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Risky sovereign bond holdings by commercial banks in the euro area: Do safe assets availability and differences in bank funding costs play a role?

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NON-TECHNICAL SUMMARY

RESEARCH QUESTION

Commercial banks in some euro area countries display a preference for domestic government bonds offering a risk premium in their portfolios rather than low-yield bonds rated as highly safe by the market (safe assets). We refer to this phenomenon as a feature of the interdependency between the government and commercial banks (sovereign-bank-nexus) and examine whether it can be explained by a scarcity of available safe assets or whether other factors, such as differences in bank funding costs across individual banks and countries, account for it. While several theories usefully shed light on factors driving the nexus, few empirical studies have explored the role that funding costs play in the composition of government bond holdings at commercial banks. We attempt to demonstrate that elevated funding costs restrict the set of government bonds banks are willing to purchase, as high credit quality bonds issued by core euro area countries offer low yields, which would erode their net interest margins.

CONTRIBUTION

We contribute to the growing literature on safe assets and the sovereign-bank nexus by 1) analysing the role of supply factors, i.e., the availability of safe assets, building on the concept of free float, and by 2) offering a scarcely studied perspective on the demand-driven factors behind the sovereign-bank nexus and banks' appetite for safe sovereign bonds, namely banks' funding costs. We estimate the weighted average yield of the sovereign bond portfolio of the banking sector of nine euro area countries and show that banks match the return on their euro government bond portfolio with their own funding costs.

RESULTS

We show that, taken in isolation, the different availability of euro-denominated safe assets in the euro area is not responsible for banks in some member states holding disproportionately large holdings of domestic government bonds in their portfolios. We argue that this bias can partially be explained by the attempt of banks located in vulnerable countries to preserve their net interest margins. Higher financing costs therefore make government bonds with comparatively high yields more attractive than debt securities issued by other euro area countries or EU supranational entities, despite the higher risk. This is especially true in a context where all euro area government bonds – regardless of their actual credit risk – virtually enjoy the same regulatory treatment. Compared with other rather risky investments, particular incentives to hold domestic securities instead of foreign securities could arise from the expectation that domestic creditors would be favoured in the event of a public default (creditor discrimination). Similarly, governments may exert pressure on resident commercial banks in the context of political communication to purchase mainly domestic government bonds (moral suasion).

NICHTTECHNISCHE ZUSAMMENFASSUNG

FRAGESTELLUNG

Geschäftsbanken einiger Euroraum-Länder bevorzugen in ihren Portfolios inländische Staatsanleihen, die eine Risikoprämie anbieten, anstatt niedrig verzinslicher Anleihen, die vom Markt als sehr sicher eingestuft werden (Safe Assets). Wir betrachten dieses Phänomen als ein Merkmal der wechselseitigen Abhängigkeit von Regierung und Geschäftsbanken (Staaten-Banken-Nexus) und untersuchen, ob es mit der Knappheit verfügbarer Safe Assets erklärt werden kann oder ob andere Faktoren, wie unterschiedliche Refinanzierungskosten zwischen Banken und Mitgliedsländern verantwortlich sind. Während es unterschiedliche Theorien zu den Ursachen für den Nexus gibt, haben bislang nur wenige empirische Studien die Bedeutung der Finanzierungskosten für die Zusammensetzung der Bestände an Staatsanleihen bei Geschäftsbanken untersucht. Wir untersuchen, ob erhöhte Finanzierungskosten die Auswahl an Staatsanleihen begrenzen, die eine Bank zu halten bereit ist. Grund dafür könnte sein, dass eine hohe Bonitätsbewertung von Anleihen der Kernländer mit niedrigen Renditen einhergeht und somit die Zinsmarge der Banken erodieren kann.

BEITRAG

Wir leisten einen Beitrag zur wachsenden Literatur über Safe Assets, ihre Verfügbarkeit und den Staaten-Banken-Nexus. Dabei untersuchen wir 1) die Rolle von Angebotsfaktoren, also die Verfügbarkeit von Safe Assets, indem wir uns auf den Streubesitz (free float) konzentrieren und 2) die bislang wenig beachtete Bedeutung der Nachfrageseite, also das Interesse der Banken an sicheren Staatsanleihen in Abhängigkeit von ihren Finanzierungskosten. Schließlich berechnen wir für neun Euroländer näherungsweise den gewichteten Durchschnitt der Rendite, die Banken mit ihrem Portfolio an europäischen Staatsanleihen erzielen. Wir legen dar, dass Banken diese ihren eigenen Finanzierungskosten anpassen.

ERGEBNISSE

Wir zeigen, dass die unterschiedliche Verfügbarkeit von auf Euro lautenden Safe Assets im Euro-Währungsgebiet für sich genommen nicht verantwortlich dafür ist, dass Banken in einigen Mitgliedstaaten überproportional hohe Bestände heimischer Staatsanleihen in ihren Portfolios halten. Wir argumentieren, dass diese Präferenz wesentlich darin begründet liegt, dass Geschäftsbanken in anfälligen Ländern eine positive Zinsmarge bewahren müssen. Daher machen höhere Finanzierungskosten Staatsanleihen mit vergleichsweise hohen Renditen trotz des höheren Risikos unter Umständen attraktiver als Schuldverschreibungen anderer Euroländer oder supranationaler EU-Organisationen. Dies gilt insbesondere, da alle Staatsanleihen des Euroraums – unabhängig von ihrem tatsächlichen Kreditrisiko – regulatorisch nahezu gleichbehandelt werden. Besondere Anreize,

inländische anstelle ausländischer Papiere zu halten, könnten sich im Vergleich mit anderen eher riskanten Anlagen aus der Erwartung ergeben, dass inländische Gläubiger im Falle eines öffentlichen Zahlungsausfalls bevorzugt würden (Gläubigerdiskriminierung). In ähnlicher Weise wirken moralische Appelle, mit denen Regierungen im Rahmen der politischen Kommunikation Druck auf ansässige Geschäftsbanken ausüben können, bevorzugt heimische Staatsanleihen zu erwerben (Moral Suasion).

DEUTSCHE BUNDESBANK DISCUSSION PAPER NO 35/2024

Risky Sovereign Bond Holdings by Commercial Banks in the Euro Area: Do Safe Assets Availability and Differences in Bank Funding Costs Play a Role?*

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Abstract

Commercial banks in some euro area member states hold large amounts of sovereign debt that offer a risk premium and hence higher yields than AAA-rated bonds issued by the most creditworthy countries. In particular, banks in vulnerable countries exhibit a bias towards domestically issued government bonds as *de jure* safe assets. We show that scarcity of the domestically available stock of *de facto* safe assets cannot by itself account for this home bias. Instead, we provide indications that differences in bank funding costs help explain the varying appetite of banks for relatively high-yielding (and hence riskier) government bonds at the expense of bonds issued by core countries governments or EU supranational entities, as banks match the return on their euro government bond portfolio with their own funding costs. In addition, prospects for a preferential treatment of domestic creditors in case of a public default and government pressure on banks to increase their holdings of government debt give incentives to hold domestic securities.

Keywords: sovereign-bank nexus, safe assets, funding costs

JEL Classification Codes: F02, G15, G21, H63

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1 Introduction

The banking sector of those euro area countries that were particularly affected by the global financial crisis and the subsequent sovereign debt crisis – hereafter vulnerable countries – is characterized by large, concentrated holdings of domestic sovereign debt. This "home bias" exposes resident banks to substantial sovereign risk. By contrast, banks in countries with comparatively better macroeconomics and sustainable public finances – hereafter safe countries, or highly rated countries – hold comparatively less domestic sovereign debt – as a proportion of total assets and their own funds – and tend to own a higher regional diversity of bonds issued by creditworthy sovereign issuers. The large holdings of relatively risky domestic sovereign debt in the balance sheet of banks located in vulnerable countries relate the creditworthiness of the banking sector to that of its domestic government, a dynamic referred to as the "sovereign-bank nexus".

Dell'Ariccia et al. (2018) distinguishes three channels by which banks and sovereigns are linked: (i) The *sovereign-exposure channel* refers to the situation that banks hold large amounts of domestic sovereign debt; (ii) the *safety net channel* is characterised by governments protecting domestic banks with public guarantees; (iii) the *macroeconomic channel* is more of an indirect nature and is based on the fact that the health of both banks and government interact with the macroeconomic situation of the country. We choose to focus on the first channel as we are mainly interested in banks' portfolio allocation choices and how they relate to the supply of free-floating safe assets. Moreover, this channel is comparatively easier to quantify and measure than the two others.

Building on the vast literature on the sovereign-bank nexus and safe assets, the present study aims to re-examine the safe asset conundrum from a novel perspective, by analysing both supply and demand factors. Our contribution to the literature is two-fold.

First, we investigate whether a possible scarcity of euro-denominated safe assets contributes to reinforce the sovereign-bank nexus (domestic general government debt holdings as a ratio over either bank assets or bank equity) in vulnerable countries, as banks satisfy their need for safety by holding quasi-safe domestic sovereign bonds. After providing an overview of the status of the sovereign-bank nexus in the euro area, we construct a safe assets availability estimate for a set of countries, articulated around the concept of free float. We regress our sovereign-bank nexus measure over free-floating safe assets (relative to country-level bank assets or equity), sovereign spreads (which capture the opportunity cost of investing in low yielding safe bonds[1]), and a capital market development indicator, using a panel OLS in first differences and a dynamic OLS (DOLS) in levels. We show that the domestically available free-floating amount of safe assets has no significant impact on the nexus irrespective of whether it is measured relative to total bank assets or equity. In contrast, sovereign yield spreads are strongly positively correlated with the sovereign-bank nexus. This finding supports the search-for-yield theory,

[1] Additionally, the sovereign spread can be thought of as a reasonable proxy for (excess) bank funding costs.

which hypothesizes that banks buy risky government bonds for purely economic reasons, and suggests that banks located in vulnerable countries may find AAA-rated safe assets (e.g., German bunds, EU supranational bonds) comparatively less attractive.

Second, we focus on demand-side dynamics by analysing whether bank funding costs can account for the sovereign-bank nexus, and whether they help explain the varying appetite of banks for core countries government bonds and EU supranational bonds, which typically yield a lower return than government bonds from vulnerable countries. We construct a country-level proxy for bank marginal funding costs – covering deposit and bond funding, estimated either jointly or separately. We then estimate the weighted average yield of the euro government bond portfolio for a set of euro area countries, which we regress on our estimate of funding costs using a DOLS-estimator, extended by an error correction (EC) model. Our results support the hypothesis that country-level bank funding costs positively contribute to the weighted average yield on banks' euro government bonds portfolio.

One caveat of our approach is that we rely on country-level panel data, as opposed to bank-level data. The use of micro-data would allow to control for bank-specific factors, such as solvency and liquidity ratios, profitability, and size, all of which could help explain variations in banks' portfolio allocation choices with respect to sovereign debt. Lastly, other approaches could be used to better establish causality between bank funding costs and the demand for risky or safe assets, e.g., based on instrumental variables, or micro-data.

2 Overview of the literature on the sovereign-bank nexus

The concept of sovereign-bank nexus gained traction following the financial sector bailouts in the wake of the 2007-2008 financial crisis, which ignited a rise of sovereign credit risk. The latter in turn fragilized the banking sector through market losses on government bond holdings and the weakening of implicit and explicit government guarantees on the financial sector. Building on a model where the government can finance a bailout either with taxes or additional government debt, Acharya et al. (2014) show that a possible bailout is necessarily linked with some "collateral damage" for the financial sector: This is, because the bailout itself or even the mere expectation of a bailout can put pressure on sovereign bond prices. This is affecting banks that hold significant amounts of government debt or credit institutions that heavily rely on explicit or implicit government guarantees. This mechanism may result in a feedback loop between the financial vulnerability of sovereigns and banks. Makinen (2020) further explores the relationship between implicit government guarantees and sovereign risk, by showing that banks may have to pay a risk premium that is closely linked to sovereign risk. This is especially true of banks that are systematically relevant for the national economy and enjoy an implicit government guarantee. Similarly, Selva et al. (2023) find that bank risk – measured by the standard deviation of return on average assets (ROAA) and the Z-score – is higher when a bank is domiciled in a country with elevated sovereign risk, and when the bank holds a large share of relatively risky debt securities in its portfolio. Lee et al. (2016) also demonstrated a systematic relationship between sovereign risk and commercial

banks' risks and their financing costs due to the quality of property rights institutions through their foreign asset positions.

Another strand of the literature focuses on the detrimental impact of sovereign debt impairments on financial markets and the real economy. Almeida et al. (2017) show that firms reduce their investment following a sovereign rating downgrade because of rising debt capital costs. In a paper using the 2011 US debt ceiling standoff as an instrumental variable, Gori (2019) finds that a 100 basis points increase in US sovereign default risk produces a 40 basis points increase in bank credit risk. Lastly, Corsetti et al. (2013) quantify the implications of the sovereign risk channel in a model where sovereign risk premia respond to changes in the fiscal outlook of the country, and where private credit spreads rise with sovereign risk, as strained public finances raise the cost of financial intermediation.

In a business cycle model where banks collect savings from households in order to purchase domestic government bonds or lend to firms, Bocola (2016) shows that news of impending sovereign default hinder financial intermediation. Two channels are at play: First, *the liquidity channel* affects the market value und the funding ability of banks, whenever news of a possible government default is circulating. Second, *the risk channel* causes banks to act more cautiously, also when lending to the private sector. Both channels generate a deleveraging of banks, as the latter reduce their holdings of financial claims on firms. The author show that the euro sovereign debt crisis was responsible – through these channels – for a decline in output of 1.4 percent in annualised terms.

The literature offers several explanations for the banks' large holdings of domestic sovereign bonds and associated sovereign-bank nexus. Among them, the preferential regulatory treatment of euro-denominated sovereign debt in the EU, which requires no capital backing by banks and enjoys a favourable status for meeting liquidity requirements, is widely seen as a significant factor (Frey and Weth, 2019). This preferential treatment largely applies uniformly to all euro area sovereign issuers, regardless of their creditworthiness[2]. This means that from a regulatory perspective, euro-denominated sovereign debt is treated as safe irrespective of its perception by the market. This renders sovereign debt issued by less creditworthy euro area countries an imperfect substitute for truly safe assets – which are also regarded as safe by the market – but also makes it comparatively interesting for banks on a regulatory requirements/return ratio.

However, these factors alone cannot explain the bias towards domestic sovereign bonds. While all euro area banks enjoy the preferential regulatory treatment of euro government bonds, empirical evidence finds that the sovereign bank nexus predominantly concerns vulnerable countries, as the latter tend to own more government bonds as a proportion of their total assets, but also to concentrate their

[2] Credit exposures to EU governments denominated and funded in euros are largely exempt from capital requirements under the Capital Requirements Regulation (CRR). Debt securities issued by EU governments also enjoy a favourable liquidity requirement treatment, as they qualify as high-quality liquidity assets (HQLA), making them desirable from the perspective of banks.

government bond holdings on their own sovereign. To account for the sovereign bank nexus, two non-mutually exclusive strands of theories have emerged.

The first one is the moral suasion theory, whereby publicly owned or recently bailed-out banks in vulnerable countries can be pressured by or compelled to please their government by increasing their purchases of sovereign debt. The same behaviour can apply to stressed banks with low capital endowments and pre-existing strong investments in domestic sovereign bonds, which is referred to as "indirect moral suasion". The second theory is the search-for-yield strategy (or carry trade), in which banks – located in both vulnerable and non-vulnerable countries – buy risky government bonds for purely economic reasons. While this strategy is in principle open to all euro area banks, and cannot, in isolation, account for the home bias, several studies conclude that it mainly concerns banks in vulnerable countries (Andreeva and Vlassopoulos, 2016; Frey and Weth, 2019).

As a complement to the search-for-yield theory, Andreeva and Vlassopoulos (2016) argue that resident banks may price the credit risk of vulnerable domestic government bonds differently than foreign credit institutions. This was the case during the sovereign debt crisis, when the credit risk on domestic sovereign bonds materialised in a situation, where banks located in vulnerable countries were very likely become insolvent anyway, pushing the weakest banks to engage in a "gambling for resurrection". This allowed them to earn the full risk premium, while potential losses were borne by their external creditors. The authors referred to this behaviour as "risk shifting". The latter is also explored by Crosignani (2021) who shows that, in the presence of deposit insurance, banks in vulnerable countries with low capital tend to hold more domestic sovereign bonds. Doing so, they link their destiny to that of the government. This behaviour leads to a risk-shift, where banks effectively support public debt issuance and lower sovereign yields at the expense of lending to the productive sector. Additionally, Broner et al. (2013) argue that this differentiated pricing of sovereign risk also finds its roots in creditor discrimination, whereby domestic creditors are less likely to be defaulted on than their foreign peers. The literature confirms to some extent the validity of the search for yield theory (Altavilla et al., 2017; Horváth et al., 2015), the moral suasion theory, in its various forms (Frey and Weth, 2019; Altavilla et al., 2017), as well as the risk-shifting (Andreeva and Vlassopoulos, 2016; Farhi and Tirole, 2018; Crosignani, 2021) and credit discrimination theories (Broner et al., 2013).

While sovereign risk pricing differentials – across countries and banks – and moral suasion usefully shed light on the home bias and sovereign-bank nexus, there is another crucial aspect of the search for yield/carry trade theory which, to our knowledge, has largely been neglected by the literature: bank funding costs. Whereas numerous studies focus on the asset side of the equation, that is, risk-adjusted returns from the perspective of domestic banks, understanding banks' funding costs is essential to account for their sovereign exposures arbitrage, as the latter is driven by the spread between expected risk-adjusted returns and funding costs, subject to regulatory constrains (e.g., capital requirements, or absence thereof). As bank funding costs are highly heterogeneous across euro area countries, and

significantly higher in vulnerable countries, due notably to the sovereign rating ceiling[3], we hypothesize that bank funding costs constitute a key determinant of the home bias and sovereign-bank nexus, and of banks' desire or ability to hold safe assets. More specifically, we argue that banks have a relatively inelastic demand for euro-denominated government bonds – for meeting regulatory requirements, to pledge as collateral for repurchase agreements etc. – and that the high funding costs faced by banks located in vulnerable countries restrict the pool of issuer countries from which to buy debt securities. Indeed, sovereign bonds issued by highly-rated countries offer much lower yields, while offering virtually the same regulatory treatment as lower credit quality sovereign bonds issued by vulnerable countries. While banks located in vulnerable countries could purchase high-yielding government bonds from other vulnerable countries, the moral suasion, creditor discrimination and risk shifting theories suggest they would rather tilt their euro government bond portfolio towards their own domestic government.

Our work distinguishes itself from the literature on several grounds. First, while the rich literature on the nexus has documented the pass-through channels through which sovereign risk feeds into banking risk and vice-versa, few studies have thoroughly quantified the contribution of bank funding costs to banks' sovereign bond portfolio allocation. This relationship is particularly important in the context of the long-standing debate on the issuance of an EU-wide safe asset, which would, according to its proponents, help mitigate the nexus – among other policy goals. Second, the excellent quality of our data allows us to estimate bank funding costs in a holistic and comprehensive manner, by relying on two ECB proprietary datasets for both wholesale funding costs and deposit rates. Indeed, many studies on the pass-through of sovereign risk use CDS spreads as a proxy for risk and/or funding costs, thereby neglecting some comparatively less risk-sensitive funding options offered to banks, such as bank deposits, which in the euro area make up a significant proportion of banks' liabilities. Likewise, while many studies rely on limited datasets only revealing domestic sovereign debt holdings by banks, the excellent quality of our dataset allows us to retrieve cross-country sovereign debt holdings by banks at the country level, allowing us to estimate the weighted average yield on the euro sovereign bond portfolio of a sample of banks.

3 Safe assets availability and the sovereign-bank nexus

3.1 Overview and data

3.1.1 Availability of safe assets

While the literature offers several definitions of safe assets, there is no clear-cut, universal methodology to unambiguously identify safe assets in practice. In general, safe assets can be defined as assets that carry minimal credit risk, are sufficiently liquid and guarantee stable nominal payoffs. One major

[3] The "country (or sovereign) rating ceiling" refers to the fact that sovereign debt ratings act as a rating "ceiling" for most corporate borrowers within their home country, meaning that only a few of them might achieve a rating one or two notches higher.

characteristic of safe assets is the apparent stable demand for them. Gorton and Ordoñez (2013) show that the demand for safe assets in the US as a proportion of wealth has been stable since World War II. Gourinchas and Jeanne (2012) come to the same conclusion scrutinizing the demand for safe assets relative to of GDP. Golec and Perotti (2017) conclude that these constant ratios imply a distinct market for safe debt that is isolated from markets for speculative investment. Apparently, economic agents exhibit a stable preference for safety and liquidity. This can be due to regulatory requirements or to basic needs like value-storing, exchange and the deposit of collateral for certain transactions.

Throughout history, numerous sovereign and corporate issuers, including some of the now most creditworthy such as Austria, France and Germany, have resorted at least once to a default of some sort (Reinhart and Rogoff, 2013). Sovereign defaults have taken different forms, including outright defaults, selective defaults on either domestic debt or foreign debt, currency redenomination, distressed debt exchanges, restructuring, or defaults through inflation (Reinhart and Rogoff, 2011). Likewise, central banks liabilities – reserves and currency –, while technically default-free because they are the unit of account and therefore are always nominally paid, are subject to inflation risk and exchange risk (Reis, 2017).

Safe assets availability in the euro area may be impeded by the fact that they are issued by a limited set of countries, whose creditworthiness and bond market liquidity is sufficient to uphold the safe asset status. The Great Financial Crisis (GFC) and ensuing European sovereign debt crisis put a significant strain on the public finances of European countries. This fiscal burden, combined with already high debt levels in some EU countries, resulted in a worsening of the creditworthiness of several euro area countries, namely the so called GIIPS (Greece, Italy, Ireland, Portugal and Spain). As a consequence, these countries lost their previous "safe status", as reflected in their credit ratings. Despite an increase in overall public debt issuance since the GFC, the supply of highly-rated euro-denominated sovereign debt bonds, the prime source of safe assets, has in fact diminished (European Commission, 2018, Gossé and Mourjane, 2021). Moreover, the supply of safe government securities available to the private sector, known as the free float, was further reduced by the large-scale asset purchases conducted by the Eurosystem since 2015, as well as the substantial holdings of foreign central banks, sovereign wealth funds, pension funds, and insurance companies (Rossi et al., 2023). These actors are generally viewed as price-insensitive, buy-and-holder investors, so their purchases reduce the supply of securities available for sale from the perspective of banks, as evidenced by the empirical literature (Koijen et al., 2017). The scarcity of free floating, safe euro government bonds is particularly acute for German bunds, which display a so-called Bund-specialness. Although the Eurosystem possesses tools to mitigate the safe government bond scarcity, such as the securities lending facility, the well-documented declining free float of core countries' sovereign debt ought to be considered in policy debate on safe assets.

Concerns about the sovereign-bank nexus and safe assets scarcity has fuelled the debate on the provision of EU-wide safe bonds, whether in the form of jointly issued, mutually guaranteed debt, or in

the form of senior tranches of a pool of national government bonds (Sovereign Bond-Backed Securities, or SBBS).[4] Proponents argue that an EU-wide safe asset might sever the financial link between national governments and banks by helping banks to diversify their sovereign portfolio[5]. Brunnermeier et al. (2016a) show that restricting euro-area banks to hold SBBS would effectively break the doom loop described above.[6]

We choose to narrow the scope of safe assets to high-grade general government debt, EU supranational debt securities and central bank reserves held by banks. As we are examining the influence of safe asset availability on the sovereign bank-nexus, we define safe assets from the perspective of banks. For this reason, we exclude demand deposits, which are rightly viewed as privately-issued – but government-guaranteed up to the deposit insurance limit – safe assets from the perspective of households and NFCs. We also choose to exclude (reverse) repurchase agreements ("repos") backed by otherwise safe assets, e.g., French or German government bonds, as they leave the net safe asset supply unchanged for the banking sector as a whole when they involve two credit institutions[7]. Indeed, in such transactions, a safe asset (safe government bond) is simply swapped for another asset (central bank reserves or commercial bank money)[8] within the banking system.

The treatment of central bank reserves (i.e., monetary base, high-powered money, or M0) deserves a thorough investigation. Given that central bank reserves constitute the quintessential safe asset in today's fiat-currency system, it is natural to consider that claims on the Eurosystem, in the form of bank deposits at the national central bank (NCB) or at the ECB, offer a liquid and secure store of value for institutions having access to the Eurosystem's balance sheet. However, central bank reserves are partly endogenous, and partly exogenous to the banking sector. Schematically, reserves can be created either through outright purchases of securities – predominantly investment grade government securities, but also private debt securities –, over which banks have no control, or through refinancing operations[9] (over)collateralized by low-risk assets – marketable and non-marketable assets –, to which banks have an unlimited access[10]. Through the second channel, banks can theoretically borrow from and store unlimited amounts of safe reserves with their central bank as long as they can find and pledge eligible collateral, which needs to meet the high credit standards of the Eurosystem credit assessment framework (ECAF). In that sense, the supply of safe assets provided by the Eurosystem is partially

[4] See Brunnermeier, M.K. et al. (2016b).
[5] See Alogoskoufis, S. et al (2020) and Mack, S. (2021).
[6] According to the authors, SBBS would not involve joint liabilities of individual euro-area countries. This would be a major distinction from Eurobonds as proposed by Von Weizsäcker and Delpla (2011).
[7] In light of our free float framework, a reverse repo collateralized by a safe asset and involving a bank (lender of cash) and a price-insensitive (i.e. not included in the free-float) counterpart (borrower), such as a pension fund, an insurance corporation, a central bank or a foreign official holder, would have a net positive impact of the free floating amount of safe assets from the perspective of the banking sector, if and only if the transaction is settled with commercial bank money and not with central bank money.
[8] Going further, if a repo transaction is settled with commercial bank money, then the borrower of cash is exposed to settlement risk (a combination of credit and liquidity risks).
[9] Main Refinancing Operations (MRO), Marginal Lending Facility, Target Long-Term Refinancing Operations (TLTRO), and Pandemic Emergency Long-Term Refinancing Operations (PELTRO), all of which are collateralized operations.
[10] The possibility for unlimited use of refinancing operations is only valid, since the Eurosystem switched to fixed-rate, full allotment tender procedures in October 2008, as a response to the 2007-2008 financial crisis.

elastic and responsive to banks' demand for safety. Nonetheless, the eligible pool of collateral is limited, it is largely exogenous to the banking sector, and the assets pledged for refinancing operations are removed from the free float, although they can be lent back to the market through securities lending operations.

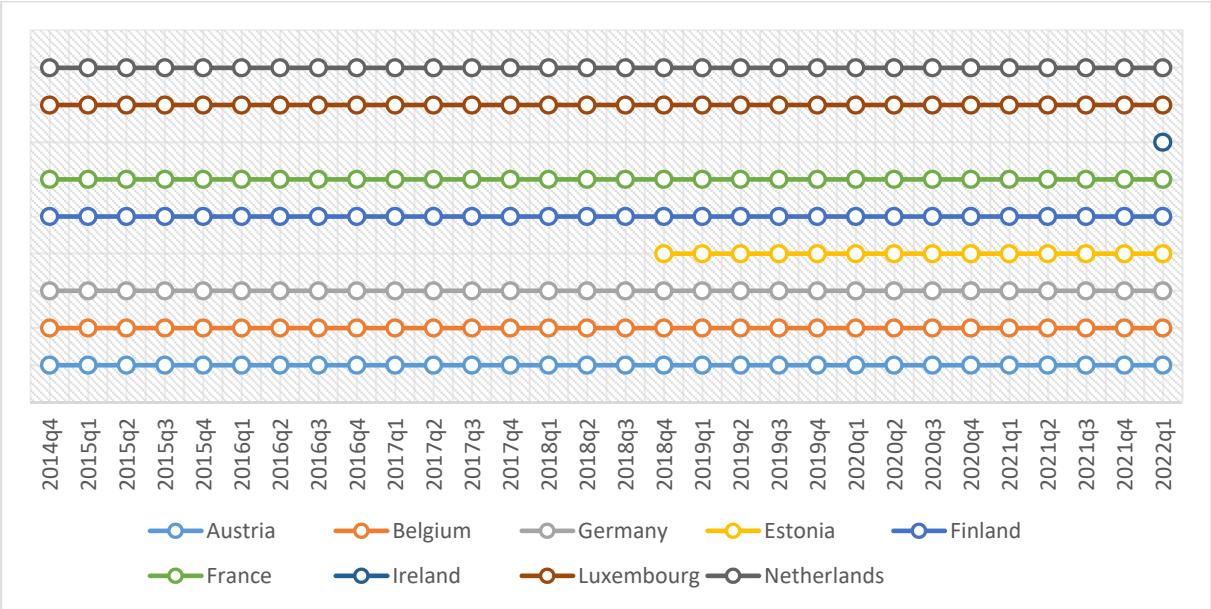
However, the net impact of central bank monetary policy operations on safe asset availability is not neutral, as banks can pledge low-risk, but nonetheless non-default free – and sometimes illiquid – collateral for monetary policy operations, subject to a valuation haircut commensurate with the level of risk. Currently, the Eurosystem only accepts assets as eligible collateral that meet the minimum requirement of a credit assessment of credit quality step 3 (CQS 3). This corresponds to a BBB-/Baa3 credit rating, or a probability of default of 0.4% during the next year. Therefore, the Eurosystem can carve out safe assets – in the form of central bank liabilities – from relatively riskier assets (securities and loans with ratings below AA-/Aa3 or equivalent). The net impact of the Eurosystem on safe asset supply is substantial for countries whose government lack the creditworthiness to issue safe debt securities. For these reasons, we choose to include central bank reserves held by banks in the scope of our safe assets availability measure, but to remove general government securities held by the Eurosystem for monetary policy purposes.

Considering the discussion on the definition of safe assets, we choose to rely on external credit ratings for identifying safe government debt. While credit ratings are not perfect indicators of credit risk – they have been found to be mildly procyclical, are usually slow to adjust compared to market-based indicators, and are subject to threshold effects –, credit ratings remain a reliable proxy of relative credit risk (Lecomte and Torres, 2023). Specifically, we use the arithmetic mean of the issuer credit rating assigned by the three main rating agencies, S&P Global, Fitch Ratings and Moody's, which we extract from Bloomberg, and use AA-/Aa3 as a threshold, meaning that any asset with a rating equal to or above AA-/Aa3 is deemed safe. This threshold matches the Eurosystem Credit Quality Step 1 (CQS 1), the highest credit quality bucket, which corresponds to a probability of default over a one-year horizon significantly lower than 0.10%[11]. Our results are roughly consistent with the approach used by Frey and Weth (2019), which define sovereign issuers with CDS spreads (based on 2003 ISDA contracts) over 100bp as vulnerable, although our method is slightly stricter. Over the period of our study, from 2014Q4 to 2022Q3, Austria, Belgium, Germany, Finland, France, Luxembourg and the Netherlands are safe without discontinuity, while Estonia and Ireland only become safe from October 2018 and January 2022 respectively (see figure 1 below). In addition to safe general government debt, we include all free-floating EU supranational debt securities – bills and bonds – given their excellent credit quality. More specifically, we include issues from the European Union (NGEU, SURE, EFSM, MFA, BOP and

[11] See the Eurosystem credit assessment framework (ECAF) (europa.eu). The ECB does not provide a probability of default over a one-year horizon for CQS 1 (the highest credit quality category), but only for CQS 2 (0.10%). We can only infer that CQS 1 implies a probability of default over a one-year horizon strictly less than 0.10%.

Euratom), the European Investment Bank (EIB), the European Stability Mechanism (ESM) and the European Financial Stability Facility (EFSF), which we obtain from the latter's respective websites.

Figure 1: List of highly-rated, or safe, countries



For testing whether a scarcity of domestic safe assets positively contributes to the sovereign-bank nexus, we calculate the total outstanding amount of free-floating safe assets available in each euro area country.[12] We construct our free-floating safe assets estimate using sector-level information from the quarterly Securities Holdings Statistics (SHS-S), which are available without discontinuity from 2013Q4. For euro area holdings SHS-S provides granular information on the holding sector: monetary and financial institutions (MFI), money market funds (MMF), non-MMF investment funds, insurance corporations and pension funds (ICPF), other financial institutions, non-financial corporations, and households. For non-residents, i.e. persons and institutions outside the euro area, only a distinction between official and non-official portfolios is reported. Following the classification of investor types as price-sensitive vs. price-insensitive in Koijen et al. (2017) and Bergant et al. (2018), we remove general government debt securities held by pension funds and insurance corporations (ICPFs), by the Eurosystem, and by foreign officials to construct our estimate of free-floating public-sector debt securities for safe countries (see equation (1) below).

Free floating general government debt securities ≡ [outstanding amount of securities] – [holdings of the Eurosystem] – [holdings of insurance corporations and pension funds (ICPFs)] – [foreign official holdings]

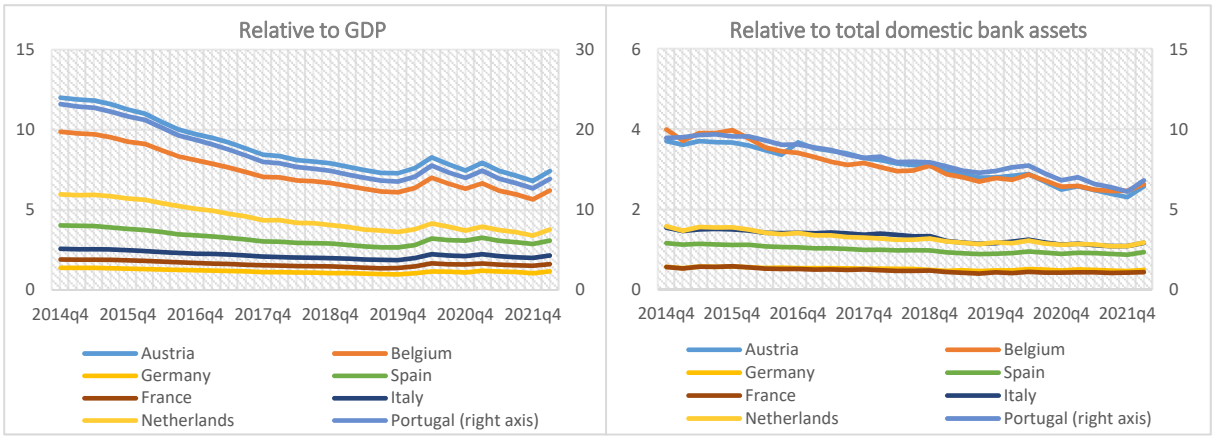
Eurosystem securities holdings under the asset purchase programme (APP) and the pandemic emergency purchase programme (PEPP), national debt securities outstanding as well as national central bank (NCB) reserves held by banks are extracted from the ECB Statistical Data Warehouse (SDW).

[12] While we calculate the free float for every euro area country for descriptive purposes, we conduct our empirical tests on the nine euro area Member States only (Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain).

Two limitations in our methodology ought to be highlighted. First, securities purchased under the Securities Market Progamme (SMP) are not accounted for. Second, unlike securities purchased under APP or PEPP, securities pledged for refinancing operations with the Eurosystem are not deducted from our free-floating estimate of safe assets. As we include central bank reserves in our safe asset estimate, there is undoubtedly some double counting, as this central bank liquidity is lent to market participants against eligible marketable and non-marketable assets, some of which would be categorized as safe according to our methodology. Nonetheless, according to the Eurosystem Collateral Data, as of 2022Q3, only around 17% of the collateral pledged for refinancing operations (463.9 billion euros out of 2,693.5 billion euros) was composed of central and regional government securities, the rest being mainly composed of non-marketable assets and credit claims (898.1 and 896 billion euros respectively). In comparison, euro area outstanding general government debt securities amounted to slightly over 10 trillion euros in 2022Q2. Furthermore, according to Brueckner et al. (2022), overall, banks pledge securities of relatively similar quality to the securities they hold, and are less likely to pledge sovereign bonds, in part because the latter are eligible as high-quality liquid assets (HQLA), as opposed to ABS and covered bonds, which are of high quality but relatively illiquid. Lastly, as we do not include privately issued securities in our safe assets estimate, the latter is likely largely underestimated given the significant amounts outstanding of corporate bonds and ABS rated AA- or higher. For these reasons, we believe that the double-counting is both negligible, and in any case more than offset by the exclusion of private-label.

When scaled to domestic GDP or domestic bank assets, the availability of public safe assets varies widely across EU Member States, as evidenced by figure 2. Among the eight largest euro area countries, Portugal boasts the largest ratio of total free floating public safe assets to GDP – although its sovereign debt is not classified as safe according to our methodology –, followed by Austria, while Germany and France display the lowest ratios (see figure 2.a). Focusing on safe countries, Estonia, Luxembourg, Ireland and Finland stand out given the relatively small size of their economies and/or banking system vis-à-vis the total stock of free-floating safe assets (see figure 2.b). Regarding vulnerable countries, Malta and Cyprus display safe assets ratios over 100 when scaled to GDP, while Lithuania, Malta and Slovenia have safe assets ratio over 50 when scaled to their total banking sector's assets (see figure 2.c).

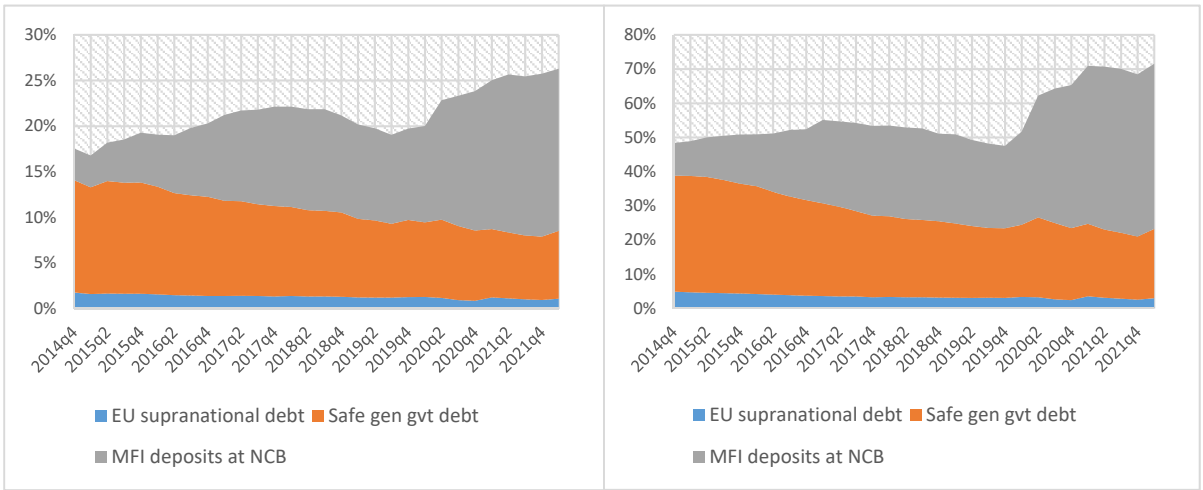
Figure 2: Ratio of domestically available total euro area free floating public safe assets over GDP (left) and total bank assets (right), eight largest euro area economies



Note: Domestically available public safe assets are here defined as total euro area free floating safe general government debt securities, free floating EU supranational debt, and domestic MFIs' deposits at their NCB.

When looking at the composition of free-floating safe assets available in each country, figure 3 highlights the growing share of central bank reserves (i.e., MFI deposits at their NCB), accounting for more than half of the total towards the end of the period. Free-floating safe general government debt on the other hand is characterized by a secular decline from the beginning of the examined period, despite growing issuance volumes. This seemingly contradictory observation is explained by the large-scale APP of the Eurosystem, but also by substantial holdings by foreign officials as well as insurance corporations and pension funds (ICPF). Likewise, despite growing outstanding amounts, the free-floating amount of EU supranational debt has remained roughly constant since late 2013, resulting in a shrinking share of euro area GDP and total MFIs' assets.

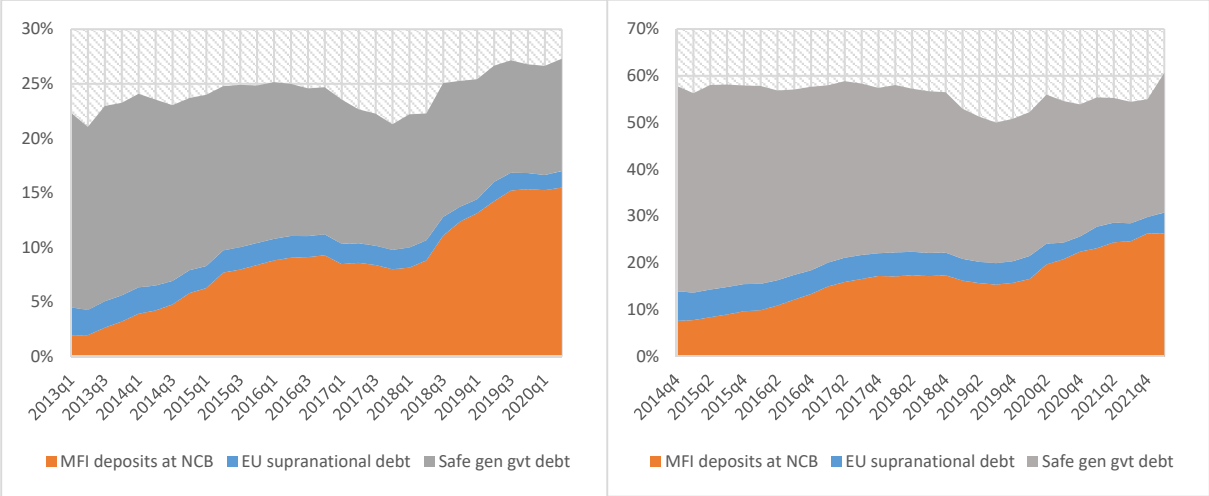
Figure 3: Composition of free-floating safe assets in the euro area, relative to total bank assets (left) and relative to GDP (right)



Interestingly, the ratio of total free floating safe assets to bank assets is *higher* in vulnerable countries, oscillating between 50% and 60%, compared to around 20% to 25% in safe countries (figure 4). This finding casts doubt on the safe assets scarcity hypothesis, at least if not complemented by

additional factors such as the interaction between prudential requirements, differentiated pricing across investors, and bank funding costs.

Figure 4: Composition of free-floating safe assets for highly-rated (left) and vulnerable (right) countries, relative to domestic bank assets

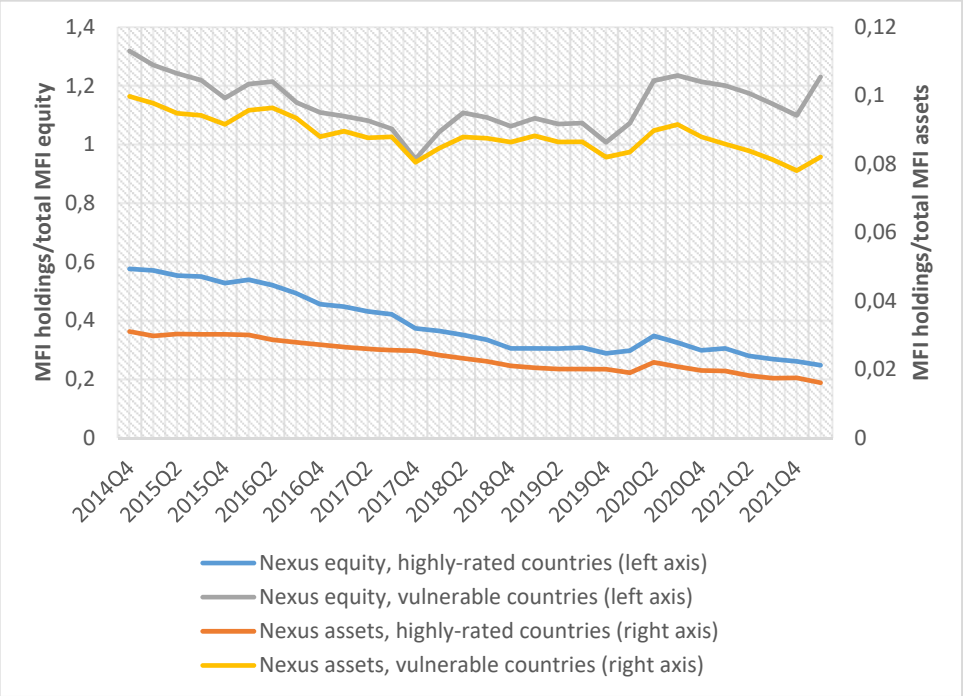


3.1.2 The sovereign-bank nexus

At the height of the euro sovereign debt crisis and in the following years, the banking sector of GIIPS countries absorbed large volumes of the debt issued by their own governments, which made both sectors' respective balance sheets increasingly intertwined. This phenomenon, known as the sovereign-bank nexus, or "doom loop", has been a source of concern for European policy makers as it acts as an amplifier of vulnerabilities for both sectors. The sovereign bank nexus is widely documented to have amplified the global financial crisis of 2008/09 and contributed to the sluggish economic growth of the European economy in the following decade. The literature encompasses a wide range of metrics and approaches to quantify the sovereign-bank nexus.

We concentrate on a simple but transparent measure of the sovereign bank nexus by taking general domestic government debt relative to total bank assets or relative to bank equity. For both ratios we use sector-level information from the SHS-S. For each security, our data set comprises information on the nominal value and the holding sector. As already well documented by the literature, banks located in vulnerable countries hold proportionally more domestic sovereign debt as a share of total assets or total equity (see figures 5, 6, 7). While presently none of the identified safe countries' banking sectors holds domestic general government bonds in excess of its total equity, commercial banks in vulnerable countries as a whole do (figure 5), with Italy and Greece displaying ratios well above one (figure 7). These figures point to a secular decline in domestic sovereign exposures in safe countries over the period 2014Q4 – 2022Q1, and to a stabilized sovereign-bank nexus in vulnerable countries, or slightly declining one if measured against banks' total assets.

Figure 5: Sovereign-bank nexus, highly-rated and vulnerable countries



3.2 Empirical strategy

To test our first hypothesis, namely whether safe assets availability is a determinant of the sovereign bank nexus, we run the following panel data regressions:

$$(1)\ \boldsymbol{Nexus_{i,t} = \beta_0 + \beta_1 Safe_{i,t} + \beta_2 Spread_{i,t} + \beta_3 Kmarkets_{i,t} + \varepsilon_{i,t}}$$

Where i and t are country and time subscripts respectively.

$\boldsymbol{Nexus}$ measures the sovereign-bank nexus, defined here as follows:

$$\boldsymbol{Nexus_{assets_{i,t}} \equiv \frac{domestic\ sovereign\ debt\ held\ by\ banks_{i,t}}{banking\ sector\ total\ assets_{i,t}}}$$

Alternatively, we use the following approach as a robustness check:

$$\boldsymbol{Nexus_{equity_{i,t}} \equiv \frac{domestic\ sovereign\ debt\ held\ by\ banks_{i,t}}{banking\ sector\ total\ equity_{i,t}}}$$

$\boldsymbol{Safe_{i,t}}$ is the total euro area free-floating stock of public safe assets, as a share of each country's total bank assets.

$\boldsymbol{Spread_{i,t}}$ measures the spread between the German 10-years bunds yield and the domestic government bond yield over the same tenor. It is used as a proxy for the "*carry trade / search for yield"* hypothesis of the sovereign-bank nexus and suggests that the incentives to invest in domestic assets depends on the yield differential of domestic assets vis-à-vis the German bund, which constitutes the safe asset benchmark in the euro area. Given the "sovereign rating ceiling" mentioned above, this variable also correlates with average funding costs of the domestic banking sector.

$\boldsymbol{Kmarkets_{i,t}}$ is an IMF composite measure of capital markets development. The higher this indicator, the more developed capital markets are.

We first estimate the above equations using panel regressions in first differences, as the variables are integrated of order one in levels but become stationary after first differencing.[13] We use both time and country fixed effects, as well as clustered standard errors to control for serial correlation in the residuals. Furthermore, Kao panel-data cointegration tests suggest that the variables in the regression are cointegrated.[14] This allows us to run a Dynamic Ordinary Least Squares (DOLS) model to estimate the model in levels. We control for possible endogeneity by including leads and lags of the dependent variable. The estimation period ranges from 2013Q2 – 2022Q1 and the panel includes the following nine countries: Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Portugal, and Spain.

3.3 Empirical results

Table 1 below displays our empirical results using OLS in first differences. First, based on the nine selected countries, it appears that the total free-floating amount of safe assets has no significant impact on the nexus irrespective of whether it is measured relative to total assets or to equity. Sovereign yield spreads are strongly positively correlated with the equity based sovereign-bank nexus but not significantly linked to the nexus measure based on total assets. Finally, the IMF index for financial markets development has – if at all – a slightly negative impact.

Table 1: Determinants of the Nexus (Panel OLS in first differences)

	Nexus Assets	Nexus Equity
Free-floating safe assets	0.0000933 (0.000170)	0.0000425 (0.000133)
Long-term interest rate spread	-0.0977 (0.0770)	1.965** (0.729)
Capital markets development	0.00429 (0.00341)	-0.122* (0.0590)
Observations	288	288

Standard errors in parentheses, *** (**) [*] indicate a significance level of 1% (5%) [10%].
Note: Estimated with one lead and one lag, robust standard errors.

Turning to the DOLS-model (Table 2), the free-floating volume of safe assets remains insignificant for the nexus measured relative to bank assets but has a small negative impact when measured against bank equity. Long term sovereign yield spreads again turn out to have a strongly

[13] According to the Fisher-type test of Philipps-Perron with one lag.
[14] We rely on the modified Dickey-Fuller and the augmented Dickey-Fuller specifications.

positive impact on both measures. The coefficient of the financial markets development index on the nexus fails to be significant for both specifications.

Table 2: Determinants of the Nexus (Panel DOLS)

	Nexus Assets	Nexus Equity
Free-floating safe assets	-0.000481 (0.000460)	-0.00151** (0.000660)
Long-term interest rate spread	3.824*** (0.170)	22.16** (2.842)
Capital markets development	0.0414 (0.0290)	-0.658 (0.0472)
Observations	272	272

Standard errors in parentheses, *** (**) [*] indicate a significance level of 1% (5%) [10%].
Note: Estimated with one lead and one lag, robust standard errors.

Overall, and as initially suggested by a visual inspection of the ratio of total free-floating safe assets to GDP and/or bank assets across countries, the relationship between the availability of euro denominated safe assets and the sovereign-bank nexus appears tenuous at best. Countries having access to vast volumes of free-floating assets denominated in euros and requiring no capital backing can either display strong interlinkages between their banking sector and their respective domestic government (Malta, Cyprus), or on the contrary, weak ones (Luxembourg, Finland).

By contrast, sovereign bond yield spreads – which capture the opportunity cost of investing in low yielding safe bond from core countries from the perspective of banks located in vulnerable countries – appear to have a significantly positive effect on the sovereign-bank nexus, corroborating the search-for-yield hypothesis. Considering the strong link between sovereign yields and banks' funding costs, our findings suggest that the sovereign-bank nexus is driven – at least partially – by banks' own funding costs. In the next section we will investigate this issue in more detail and test the hypothesis that the link between funding costs and the preference for safe assets can be traced backed to banks' willingness to match the return of their sovereign government bond portfolio to their own funding costs.

4 Bank funding costs as determinants of the sovereign-bank nexus and demand for safe assets in the euro area

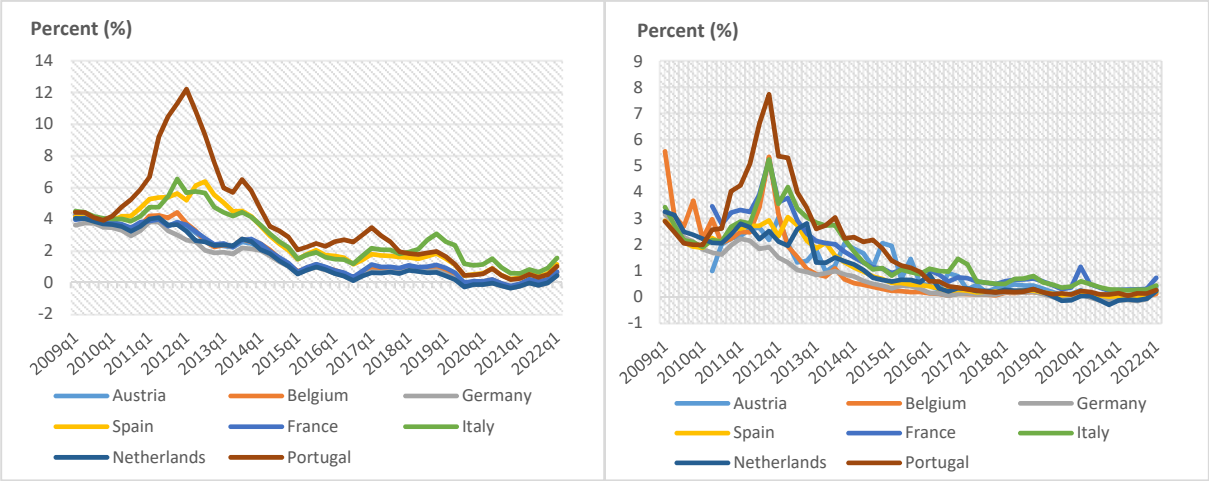
4.1 Overview and data

As shown in the previous section, domestic interest rates and their implications for bank funding costs seem to have a significant impact on the preference of banks to hold domestic sovereign bonds. We argue that in performing their asset allocation decisions, banks maximize the spread between the expected risk-adjusted returns of their investments over their total funding costs – debt and equity. Conventional finance theory tells us that total funding costs is equal to the sum of the risk-free rate, a liquidity premium and a risk premium, the latter being composed of a country-specific risk premium and a bank-specific premium. In light of the heterogeneity of banks' funding costs across the euro area, it is fair to hypothesize that banks' appetite for safe bonds – e.g., German bunds, EU supranational bonds

or hypothetical SBBSs – must vary widely and be inversely related to funding costs. Given both the overall lower credit quality of GIIPS' banking sector balance sheets, as well as the higher country risk premium over core countries, there are reasons to doubt whether banks in vulnerable countries will buy these safe assets, at least not without introducing changes to the regulatory treatment of sovereign exposures (RTSE).

As evidenced by figure 6, MFIs' funding costs and the average yield on their euro government bonds portfolio vary substantially across countries, and both seem to be tightly related[15]. Yields on both sides of the balance sheet are on average significantly higher in vulnerable countries, in particular during the period 2009-2016.

Figure 6: Estimated weighted average yield on the euro general government bond portfolio of MFIs for eight EA countries (left) and their overall funding costs (right)



In addition to the datasets used in the previous section, we use the ECB individual MFI balance sheet items (IBSI) dataset to obtain bank-level, quarterly data on banks' structure of liabilities. IBSI offer extensive balance sheet items coverage, a high level of granularity and representativeness of the total population of reporting banks.[16] We extract deposit rates from the Eurosystem individual MFI interest rate statistics (IMIR), which covers all interest rates that monetary financial institutions (MFIs) resident in the euro area apply to euro-denominated deposits from and loans to households and non-financial corporations. Finally, we rely on an ECB dataset (hereafter Markit iBoxx) that provides information on senior bond yields at the bank level. These yields are computed for each issuer as the weighted average of the yields of outstanding euro denominated senior bonds. They indicate the interest rate banks would have to pay on newly issued bonds.

[15] For a breakdown of funding structure and funding costs between deposits and debt securities, see Figure 4 in the Appendix.
[16] See Bojaruniec, P. Morandi, G. (2016).

4.2 Empirical strategy

In this section we test whether funding costs play a role in banks' appetite for safe assets in the form of government securities rated AA- and above, and EU supranational securities. We do this by testing the relationship between funding costs and the weighted average yield on the portfolio of euro area government bonds. Since less safe government bonds bear a risk premium, their nominal yield exceeds the yield on safe benchmark securities.

Different methods can be used to proxy bank funding costs, reflecting the wide array of funding instruments and markets available for banks to finance their operations. On the debt-funding side, banks can tap retail deposits, wholesale funding (including money markets, bond markets, and unsecured corporate deposits), and secured funding (repos, securities lending and securitization, as well as central bank refinancing operations). On the equity-funding side, banks can issue common stocks on public or private markets to raise equity capital. Their exist various approaches to proxy a bank's debt-funding costs: The first relies on Credit Default Swap (CDS) spreads; A second one uses balance sheet and profit and loss (P&L) data, such as interest expenses over total liabilities, or interest paid on various types of deposits. Finally, a third approach refers to bond yields. We choose to build on the second and third approach to test our second hypothesis, by using deposit rates and bond yields to compute a weighted average proxy of debt funding costs, as deposits and bonds constitute the lion's share of banks' debt funding sources. Since the onset of the Great Financial Crisis, the Eurosystem has provided European banks with relatively attractive funding – particularly for weaker banks – through its large-scale lending operations (LTROs, TLTROs, PELTROs), While the pricing of these debt offerings is relatively uniform and insensitive to risk (the collateral and counterparty frameworks act as mitigants against financial losses), their use and associated impact on overall cost of funds varies widely across banks. Nonetheless, we choose to omit this source of funding for simplicity.

We extract total seniority bond yields from Markit iBoxx[17] for a sample of 96 banks from eight euro area countries: Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Portugal, and Spain. Due to insufficient data, Greece is not included in the sample, which otherwise corresponds to the list of countries used for hypothesis one. Bond yields constitute a good proxy of bank marginal wholesale funding cost, which in turn is a key driver of banks' lending rates (Bank of England 2019). For deposit rates, we take the average interest rate on new business – to capture marginal cost – across all deposit segments and all maturities, at the bank-level. The rational for using marginal cost instead of historical cost pertains to the fact that investment decisions should be based on the cost of new money, as banks synchronize actual pricing with actual cost of funding. Our overall – or blended – funding cost proxy at the bank-level is thus the weighted average of deposit and bond funding costs:

[17] More specifically, we use the annual yield as a weighted average of asset swap spread weighted by base market value, total residual maturity, denominated in euro.

$$\boldsymbol{Blended\ funding\ cost}_{i,t} \equiv \boldsymbol{Share}_{\boldsymbol{bonds,it}} \boldsymbol{x\ Bond\ yield}_{i,t} + \boldsymbol{Share}_{\boldsymbol{deposits,i,t}} \boldsymbol{x\ Deposit\ rate}_{i,t}$$

Where

$$\boldsymbol{Share}_{\boldsymbol{bonds}} + \boldsymbol{Share}_{\boldsymbol{deposits}} = \mathbf{1}$$

We then construct a country-level funding cost index by weighting each individual bank's funding costs by its share of total bank assets within the sample, at the country level. We compute this country-level index both for overall funding costs, but also for bond funding costs only. Historically, wholesale funding, which is often unsecured, has been the main measure of banks' marginal funding. Bond funding costs have the advantage to be readily observable in terms of market pricing. Furthermore bonds are an important funding instrument, since they can raise a large amount of funding relatively quickly (Bank of England 2019).

Capturing the cost of equity is more delicate, as it poses certain methodological obstacles and requires relying on simplifying assumptions regarding market efficiency, asset pricing and dividend policy. Models include one factor Capital Asset Pricing Models (CAPM), or the three-factor model of Fama and French, as described in Altavilla et al. (2021). For the euro area, supervisory data such as ECB/SSM or EBA self-assessed cost of equity could also be used. Nonetheless, we decide to leave aside cost of equity and focus on cost of debt.

To test our hypothesis that funding costs play a role in banks' appetite for safe assets, we estimate the weighted average yield of the euro general government debt securities portfolio of banks (hereafter euro government bond portfolio), at the national level, for the eight euro area countries mentioned above[18]. We do so using SHS-S and IBSI data, by multiplying the share of each issuer country's debt securities by the corresponding 10-year constant maturity yield, which we extract from SDW, as follows:

$$\boldsymbol{Weighted\_yield\_PF}_{i,t} \equiv \sum_{j=1}^{19} \mathbf{10}\boldsymbol{y\_gvt\_bond\_yield}_{\mathrm{j,t}} * \frac{\boldsymbol{gov\_bond}_{i,j,t}}{\boldsymbol{gov\_bond\_PF}_{i,t}}$$

Where i and j are individual bank subscripts and t a time subscript.

While SHS contains the holdings of government bonds issued by all nine countries identified as safe by our methodology from 2009, banks' sovereign debt holdings from the remaining euro area Member States are only available from 2013Q4. To infer the missing holdings, we take the composition of each holding country's euro government bond portfolio in 2013Q4 to compute weights for each missing issuer countries. We simply assume that their relative shares within the "missing countries

[18] Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal and Spain.

portfolio" are constant for the 2009Q1-2013Q3 period. As IBSI provides the total stock of euro government bonds held by banks for each country, we can infer the outstanding amount of the missing countries portfolio, by subtracting for each country the holdings of the nine available issuer countries from the total euro government bonds portfolio. When then multiply the fixed weights by their corresponding 10-year government bond yields to compute the average yield of the missing countries portfolio, and we calculate the overall portfolio's weighted average yield using the relative shares and bond yields of the nine available countries. Given that IBSI also provides domestic government debt holdings from 2009, we further improve the reliability of our estimate by directly computing vulnerable countries' exposure to their own sovereign, which reduces to less than 10% the share of the bond portfolio having to be inferred by using fixed weighs as described above.

This approach is not without its shortcomings, as we do not know the average residual maturity of banks' government bond portfolios. Moreover, the residual maturity may differ according to the issuer country – banks may for instance elect to hold shorter maturity foreign bonds, while positioning themselves on the back end of the yield curve for domestic debt –, and residual maturity may evolve over time. Finally, even if the residual maturity in MFIs' sovereign portfolio was constant across issuing countries, the shape of the yield curve may not be the same, resulting in a potential under- or over-estimation of the weighted average yield. Notwithstanding the above, we believe that our methodology provides a reasonably accurate proxy of the average yield-to-maturity of the euro sovereign bond portfolio of banks in the selected eight euro area countries.

Formally, we are interested in the following equation:

$$(2) \quad Weighted\_yield\_PF_{i,t} = \beta_0 + \beta_1 Funding\_costs_{i,t-1} + \varepsilon_{i,t}$$

Where funding costs is either the blended (bonds and deposits) or bond funding costs proxy.

However, holding relatively risky assets may itself raise banks' own funding costs through a higher risk premium, leading to a reverse causality running from a bank's portfolio to its funding costs. This relationship can be formalized as:

$$(2a) \quad Funding\_costs_{i,t} = \beta'_0 + \beta'_1 Weighted\_yield\_PF_{i,t-1} + \varepsilon'_{i,t}$$

4.3 Empirical results

In a first approach, we run a structural panel VAR in order to estimate both equations (2 and 2a) simultaneously. We generate orthogonalized impulse-response functions with Cholesky ordering (*Weighted_yield_PF Funding_costs*), since we suppose funding costs to react immediately, whereas restructuring the sovereign debt portfolio should take some time.[19] Whereas each impulse-response

[19] We fit a multivariate panel regression of each dependent variable on one lag of itself and one lag of the other dependent variable using generalized method of moments (GMM).

combination shows a positive and significant reaction after an innovation,[20] the model turns out to be instable with responses persisting on an elevated level after an exogenous shock.

Indeed, both weighted yields on the sovereign bond portfolio and funding costs are I(1). However, the variables are cointegrated and we rely on a DOLS-estimator in order to define the long-term relationship. To correct for endogeneity, we use a one-period lag and lead for funding costs. We extend the DOLS model with an error correction (EC) and calculate the EC-term (γ_1) based on the residuals of the DOLS regression (*DOLS_res*). In addition, the short term parameter γ_2 indicates the immediate response of the sovereign debt portfolio after a shock in funding costs:

$$(3)\ d\,Weighted\_yield\_PF_{i,t} = \gamma_0 + \gamma_1\, DOLS\_res_{i,t-1} + \gamma_2\, d\,Funding\_costs_{i,t-1} + \eta_{i,t}$$

Table 3: Weighted average yield on euro government debt portfolio and Bank funding costs (DOLS)

	Weighted average yield	
Variable	Blended Funding Costs	Bond Funding Costs
Long-run	1.523*** (0,058)	0.533*** (0.034)
EC-term	-0.238*** (0.059)	-0.087*** (0.032)
Short run	0.549*** (0.124)	0.079* (0.042)
Observations	300	350

Standard errors in parentheses, *** (**) [*] indicate a significance level of 1% (5%) [10%].
Note: Estimated with one lead and one lag, robust standard errors.

The results from the DOLS model displayed in Table 3 support the hypothesis that country-level bank funding costs positively contribute to the weighted average yield on banks' euro government bonds portfolio, with a 1% change in overall funding costs and bond funding costs being associated, respectively, with a 1.523% and 0.533% change in the same direction in the average portfolio yield, significant at the one percent level. The EC-term, which measures the speed of adjustment towards long-run equilibrium, is significantly negative for each specification. This confirms that the weighted average yield of a bank's government debt portfolio converges to the long-run relationship. Finally, the significant and positive short term coefficients (γ_2) for blended and bond funding costs suggest that government debt portfolios shift immediately towards higher yielding government bonds, whenever a bank's funding costs rise.

[20] At the 95% significance level.

Table 4: Weighted average yield on euro government debt portfolio and Bank funding costs (PMG)

	Weighted average yield	
Variable	Blended Funding Costs	Bond Funding Costs
Long-run	1.723***	1.017***
	(0.073)	(0.036)
EC-term	-0.142***	-0.190***
	(0.052)	(0.046)
Short run	0.271***	0.093***
	(0.085)	(0.032)
Observations	406	411

Standard errors in parentheses, *** (**) [*] indicate a significance level of 1% (5%) [10%].
Note: Estimated with one lead and one lag, robust standard errors.

In addition to the DOLS model we also estimate equation (2) using the pooled mean group (PMG) estimator as a robustness check. The PMG estimator calculates the long run relationship and the error correction term simultaneously. It allows the intercept, short-run coefficients, and error variances to differ freely across groups but constrains the long-run coefficients to be the same.

The PMG model confirms the qualitative results of the DOLS estimates (Table 4). The respective coefficients for blended and bond funding costs are 1.723 and 1.017 for the long-run coefficient, and 0.142 and 0.190 for the short-run coefficient, also significant at the one percent level. The EC-term indicates that it takes approximately 5 to 7 quarters for a bank funding shock to be fully spread/transmitted to the average yield of banks' euro govies portfolio[21]. Altogether the results confirm the hypothesis that banks facing high funding costs tend to concentrate their euro government bond portfolio – for which they have a rather inelastic demand – towards higher-yielding, risky bonds, and vice-versa. This finding raises doubts that a larger supply of EU supranational bonds alone would be sufficient to diversify banks' portfolios in vulnerable countries.

5 Conclusions

The present study has shed light on the composition of commercial banks' government debt portfolios in the euro area. We show that an alleged scarcity of highly-rated safe assets alone cannot explain the preference for higher yielding, predominantly domestic government bonds displayed by banks in vulnerable countries. Instead, we propose a framework to explain how bank funding costs impact banks' demand for highly-rated *de facto* safe assets or lower-rated sovereign bonds which are safe only *de jure*. We posit that banks have a relatively inelastic demand for euro denominated sovereign debt for meeting regulatory requirements, acquiring eligible collateral for secured funding operations, and building a stock of (quasi-)safe, countercyclical assets. Furthermore, we argue that high funding costs for banks located in vulnerable countries restrict the pool of issuer countries from which to buy debt securities, as those issued by safe countries offer much lower yields, while offering virtually the same regulatory treatment as lower credit quality bonds issued by vulnerable countries. This restriction ultimately leaves

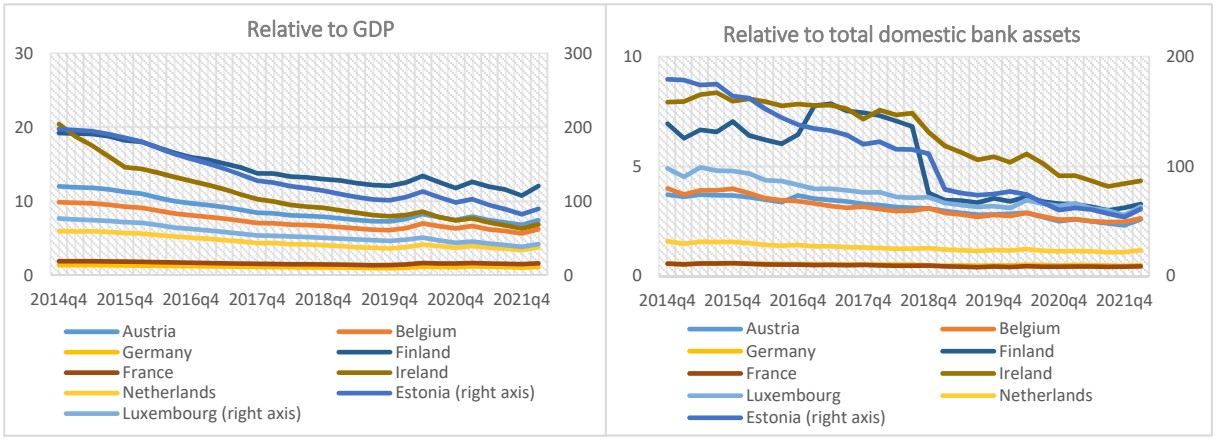
[21] The speed of adjustment, derived from the EC term (γ_I) is calculated as follows: $1/|\alpha|$, which yields $1/|-0.142| \approx 7$ quarters and $1/|-0.190| \approx 5$ quarters, respectively.

those banks with little choice but to concentrate their euro sovereign debt portfolio towards their domestic government or other vulnerable countries, as they strive to preserve their net interest margins. As a consequence, banks' propensity to hold safe general government or EU supranational debt appears to be inversely related to their funding costs. This narrative is both compatible with, and further compounded by other well-known factors identified by the literature, such as the moral suasion and creditor discrimination theories. The latter theories also help explain why banks located in vulnerable countries disproportionately purchased domestic risky debt in times of stress, as opposed to similarly high-yielding securities issued by other vulnerable sovereigns.

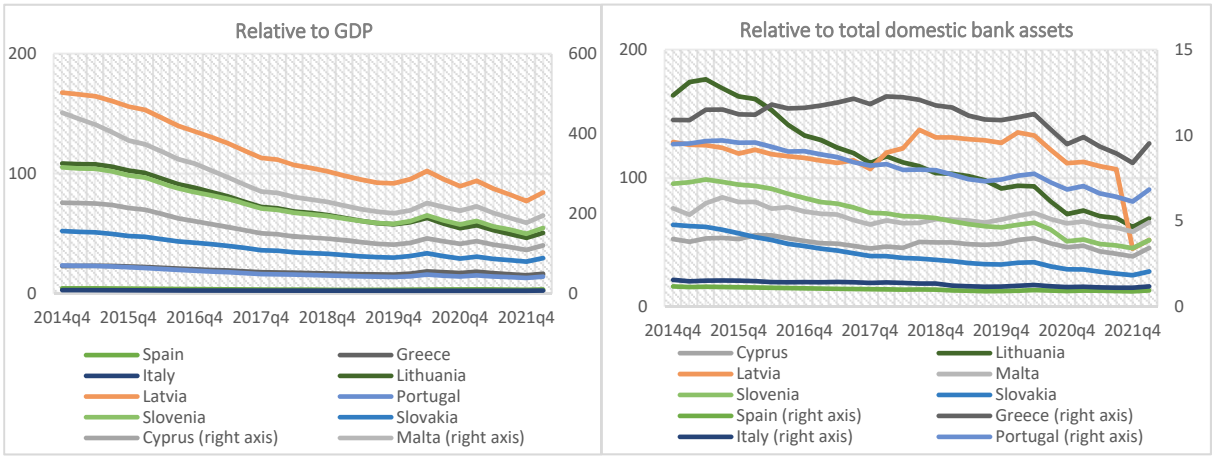
6 Appendix

Figure A1: Ratio of domestically available total euro area free floating public safe assets over GDP (left) and total bank assets (right)

a) Highly-rated countries



b) Vulnerable countries



Note: Domestically available public safe assets are here defined as total euro area free floating safe general government debt securities, free floating EU supranational debt, and domestic MFIs' deposits at their NCB.

Figure A2: Holdings of domestic general government debt securities by domestic MFIs relative to MFIs total assets, highly-rated (left) and vulnerable (right) countries

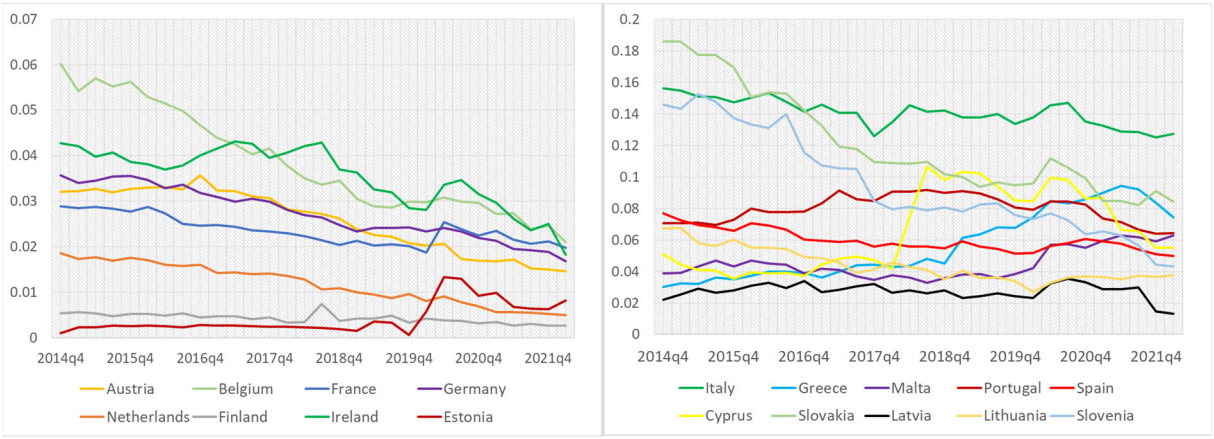


Figure A3: Holdings of domestic general government debt securities by domestic MFIs relative to MFIs total equity, highly-rated (left) and vulnerable (right) countries

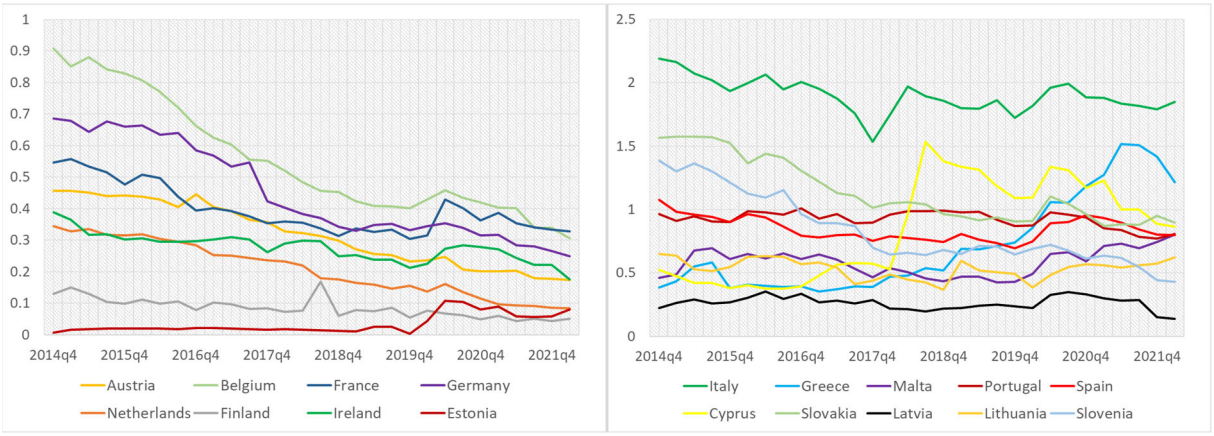
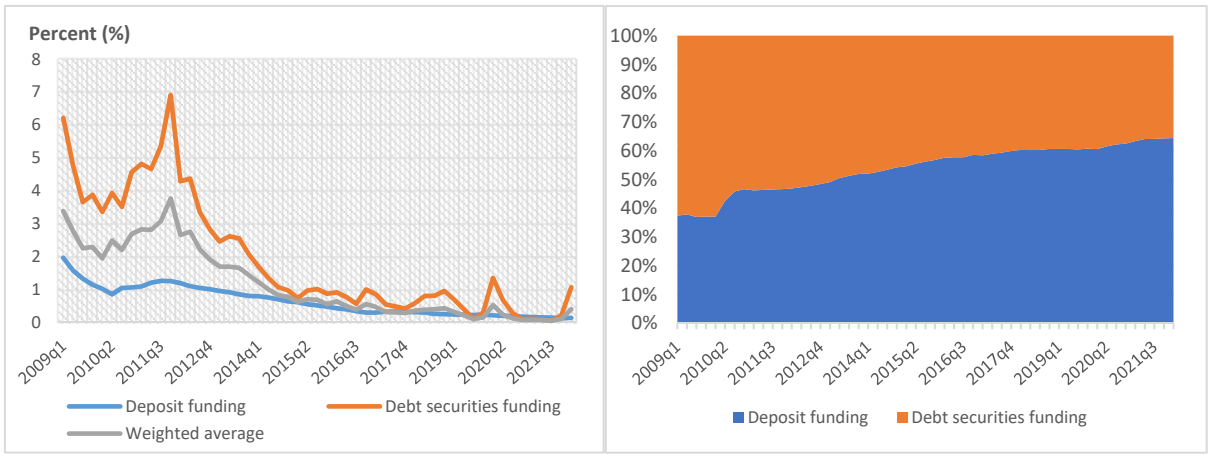


Figure A4: Estimated asset-weighted bank funding costs for a sample of eight euro area countries[22] (left) and its breakdown between deposits and debt securities (right)



[22] Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal, and Spain.

References

Acharya, V., Drechsler, I., and Schnabl, P. (2014). A pyrrhic victory? Bank bailouts and sovereign credit risk. *The Journal of Finance* 69:2689–739.

Almeida, H., Cunha, I., Ferreira, M. A., and Restrepo, F. (2017). The real effects of credit ratings: The sovereign ceiling channel. *The Journal of Finance* 72:249–90.

Alogoskoufis, S., Giuzio, M., Kostka, T., Levels, A., Molestina Vivar, L., and Wedow, M. (2016). How could a common safe asset contribute to financial stability and financial integration in the banking union? In ECB Special Features: Financial Integration and Structure in the Euro Area, March 2020.

Altavilla, C., Bochmann, P., DeRyck, J., Dumitru, A.-M., Grodzicki, M., Kick, H., Fernandes, C.M., Mosthaf, J., O'Donnell, C., and Palligkinis, S. (2021, January). Measuring the cost of equity of euro area banks. Occasional Paper Series 254, European Central Bank.

Altavilla, C., Pagano, M., and Simonelli, S. (2017). Bank Exposures and Sovereign Stress Transmission. *Review of Finance*, 21(6), 2103-2139.

Andreeva, D., and Vlassopoulos, T. (2016). Home Bias in Bank Sovereign Bond Purchases and the Bank-Sovereign Nexus. ECB Working Paper No. 1977.

Bank of England. (2019). Has the link between wholesale bank funding costs and lending rates changed? Bank Overground, March 2019.

Bergant, K., Fidora, M., and Schmitz, M. (2018). International capital flows at the security level–-evidence from the ECB's asset purchase programme. ECMI Working Paper 7.

Bocola, L. (2016). The pass-through of sovereign risk. *Journal of Political Economy* 124:879–926.

Bojaruniec, P., and Morandi, G. (2016). Setting-up the transmission of individual MFI statistics on balance sheet items and interest rates across the Eurosystem, paper presented at the IFC workshop on "Combining micro and macro statistical data for financial stability analysis – Experiences, opportunities and challenges" in Warsaw, Poland, 14-15 December 2015.

Broner, F., Erce, A., Martin, A., and Ventura, J. (2013). Sovereign Debt Markets in Turbulent Times: Creditor Discrimination and Crowding-Out. IMF Working Paper, WP/13/270.

Brueckner, B., Lez, P., and Nguyen, B. (2022). How did the Eurosystem's collateral strategy adapt to the Covid-19 crisis? Banque de France Bulletin, No. 241/2, July-August.

Brunnermeier, M. K., Garicano, L., Lane, P. R., Pagano, M., Reis, R., Santos, T., Thesmar, D., Van Nieuwerburgh, S., and Vayanos, D. (2016a). The sovereign-bank diabolic loop and ESBies. *American Economic Review* 106:508–12.

Brunnermeier, M. K., Langfield, S., Pagano, M., Reis, R. A. M. R., Van Nieuwerburgh, S., and Vayanos, D. (2016b). ESBies: Safety in the Tranches. ESRB: Working Paper Series No. 2016/21. https://ssrn.com/abstract=3723366 or http://dx.doi.org/10.2139/ssrn.3723366.

Corsetti, G., Kuester, K., Meier, A., and Muller, G. J. (2013). Sovereign risk, fiscal policy, and macroeconomic stability. *The Economic Journal* 123:99–132.

Crosignani, M. (2021). Bank capital, government bond holdings, and sovereign debt capacity. *Journal of Financial Economics* 141:693–704.

Dell'Ariccia, G., C. Ferreira, N. Jenkinson, L. Laeven, A. Martin, C. Minoiu, and A. Popov. 2018. Managing the sovereign-bank nexus. European Central Bank Discussion Papers No 2177.

Delpla, J., and von Weizsäcker, J. (2011). Eurobonds: The blue bond concept and its implications. Policy Contributions 509, Bruegel.

European Commission. (2018). Proposal for a Regulation of the European Parliament and of the Council on sovereign bond-backed securities.

Farhi, E., and Tirole, J. (2018). Deadly embrace: Sovereign and financial balance sheets doom loops. *Review of Economic Studies*, 85(3), 1781–1823.

Frey, R., and Weth, M. (2019). Banks' holdings of risky sovereign bonds in the absence of the nexus – yield seeking with central bank funding or de-risking? Deutsche Bundesbank Discussion Paper No 19/2019.

Golec, P., and Perotti, E. (2017). Safe assets: a review. European Central Bank, Working Paper Series 2035.

Goodhart, C. (2013). Globalization in an Age of Crisis: Multilateral Economic Cooperation in the Twenty-first Century, chapter Global Macroeconomic and Financial Supervision: Where Next? University of Chicago Press.

Gori, F. (2019). Dissecting the 'doom loop': the bank-sovereign credit risk nexus during the US debt ceiling crisis. MPRA Paper No. 109988.

Gorton, G., and Ordoñez, G. (2013). The Supply and Demand for Safe Assets. NBER Working Paper, No 18732, January.

Gossé, J-B., and Mourjane, A. (2021). A European safe asset: new perspectives. Banque de France, Bulletin 234/6 – March-April.

Gourinchas, P-O., and Jeanne, O. (2012). Global Safe Assets. Working Paper, Berkeley.

Horváth, B. L., Huizinga, H., and Ioannidou, V. (2015). Determinants and Valuation Effects of the Home Bias in European Banks' Sovereign Debt Portfolios. Available at SSRN: https://ssrn.com/abstract=2624906 or http://dx.doi.org/10.2139/ssrn.2624906.

Koijen, R. S. J., Koulischer, F., Nguyen, B., and Yogo, M. (2017). Euro-area quantitative easing and portfolio rebalancing. *American Economic Review*, 107(5), 621–627.

Lecomte, E., and Torres, C. (2023). Are credit ratings procyclical? A study of French banks' capital requirements during the Covid crisis. Banque de France Bulletin, No. 245/1, March-April.

Lee, J., Naranjo, A., and Sirmans, S. (2016). Exodus from sovereign risk: Global asset and information networks in the pricing of corporate credit risk. *The Journal of Finance* 71:1813–6.

Mack, S. (2021). Don't change horses in midstream – How to make NGEU bonds the euro area's safe asset. Hertie School Policy Paper August 2021.

Makinen, T., Sarno, L., and Zinna, G. (2020). Risky bank guarantees. *Journal of Financial Economics* 136:490–522.

Reinhart, C. M., and Rogoff, K. S. (2011). From Financial Crash to Debt Crisis. *American Economic Review*, 101, 1676–1706.

Reinhart, C. M., and Rogoff, K. S. (2013). Financial and Sovereign Debt Crises: Some Lessons Learned and Those Forgotten. IMF Working Paper, WP/13/266.

Reis, R. A. M. R. (2017). Can the Central Bank Alleviate Fiscal Burdens? CEPR Discussion Papers 11736.

Rossi, A., Lecomte, E., Legrand, T., and Nguyen, B. (2023). French sovereign debt liquidity: main factors, recent developments and resilience during the Covid crisis. Banque de France Bulletin, No. 246/1, May/June.

Selva, B. B., Nieto, M. J., and Turk-Ariss, R. (2023). Sovereign portfolio composition and bank risk: The case of European banks. *Journal of Financial Stability*, Volume 65, 2023/101108.