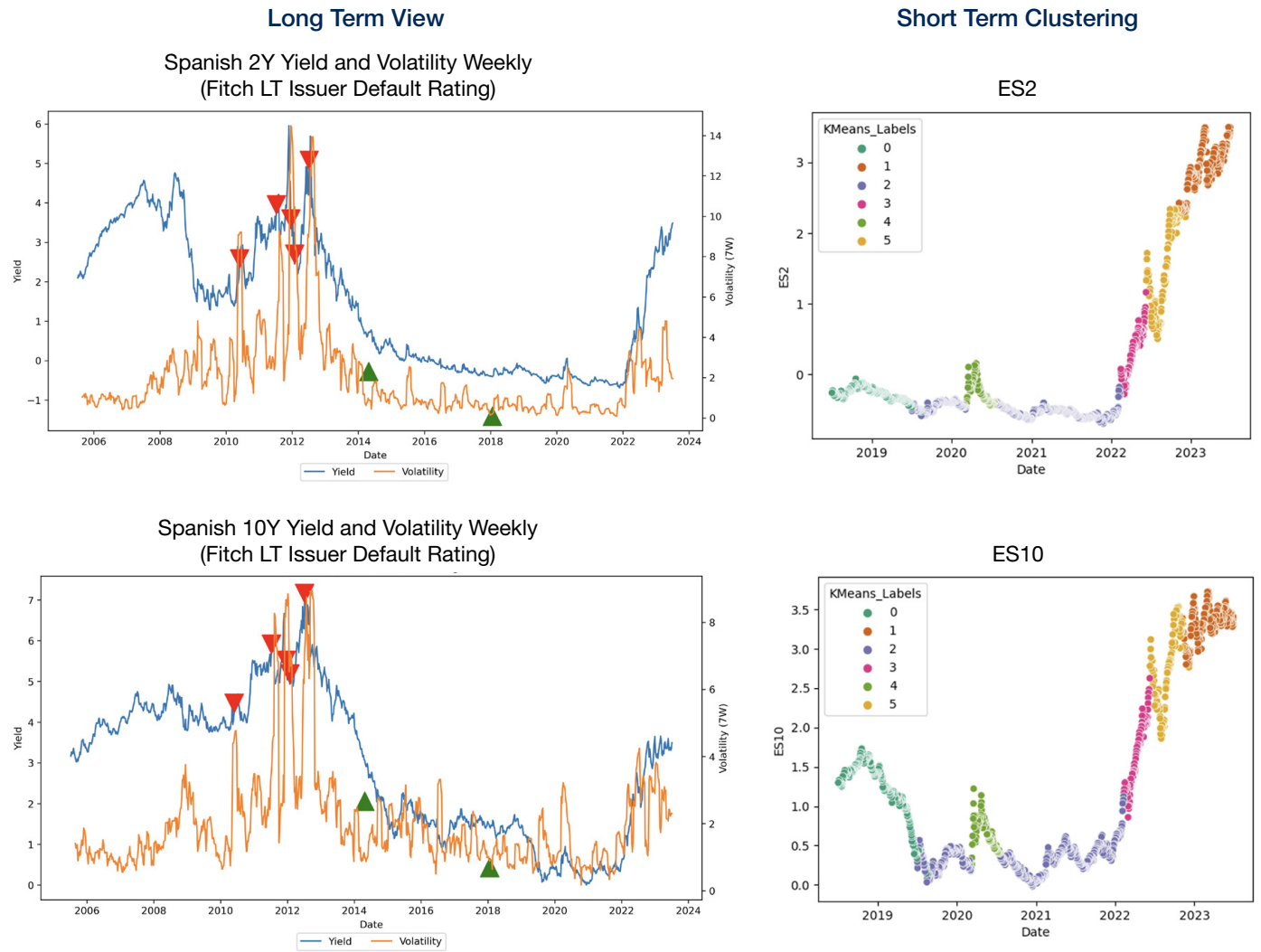


Figure 59: Spain Government Bond Weekly Traded Volumes

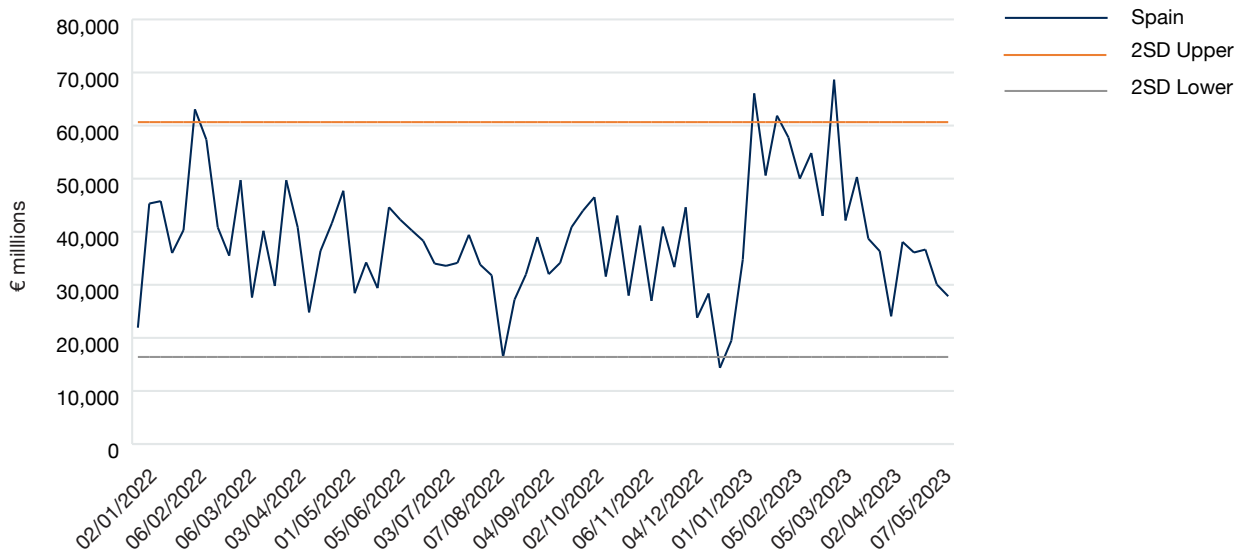
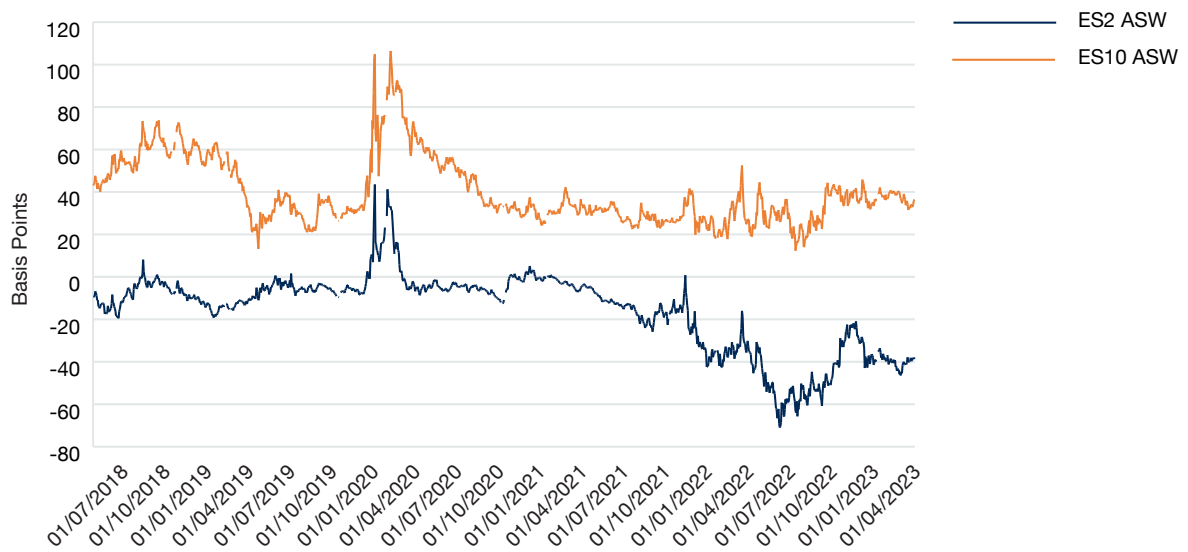


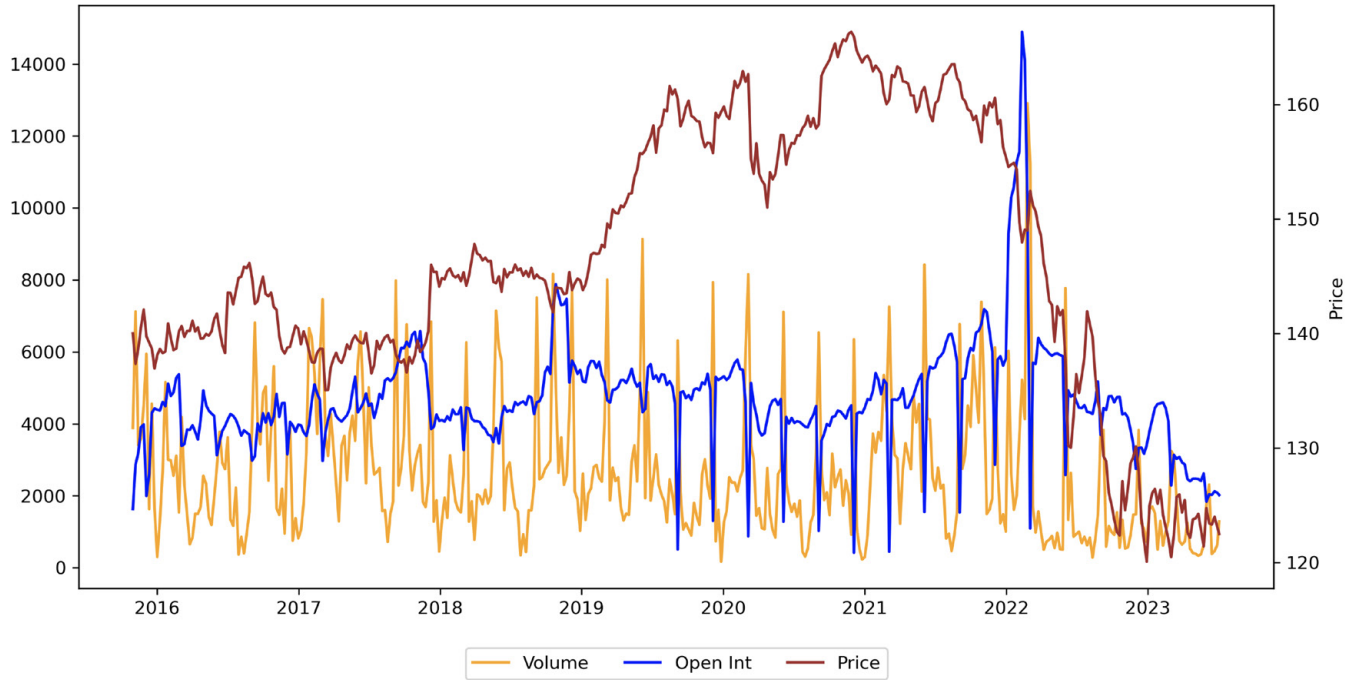
Figure 60: Spain Swap-Spread



Futures

Available Futures	Exchange	Bloomberg Ticker
Euro-BONO Sp Gov	Eurex	KOA

Figure 61: KOA1 Future



UK

List of primary dealers

To be recognised as a UK Primary Dealer (or Gilt-edged Market Makers, GEMM), players must⁴²:

- *“GEMMs are expected to play an active role in the issuance, distribution and marketing of UK government debt”.*
- *“GEMMs should aim to purchase at least 2.0% of gilt issuance by sector, conventional and index-linked, on a six-month rolling average basis”.*
- *“GEMMs are expected to participate in every operation for which they are a designated market maker. GEMMs must aim to participate effectively in the price formation process at auctions: it is envisaged that each wholesale GEMM’s bids 5 would amount to the equivalent of at least 5.0% of the amounts issued, calculated on a six-month rolling average basis”.*

Full information on page 4 of reference 42.

The list of primary dealers is as below⁴³:

Banco Santander S.A. (London Branch)	Merrill Lynch International
Barclays Bank plc	Morgan Stanley & Co. International plc
BNP Paribas	NatWest Markets plc
Citigroup Global Markets Limited	Nomura International plc
Deutsche Bank AG (London Branch)	RBC Europe Limited
Goldman Sachs International Bank	The Toronto-Dominion Bank
HSBC Bank plc	UBS AG (London Branch)
J.P. Morgan Securities plc	Winterflood Securities Limited
Lloyds Bank Corporate Markets plc	

Requirements to support secondary

Requirements for secondary markets are outlined as per reference 42 page 5.

The main two points are quoted as below:

1. *“GEMMs are committed to make, on demand and in all conditions, continuous and effective two-way prices to their clients, in all gilts for which they are recognised as a market maker”.*
2. *“GEMMs must aim to achieve and maintain an individual secondary market share of at least 2.0% on a 6-month rolling average basis, in the sectors for which they are a recognised market maker”.*

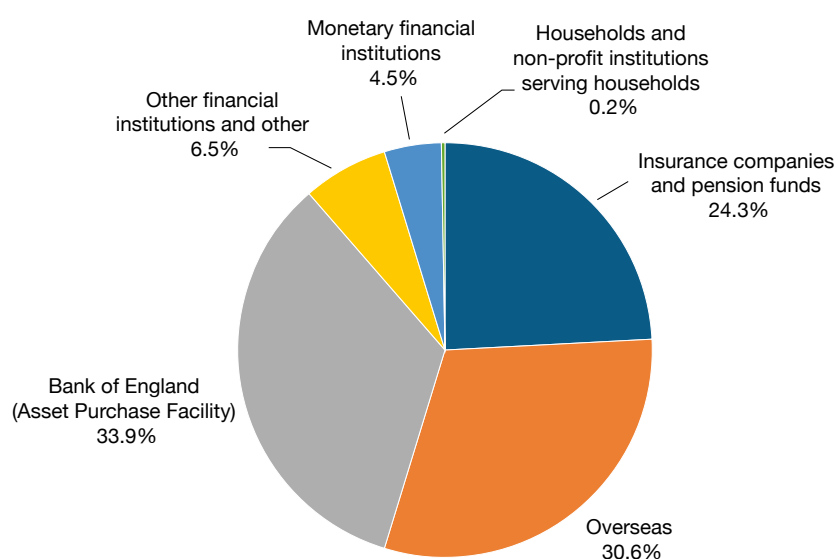
42. <https://www.dmo.gov.uk/media/22bbjndz/guidebook200921.pdf>

43. <https://www.dmo.gov.uk/responsibilities/gilt-market/market-participants/>

Main investor types⁴⁴

	%
Insurance companies and pension funds	24.3
Overseas	30.6
Bank of England (Asset Purchase Facility)	33.9
Other financial institutions and other	6.5
Monetary financial institutions	4.5
Households and non-profit institutions serving households	0.2

Figure 62: Gilt and Treasury Bill Holdings as of Q4 2022



44. <https://www.dmo.gov.uk/media/4vbe3gwh/jan-mar-2023.pdf>

Issuance by tenor

Figure 63: Issuance Count per Quarter for GB

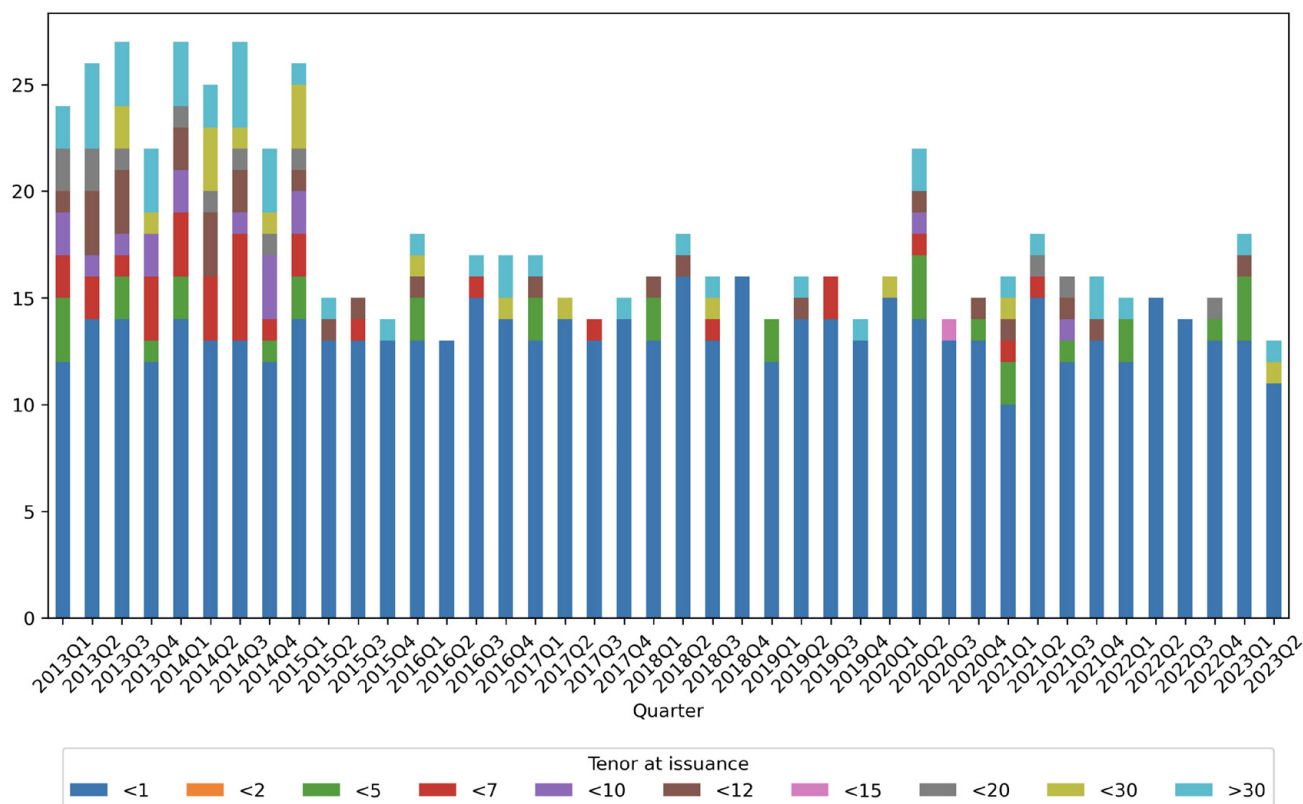
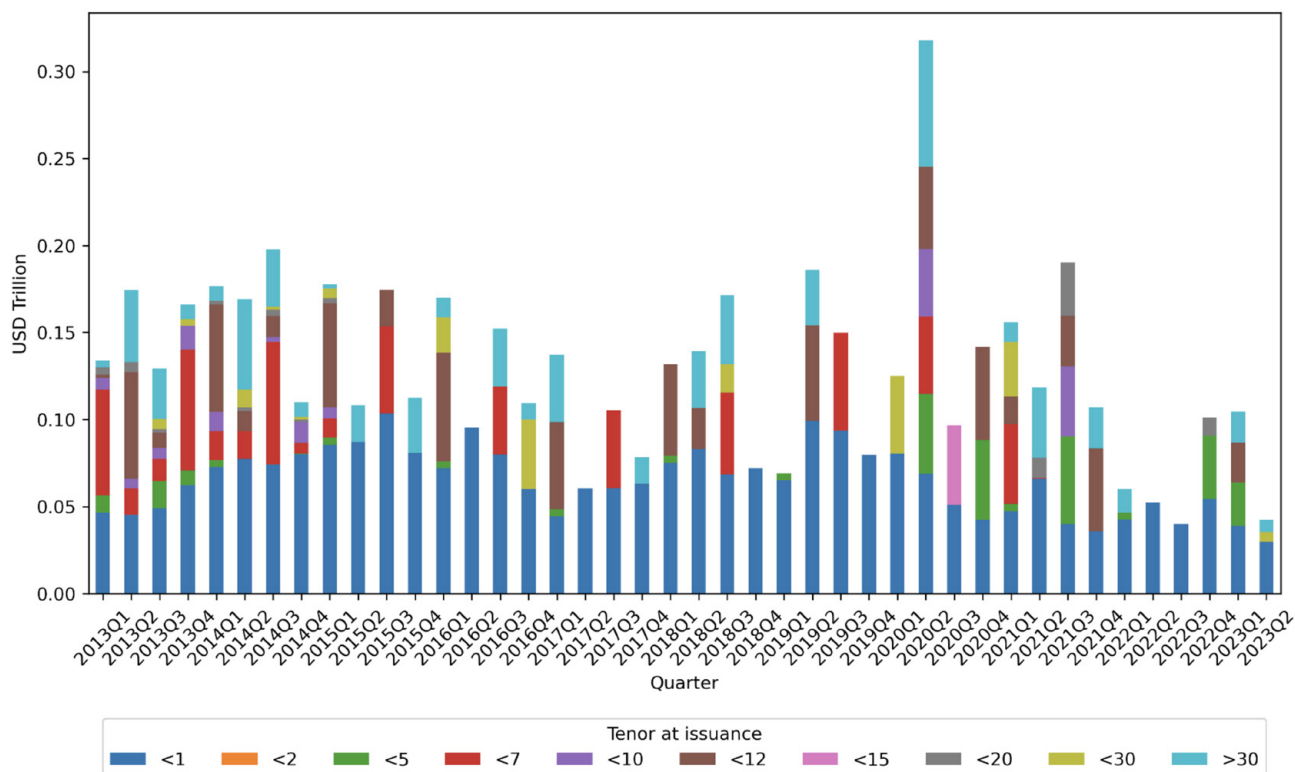


Figure 64: Issuance Amount per Quarter for GB



Tap issuance

Figure 65: Tap Issuance Count per Quarter for GB

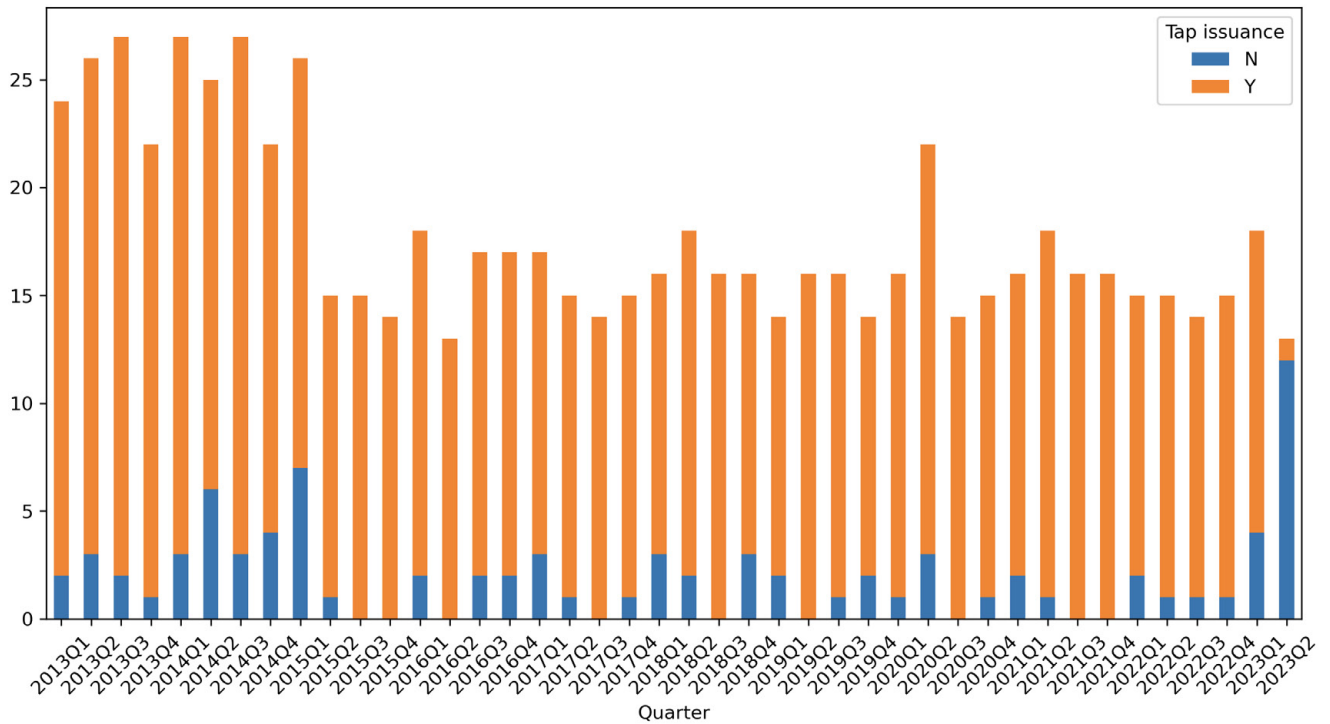
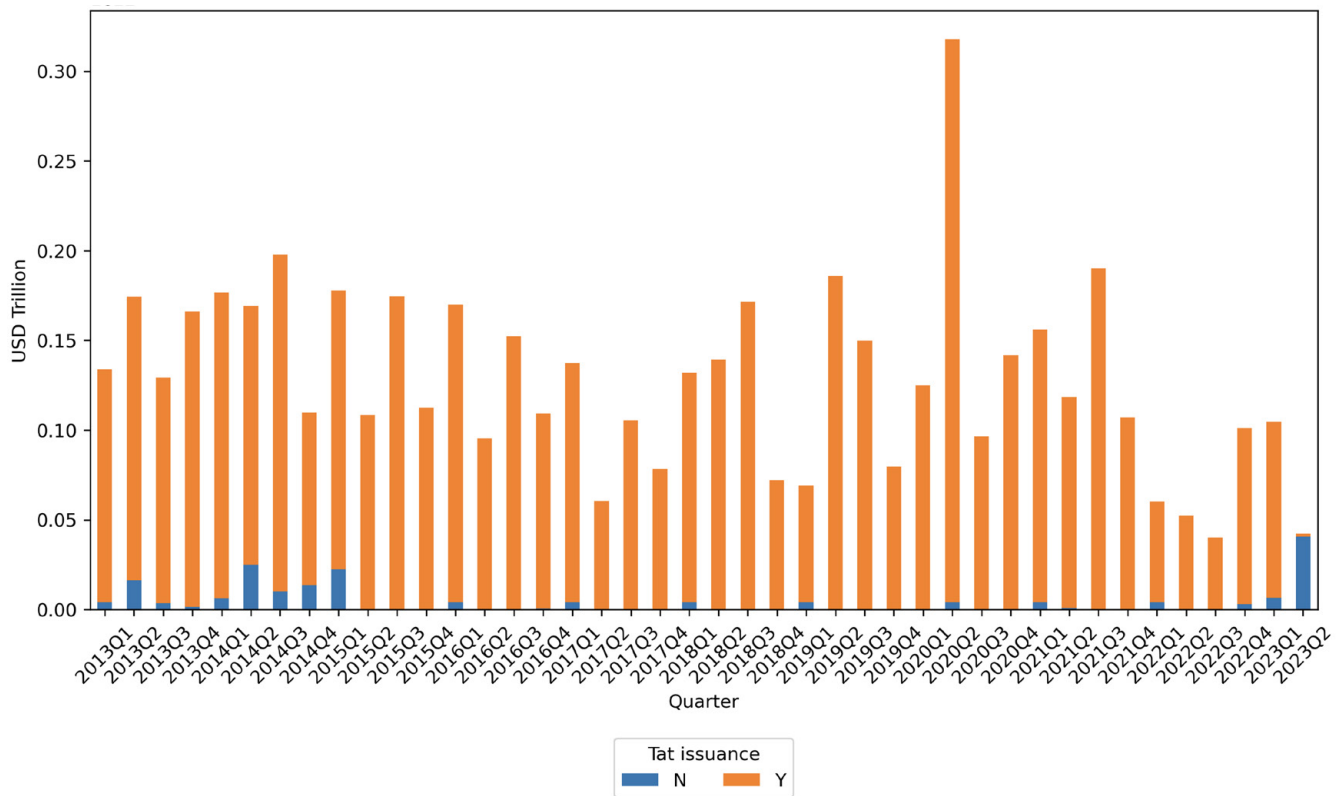


Figure 66: Tap Issuance Amount per Quarter for GB



Yields, Volatility, Volumes and Swap-Spreads

English sovereign debt shows slightly different trends. Whilst we see an increase in volatility post 2008, this has a much shorter duration compared to the peers seen in this paper. In addition, the k cluster 4 (which we label as the pandemic outbreak) is much smaller. Liquidity decreased in December 2022, however compared to the rest of the peers, it did not break the 2 standard deviations value.

Figure 67

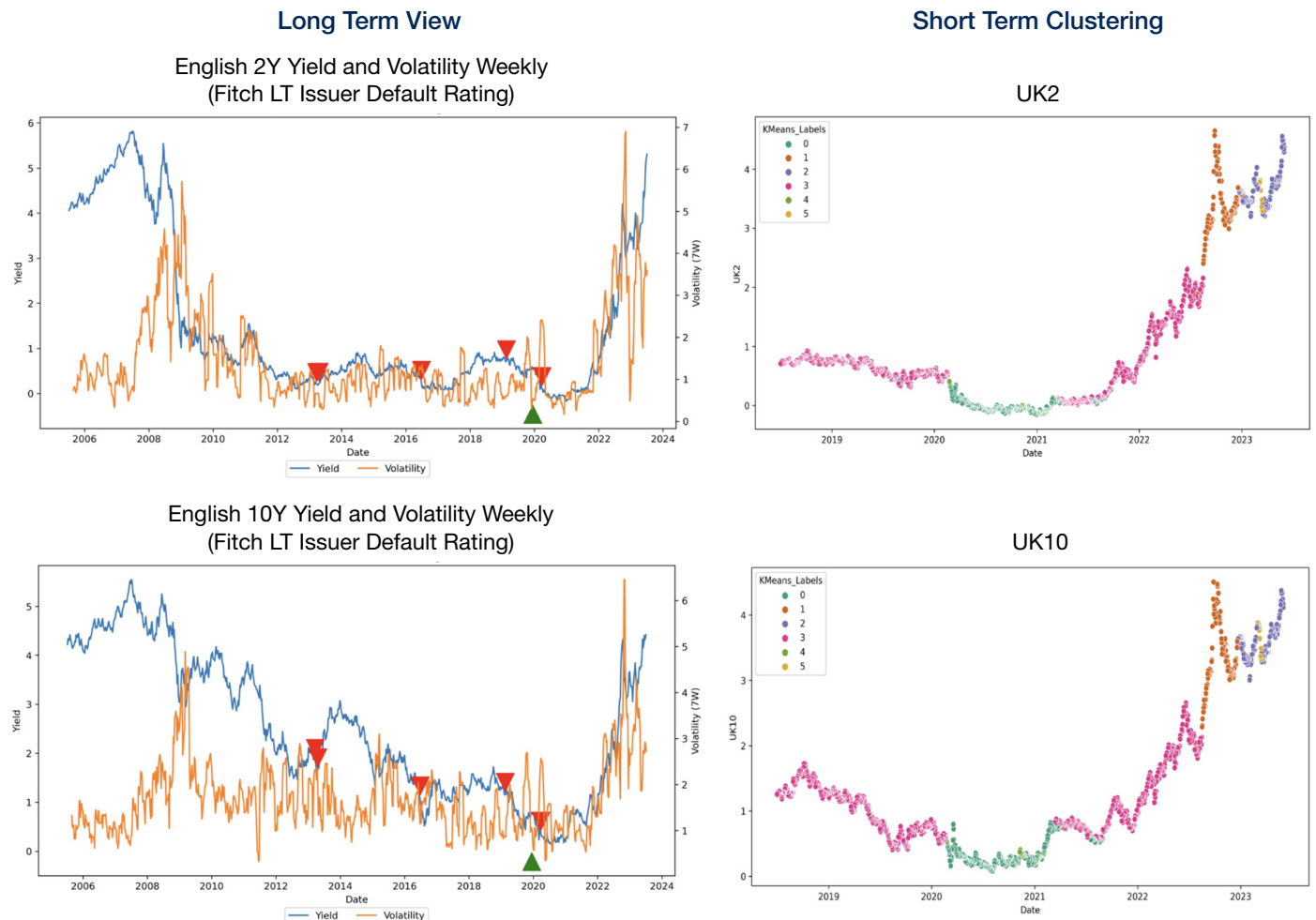


Figure 68: UK Gilt Bond Weekly Traded Volumes

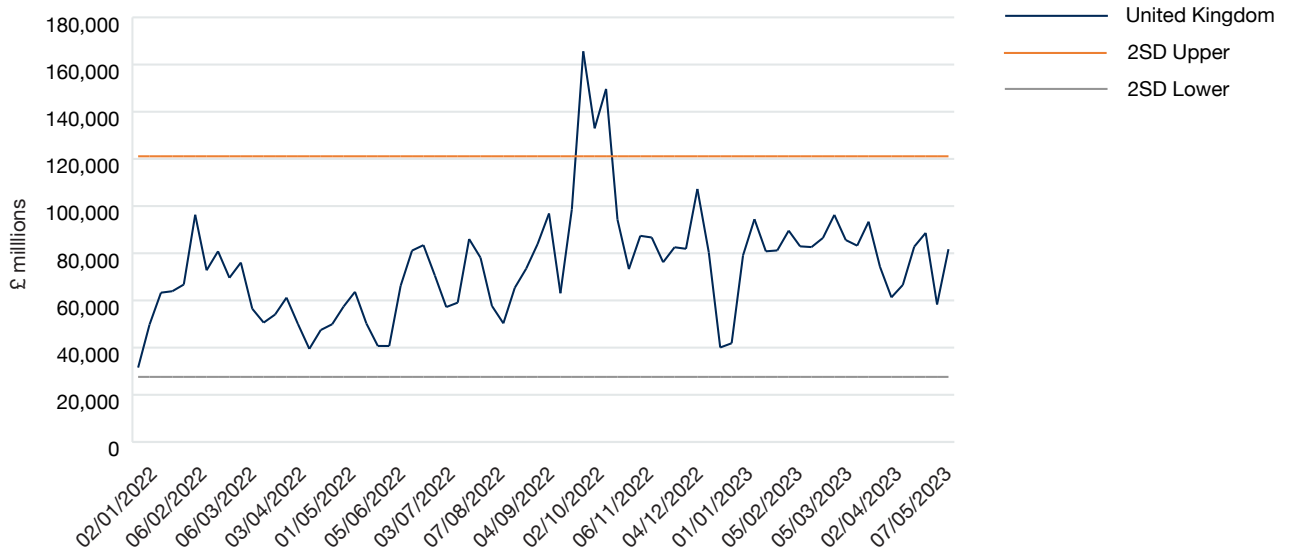
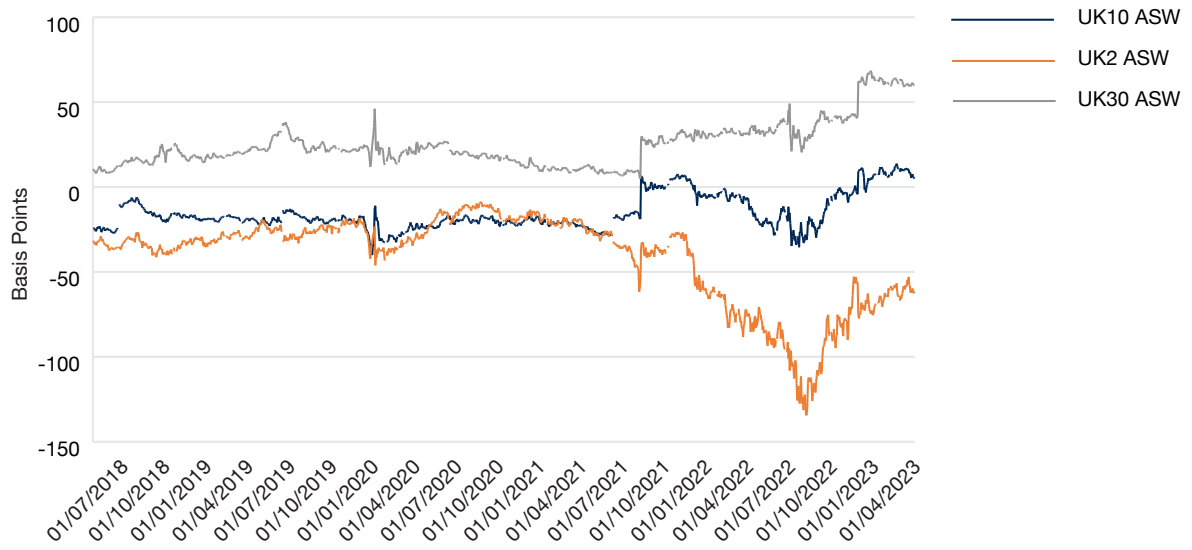


Figure 69: UK Swap-Spread



Futures

Available Futures	Exchange	Bloomberg Ticker
LONG GILT FUTURE	ICE	G
SHORT GILT FUTURE	ICE	WB

Figure 70: G 1 Future

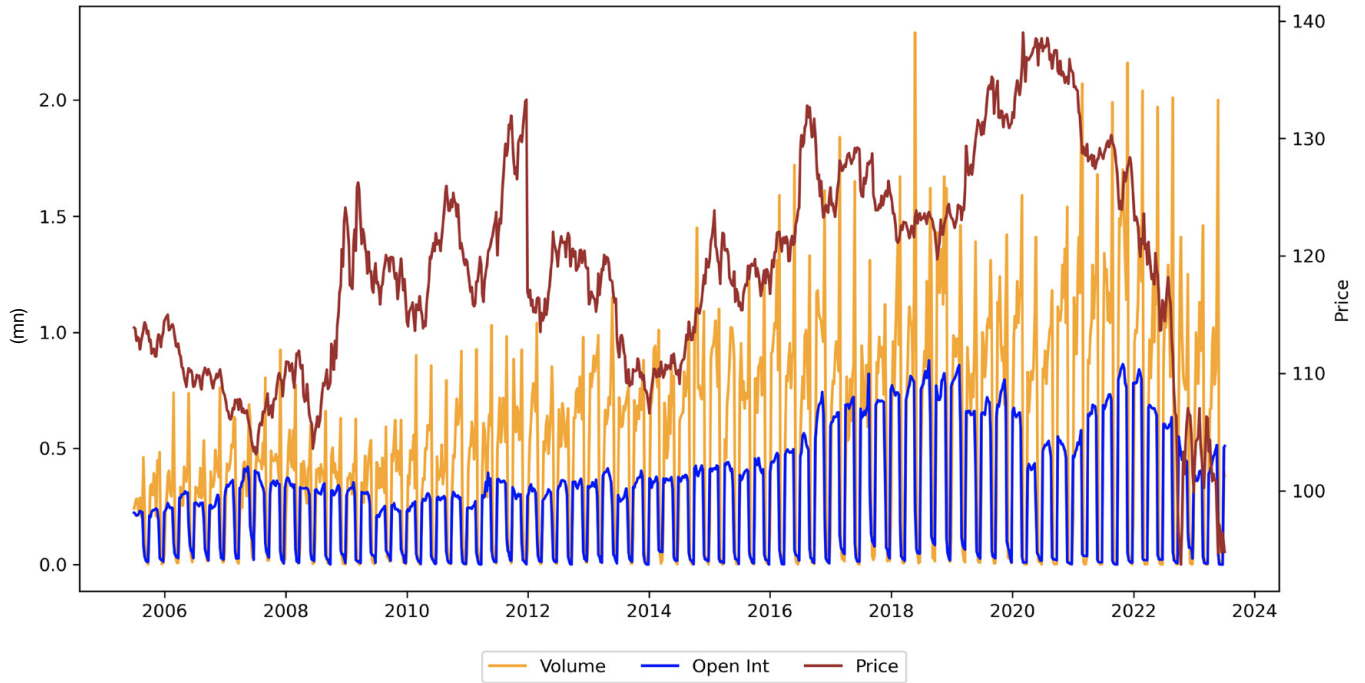
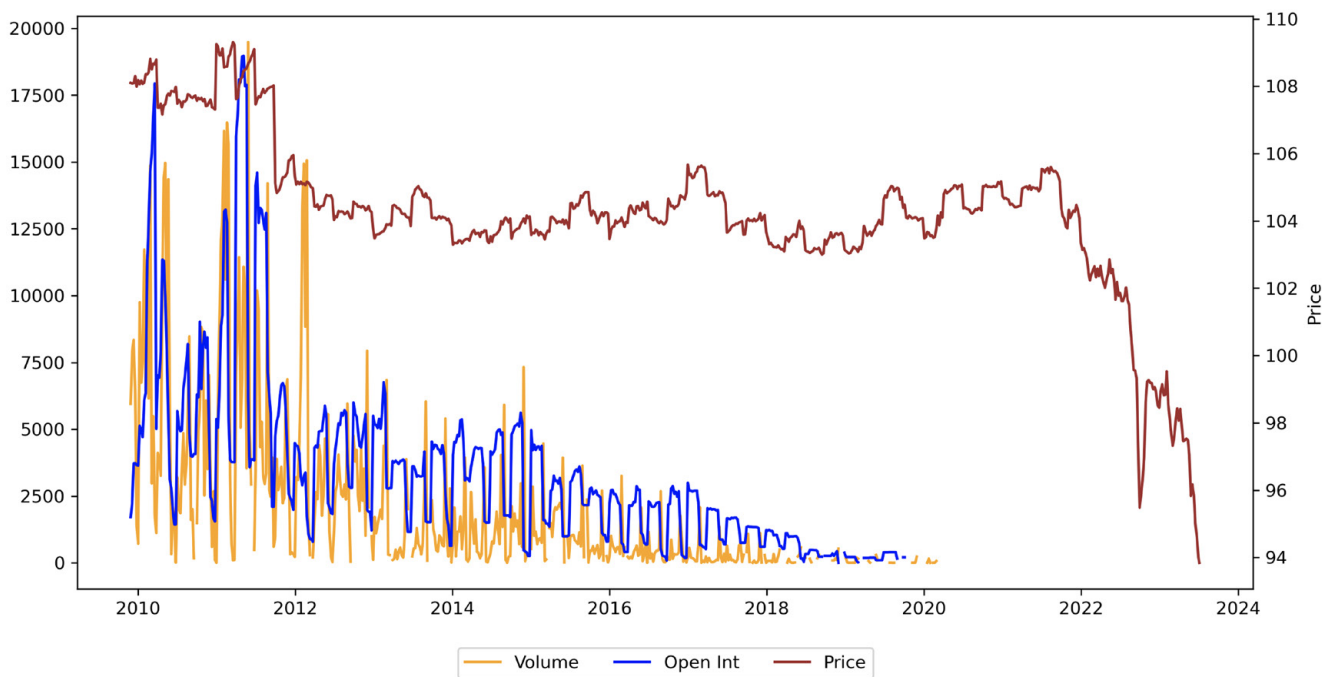


Figure 71: WB1 Future



Liquidity and resilience in the core European sovereign bond markets

Part Two – Section two



An analysis of recent trends in the underlying repo markets

Literature reveals relevant factors that lower repo rates as⁴⁵:

Dynamic 1: Collateral scarcity.

Dynamic 2: Excess Cash.

The charts below provide an illustration of the European repo markets.

Figure 72 illustrates volume weighted rates against repo volumes.

It is noticeable that at year end, repo rates have significant negative shift. Simultaneously, the same trend is noticeable in volumes. To better show the trend, Figure 73 shows volumes as a line chart.

This dynamic can be attributed to excess cash being held in central bank reserves as a result of quantitative easing. Major banks are forced to shrink their balance sheets over quarter end and year end due to various reporting requirements, including Basel metrics and G-SIB score calculations. Literature on this topic finds that repo volumes often decrease 12.5% around quarter end and 25% at year end⁴⁶.

The third chart illustrates IT, FR and ES spreads to DE repo rate. We notice dispersion only during year and quarter end periods. In addition, this time series has mainly positive values, making German repo consistently more expensive to its peers. The lower rate can be due to a lack of availability of collateral. As per source number 26 in the “Main investor types” chapter of Germany, DMOs evaluate holding of the Eurosystem at 43% of outstanding. Figure 76 below shows how monthly PSPP for Germany are on average larger, compared to peers. Figure 77 Shows the cumulative PSPP, and German cumulative values is on average 23% bigger compared to France and 43% compared to Italy. Figure 83 also includes PEPP in addition to PSPP, and shows how German total holdings are far larger compared to peers.

Figure 75 illustrates Specific Collateral Rates spread to the EUR General Collateral Rate. In addition to dispersion at quarter/year end, a relative widening of the German Specific Collateral spread is noticeable from Q4 2021 compared to Euro GC component.

Q4 2021 is also the quarter where PEPP Monthly purchases started to decrease with negative net purchases starting from Q1 2022. PSPP on the other hand, does not stop to decrease till Q3 in 2022 (Figure 78 and 79).

Figure 80 illustrates the German 10 ASW and the German Specific collateral spread. It is noticeable that both widen simultaneously. Again, this can largely be attributed to scarcity pressures arising from QE (Figure 82).

In the next chapter, we model and forecast Bid-Ask Spreads. We also define a BA Premium which is the spread between the observations and our predictions. The German 10Y BA premium sharply increases from Q4 2021. German 10Y Swaps also increase from Q4 2021 (as per figure 81).

45 <https://www.esrb.europa.eu/pub/pdf/wp/esrb.wp55.en.pdf>

46 <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2771-fc55bab0d6.en.pdf>

Figure 72: Repo Funds Rate Daily Volumes

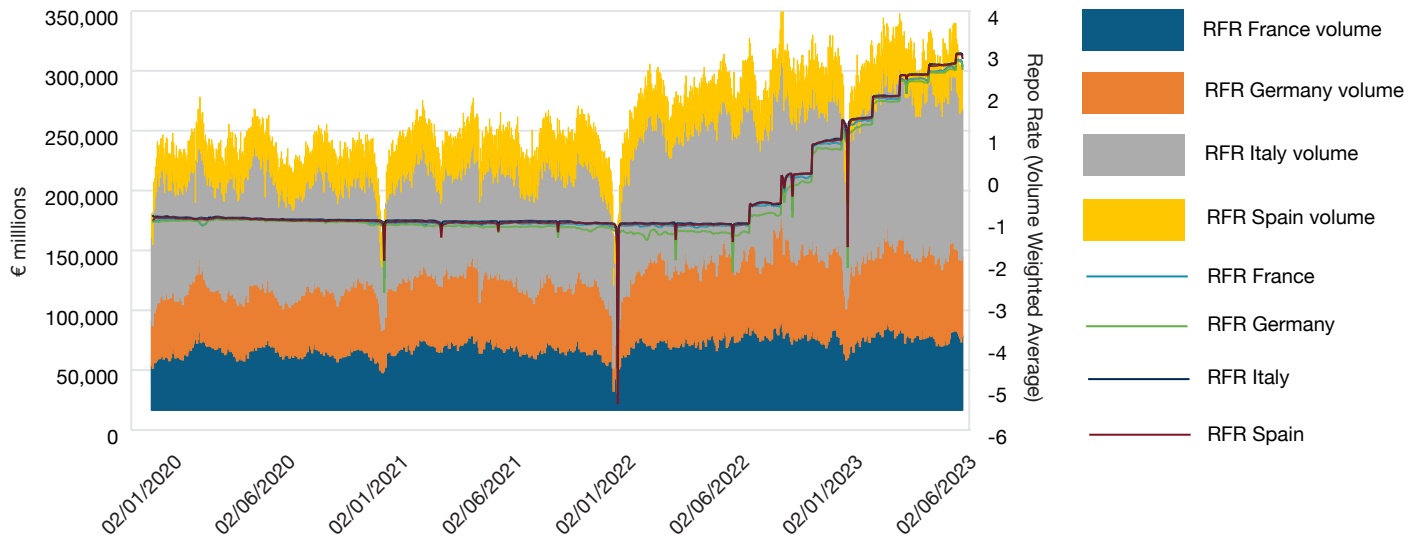


Figure 73: Repo Daily Volumes

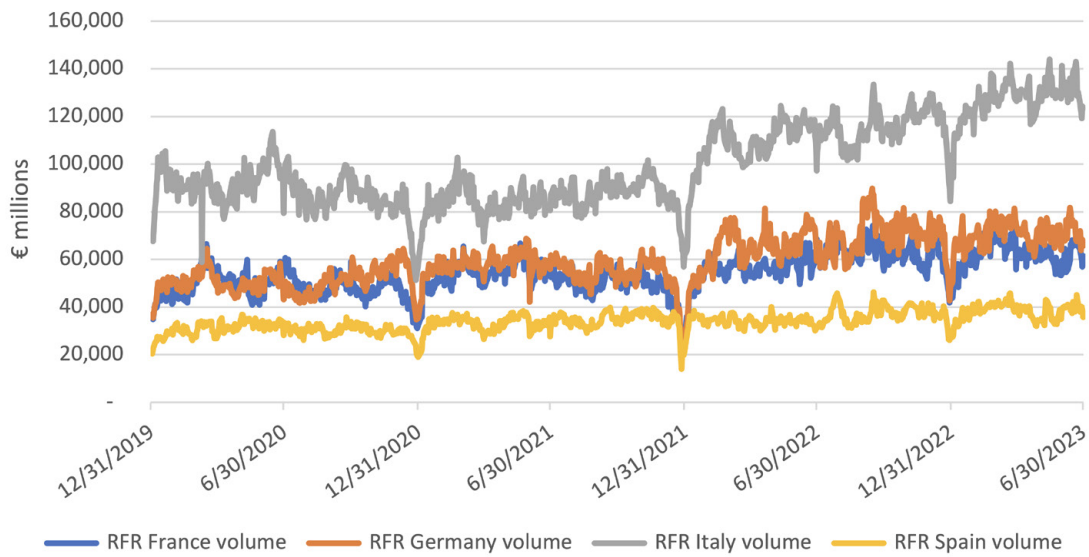


Figure 74: Repo Spread to DE (X - DE)

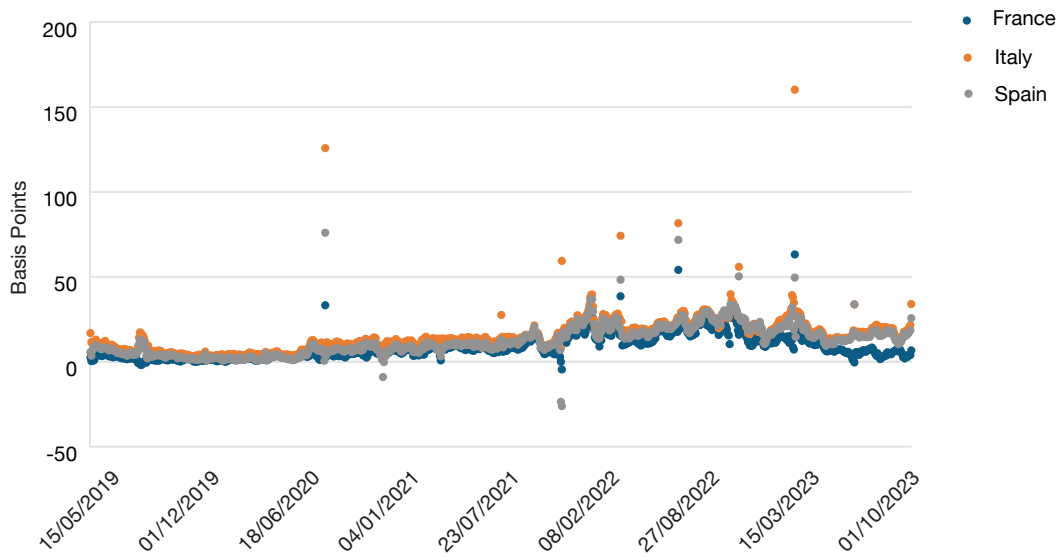


Figure 75: Specific Collateral Spread to EUR GC (EUR GC - X)

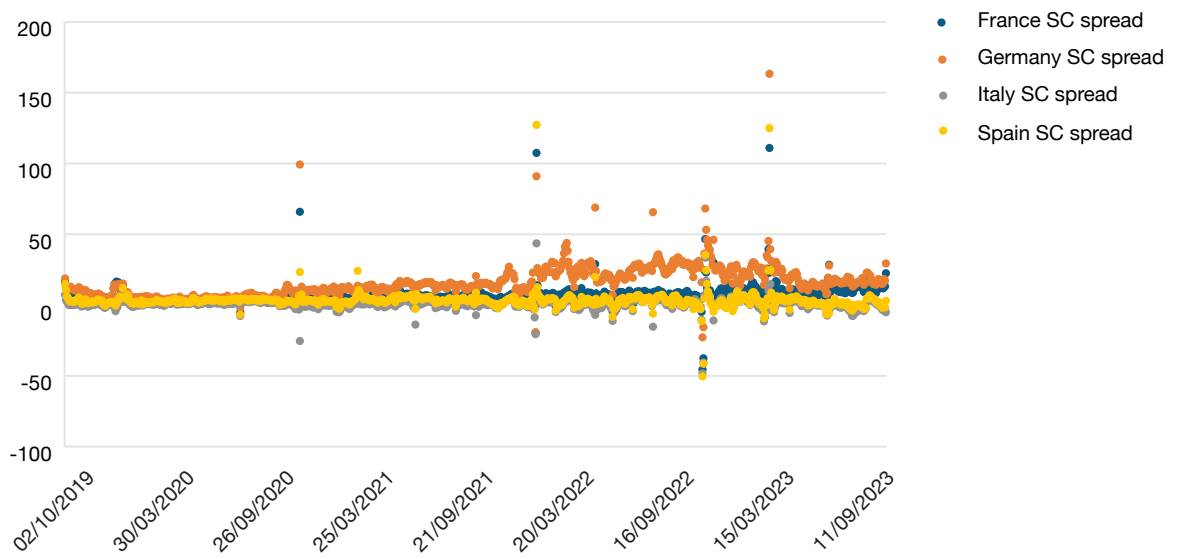


Figure 76: PSPP Monthly Net Purchases in Euro Millions

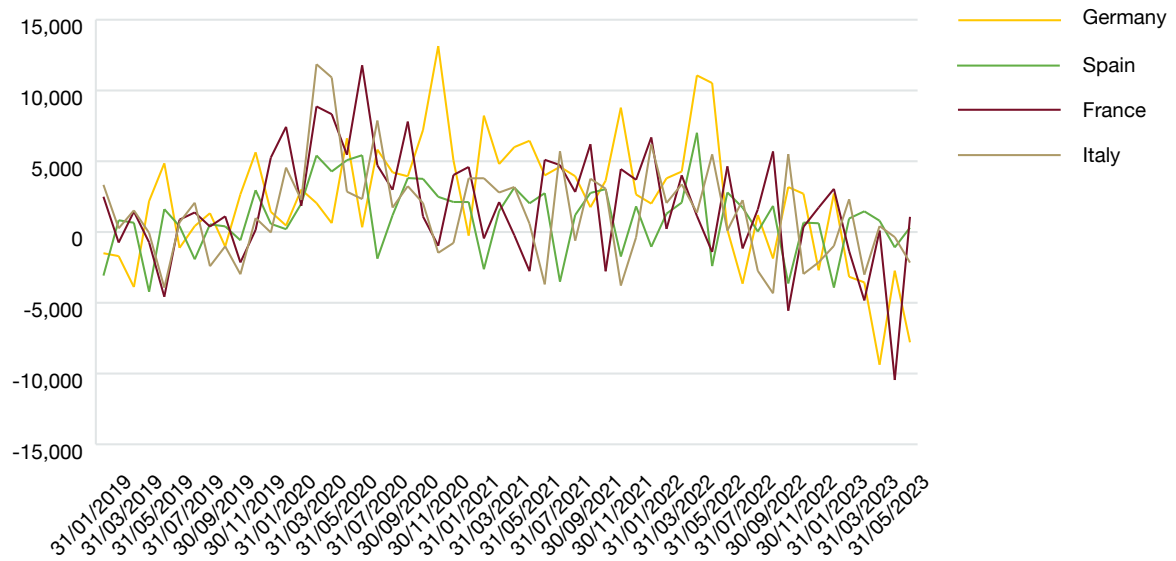


Figure 77: Cumulative PSPP in Euro Millions

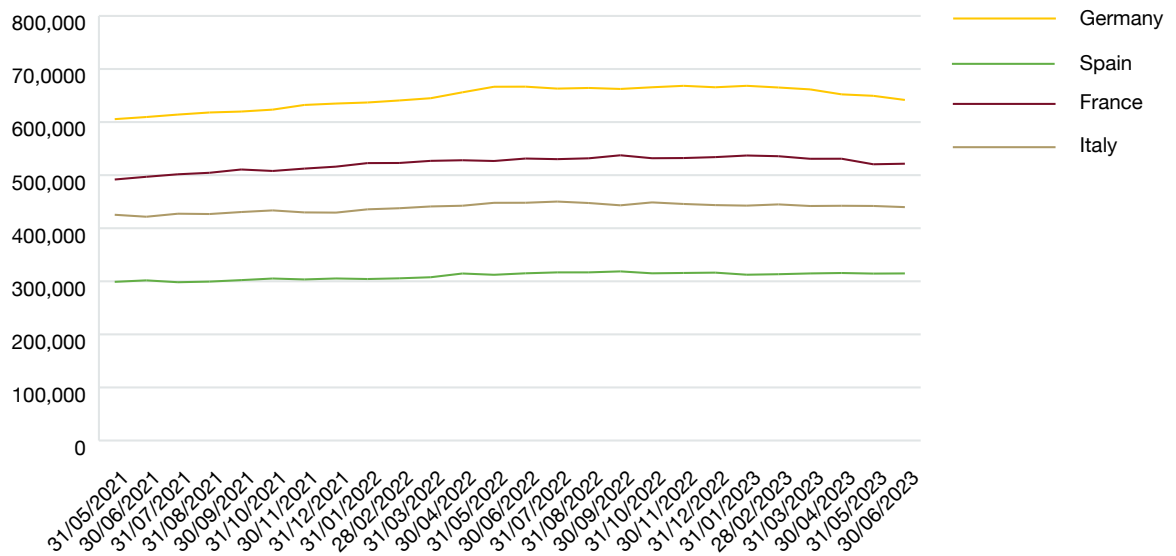


Figure 78: Germany Cumulative PSPP in Euro Millions

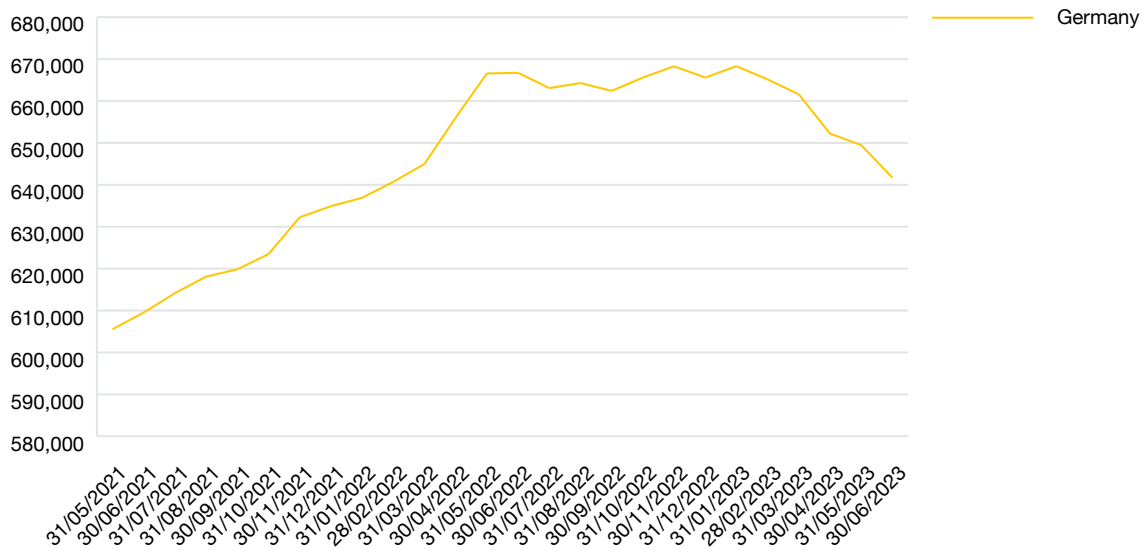


Figure 79: History of Monthly Net Purchases Under the PEPP in Euro Millions

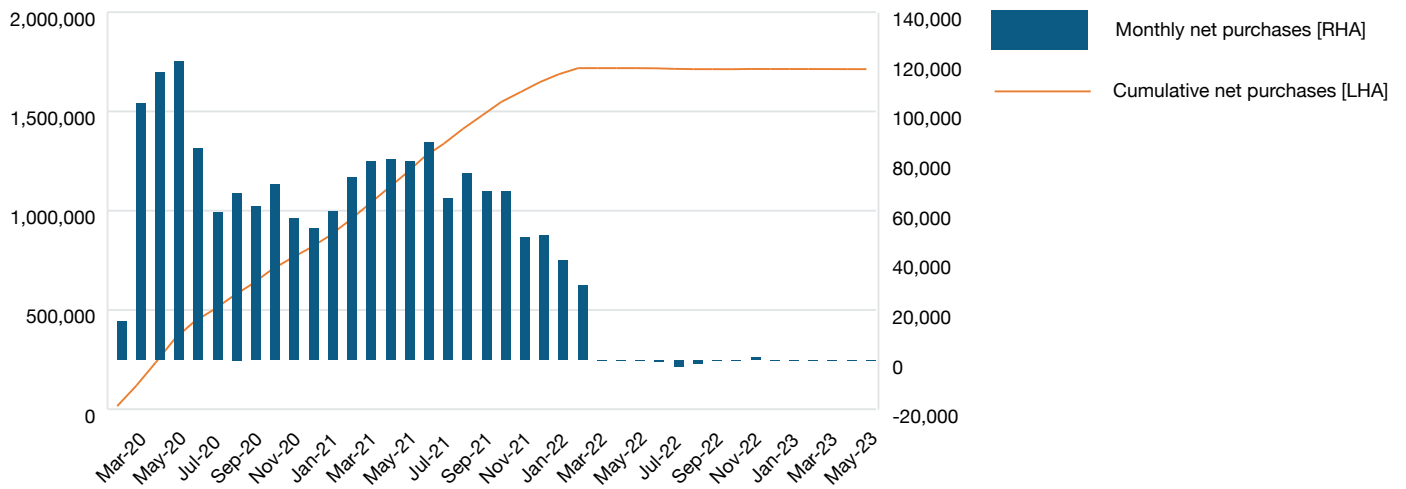


Figure 80: 10yr Germany ASW & German Specific Collateral Spread to EUR GC

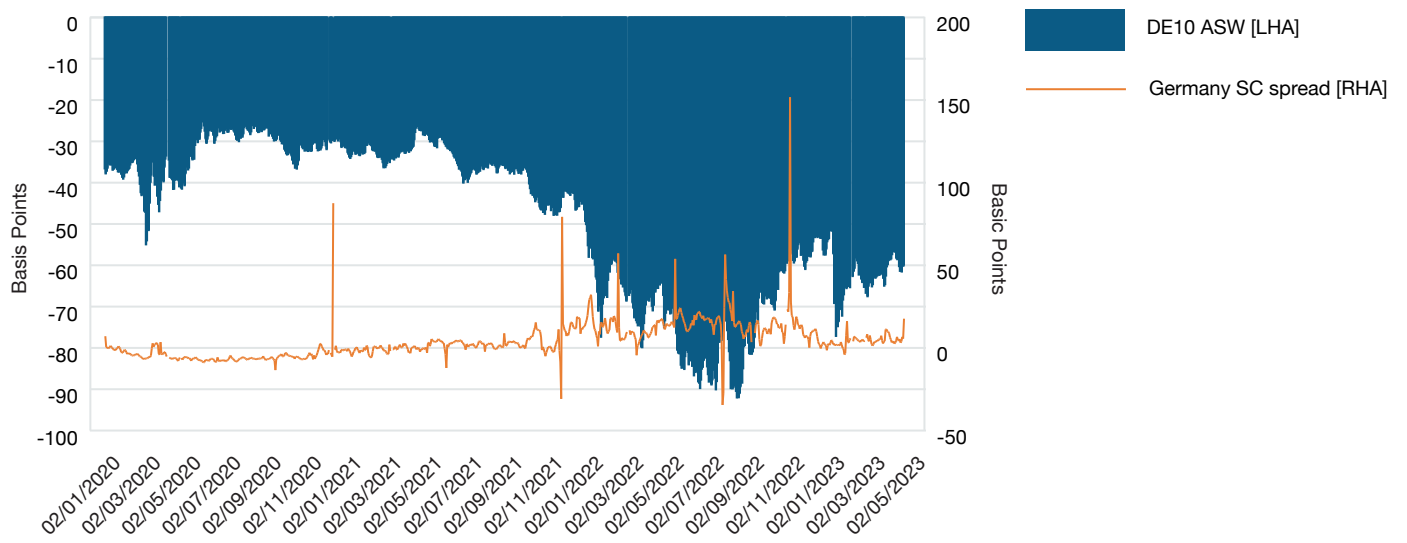


Figure 81: German 10Y Swap



Figure 82: Central Bank Balance Sheets (USD Billion)

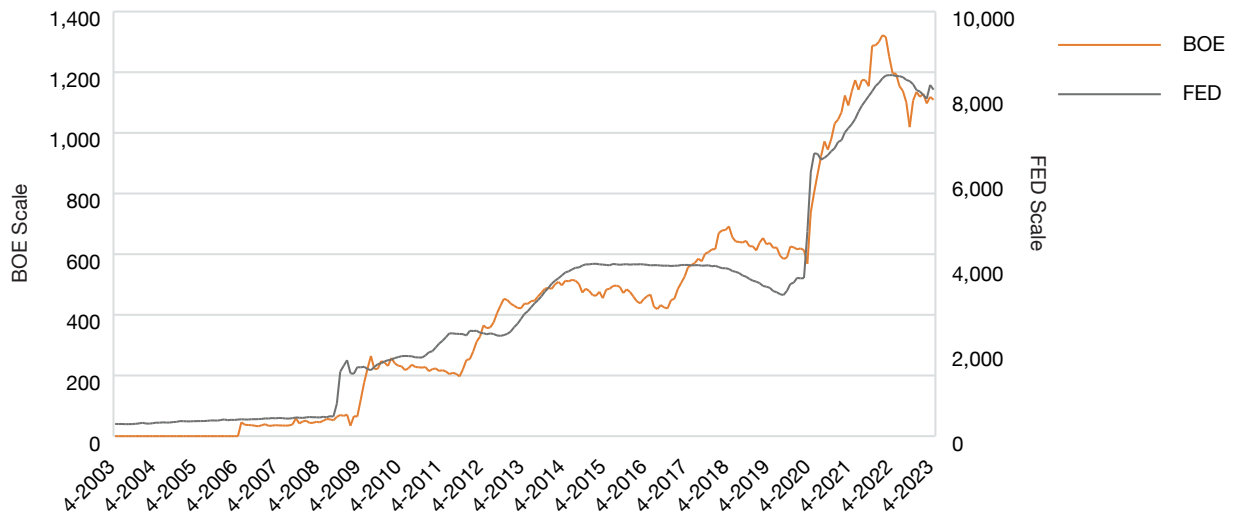
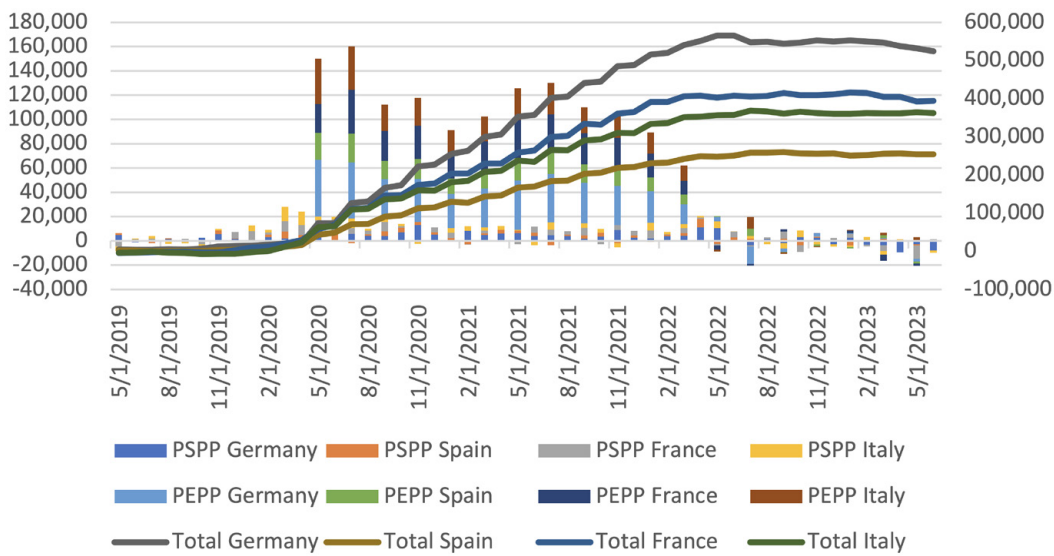


Figure 83: Monthly net purchases in € mn (PEPP & PSPP)



Ronia & Sonia

The chapter above does not include GBP figures due to data availability. As proxies we can use Ronia and Sonia. In a situation as per dynamic 2, (Excess cash), we would expect Ronia to trade below Sonia, resulting in a negative spread with Sonia. We experience this from March 2020. BOE QE increases as per Figure 82 above. The same period sees an inversion of the spread from positive to negative, with extreme values at year end (see figure 85 below).

Figure 84: GBP SONIA & RONIA

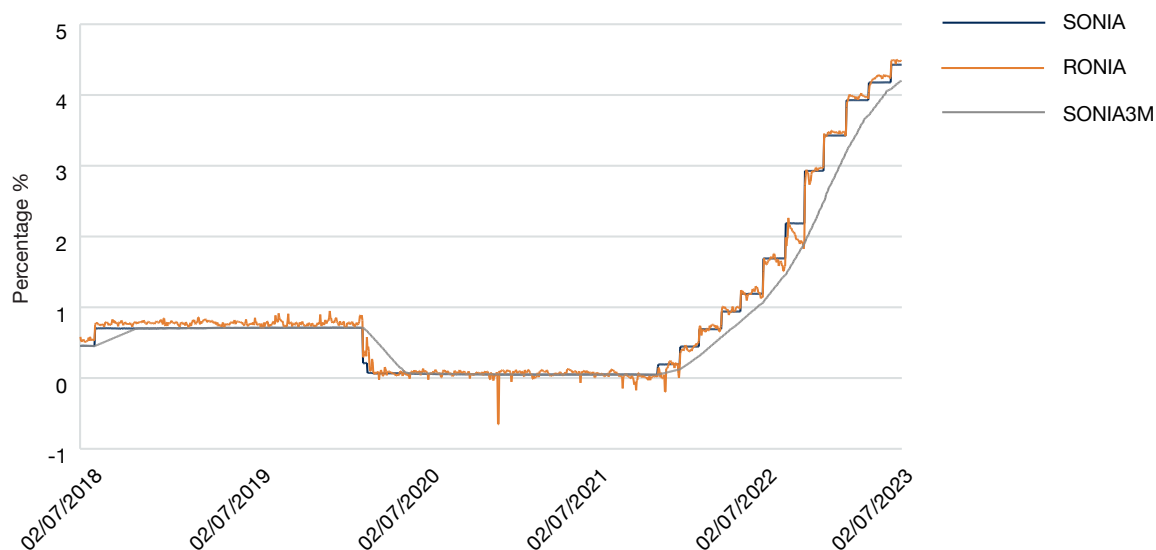
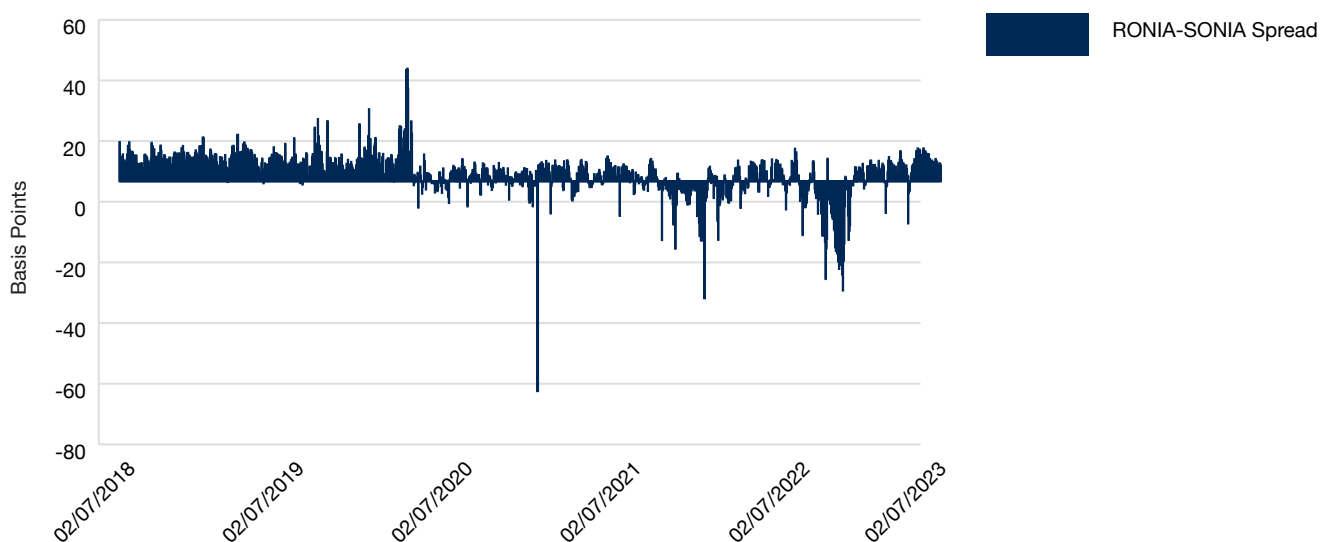


Figure 85: RONIA-SONIA Spread



Empirical Evidences: modelling for market performance and liquidity

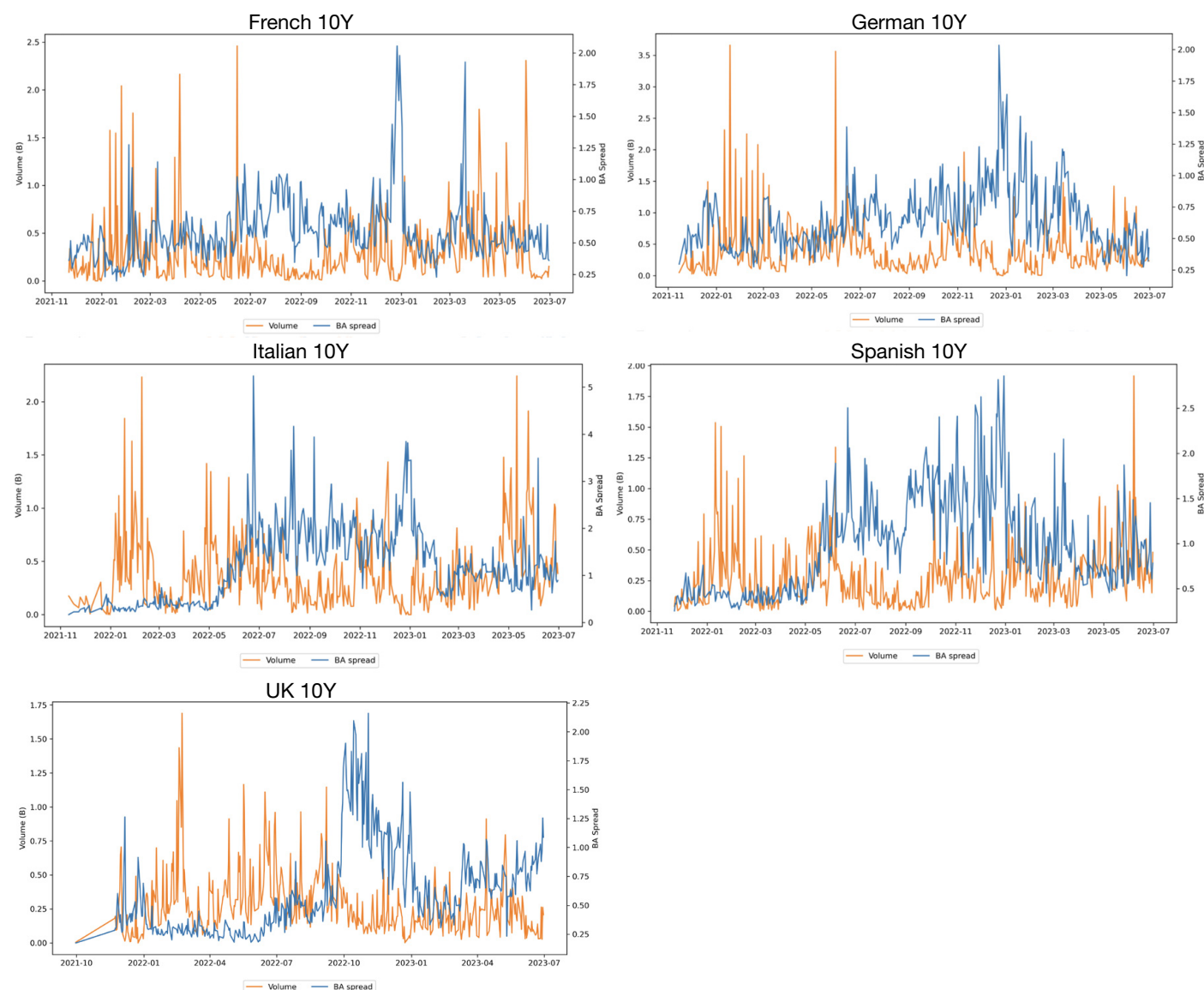
This section aims to analyse liquidity structure with a quantitative approach as opposed to the desk study methodology employed in the previous part of this paper.

Bid-Ask Spreads and Volumes

We begin by exploring correlation coefficients amongst several variables. Bid-Ask spread, appear to be negatively correlated with traded notional. For the period that goes from November 2021 and June 2023, 10Y Tenors Bid-Ask spread and traded volumes showed the following correlation coefficients:

- FR10Y: -0.11
- DE10Y: -0.10
- IT10Y: -0.18
- ES10Y: -0.12
- UK10Y: -0.23

Figure 86



Modelling Bid-Ask Spread

Since Bid-Ask spread negatively correlates with volumes, we model it using OLS regression. Once the model is defined, we employ the results to predict BA spreads. The predictions highly correlate with observed values. To better understand the phenomenon, as previously mentioned, we take the spread between observed and forecasted values. From a theoretical standpoint, the liquidity premium should behave like white noise, IE, the error terms one is not able to model, with finite standard deviation, and time independence.

By observing the modelled premiums, we notice this might not be the case, as common time trends emerge.

10Y tenors' premiums increases around March 2020 and H2 2022/H1 2023.

2Y tenors' premiums increases mostly around H2 2022/H1 2023, with some minor movements around March 2020 too.

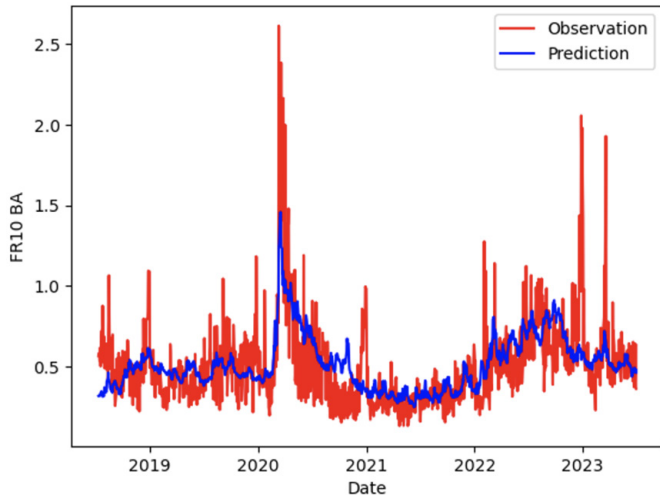
It can then be assumed that the model is not able to forecast "shocks" in the market, namely COVID outbreak, Ukraine invasion, SVB collapse, and rate hike expectations.

10Y BA Spread

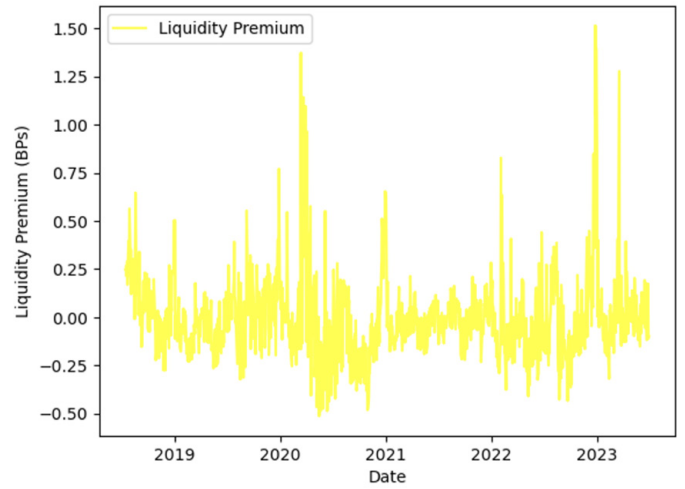
Dependent BA Spread	FR10 BA		DE10 BA		IT10 BA		ES10 BA		UK10 BA	
Model R2	0.37		0.52		0.57		0.57		0.52	
	Coeff	P-Value	Coeff	P-Value	Coeff	P-Value	Coeff	P-Value	Coeff	P-Value
const	0.511	0	0.4248	0	0.6477	0	0.6912	0.009	0.4123	0
EURUSD	-0.0949	0	-0.0769	0	-0.2071	0	-0.2437	0.014		
SXXP	-0.0557	0	0.0324	0	-0.0985	0	-0.1638	0.016		
V2X	0.0851	0	0.0523	0	-0.0473	0.002	-0.0521	0.012		
FR2 ASW	-0.0298	0.031								
FR10 ASW	0.0362	0								
DE10_ASW_vol			0.0222	0.001						
EONIA			0.0503	0						
DE10 ASW					-0.3131	0				
IT10 ASW					-0.1168	0	-0.1009	0.018		
IT10_vol					-0.0502	0				
ES2 ASW							-0.1525	0.015		
ES10 ASW							0.0777	0.016		
UKBE5									-0.0437	0
UKX									-0.0593	0
UK10 ASW									-0.04	0.002
UK2 ASW									-0.1901	0
UK30 ASW									0.0815	0
UK10_vol									-0.0289	0.004

Figure 87

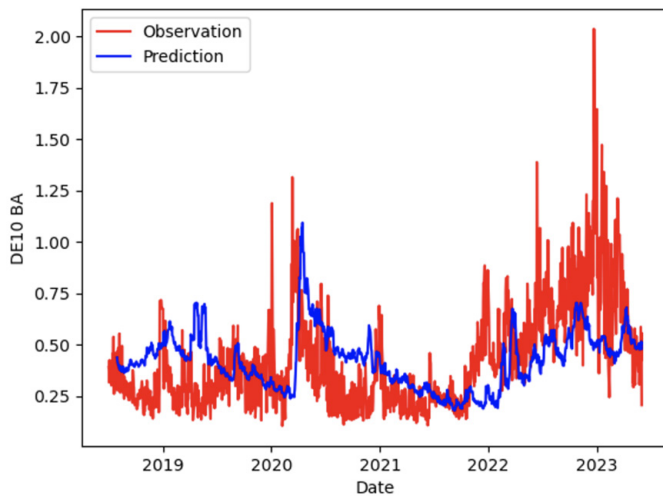
France 10YR OAT Bid-Ask Spread IG Prediction vs Observation



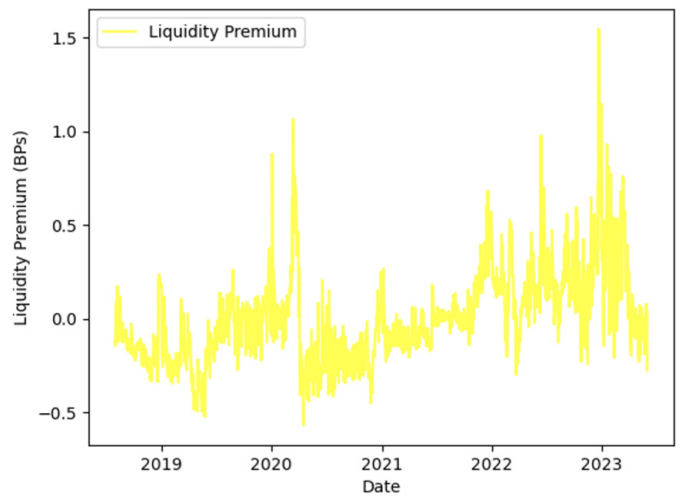
10YR FR Liquidity Premium



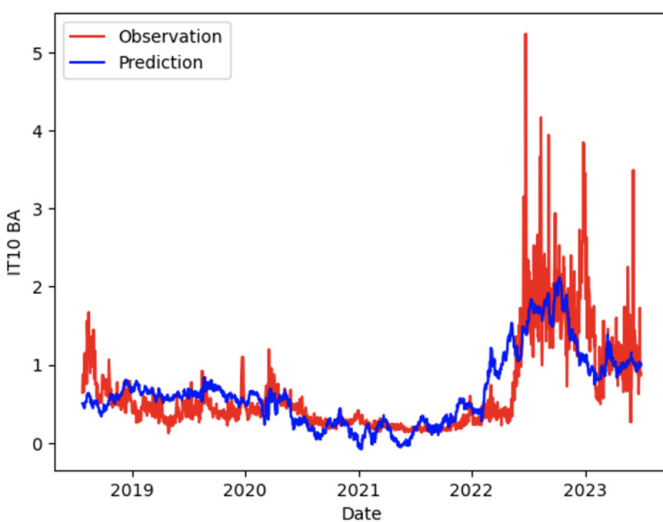
ITRX IG Prediction vs Observation



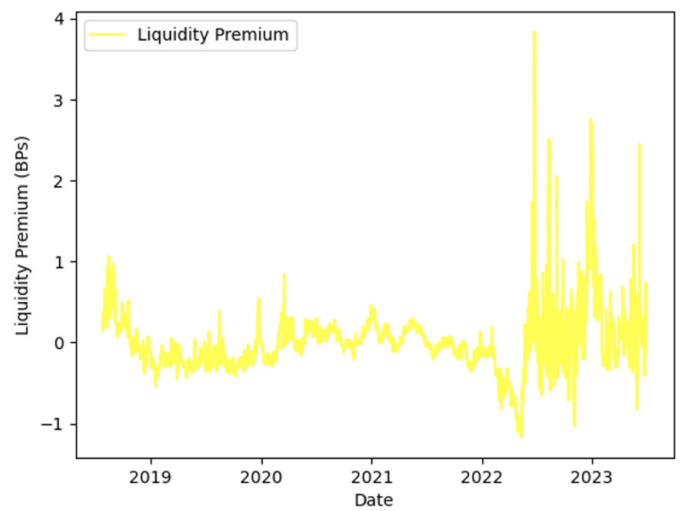
10YR DE Liquidity Premium



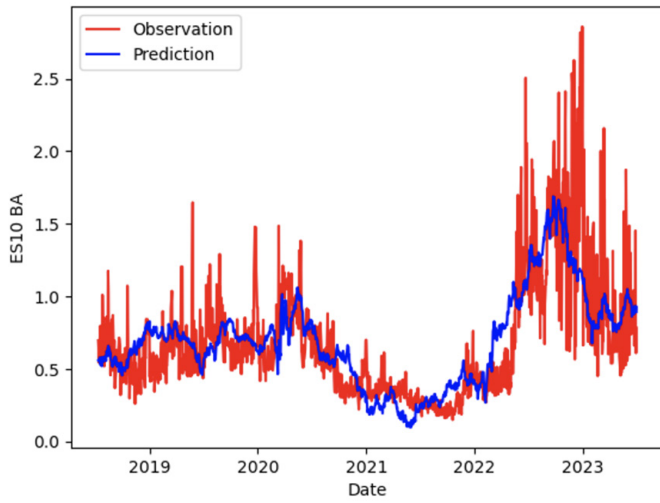
Italian 10YR Bund Bid-Ask Spread IG Prediction vs Observation



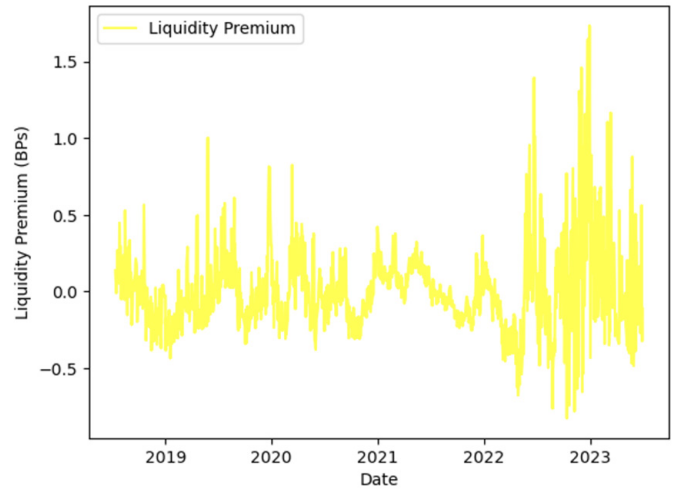
10YR IT Liquidity Premium



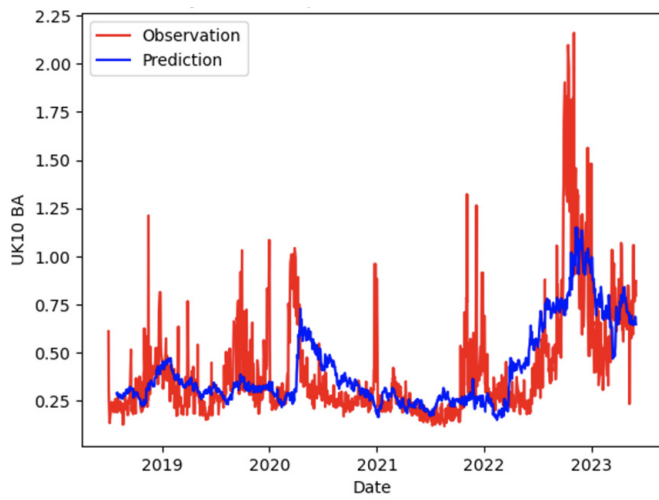
Spain 10YR Government Bond Bid-Ask Spread IG Prediction vs Observation



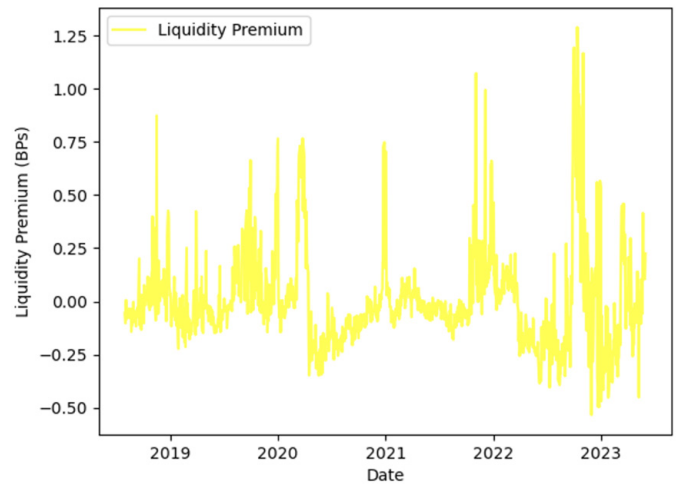
10YR ES Liquidity Premium



UK 10YR Bid-Ask Spread Prediction vs Observation



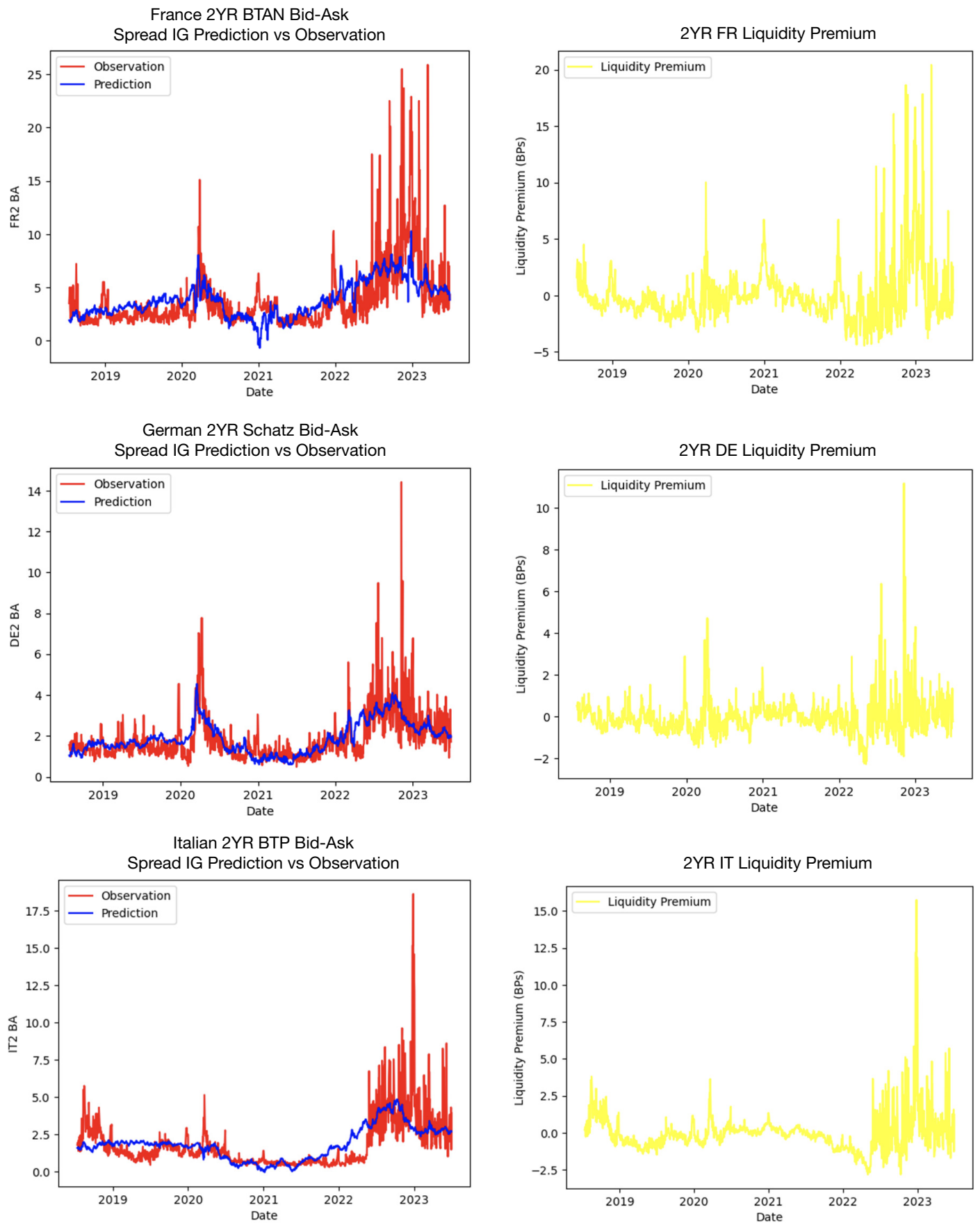
10YR UK Liquidity Premium



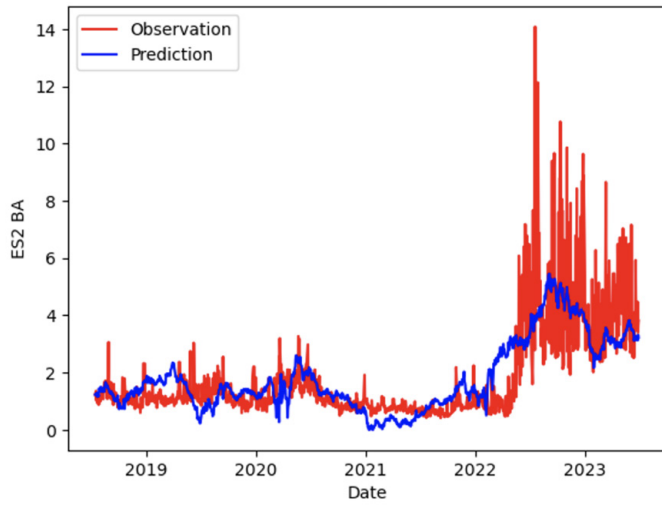
2Y BA Spread

Dependent BA Spread	FR2 BA		DE2 BA		IT2 BA		ES2 BA		UK2 BA	
Model R2	0.29		0.43		0.38		0.55		0.72	
	Coeff	P-Value	Coeff	P-Value	Coeff	P-Value	Coeff	P-Value	Coeff	P-Value
const	0.0379	0	0.0189	0	1.8287	0	1.798	0	2.4951	0
EURUSD	-0.014	0	-0.0064	0	-0.6036	0	-0.5897	0		
SXXP	0.0032	0					-0.1868	0.003		
V2X	0.0037	0	0.0031	0	-0.1077	0.015	-0.1174	0.014		
FR2_vol	-0.002	0.016								
FR2_ASW_vol	0.0052	0								
DE2_vol			0.0006	0.038						
DE10 ASW					-0.5314	0				
IT10 ASW							-0.3803	0		
ES2 ASW							-0.9531	0		
ES10 ASW							0.5332	0		
UKBE5									-0.2876	0
UKX VOL									-0.1981	0
UK10 ASW									-0.3714	0
UK2 ASW									-2.1722	0
UK30 ASW									0.1667	0.039
UK2_vol									-0.1145	0.011
UK2_ASW_vol									0.4562	0

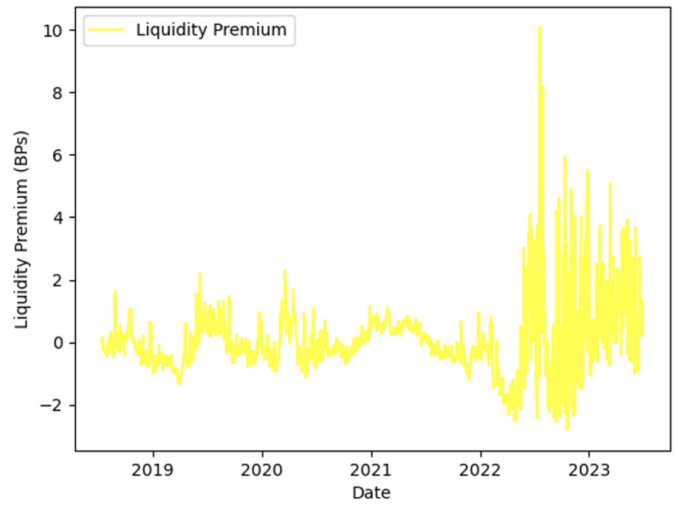
Figure 88



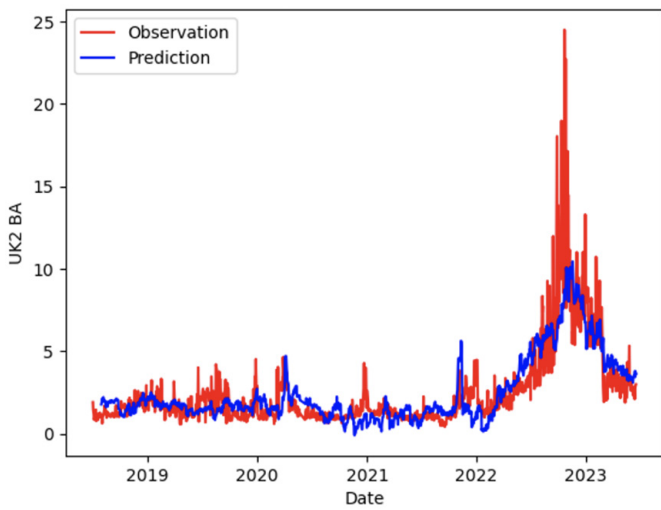
Spain 2YR Government Bond Bid-Ask Spread IG Prediction vs Observation



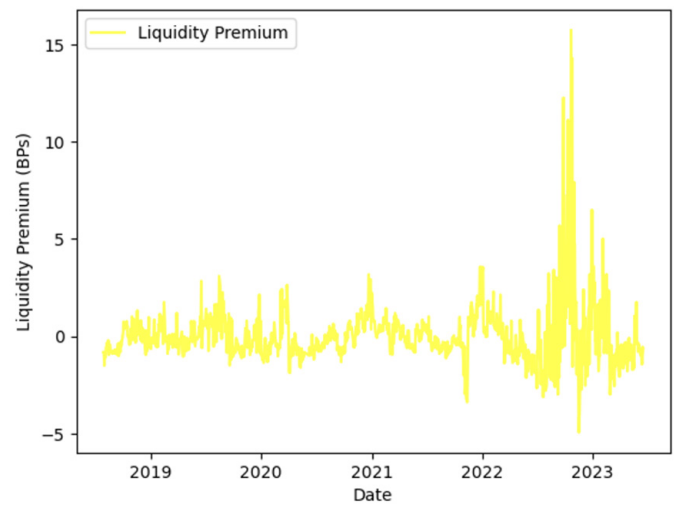
2YR ES Liquidity Premium



UK 2YR Bid-Ask Spread Prediction vs Observation



2YR UK Liquidity Premium



Clustering

We ran a clustering algorithm (“K-means”) using a number of key market indicators and data points, including sovereign bond yields and swap-spreads, for both EUR core markets and the UK Gilt market. The objective was to identify key market dynamics and drivers over time (we used 5 years of historical data, from July 2018 to June 2023) as well as any relationships and interactions between different markets.

For our EUR analysis, we used the following data points: EONIA/ESTR; EURUSD; Euro Stoxx 600; Euro Stoxx 600 volatility index; EUR iTraxx Main; 10yr German break-even inflation rate; 2yr German Government yield; 10yr German Government Yield; 2yr German Government swap-spread; 10yr German Government swap-spread; 2yr France Government yield; 10yr France Government Yield; 2yr France Government swap-spread; 10yr France Government swap-spread; 2yr Italy Government yield; 10yr Italy Government Yield; 2yr Italy Government swap-spread; 10yr Italy Government swap-spread; 2yr Spain Government yield; 10yr Spain Government Yield; 2yr Spain Government swap-spread; 10yr Spain Government swap-spread.

For our GBP analysis, we used the following data points: O/N SONIA; 3mth SONIA; RONIA; UK 5yr break-even inflation rate; FTSE 100; FTSE 100 volatility; SLX corporate bond ETF (credit spread); 2yr Government yield; 2yr Government swap-spread; 10yr Government yield; 10yr Government swap-spread; 30yr Government yield; 30yr Government swap-spread.

EUR

From our EUR analysis, we identified 6 distinct clusters over our time horizon:

Group 0: low yields; tight swap-spreads; low money market rates; low stock prices; low volatility; tight credit spreads

Group 1: high yields; wide swap-spreads; high money market-rates; high stock-prices; low volatility; medium credit spreads

Group 2: low yields; tight swap-spreads; low money market rates; high stock prices; low volatility; tight credit spreads

Group 3: low yields; medium swap-spreads; low money market rates; high stock prices; medium volatility; medium credit spreads

Group 4: low yields; tight swap-spreads; low money market rates; low stock prices; high volatility; wide credit spreads

Group 5: medium-to-high yields; low-to-medium money market rates; wide swap-spreads; medium-to-high stock prices; medium-to-low volatility; wide credit spreads.

The following charts show box plot distributions of each of the clusters for different data points:

Figure 89: 10yr German Yields and swap-spreads

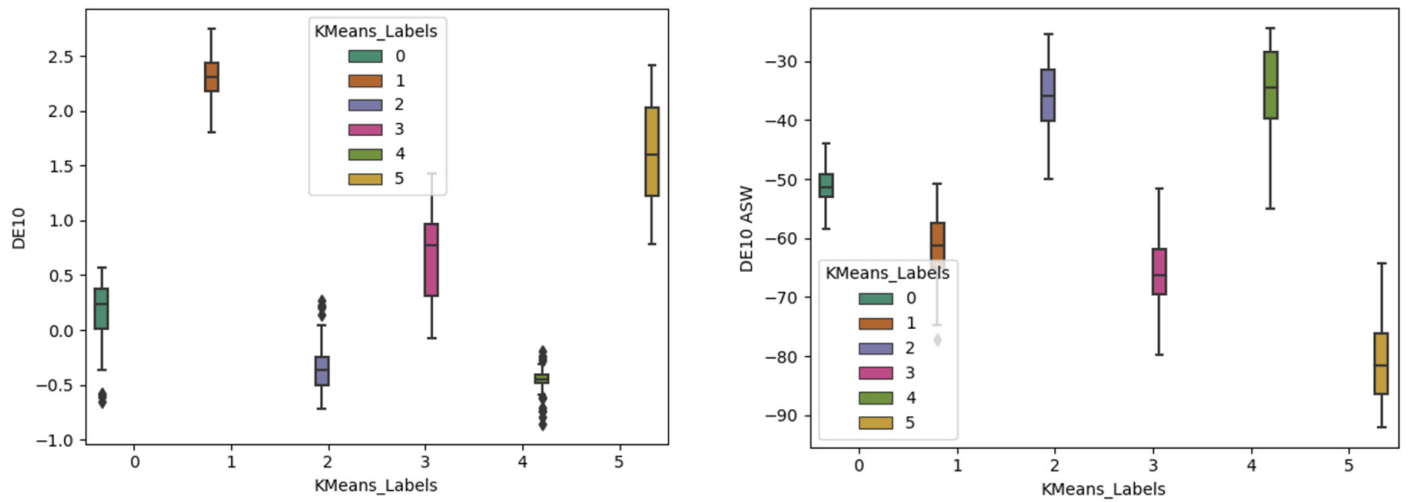


Figure 90: EONIA/ESTR and iTraxx Main

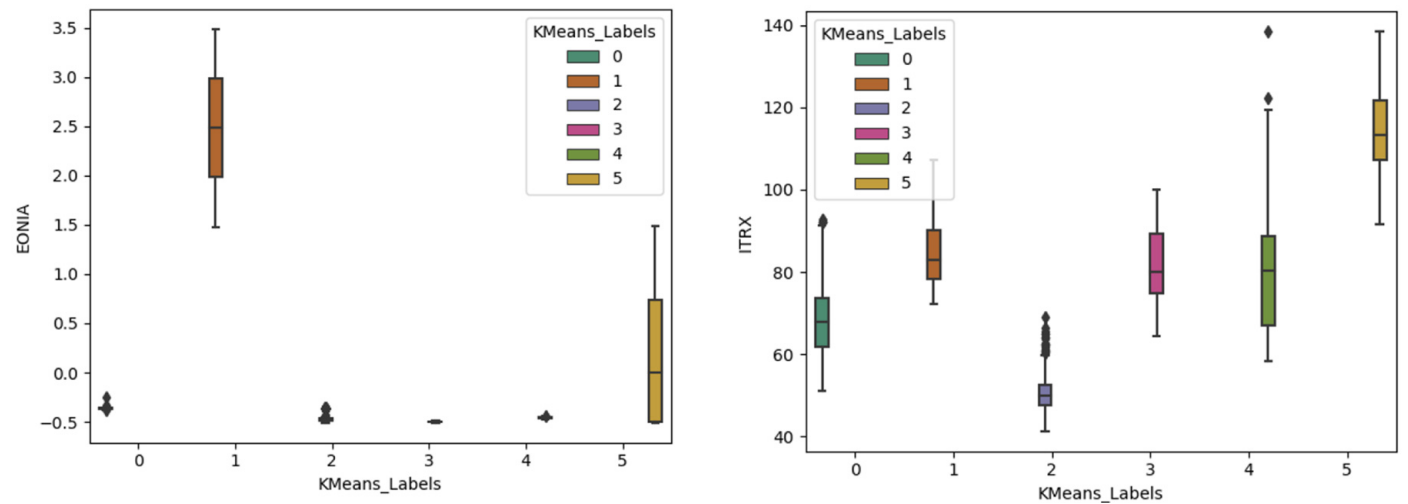
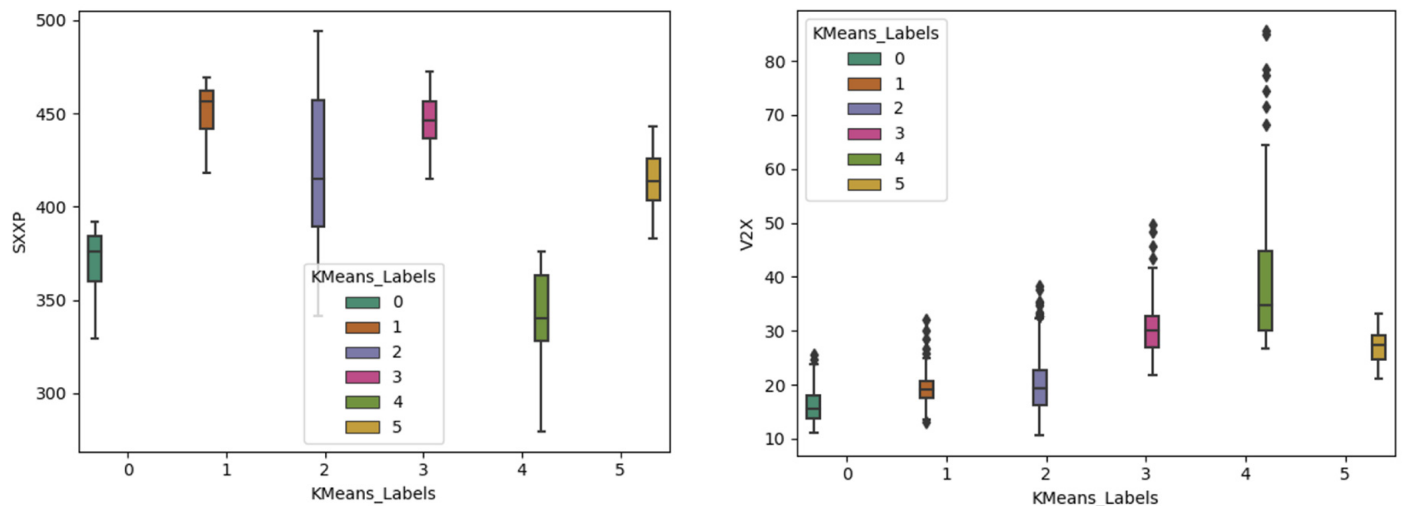


Figure 91: Euro Stoxx price and volatility



We also plotted the clusters for different data points as a time series, which helps to identify the evolution of market conditions over time, including changes in volatility.

Figure 92: Germany and Italy 2yr yields

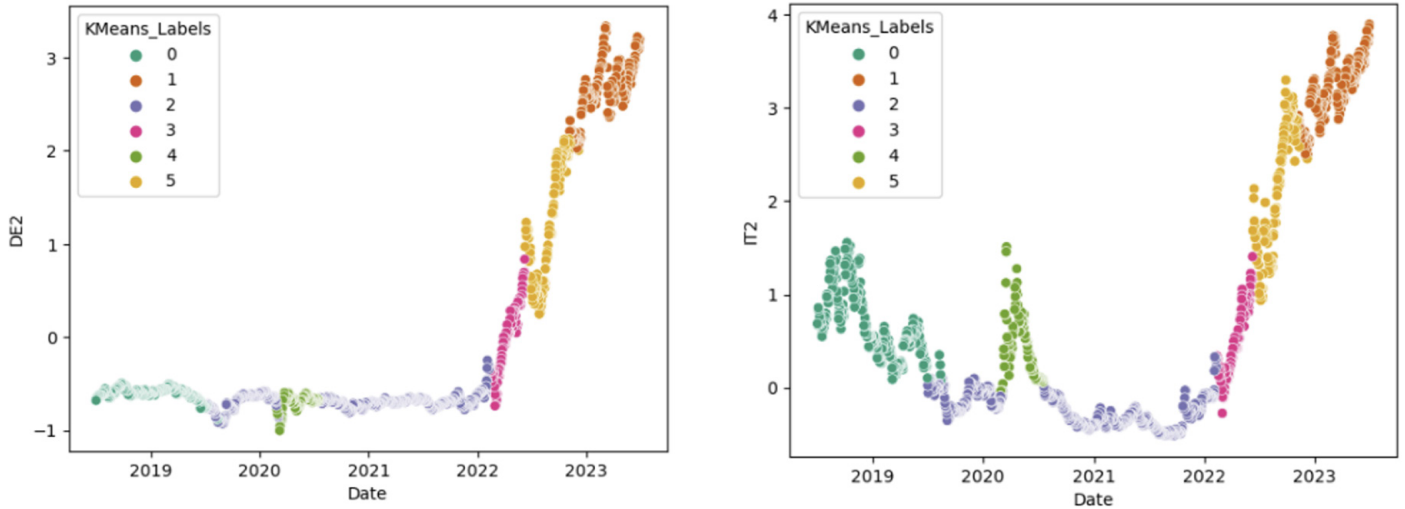


Figure 93: Germany and Italy 10yr swap-spreads

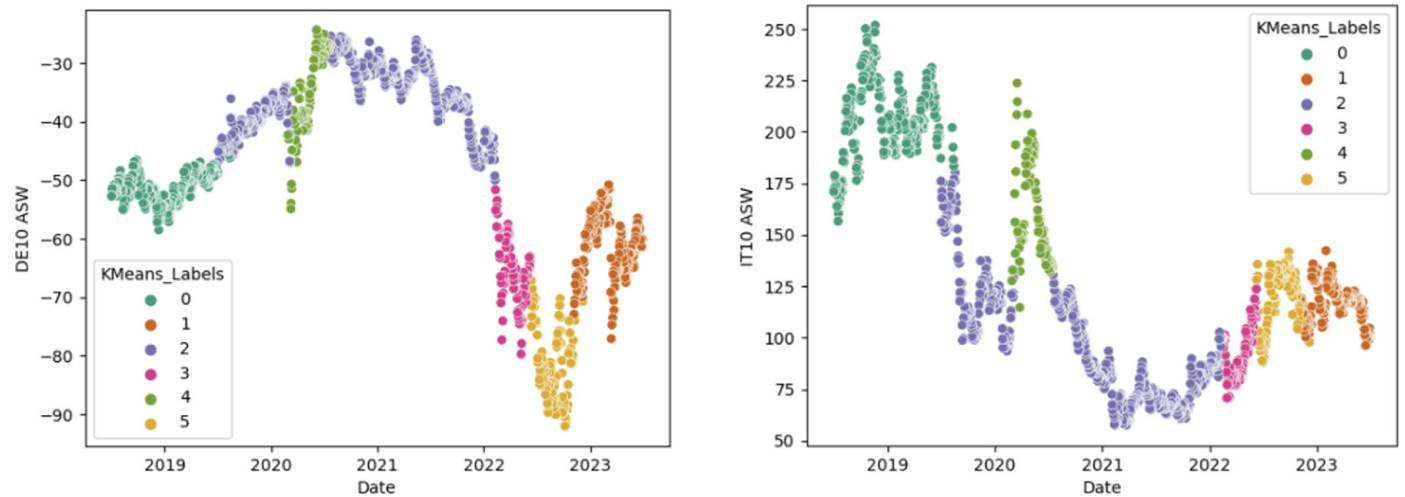
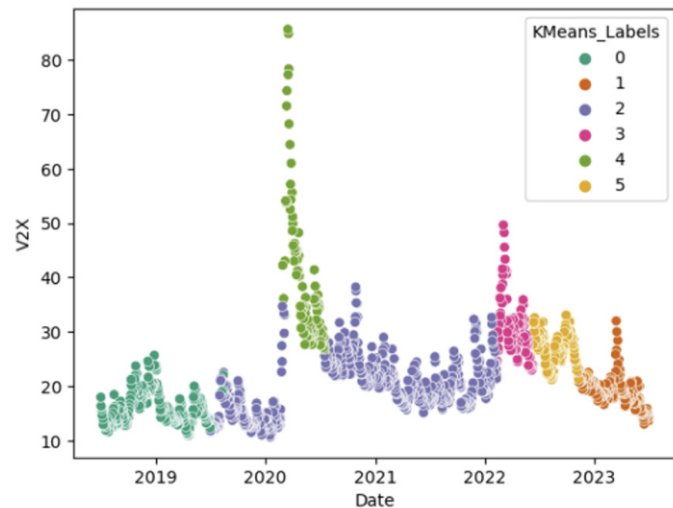


Figure 94: Euro Stoxx volatility



GBP

From our GBP analysis, we identified 5 distinct clusters over our time horizon:

Group 0: low money market rates; high stock prices; wide credit spreads; low volatility; low yields; medium-to-tight swap-spreads

Group 1: high money market rates; high stock prices; tight credit spreads; low volatility; high yields; tight-to-positive swap spreads

Group 2: medium-to-high money market rates; high stock prices; tight credit spreads; low volatility; high yields; medium-to-wide swap spreads

Group 3: low money market rates; medium-to-low stock prices; medium-to-wide credit spreads; medium-to-high volatility; low yields; medium-to wide swap spreads

Group 4: low money market rates; high stock prices; wide credit spreads; low-to-medium volatility; medium yields; medium to tight swap spreads.

The following charts show box plot distributions of each of the clusters for different data points:

Figure 95: Sonia and 2yr Gilt yields

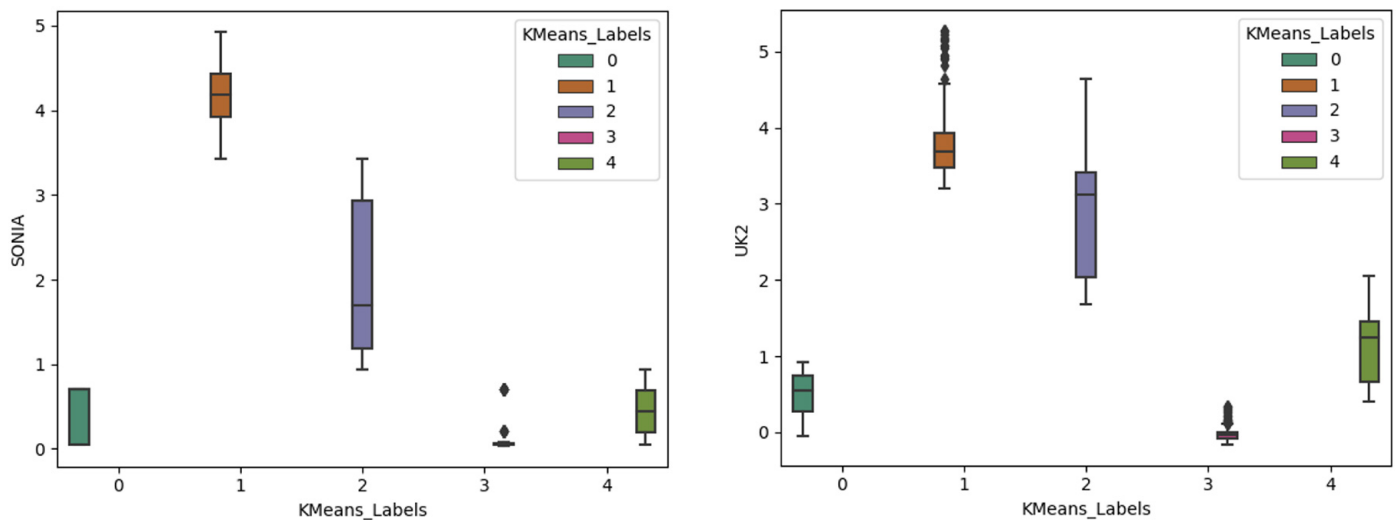


Figure 96: 10yr Gilt yields and swap-spreads

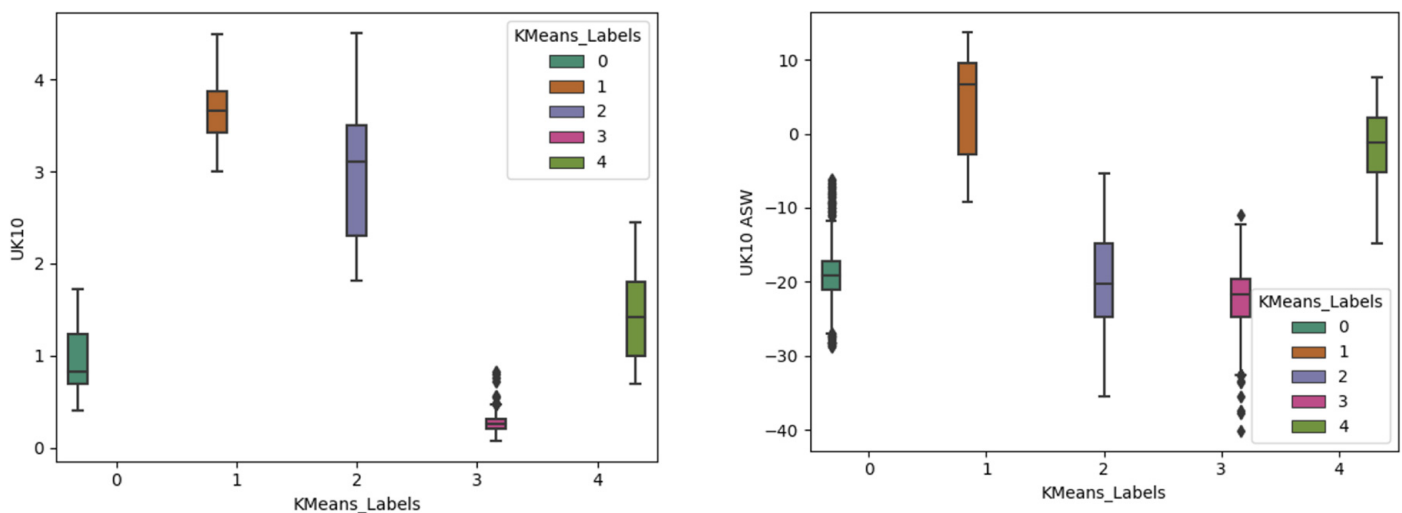
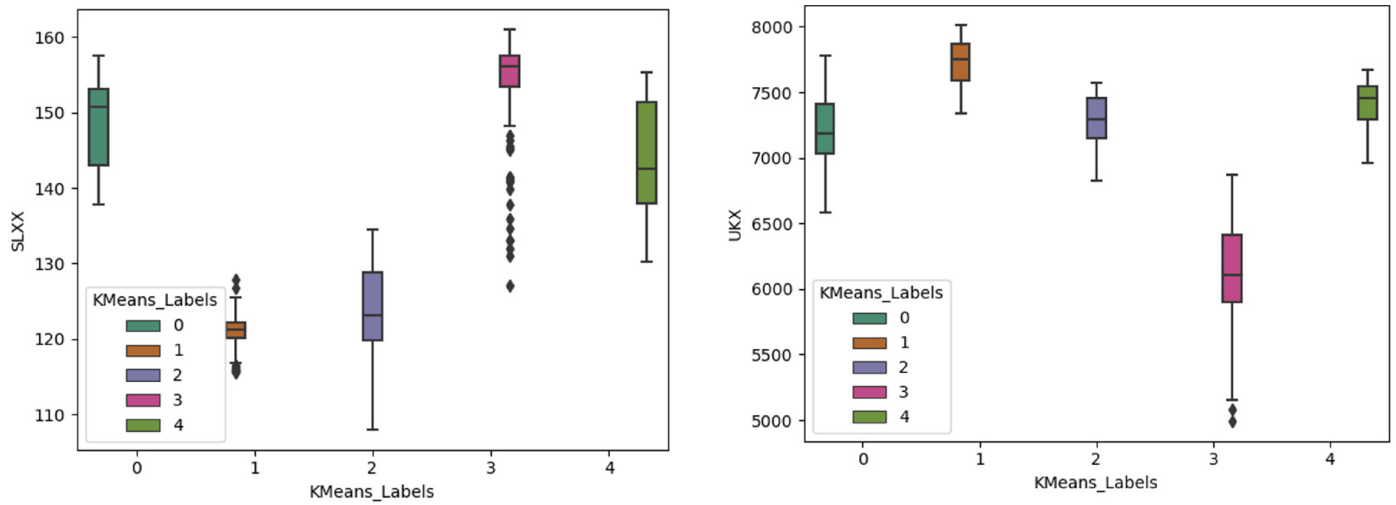


Figure 97: Credit spreads and equity volatility



We plotted the clusters for different data points as a time series, which helps to identify the evolution of market conditions over time, including changes in volatility.

Figure 98: 2yr Gilt yield and swap-spread

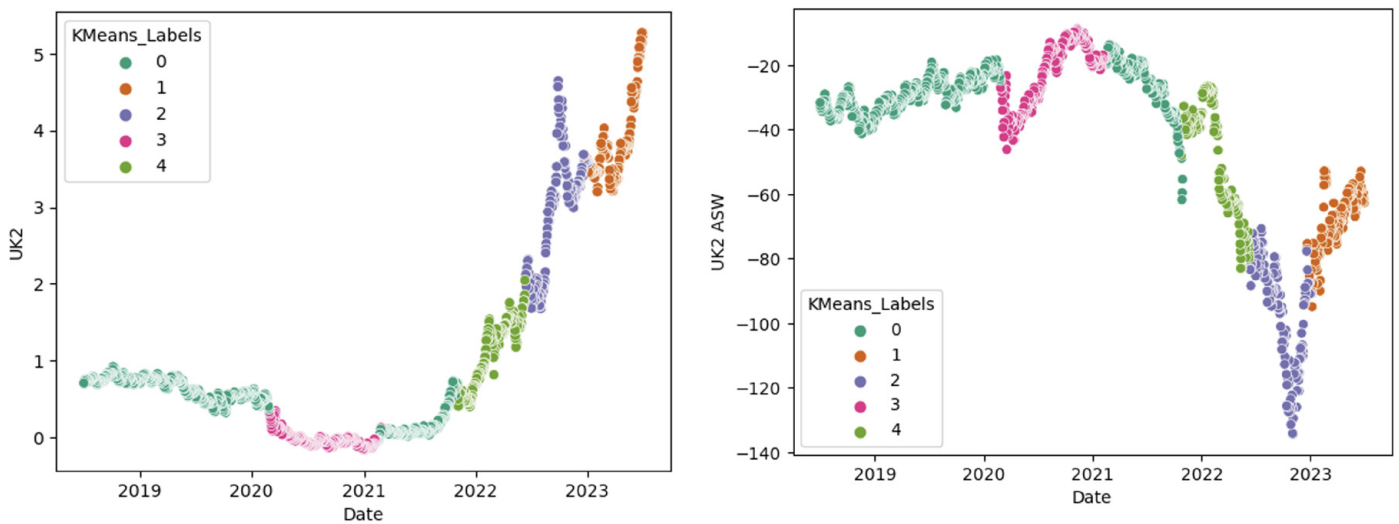


Figure 99: 10yr Gilt yield and swap-spread

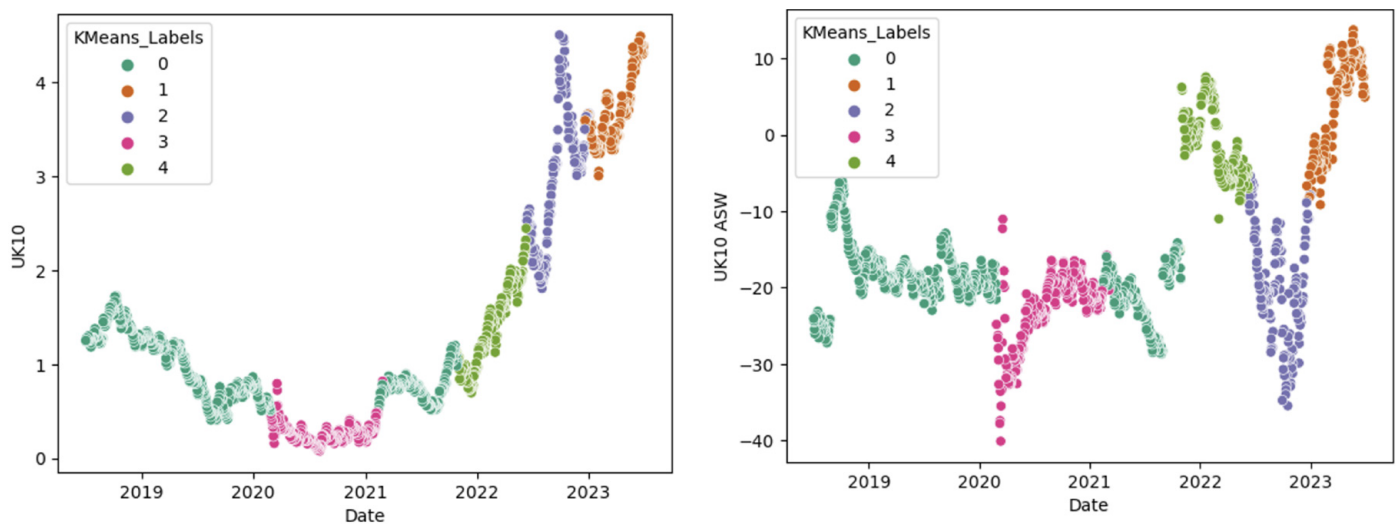
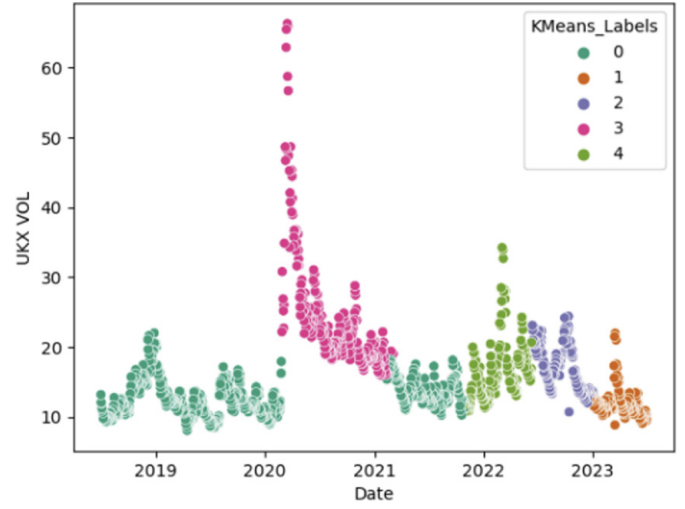
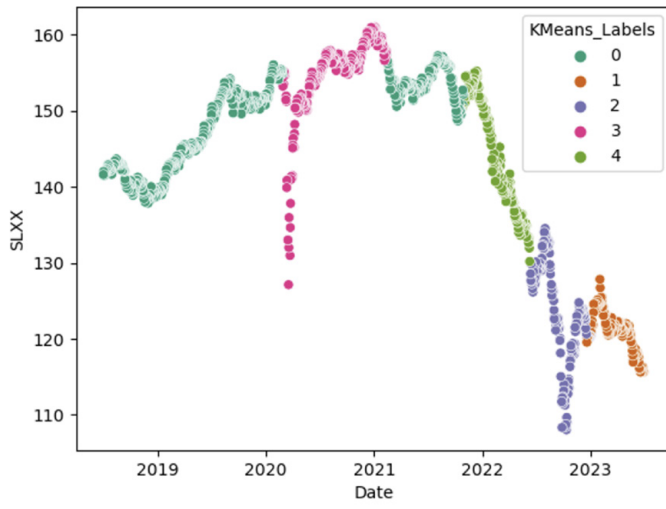


Figure 100: Credit spread and equity volatility



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