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Article

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National Bank OF BELGIUM
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Transmission of recent monetary policy tightening: fragmented or not?

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Introduction

For the first decade following its creation in 1999, the euro area was characterised by a strong convergence of sovereign yields between Member States. This broad alignment of yields reflected the markets' belief that, with the elimination of foreign exchange risk, differences in credit risk between euro area countries had largely disappeared or that the risk would be shared within the area, if need be. The global financial crisis and ensuing European sovereign debt crisis put an abrupt end to this belief. Yields on euro area sovereign debt began to strongly diverge, as reflected by a sharp widening of peripheral sovereign spreads. A host of fiscal, monetary, supervisory and structural policy initiatives eventually succeeded in alleviating these so-called fragmentation issues.

However, fragmentation in the euro area affects not only sovereign bond markets. It can also concern money markets, corporate bonds and bank retail rates. Only by looking at all of these markets is it possible to obtain a general idea of the degree of fragmentation.

From the point of view of monetary policy, fragmentation can be defined as a situation where the same monetary policy impulse does not result in an equivalent change in financing conditions across countries. Monetary policy is not only about setting the right policy *stance* but also about ensuring that this stance is *transmitted evenly* throughout the euro area. Preventing fragmentation issues from arising does not mean, however, that financing conditions need to be exactly the same in all euro area countries. In essence, the functioning of financial markets is based on the principle that interest rate differentials reflect differences in risk between financial instruments. The euro area's specific institutional set-up – a monetary union, not a fiscal one – means that fragmentation issues can continue to pop up. Indeed, although fiscal unions may differ in design, their common features – mutualised debt, fiscal transfers between members, etc. – largely prevent fragmentation issues from arising. By contrast, differences due solely to the issuer's country of origin rather than to fundamental factors related to the risk profile of the instrument and/or the issuer can lead to fragmentation that distorts the transmission of monetary policy in an unwarranted way.

The main goal of this article is to review various indicators useful for the identification and measurement of possible fragmentation and transmission issues. While maintaining a historical perspective, the focus of this article is on the tightening of monetary policy since late 2021. In the current policy context, fragmentation arises when higher policy rates are passed on to borrowers in different countries to varying degrees, resulting in an

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uneven tightening of financing conditions across the euro area. The pace and strength of interest rate hikes may cause risk premia to widen, for fundamental reasons (e.g. investors become less inclined to search for yield) or non-fundamental ones (unwarranted macroeconomic stability concerns).

The structure of this article reflects the different segments of the monetary policy transmission chain. It first examines fragmentation and transmission in the "upstream" segments of the chain, i.e. the money markets (Section 1) and sovereign bond markets (Section 2). Pricing on these markets serves as a benchmark for the financing conditions of households and firms seeking funding on the capital markets (Section 3) or via bank loans (Section 4), which make up the "downstream" segments of the transmission chain.

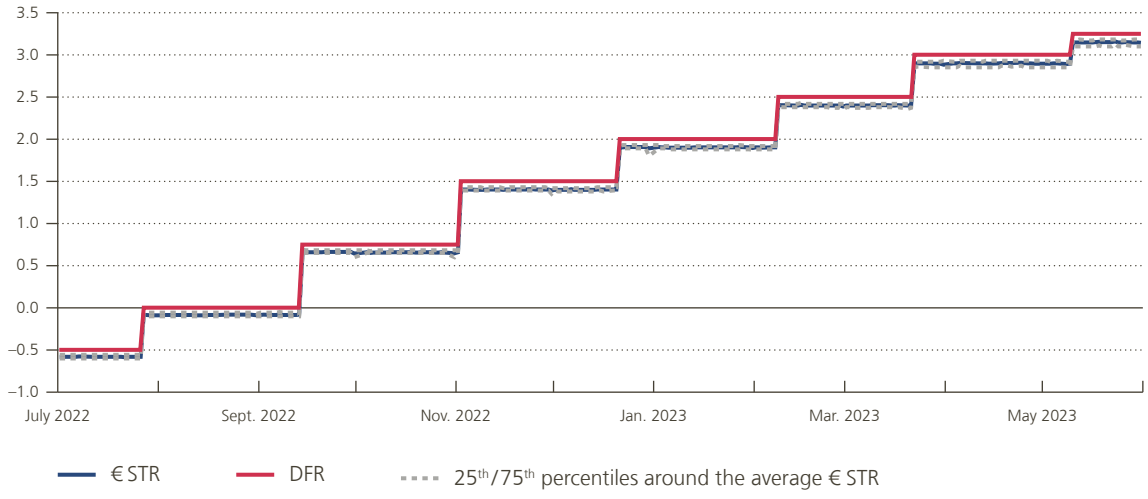
1. Money markets

Money markets are the first link in the monetary policy transmission chain. The Eurosystem sets the policy rates at which it provides short-term liquidity and a deposit facility to euro area commercial banks and in this way has a direct impact on the rates at which commercial banks transact with other banks and financial institutions in general on a short-term – often day-to-day – basis. Together with sovereign bond yields, money market interest rates form the benchmark for pricing other financial instruments, such as corporate bonds and retail bank loans. In particular, the lending capacity of commercial banks depends at least to some extent on the possibility to use the interbank market as a marginal source of financing. Well-functioning, non-fragmented money markets are therefore essential for the effective transmission of monetary policy.

Chart 1

Transmission of recent monetary policy tightening to the euro short-term rate (€STR)

(%)



Source: ECB.

When the ECB started raising its policy rates in July 2022, these changes were transmitted one-to-one to the euro short-term rate (€STR, Chart 1[1]). The €STR is the average rate at which euro area banks can borrow from

1 For charts with daily data shown in this article, the cut-off date is at the end of May 2023.

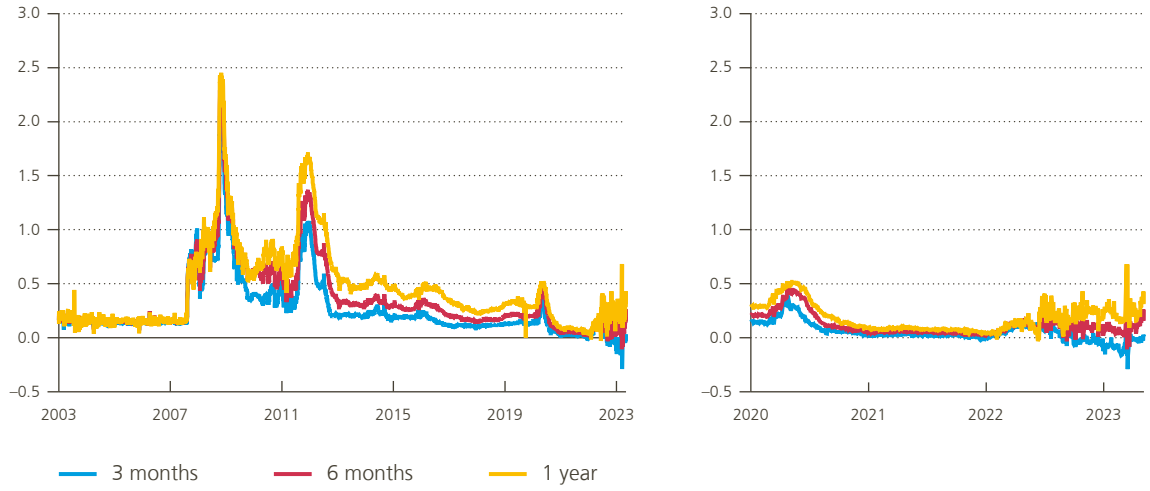
other banks and financial institutions in the unsecured overnight money market. In the current environment of abundant liquidity, the €STR is close to the ECB's deposit facility rate (DFR). The €STR tends to be slightly below the DFR, about 10 basis points on average in 2022, as it takes into account banks' transactions with financial institutions that do not have access to the ECB's deposit facility.

Fragmentation in unsecured money markets is practically non-existent. The 25th and 75th percentiles of the distribution of rates reported by euro area banks have been only two basis points from the €STR over the past years. The absence of fragmentation in these markets is a reflection of the well-integrated euro area interbank market.

Chart 2

Spreads between EURIBOR and OIS rates at different maturities

(%)



Source: Refinitiv.

Spreads between the euro interbank offered rates (EURIBOR) and the overnight indexed swap (OIS) rates at different maturities do not indicate tensions in the interbank market either (Chart 2). EURIBOR rates include risk premia as they are associated with loans of a few months, while OIS rates are considered risk-free as they are indexed to the €STR (an overnight rate). Therefore, widening EURIBOR-OIS spreads usually indicate rising risks in the banking sector, as for instance was observed around the time of the global financial crisis and the European sovereign debt crisis and, to some extent, at the start of the COVID-19 crisis. More recently, these spreads have been somewhat volatile, but for tenors of up to six months EURIBOR rates have even traded below OIS rates, reflecting negative liquidity premia. These negative spreads are mainly due to the reluctance of investors to take longer-term risks in the current context of high uncertainty about the future level of interest rates as well as less inclination on the part of banks to take on short-term wholesale deposits for regulatory reasons.[1]

The pass-through of policy rate hikes to the secured money market segment was also complete, although somewhat less smooth than to the unsecured segment. Pricing in the secured interbank market is affected not only by the supply and demand for cash but also by the supply and demand for collateral.

1 Only instruments with a maturity of more than six months are taken into account when calculating the net stable funding ratio of banks.

Specifically, the pass-through of the September 2022 rate hike took some days, especially for transactions backed by German (sovereign bond) collateral. September 2022 marked the return of positive rates to the money markets, which was thought likely to attract investors looking for facilities to park liquidity reserves, including governments that had accumulated large volumes of deposits at the ECB. Collateral would thus be needed to guarantee (at least some of) the additional loans to be granted after the expected liquidity inflow, especially in an environment characterised by heightened volatility. However, collateral had become relatively scarce due to the accumulation of assets on the Eurosystem's balance sheet (asset purchase programmes), the Eurosystem's targeted longer-term refinancing operations (requiring collateral), and the (expected) rise in policy rates which lowered the value of assets used as collateral. The Eurosystem thus took measures to mitigate the issue of collateral scarcity in order to preserve the effectiveness of monetary policy transmission and safeguard the orderly functioning of the markets.[1]

2. Sovereign bond markets

While changes in policy rates directly impact short-term money market rates, monetary policy also affects market participants' expectations of future policy rates. Combined with the risk premia demanded by markets, these expectations determine medium- and longer-term interest rates and, hence, allow the impact of monetary policy to spread throughout the entire yield curve. In this respect, the adjustment of interest rates along the sovereign yield curve is of particular importance for the transmission of monetary policy, as sovereign bond yields act as benchmarks for other markets.

In the euro area, the transmission of monetary policy to sovereign bond markets can pose specific challenges. Under normal circumstances, differences in sovereign spreads between euro area countries reflect country-specific factors, such as a country's fiscal situation or growth potential. A significantly unequal widening of spreads can hinder the smooth transmission of monetary policy. In times of financial stress in particular, the fact that the euro area is not a fiscal union with a fully integrated sovereign debt market represents a risk of the ECB's monetary policy stance not being evenly transmitted across Member States.

Before the global financial crisis, such fragmentation issues were nearly non-existent on sovereign bond markets (Charts 3 and 4). Looking at spreads vis-à-vis risk-free rates (proxied by OIS rates), the GDP-weighted average of euro area ten-year sovereign spreads and their standard deviation remained close to zero.[2] Market participants essentially considered the probability of a Member State defaulting on its debt to be very low. However, during the global financial crisis and the subsequent European sovereign debt crisis, a substantial reassessment of sovereign default risks led spreads to widen to record highs. Fragmentation only dissipated after the ECB's announcement of its outright monetary transactions (OMT) programme. While it was never actually used, the ECB's clear commitment to preserving the euro ("whatever it takes")[3] calmed markets and led to narrower sovereign spreads.

1 On 8 September 2022, the ECB removed the 0% interest rate ceiling for remuneration of government deposits. On 7 February 2023, the ECB further adjusted the remuneration of government and certain other non-monetary policy deposits, effective 1 May 2023. On 10 November 2022, it increased the limit for lending against cash as collateral under the securities lending facility, which allows investors to borrow securities from the Eurosystem. Finally, the normalisation of the Eurosystem's balance sheet will also provide relief in terms of the availability of collateral.

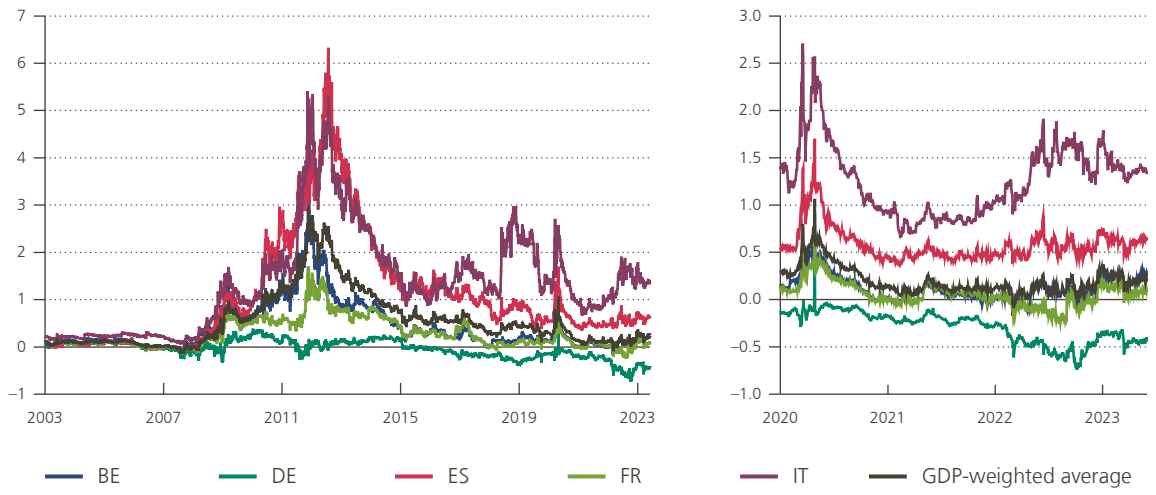
2 In this article, data for eleven member states (AT, BE, DE, EL, ES, FI, FR, IE, IT, NL and PT) are aggregated to comprise the euro area. Data for other countries were not always available.

3 See the ECB's website for the full text of Mario Draghi's speech of 26 July 2012.

Chart 3

Euro area ten-year sovereign spreads

(spreads vis-à-vis the ten-year OIS rate, %)



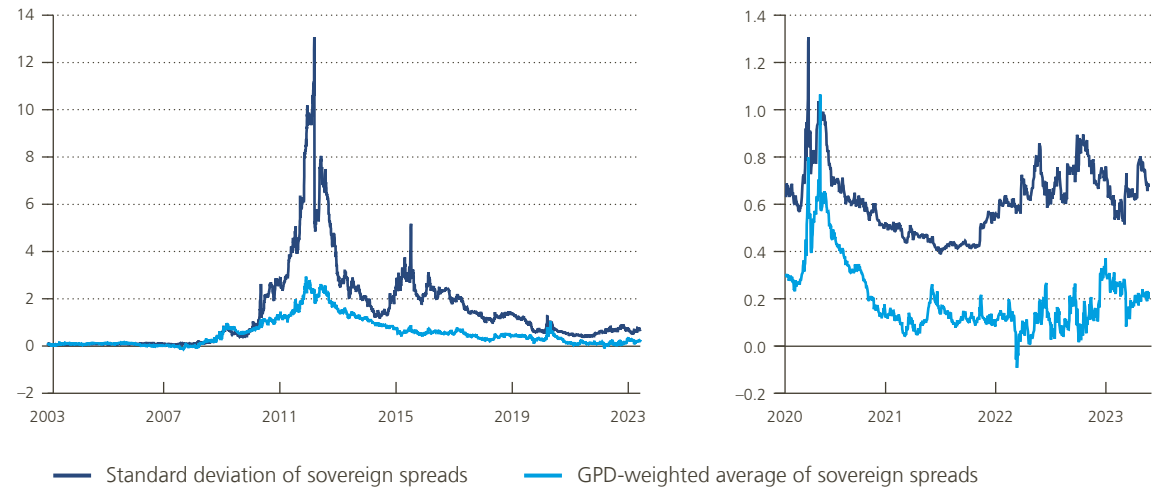
Sources: Refinitiv and own calculations.

At the start of the COVID-19 crisis, fragmentation issues resurfaced, although to a much lesser extent than during previous crises. Spreads on Spanish and Italian government bonds widened again as these countries were perceived as having more limited fiscal space to deal with the impact of the crisis and in addition were initially hit harder by the pandemic. It was in this context that the ECB decided to introduce a new asset purchase programme, the pandemic emergency purchase programme (PEPP). The massive purchases carried out under the PEPP not only helped to ease the monetary policy stance but were also particularly effective in addressing

Chart 4

GDP-weighted ten-year sovereign spread and standard deviation of euro area sovereign spreads

(spreads vis-à-vis the ten-year OIS rate, %)



Sources: Refinitiv and own calculations.

fragmentation risks. While PEPP purchases were generally subject to the same rules as those made under the ECB's asset purchase programme (APP), they could be spread out more flexibly over time, asset classes and jurisdictions. That is, unlike under the APP, PEPP purchases could temporarily deviate from the ECB's capital key, [1] allowing the Eurosystem to scale up purchases of Italian and Spanish government bonds at the start of the COVID-19 crisis. In combination with substantial fiscal measures (at European level, e.g. SURE and NGEU), these programmes facilitated the relatively quick easing of fragmentation issues and a return of sovereign spreads to pre-crisis levels.

At the end of 2021 and in the first half of 2022, as inflation continued to rise more strongly than expected, the markets started to anticipate more pronounced ECB rate hikes and thus increased government borrowing costs, in particular for heavily indebted sovereigns, as reflected in some re-emergence of fragmentation. However, two specific measures helped to keep such tensions in check. First, while PEPP purchases were ended in late March 2022, the ECB decided that the flexibility applied to PEPP purchases could be used during the PEPP reinvestment phase in the event of renewed market fragmentation related to the pandemic. When fragmentation signs resurfaced in the summer of 2022, this flexibility was put to use. Second, a new instrument, the transmission protection instrument (TPI), was introduced in July 2022. The TPI enables the ECB, under certain conditions, to purchase financial securities to counter "unwarranted, disorderly market dynamics that pose a serious threat to the transmission of monetary policy across the euro area". [2] Unlike flexible PEPP reinvestments, recourse to the TPI is not linked to the pandemic. Moreover, TPI purchases are not restricted ex ante, although countries benefiting from government bond purchases under the TPI must conduct sound and sustainable fiscal and macroeconomic policies. Purchases will be terminated either upon a lasting improvement in transmission or based on an assessment that persistent tensions are due to country fundamentals. The TPI has not been activated yet. Together with the flexibility inherent in the PEPP, the mere existence of such an instrument probably contributed to keeping fragmentation tensions in check when policy rates started to be raised, ensuring that the monetary policy stance was transmitted smoothly across all euro area countries. Finally, OMT remains part of the Eurosystem's toolkit. OMT can also be used to address fragmentation issues related to weak fundamentals, but access is tied to a country adhering to a European Stability Mechanism (ESM) [3] programme addressing country vulnerabilities. In other words, financial assistance is made contingent on the country implementing structural reforms and maintaining fiscal discipline, thereby shielding the Eurosystem from fiscal dominance.

Since that time, fragmentation issues have remained limited but have not disappeared completely. The spread between the GDP-weighted average ten-year yield on sovereign bonds and the risk-free rate remains close to zero and the dispersion of sovereign spreads has stabilised. Italian spreads, however, remain high compared to those of the three other largest euro area economies and the GDP-weighted average. By contrast, German spreads remain low and negative. Most recently, the negative German spreads reflected negative liquidity premia mainly due to the relative scarcity of German bonds intended to be used as collateral for borrowings on the money markets. The standard deviation of spreads broadly decreased at the end of 2022 as the most extreme spreads converged somewhat: Italian spreads generally came down in an environment of relative domestic stability, while German spreads became on the whole less negative as collateral scarcity became less acute.

Recent announcements related to the run-off of the ECB's balance sheet – so-called "quantitative tightening" – have not worsened fragmentation tensions. In March 2023, the ECB stopped fully reinvesting the principal of maturing securities purchased under its APP. In June 2023, the ECB announced that it would discontinue reinvestments under its APP as of July 2023. Nonetheless, given the recent turmoil in the (US) banking sector and hence somewhat higher uncertainty, the standard deviation of sovereign spreads has edged up lately.

1 Based on the share of each country in the EU's total population and GDP.

2 See the ECB press release of 21 July 2022 on the establishment of the TPI.

3 For more information, see the ESM's website: The ESM is an intergovernmental organisation established by the Member States of the euro area in 2012, to help euro area countries in severe financial distress.

The following subsections of this article discuss the fragmentation of sovereign spreads from different perspectives. Various indicators of fragmentation/co-movement are presented; these can be seen as complementary to the standard deviation of spreads presented above. Each indicator has advantages and limitations. For instance, the standard deviation of sovereign spreads, while the simplest and most intuitive indicator of fragmentation, does not account for the sign of spreads, nor does it identify common movements in clusters of countries potentially leading to segmentation or the shocks underlying spread changes.

2.1 Coherence indicators

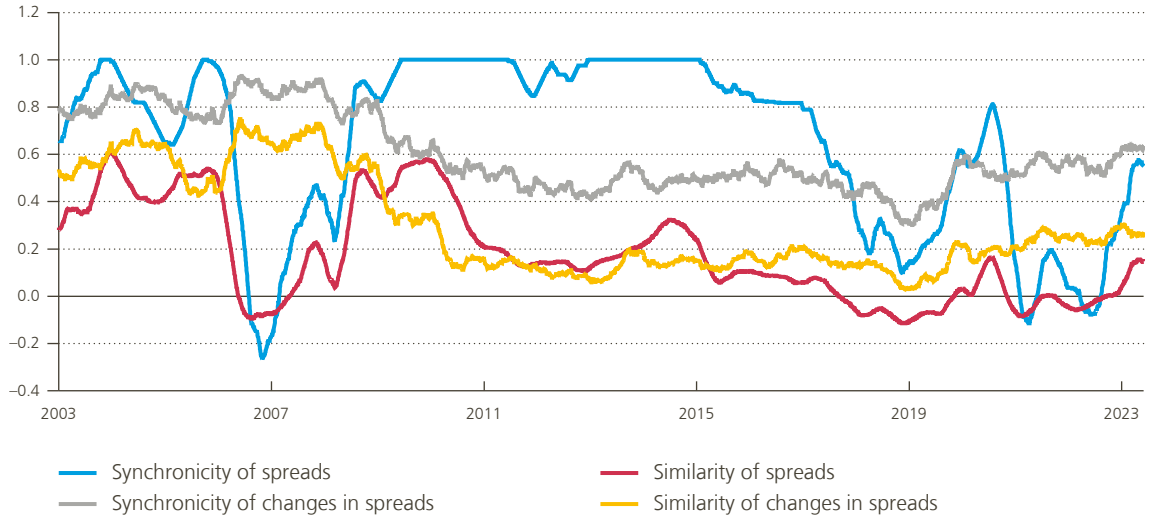
An increase in the standard deviation is not informative as to the sign of changes in spreads. It could be the result of spreads turning more positive in some countries and more negative in others or of spreads increasing more in some countries than others.

The coherence indicators – synchronicity and similarity – of Mink *et al.* (2012), originally developed to study developments in output gaps in the euro area, can be used to complement the standard deviation of sovereign spreads. The synchronicity indicator compares the sign of (changes in) euro area sovereign spreads with the sign of (changes in) a reference spread, defined here as the GDP-weighted average spread. If all countries have the same sign as the reference spread – e.g., all (changes in) spreads are positive – the synchronicity measure is one. If spreads are positive in about half the countries, the synchronicity measure will be close to zero. The similarity indicator also takes into account the size of (changes in) spreads versus the size of the (change in the) reference spread: if all (changes in) spreads are of identical size (in addition to being of the same sign), the similarity measure is one.

Chart 5

Synchronicity and similarity of euro area ten-year sovereign spreads

(100-day backward-looking moving average; spreads vis-à-vis the ten-year OIS rate)



Sources: Refinitiv and own calculations.

Sovereign spreads were quite synchronised at the beginning of the sample period (2003-2005), with all yields marginally above the risk-free rate (the blue line in Chart 5). In 2006, synchronicity decreased, but for a "good" reason: the GDP-weighted average reference spread got very close to zero, with some spreads

turning marginally negative while others remained marginally positive. Synchronicity increased again when the global financial crisis broke out and all spreads turned positive. During the ensuing European sovereign debt crisis, synchronicity remained high as spreads remained overall positive, but similarity (the red line) dropped as spreads widened sharply in some countries and remained more contained in others. Over the period 2015-2019, accommodative monetary policy, implemented through asset purchases, seemed to go hand in hand with lower synchronicity as some sovereign spreads went into negative territory, which was particularly the case for German spreads in the presence of gradually increasing scarcity. Synchronicity temporarily peaked during the COVID-19 pandemic as the health crisis raised sovereign spreads to positive figures in most countries. More recently, both the synchronicity and similarity indicators have increased, which is a sign that spreads have become more alike. Some spreads that had been slightly negative turned slightly positive.

A similar analysis can be carried out for (daily) changes in sovereign spreads (the grey and yellow lines). Coherence indicators seem to move less in phase with the business cycle and rather to capture lower-frequency developments. The coherence of sovereign spread changes has decreased from the high levels seen before the global financial crisis. This decrease reflects the fact that sovereign spreads on the whole are moving less in parallel than before, which likely reflects a greater sensitivity of investors to changing country-specific economic conditions.

2.2 Principal component analysis

Over the past 20 years, euro area sovereign spreads have exhibited significant co-movement, while also displaying a certain degree of market segmentation as some movements have been more pronounced in a subset of countries. Market segmentation is a specific kind of fragmentation, wherein certain market segments exhibit distinct dynamics. Risk premia (entailed in spreads) on comparable assets, such as government bonds, usually move according to systematic risk factors, which a principal component analysis (PCA) can help uncover. In particular, a PCA can identify potential systematic market segmentation.

The PCA carried out in this subsection uses euro area ten-year sovereign spreads spanning the period from January 2003 to May 2023. The results indicate that most of the dynamics of the euro area bond market can be attributed to two principal components : a component representing common trends and a secondary component representing segmentation. The first component explains about 75 % of the total variation in sovereign spreads, while the second (orthogonal) component explains about 15 % (Chart 6, left-hand panel). These findings are in line with previous studies analysing drivers in bond markets (Fabozzi *et al.*, 2016 ; ECB's FSR, 2022).

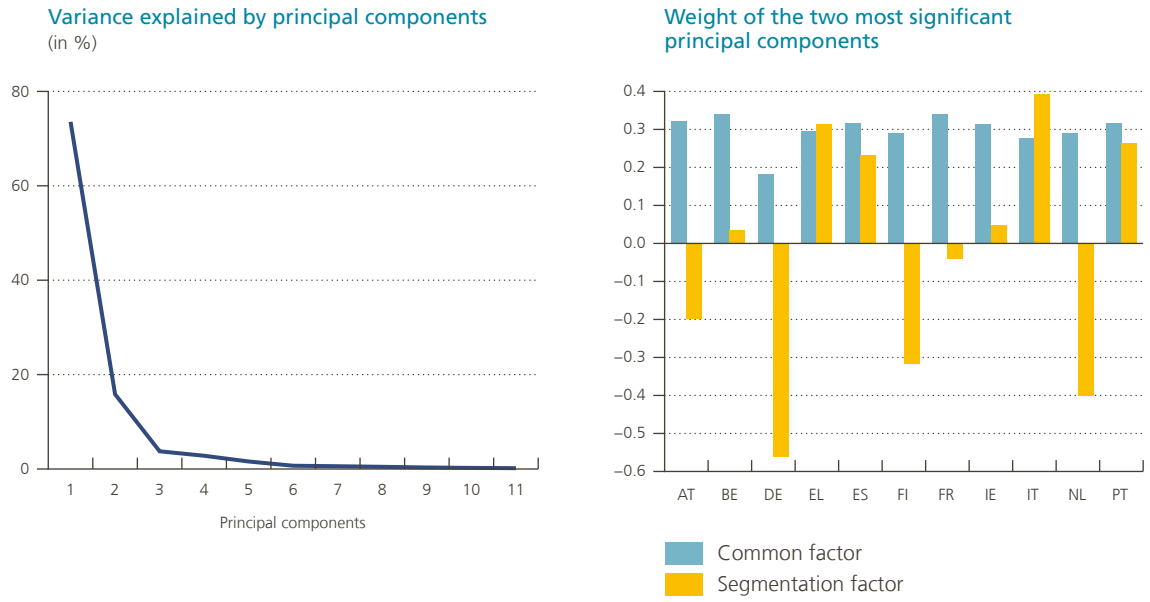
A clear interpretation of the two most significant principal components can be gleaned by looking at the weights of these components for the various countries (Chart 6, right-hand panel). The first component reflects synchronised movements across countries as all countries receive a similar weight. These weights, together with the large fraction of total variation explained by the first component, indicate that a strong commonality exists in the movements of euro area sovereign spreads across the euro area. This component typically captures factors such as global determinants and shifts in investors' risk appetite.

The second component, referred to as the segmentation factor, represents the fragmentation of bond markets into two distinct country clusters. It gives substantial positive weight to Greece, Italy, Portugal and Spain and significant negative weight to Austria, Finland, Germany and the Netherlands. The three remaining countries (Belgium, France and Ireland) are in-between cases with relatively low weights. This principal component can be viewed as a factor distinguishing so-called peripheral from core euro area countries. The clearest example of such clustering occurred during the sovereign debt crisis, when spreads of peripheral countries increased while spreads of core countries dropped overall.

Chart 6

Principal component analysis of ten-year euro area sovereign spreads

(spreads vis-à-vis the ten-year OIS rate)



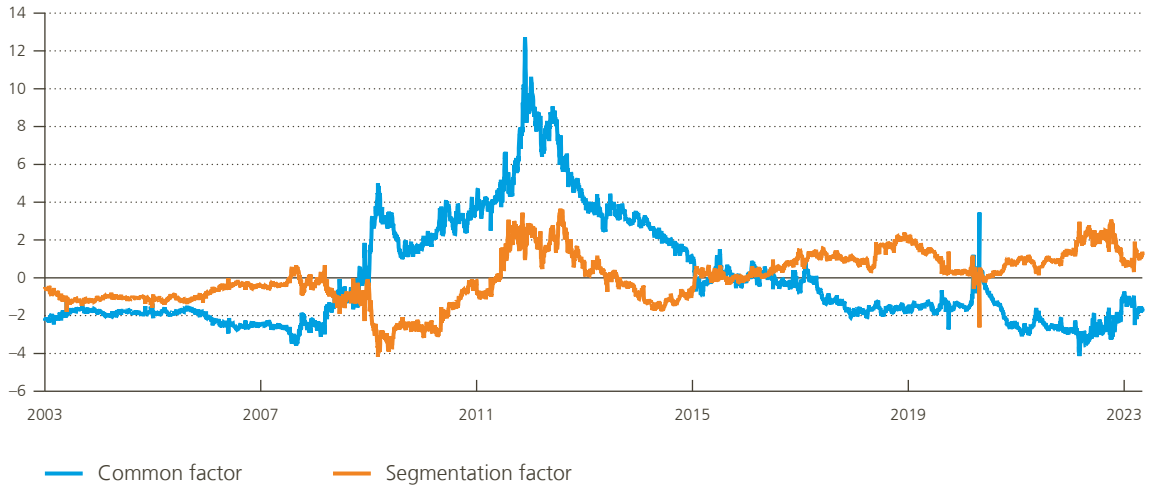
Sources: Refinitiv and own calculations.

The evolution of the common and segmentation factors provides a concise summary of sovereign bond market dynamics (Chart 7). The common factor started to increase during the global financial crisis of 2008-2009 to become positive, suggesting synchronised co-movement between the spreads of euro area countries above the sample average. The segmentation factor started to increase only later on, during the sovereign debt crisis,

Chart 7

Top two principal components of ten-year euro area sovereign spreads

(score of the two principal components; spreads vis-à-vis the ten-year OIS rate)



Sources: Refinitiv and own calculations.

and peaked in the summer of 2012. During the pandemic, all sovereign spreads increased, reflecting a common shock to the euro area bond market. A limited resurgence of segmentation has been observed since the beginning of monetary policy tightening at the end of 2021, but the component dropped again more recently.

2.3 Connectedness index

The indicators presented above look at sovereign spreads directly instead of at the shocks underlying the movement in these spreads. Therefore, the connectedness indicator of Diebold and Yilmaz (2014) is used to complement the analysis. The Diebold-Yilmaz connectedness index measures the extent to which shocks in a given variable impact other variables by estimating the percentage of forecast error variances they explain. A value of close to one (100 %) indicates a high level of connectedness. The index provides an indication of the strength of spill-over effects.

The index is calculated based on the estimation of a vector autoregressive model. For this article, a model with the ten-year sovereign spreads and one lag was estimated (by ordinary least squares) for a series of rolling windows of 100 trading days. The first 100-day window ended on 1 January 2003, and the final one on 31 May 2023. The application of the index is described in Box 1.

The aggregate connectedness index measures the connectedness of spreads across all countries in the euro area (the blue line in Chart 8). Estimates reveal that the period before the global financial crisis was characterised by a high degree of connectedness and that the crisis was followed by an overall lower level. These results are in line with the high coherence in sovereign spread changes observed at the beginning of the sample and overall lower synchronicity and similarity thereafter (Chart 5). The global financial crisis and sovereign debt crisis exposed weaknesses and disparities amongst countries, resulting in a decrease in aggregate co-movement.

As suggested by the principal component analysis, the lower degree of connectedness following the global financial crisis can be attributed to greater segmentation. Estimates attribute the drop in the aggregate connectedness index to a fall in spill-over effects from core to periphery countries. Nevertheless, spill-over effects from periphery to core countries remained, although they were quite volatile, potentially reflecting temporary search-for-liquidity and search-for-safety effects. The connectedness between periphery countries increased during the sovereign debt crisis, possibly suggesting contagion effects (in the sense of unwarranted spill-over effects). By contrast, the connectedness between core countries remained relatively stable. These results are broadly in line with Boeckx and Dewachter (2012).

BOX 1

Diebold-Yilmaz connectedness index

A vector autoregressive model takes the following form in its moving-average representation:

$$Y_t = \sum_{i=0}^{\infty} A_i \epsilon_{t-i},$$

where Y_t is a vector of ten-year sovereign spreads of the countries considered and the error term ϵ_t follows a distribution centred around zero and has covariance matrix Σ.

Following Diebold and Yilmaz (2014), pairwise directional connectedness, i.e. variable j's contribution to variable i's H-step-ahead generalised forecast error variance, is calculated as follows:

$$\theta_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1}\sum_{h=0}^{H-1}\left(e_i' A_h \sum e_j\right)^2}{\sum_{h=0}^{H-1}\left(e_i' A_h \sum A_h' e_i\right)}, H = 1,2,\ldots,$$

where σ_{jj} is the standard deviation of the error term for the j^{th} equation (i.e. the j^{th} country) and e_i is a selection vector with one as the i^{th} element and zero otherwise.

Due to the non-orthogonality of the shocks, the variance decomposition matrix does not total 100 %. Hence, all entries in the variance decomposition matrix are divided by the sum of the entries in their respective rows, to obtain:

$$B_{ij}^{g}(H) = \frac{\theta_{ij}^{g}(H)}{\sum_{j=1}^{N}\theta_{ij}^{g}(H)},$$

where $\sum_{j=1}^{N} B_{ij}^{g}(H) = 1$ and $\sum_{i,j=1}^{N} B_{ij}^{g}(H) = N$ follow by construction.

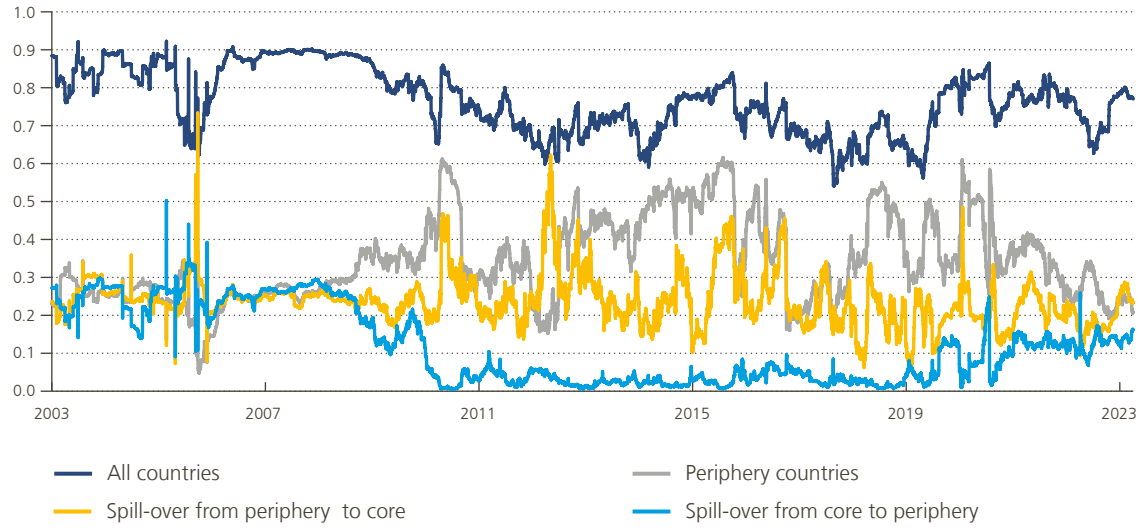
Finally, the system-wide connectedness (see also Bostanci and Yilmaz, 2020) is the average of total directional connectedness indicators across countries, which is calculated using the following formula:

$$C(H) = \frac{\sum_{\substack{i,j=1 \\ i\neq j}}^{N} B_{ij}^{g}(H)}{N}$$

Chart 8 presents results for $C(H)$, with H equal to five business days. The results when H is equal to two, seven or ten business days are similar.

Chart 8

Connectedness index (Diebold-Yilmaz)



Sources: Refinitiv and own calculations.

2.4 Bank-sovereign nexus

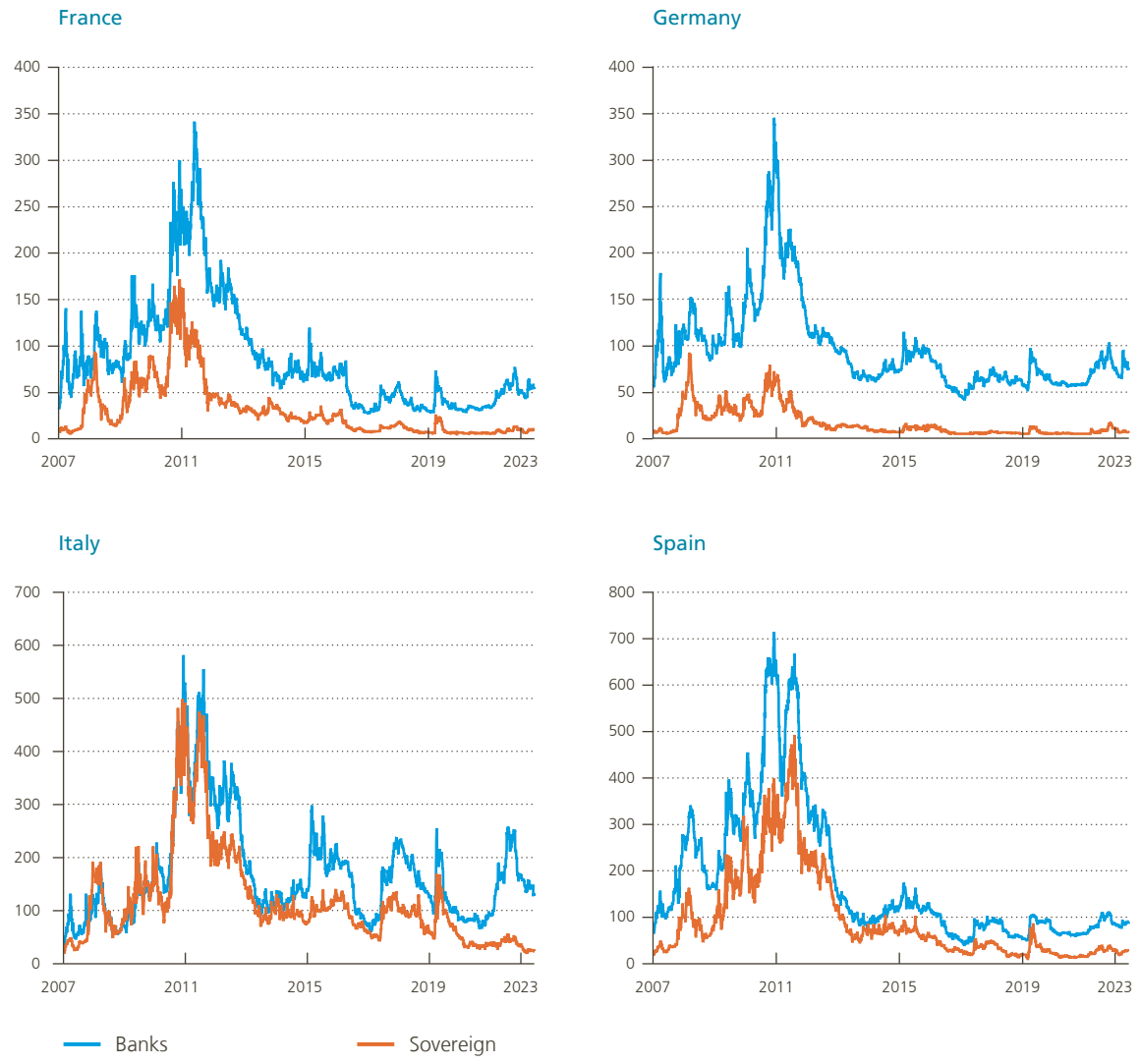
The bank-sovereign nexus denotes the mutual reliance of banks and governments, which may result in a scenario in which the stability of the banking system is closely linked to the soundness of public debt. This relationship is widely acknowledged to have been a factor that contributed to the fragmentation of the euro area sovereign debt market in past crises. Such dependence can lead to a destructive cycle of banking and sovereign debt crises, which can further aggravate fragmentation.

While this interdependence is not exclusive to the euro area, multiple authors have emphasised that the vicious cycle it engenders appears to be particularly pronounced in the euro area (see e.g. Merler and Pisani-Ferry, 2012), an issue that came to the fore during the sovereign debt crisis. This strong interdependence can be explained by two reasons. Firstly, as there was no supranational banking resolution framework in place, each Member

Chart 9

Sovereign and bank CDS spreads[1]

(five-year maturity, basis points)



Source: Refinitiv.

1 CDS spreads are averaged over the banks of a given country. Type of CDS contract: modified restructuring (in euro).

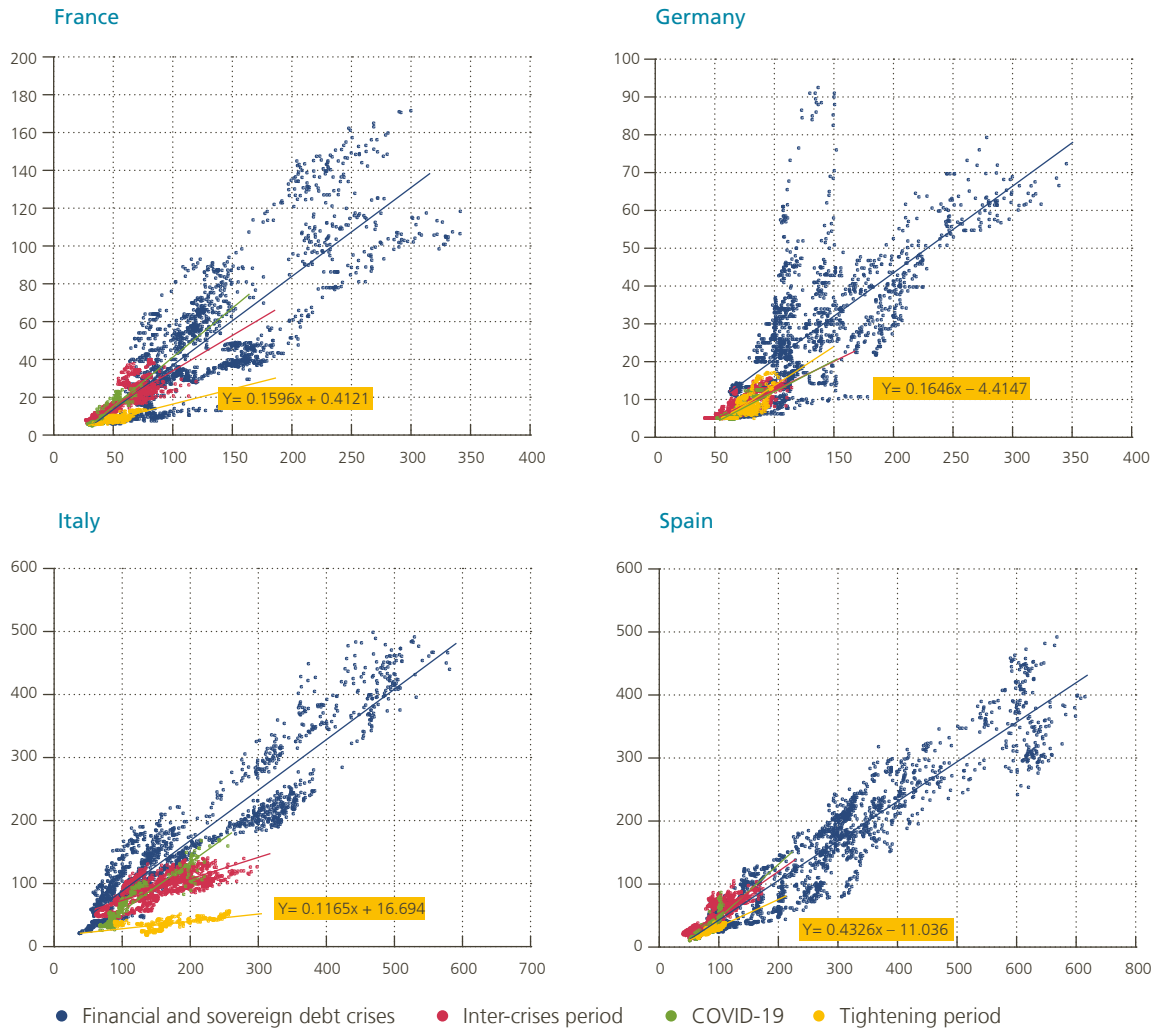
State was responsible for rescuing its national banking system. Given that banking systems in the euro area are typically large, the fiscal burden of rescuing banks can be substantial, meaning banking stress can easily spill over to sovereigns. Secondly, domestic banks in the euro area hold a significant amount of their own country's debt on their balance sheets, which means that concerns about the solvency of the state can immediately impact their balance sheet value.

The evolution of sovereign and bank credit default swap (CDS) spreads in the four largest euro area economies illustrates the degree of bank-sovereign interdependence in the euro area (Chart 9). The two series consistently moved in tandem from 2008 until 2014. However, this correlation diminished after 2014, i.e. when tensions in the sovereign bond markets eased. The announcement of the OMT programme in mid-2012 contributed significantly to the gradual calming of sovereign bond markets. In addition, this lower degree of correlation emerged concomitantly with the establishment of the European banking union in November 2014. The banking union was established in response to the sovereign debt crisis, with the aim of creating a more transparent, unified and safer market for banks in the euro area and the European Union by strengthening bank supervision (Single Supervisory

Chart 10

Correlation between sovereign and bank CDS spreads

(x axis = average five-year bank CDS spreads; y axis = five-year sovereign CDS spreads, basis points)



Sources: Refinitiv and own calculations.

Mechanism) and establishing a common framework for bank resolution (Single Resolution Mechanism), based on a common rulebook (including rules on capital requirements, recovery and resolution processes and a system of harmonised national deposit guarantee schemes). More recently, bank and sovereign CDS spreads have not displayed significant correlation, as bank CDS spreads have moved somewhat up amid (limited) banking turmoil while sovereign CDS spreads have remained broadly stable. This lack of correlation could be due to the progress made in the banking union project as well as to the introduction of monetary policy instruments, such as the TPI, which can be used to counter unwarranted, disorderly dynamics in the sovereign bond markets.

In fact, the co-movement of bank and sovereign CDS spreads has undergone various regime shifts in the past 15 years (Chart 10). The financial and sovereign debt crises saw a strong degree of interdependence, with a slope for the regression of sovereign on bank CDS spreads of 0.47 for France, 0.22 for Germany, 0.8 for Italy, and 0.65 for Spain. In the case of France, for instance, a 100-basis-point increase in bank CDS spreads went hand in hand with a 47-basis-point increase in sovereign CDS spreads. During the inter-crises period, running from the establishment of the banking union until mid-February 2020, the regression slope decreased in France (0.37), Germany (0.15) and Italy (0.33) but did not change much in Spain. During the COVID-19 crisis, regression slopes became steeper again for all countries (with slopes of 0.53, 0.23, 0.62 and 0.88, respectively), but with overall limited and temporary CDS spread increases. Finally, while the ECB began tightening monetary policy in December 2021, the regression lines remained notably flat for all countries (with slopes of 0.16, 0.16, 0.12 and 0.43, respectively).

These findings suggest that the banking union and possibly more recent policy actions such as the TPI have loosed the bank-sovereign nexus, resulting in reduced impact of disparities in banking sector stability on sovereign debt pricing in the euro area. However, while correlation has decreased, it still exists (and peaked during the COVID-19 crisis). This could be due to the fact that the banking union has yet to be fully achieved, including in the areas of crisis management and the European deposit insurance scheme.

3. Corporate bond markets

While bank lending represents their main source of external financing, euro area firms are increasingly resorting to bond financing, especially since the global financial crisis. Corporate bond markets have therefore become more important in the monetary policy transmission chain.

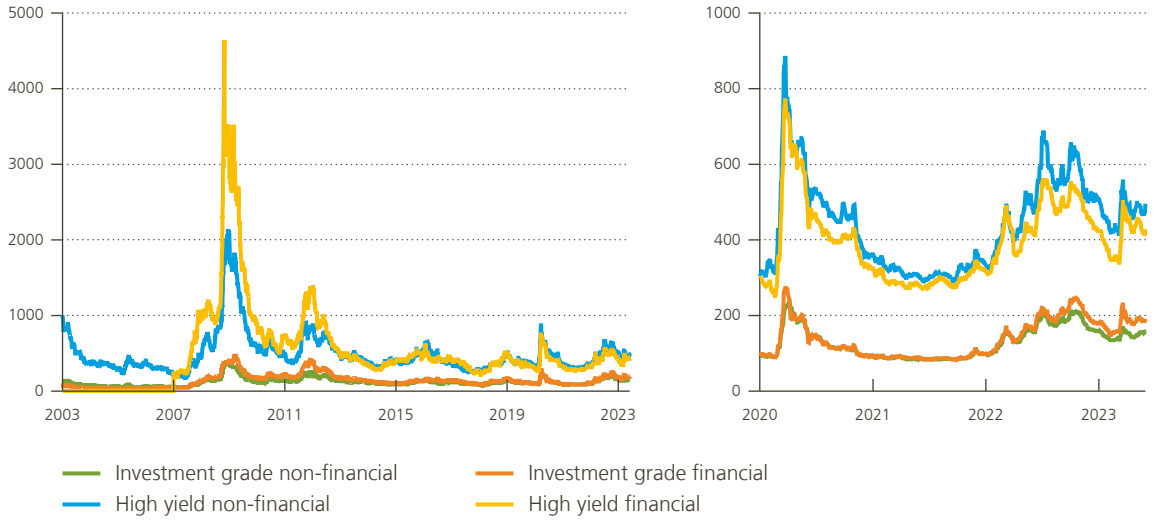
Given the specific nature of the measures taken during the COVID-19 crisis – including the closure of shops and businesses to limit the spread of the virus – it is not surprising that corporate bond spreads increased sharply in March 2020, when lockdowns were being introduced in the euro area (Chart 11). After peaking at the end of March, however, these spreads came down again to pre-crisis levels over the course of 2020, against a backdrop of enhanced Eurosystem corporate bond purchases under the PEPP and government measures to protect firms from the impact of the crisis. As is typical during downturns, spreads on high-yield corporate bonds increased more than on investment-grade bonds as the former carry significantly higher risks and are thus more sensitive to macroeconomic developments. Compared to the global financial crisis, however, the widening remained relatively contained.

A less abrupt increase in corporate spreads can be observed during the recent phase of monetary policy tightening. In fact, spreads started to widen as from the end of 2021, probably reflecting the prospect of monetary policy tightening and, thereafter, also a deterioration in risk sentiment following Russia's invasion of Ukraine, in particular the increased likelihood of a recession in the euro area due to higher energy prices. In this context, spreads on high-yield bonds widened more than on investment-grade bonds. Overall, the relatively limited increase in corporate spreads reflects the smooth transmission of monetary policy tightening to the corporate bond markets.

Chart 11

Euro area corporate spreads

(option-adjusted spreads vis-à-vis sovereign yields, basis points, average maturity)



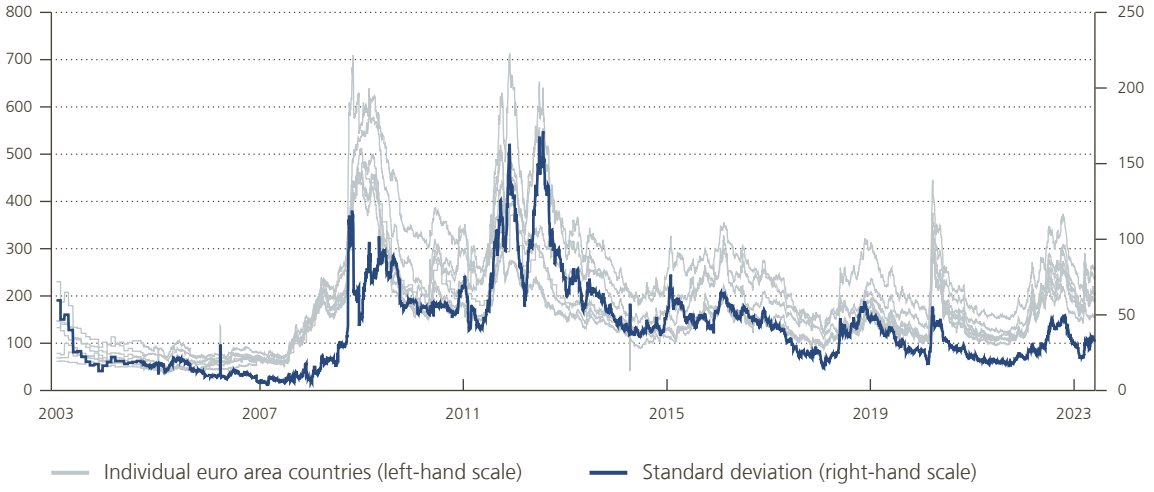
Source: Refinitiv.

The limited data available on country-specific corporate spreads reveal that while spreads widened over the course of 2022, euro area markets showed virtually no signs of fragmentation. The standard deviation of spreads went up during the first half of 2022, but only slightly, and declined again thereafter.

Chart 12

Corporate spreads in specific countries and standard deviation

(option-adjusted spreads vis-à-vis sovereign yields, basis points, average maturity)



Sources: Refinitiv and own calculations.

1 The countries considered are Austria, Belgium, Germany, Spain, France, Italy and the Netherlands.

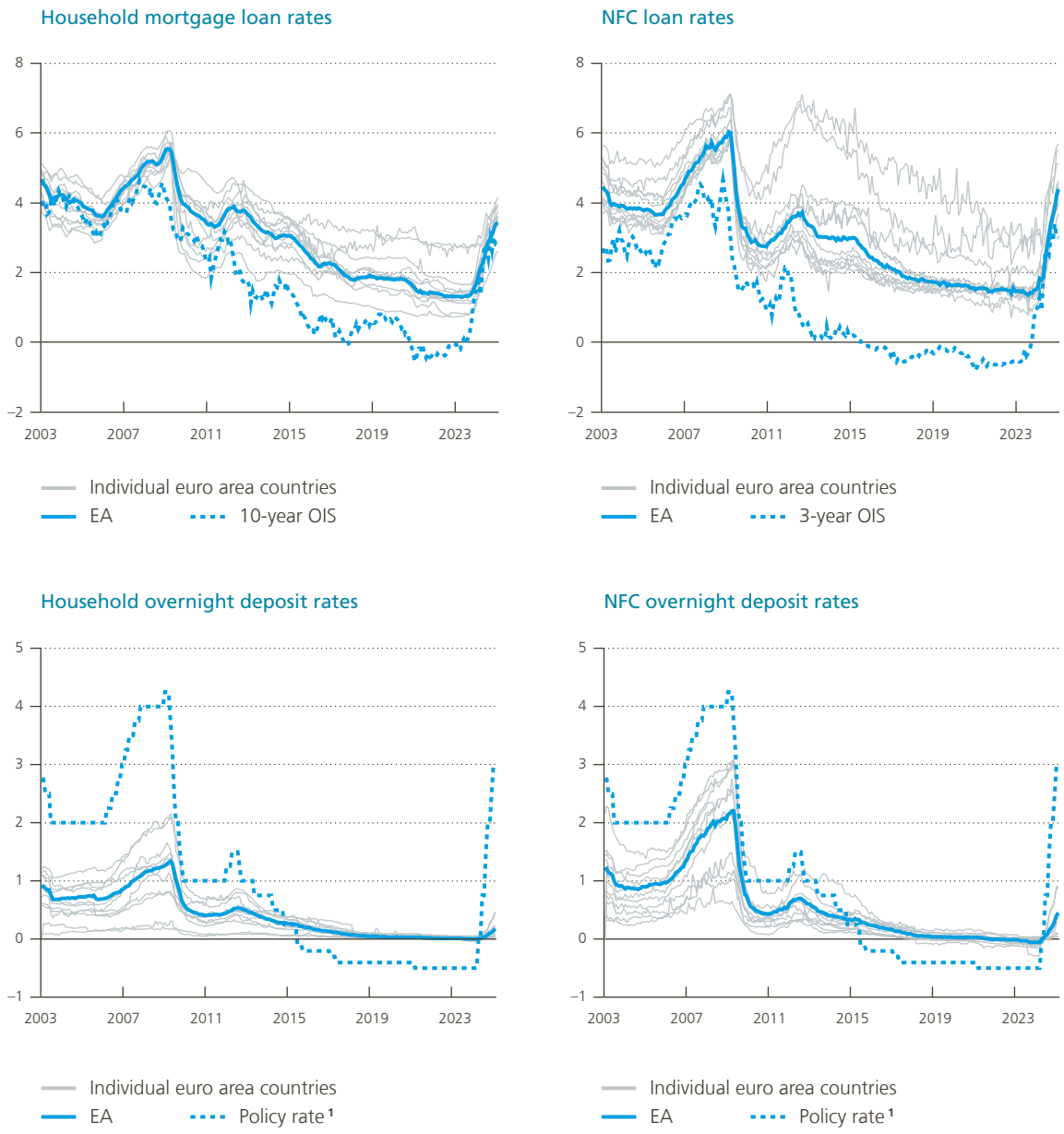
4. Bank retail markets

Bank retail rates are the last link in the monetary policy transmission chain examined in this article. These rates directly affect consumption and investment decisions of households and corporates without access to wholesale markets. Bank retail rates are influenced by developments in money market and sovereign bond rates, which, as they are higher up in the monetary policy transmission chain, often serve as benchmark interest rates for banks. Given the number of steps involved in the transmission process, the pass-through of changes in the ECB's

Chart 13

Bank retail and reference rates

(%, data until April 2023)



Source: ECB.

1 The policy rate is the main refinancing operations (MRO) rate until May 2014 and the deposit facility rate (DFR) thereafter.

policy rates to bank retail rates is slower than for market-based debt. In addition, firms and households are more reliant on bank financing in the euro area than in the US, for example, where financial markets play a bigger role. Consequently, transmission or fragmentation issues in retail bank markets have the potential to cause larger problems in the euro area and can prevent the adequate monetary stance from being transmitted to the real economy or result in unequal access to credit for firms and households in different euro area countries.

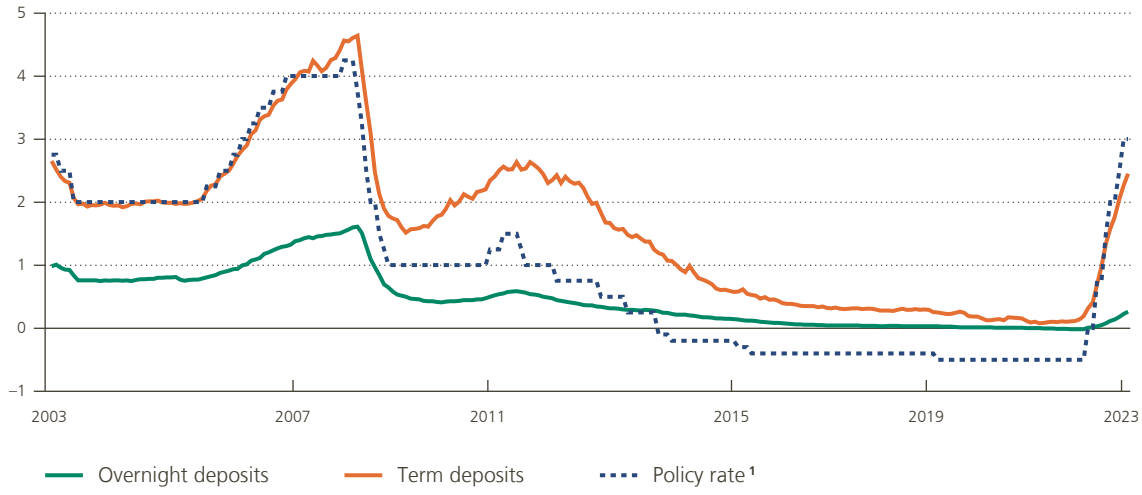
Overall, the transmission of monetary policy to bank lending rates has been rather smooth over the past 20 years (Chart 13, upper panels). Lending rates have followed quite closely developments in risk-free rates, although spreads have shown time-variation which suggests non-immediate monetary policy pass-through. To a certain extent and especially in the context of the global financial and European sovereign debt crises, this also reflected the extraordinary measures introduced by the Eurosystem for the very purpose of enhancing monetary policy pass-through. Bank lending rates had been declining since the global financial crisis – falling to around 1.5 % on average in the euro area for both loans to households and non-financial corporations (NFCs) – but have more than doubled since the beginning of 2022, to 3.4 % and 4.4 %, respectively, in April 2023.

By contrast, the transmission of monetary policy to overnight deposit rates has been more sluggish (Chart 13, bottom panels). In the first half of the sample period, overnight deposit rates for both households and NFCs remained below the relevant ECB policy rate. In particular, the tightening preceding the global financial crisis was not fully reflected in a proportional increase in overnight deposit rates. In the second half of the sample period, overnight deposit rates were mostly above the policy rate as they essentially got stuck at the zero lower bound while the Eurosystem pursued a negative interest rate policy. More recently, overnight deposit rates showed only tentative signs of following the policy rate to higher levels.

Chart 14

Bank overnight and term deposit rates in the euro area and the ECB's policy rate

(%, data until April 2023)



Source: ECB.

1 The policy rate is the main refinancing operations (MRO) rate until May 2014 and the deposit facility rate (DFR) thereafter.

The pass-through of tighter monetary policy to bank deposit rates has been very different for overnight deposits and term deposits. Rates on term deposits have risen much more than those on overnight deposits. While the latter were still below 0.5 % in April 2023, term deposit rates have risen to 2.5 % on average for households and

NFCs (Chart 14). Overnight deposit rates are typically slower to reflect changes in policy rates as they are passed on to the entire stock of deposits, while, in the case of bank loans and term deposits, interest rate changes are passed on to new volumes only.

It is also worth taking a closer look at the spread between euro area bank deposit rates and the DFR. In fact, before the global financial crisis (the only relevant reference period when excluding crises or negative interest rate episodes), the spread between the relevant ECB policy rate and the average rate on euro area overnight bank deposits was around 2 %. During the very low interest rate environment over the past years and given banks' limited ability to pass on negative policy rates to retail deposits (especially household deposits), this spread significantly narrowed and even turned negative in the past decade. But when the DFR started to rise in the summer of 2022, this spread turned positive again and began to widen, reaching around 2 % recently. This suggests that banks were rebuilding their interest margins during the first months of monetary policy tightening and that overnight deposit rates could start to increase more substantially going forward. Apart from the prevailing monetary policy rate environment, several other factors determine bank deposit rates, such as the level of competition for deposits and banks' needs for stable financing sources. Such factors will influence the spread at which deposit rates eventually settle vis-à-vis the policy rate.

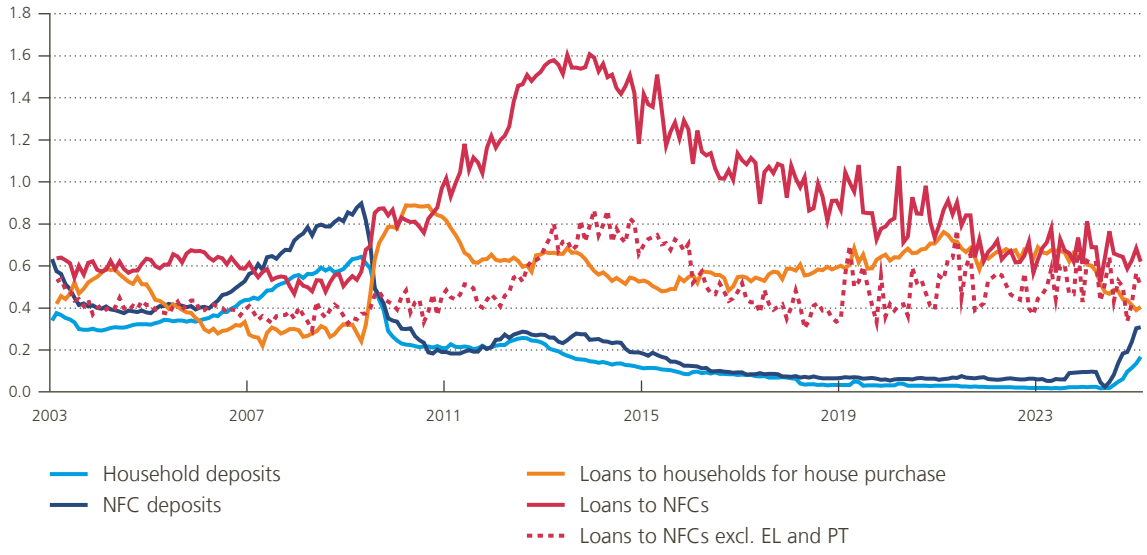
Term deposit rates have moved more in tandem with the ECB's relevant policy rate, both in the past and more recently. With term deposit rates clearly above overnight rates in the past months, firms and households have been actively transferring funds from overnight to term deposits. Such shifts were reinforced by the large stock of savings accumulated during the low interest rate period. However, the stock of term deposits in the euro area remains substantially smaller than that of overnight deposits (roughly one-fifth).

As regards fragmentation, dispersion in bank lending rates between euro area countries remains narrow (Chart 15). During the global financial and European sovereign debt crises, the standard deviations of household and NFC lending rates increased, although the high dispersion in NFC lending rates was driven strongly by

Chart 15

Standard deviation of euro area bank lending and overnight deposit spreads

(spreads vis-à-vis risk-free rates or the policy rate, %, data until April 2023)



Sources: ECB and own calculations.

developments in two countries in particular (Greece and Portugal), where lending rates were significantly higher than in other euro area countries. Since then, however, standard deviations of household and NFC lending rates have come down again and have stayed low during the recent phase of monetary tightening. Dispersion has been narrower for overnight deposit rates than for lending rates over the past decade when deposit rates were stuck at zero across the euro area. Contrary to bank lending rates, however, the standard deviation of deposit rates increased during the recent monetary policy tightening. Despite that, standard deviations for deposits remain very low and lower than for bank lending rates. In April 2023, deposit rates ranged from zero to 0.5 % for households and from zero to 0.9 % for NFCs on average across countries.

Another way of analysing monetary policy pass-through to bank retail rates is through the lens of a time-varying coefficient model. In the remainder of this section, we examine the question of possible time-variation and fragmentation in the pass-through of policy rates to bank retail rates. The pass-through can be characterised by its speed (how quickly changes in policy rates are transmitted) and size (the extent to which changes in policy rates are transmitted). Both speed and size can vary across countries and over time within the euro area. The literature suggests that the pass-through is influenced by factors such as the structure of the banking system, financial regulations, macroeconomic conditions and the characteristics of individual banks (see e.g. De Graeve *et al.* 2004; Holton and Rodriguez d'Acri, 2018; Altavilla *et al.*, 2020a).

The dynamics of bank retail and policy rates are estimated using a vector error correction model (VECM). The model is bivariate, featuring one bank retail rate and one market rate of corresponding maturity. The VECM coefficients can be time-varying, which allows changes through time in the transmission mechanism to be captured. The model is estimated for each euro area country, thereby permitting potential fragmentation in the pass-through across Member States to be gauged. The study relies on monthly time series for retail and market rates. The VECM is further described in Box 2.

BOX 2

Time-varying vector error correction model

The generic model is a bivariate specification featuring a bank retail rate and a market rate. The bank retail rate is one of four such rates studied in this article (the bank lending rate to households, the bank lending rate to NFCs, the household overnight deposit rate and the NFC overnight deposit rate). The market rate is a risk-free rate of comparable maturity. For a model using a bank lending rate to households, the reference market rate is taken to be the ten-year OIS rate. For the bank lending rates to NFCs, the three-year OIS rate is used. For overnight deposit rates, the €STR (the overnight money market rate) is the reference market rate.

The following reduced-form vector autoregressive model is then estimated:

$$\begin{pmatrix} market\ rate_t \\ bank\ retail\ rate_t \end{pmatrix} = \begin{pmatrix} c_{1,t} \\ c_{2,t} \end{pmatrix} + \begin{pmatrix} a_{11,t} & a_{12,t} \\ a_{21,t} & a_{22,t} \end{pmatrix} \begin{pmatrix} market\ rate_{t-1} \\ bank\ retail\ rate_{t-1} \end{pmatrix} + \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{pmatrix},$$

where the c's are intercepts, the a's are coefficients of the feedback matrix, and both the c's and the a's are allowed to vary over time. The error terms are represented by the ϵ's which are assumed to be normally distributed with mean zero and covariance matrix Ω_t.

The model can be recast as a vector error correction model, which gives the following equation for changes in the bank retail rate:

$$\Delta bank\ retail\ rate_t = c_{2,t} - (1 - a_{22,t})\left(bank\ retail\ rate_{t-1} - \frac{a_{21,t}}{1 - a_{22,t}} market\ rate_{t-1}\right) + \epsilon_{2,t},$$

where $\Delta bank\ retail\ rate_t = bank\ retail\ rate_t - bank\ retail\ rate_{t-1}$. This error correction form shows that $1 - a_{22,t}$ measures the speed of the pass-through: the larger $1 - a_{22,t}$, the faster the pass-through. The size of the pass-through is given by $\frac{a_{21,t}}{1-a_{22,t}}$: a value of one implies complete pass-through.

The model is estimated with the Bayesian estimation, analysis and regression (BEAR) toolbox.[1]

1 For more information, see the ECB's website (BEAR toolbox).

A strong pass-through is characterised by both a size value and a speed value of close to one, implying that bank retail rates quickly and fully reflect changes in market rates. However, when interpreting the results, it should be borne in mind that the model is rather simple. For instance, it does not control for the macroeconomic environment or the characteristics of the banking sector. It should therefore not be surprising to find pass-through size values of less than one. The model has nevertheless the advantage of looking at the direct link between bank retail rates and market rates in a simple way and can thus be applied to any of the countries considered without requiring changes in its specification, thereby facilitating cross-country comparison of the results.

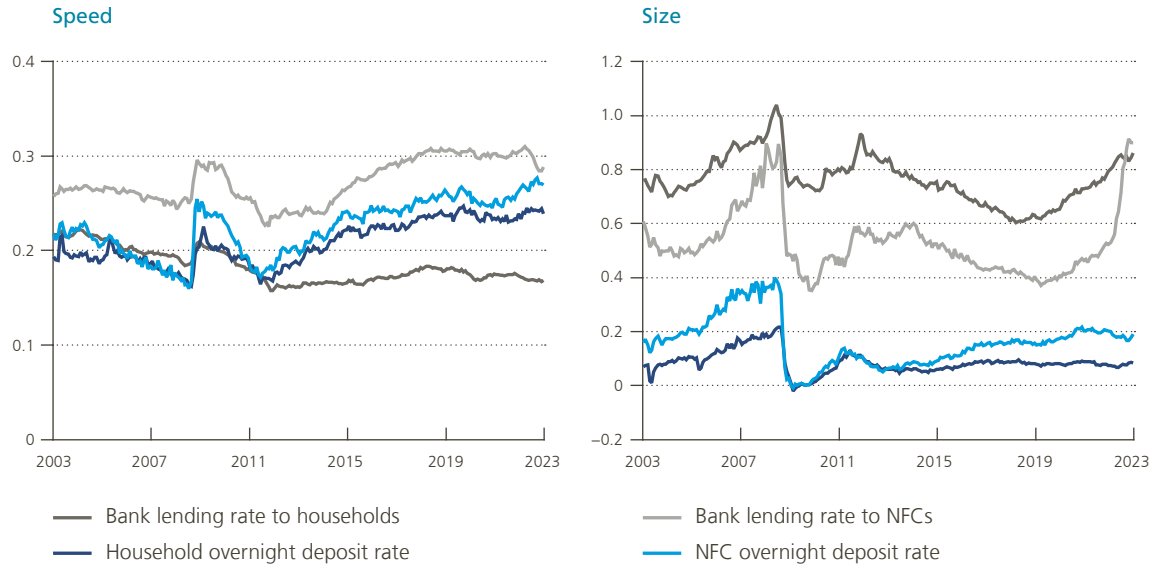
The speed and size of pass-through have changed significantly over the two past decades and, in addition, the pass-through appears to differ significantly for bank lending rates and deposit rates (Chart 16). These results are in line with the literature (see e.g. Kleimeier and Harald, 2006; Kok and Werner, 2006; Marotta, 2009).

Regarding time variation in particular, the model identifies a few distinct periods. Following the global financial crisis, the pass-through was found to be temporarily less complete (although somewhat faster), which could have been due to higher risk premia embedded in bank lending rates. The size of the pass-through deteriorated somewhat starting in 2012 amid the sovereign debt crisis and the resurgence of premia which hindered the transmission of policy rate cuts. Subsequently, the negative interest rate policy led to tensions in transmission as bank lending margins became more compressed, with deposit rates showing resistance to entering negative territory (de Sola Perea and Kasongo Kashama, 2017). However, a significant improvement in pass-through size occurred after the introduction of the ECB's "two-tier system" in 2019 (see also Altavilla *et al.*, 2022a). The two-tier system exempted a portion of bank reserves from the possibility of being remunerated at negative interest rates, effectively reducing the cost of holding these reserves and hence supporting bank-based transmission of negative interest rate policy. More recently, in the context of monetary policy tightening, the transmission of market rates to bank lending rates has improved. By contrast, the pass-through to deposit rates has remained more rigid, but not substantially more so than over the past 20 years.

Fragmentation in pass-through can be gauged by calculating the standard deviation of "speed" and "size", estimated by country (Chart 17). Some degree of heterogeneity can be seen across euro area countries (see also Kok and Werner, 2006; Holton and Rodriguez d'Acri, 2018). Standard deviations are higher for bank lending rates to households, reflecting the heterogeneity in average mortgage loan maturity across countries. Other factors could also explain fragmentation, including banking sector concentration, the amount of excess liquidity in the banking system, country-specific (sovereign) risk premia, and banking sector soundness and characteristics (see also Burriel and Galesi, 2018; Ferrer *et al.*, 2023). More recently, monetary tightening appears to have exacerbated somewhat transmission asymmetries, which however remain broadly in line with historical estimates.

Chart 16

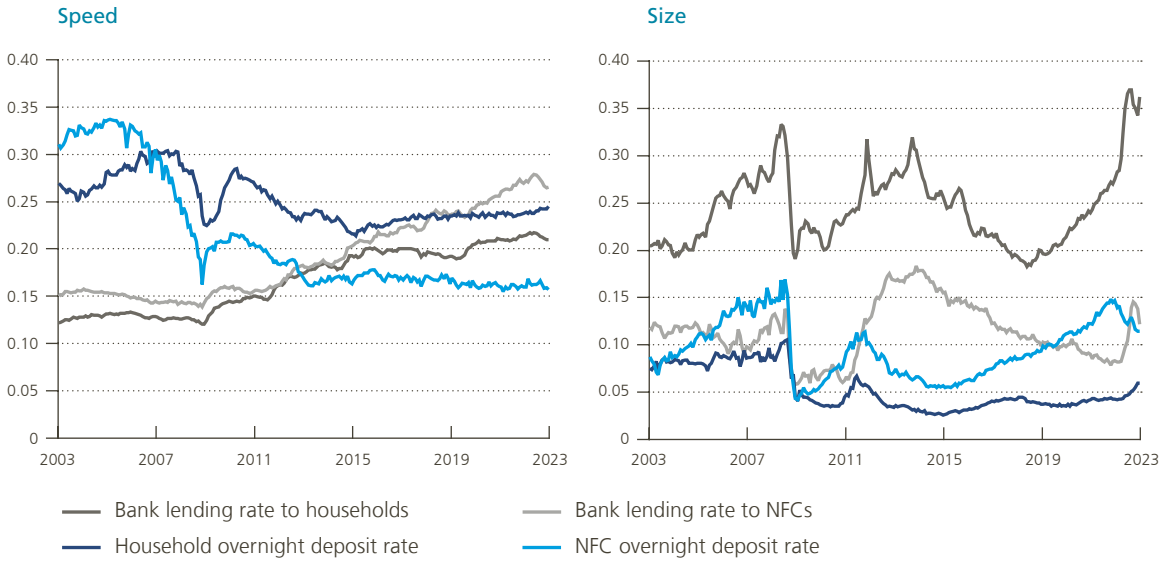
Monetary policy pass-through to euro area bank retail rates



Sources: ECB, Refinitiv and own calculations.

Chart 17

Fragmentation (standard deviation) in speed and size of the pass-through to euro area bank retail rates



Sources: ECB, Refinitiv and own calculations.

Conclusion

This article reviews a number of indicators that can be used to measure possible transmission and fragmentation issues in various segments of the monetary policy transmission chain. Overall, these indicators show that recent monetary policy tightening has yet to reignite transmission or fragmentation issues on a large scale. Although the tightening has led to more stringent financing conditions, which was the goal in the first place, it has done so on a broadly even scale across euro area countries and sectors. Transmission to money market rates has been one-to-one with the increase in policy rates. Sovereign spreads, while displaying a limited degree of fragmentation, have remained quite narrow to date. In the same vein, transmission in the downstream segments of the chain, i.e. corporate spreads and bank retail rates, has occurred smoothly. Only overnight bank deposit rates have shown some resistance to the rise in ECB policy rates, as commercial banks have been restoring their interest margins.

This resilience in the face of the most severe rate hiking cycle in the history of the monetary union probably reflects efforts made at various policy levels over the past years. On the monetary policy front, the introduction of the OMT programme, the PEPP with its inherent flexibility and, more recently, the TPI, have – to some extent probably due to their mere existence – been able to contain possible fragmentation issues. Furthermore, various enhancements in the EU's institutional arrangements in the past few years, such as advances in the establishment of a banking union, have further boosted European integration.

That being said, now is not a time for complacency. First, the ECB's tightening phase is not over yet. If the inflation outlook so requires, further rate hikes will follow; in addition, the process of balance sheet normalisation has only just begun. Moreover, taking a historical perspective, the indicators discussed in this article show that the low, virtually non-existent fragmentation in sovereign yields across euro area countries observed during the early years of the monetary union has not been restored since the global financial crisis. Differences between "core" and "periphery" euro area Member States, for example, continue to be reflected – albeit to a limited

extent – in more differentiated sovereign spreads. However, a return to essentially identical sovereign spreads across countries may not be desirable if fundamental differences across countries remain. Nevertheless, while the correlation between bank and sovereign CDS spreads – widely acknowledged to have been a factor contributing to the fragmentation of euro area sovereign debt markets in past crises – has come down significantly since the global financial crisis, it could be further reduced by completing the banking union. Similarly, a more unified and sustainable euro area fiscal policy could help limit fragmentation issues.

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Conventional signs

%	per cent
€	euro
e.g.	*exempli gratia* (for example)
et al.	*et alia* (and others)
etc.	*et cetera*
i.e.	*id est* (that is)

List of abbreviations

Countries or regions

AT	Austria
BE	Belgium
DE	Germany
EL	Greece
ES	Spain
FI	Finland
FR	France
IE	Ireland
IT	Italy
NL	Netherlands
PT	Portugal
US	United States

Abbreviations

APP	Asset purchase programme
BEAR	Bayesian estimation, analysis and regression
CDS	Credit default swap
COVID-19	Coronavirus disease
ECB	European Central Bank
ESM	European Stability Mechanism
€STR	Euro short-term rate
EURIBOR	Euro interbank offered rate
DFR	Deposit facility rate
GDP	Gross domestic product
MRO	Main refinancing operations
NFC	Non-financial corporation
NGEU	Next Generation EU
OIS	Overnight indexed swap

OMT	Outright monetary transactions
PCA	Principal component analysis
PEPP	Pandemic emergency purchase programme
SSM	Single Supervisory Mechanism
SRM	Single Resolution Mechanism
SURE	Support to mitigate unemployment risks in an emergency
TPI	Transmission protection instrument
VECM	Vector error correction model

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