DIVERSIFYING SOVEREIGN RISK IN THE EURO AREA: EMPIRICAL ANALYSIS OF DIFFERENT POLICY PROPOSALS

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Abstract

The 2010 sovereign crisis in the euro area brought to light the depth of the monetary union's structural weaknesses. In particular, it highlighted the dangers of the sovereign-bank nexus – the amplification effect resulting from sovereign debt being held primarily by domestic banks. In response, important changes have been put in place. From a crisis management perspective, new institutions were created, such as the European Stability Mechanism which acts as a lender of last resort for euro area countries in difficulties. From an ex ante perspective, the crisis led to the launch of the banking union, which comprises the Single Resolution Mechanism – including the Single Resolution Fund – and the still-pending European Deposit Insurance Scheme. In addition, a wide array of regulation has been put in place, including Basel III and MREL/TLAC requirements to reduce the need for bailouts during financial crises and therefore limit the use of public funds in resolution processes. Despite this, the regulatory debate on how banking regulation should address this sovereign-bank interdependence[1] continues today. In this paper we review the main regulatory proposals aimed at curtailing both exposure to sovereign risk and ownership concentration - two factors often associated to the broader sovereign-bank nexus. We assess their impact on bank capital and risk-weighted assets and simulate banks' responses to these measures. We find that these solutions could entail significant side effects for both banks and bond markets, highlighting the importance of completing the monetary union and, in particular, issuing a European safe asset as key measures to mitigate this vulnerability.

Keywords: sovereign debt, banking regulation, safe asset, monetary union.

JEL classification: H63, G21, G28, F45.

1 Such a feedback loop was even named as a "diabolic loop" by some authors like Brunnermeier et al. (2017).

Resumen

La crisis de deuda soberana del área del euro de 2010 puso de manifiesto las debilidades estructurales de la Unión Monetaria. En concreto, destacó los peligros del nexo entre el riesgo soberano y el bancario: el efecto de amplificación sobre la (in-)estabilidad macrofinanciera de la deuda soberana mantenida principalmente por bancos nacionales. En respuesta, se han implementado cambios estructurales significativos. Desde una perspectiva de gestión de crisis, se han creado nuevas instituciones. Por ejemplo, el Mecanismo Europeo de Estabilidad constituye un mecanismo de último recurso para prestar ayuda financiera a los países de la zona del euro en dificultades. La crisis también llevó a la creación de la Unión Bancaria, que abarca un Mecanismo Único de Supervisión, un Mecanismo Único de Resolución —incluyendo el Fondo Único de Resolución—, y el aún pendiente Sistema Europeo de Seguro de Depósitos (EDIS, por sus siglas en inglés). Además, se ha implementado una amplia gama de cambios regulatorios: la trasposición de los requisitos de Basilea III y de MREL/TLAC para reducir la necesidad de rescates durante las crisis financieras y, por lo tanto, limitar los fondos públicos utilizados en la resolución, entre otros. A pesar de esto, continúa hoy en día el debate sobre cómo la regulación bancaria debería tener en cuenta este nexo entre el riesgo soberano y el bancario. En este documento revisamos las principales propuestas regulatorias destinadas a reducir tanto la exposición al riesgo soberano como su concentración —dos factores que habitualmente se asocian con el nexo entre riesgo soberano y bancario—. Evaluamos su impacto en el capital bancario y los activos ponderados por riesgo y simulamos la reacción de los bancos a estas medidas. Concluimos que estas soluciones podrían tener efectos adversos relevantes tanto para los bancos como para los mercados de bonos, lo que implica que completar la Unión Monetaria y, en particular, emitir un activo seguro europeo, sería la solución de primer orden para mitigar esta vulnerabilidad.

Palabras clave: deuda soberana, regulación bancaria, activo seguro, Unión Monetaria.

Códigos JEL: H63, G21, G28, F45.

1. Context

The sovereign debt crisis that took place in the Euro Area (EA) in 2010 heightened the regulatory debate over how banking regulation should account for sovereign risk and the costs and benefits of assigning a zero-risk weight to sovereign exposure under a currency union. There is broad consensus that excess concentration of sovereign debt in domestic banks can lead to a weaker starting position in an event of a crisis, while central bank intervention is not always a given and can produce unintended consequences.

Nonetheless, sovereign risk presents very distinctive features. Firstly, sovereign defaults are extremely rare, especially among developed nations. However, when they happen, resulting GDP losses are substantial and the recovery periods are protracted (Reinhart and Rogoff, 2009). In addition, when combined with banking crisis, the effects can be catastrophic (Kaminsky and Reinhart, 1999).

Therefore, there has been a wide range of academic work focused on better understanding the relationship between sovereign debt and the financial system, especially in times of stress. A key part of this work relates to shedding light on the motives that drive bank holdings of sovereign debt. Certain studies show that macroeconomic variables are key determinants. For example, the deterioration of economic conditions during the global financial crisis diminished profitable and sound lending opportunities. Increased funding costs and low interest rates pressured net-interest margins making high-yield sovereign bonds an attractive investment. This led to an increase in bank's holding of public debt as macroeconomic conditions deteriorated (Castro and Mencía, 2014). Furthermore, large fiscal deficits were financed issuing debt which was partially absorbed by the banking sector inflating the balance sheets of depository institutions.[1]

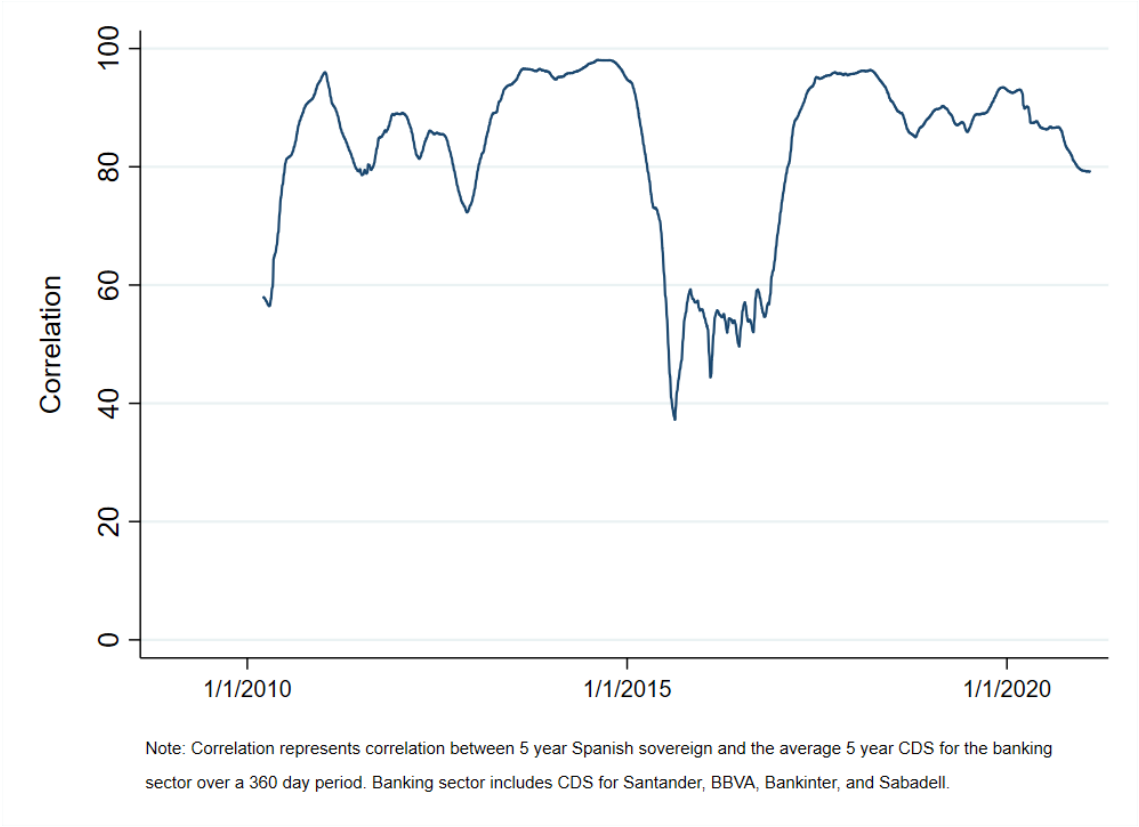
[1] More recently, during the long period of negative interest rates which followed the global financial crisis, some banks extended the maturity of their portfolios, including those of public debt, searching for yield. As a consequence, these banks were assuming increasing interest rate risks, which materialized when inflation surged and monetary policy reacted. The bad management of these risks by several medium size banks in US resulted in their resolution in

Another strand of the literature assesses the "carry trade" hypothesis under which banks would increase their holdings of sovereign debt as yields increase in order to benefit from the arbitrage opportunity arising from borrowing at low short-term wholesale rates and investing in zero-risk weight peripheral sovereign debt (Acharya and Steffen, 2013 and Battistini et al., 2013). The perception of a zero-risk of default despite increasing CDS spreads most certainly played an amplification role.

Furthermore, a bias towards holding domestic sovereign debt, particularly during crisis, presents another particularity of sovereign risk that may create a feedback loop between sovereign debt and the banking sector. This amplifies overall risk through two channels. On the one hand, increases in bank leverage can increase the probability of bank default and subsequent bail-out, heightening sovereign risk. On the other hand, increases in sovereign risk can reduce bank asset quality and increase bank leverage and default (Brunnermeier et al., 2017). As can be observed in Figure 1, correlation between sovereign and bank CDS was close to one for Spain during the 2010-12 EA sovereign debt crisis.

March 2023. However, this event should not be considered a realization of the default risk, which is the one that is mostly considered when studying the sovereign-bank nexus.

Figure 1. Correlation between sovereign and bank CDS
Percentage, %



Source: Refinitiv

Recent unconventional monetary policy has led to large asset programs by the main central banks (CB). As CBs expanded their balance sheet, they have become increasingly dominant actors in sovereign debt markets with potentially distortionary effects (Boermans & Keshkov, 2018). In that sense, CBs might have replaced banks as 'public debt holders of last resource' in the EA. Similar actions were taken during the Covid-19 pandemic, as part of the extraordinary and coordinated policy response in to such a unique shock.

Positively, sovereign debt also plays a stabilization role in the economy and in financial markets. As highly liquid assets, they are the basic collateral of any jurisdiction, especially in the interbank and short-term markets. They are also used to cover, in part, the liquidity regulatory requirements (see for example, BCBS 2013). Moreover, the implied risk-free nature of sovereign bonds functions as a reference rate for lending across the economy. Safe assets are therefore vital to the well-functioning of credit intermediation through capital markets.

Additionally, they place a key role in monetary policy as CB change money, whether currency or reserves, for quasi-money in the form of safe assets (Brunnermeier and Sannikov, 2016).

All in all, over-simplifying and leaving aside potential strategic behaviours, the main economic reasons why banks may hold domestic government debt (or increase their holdings) are:

1) In normal times: for liquidity risk and collateral management.
2) In recessions and crisis times: for macroeconomic reasons affecting the expected risk-return of available investment options; or as a protection under uncertainty.

Further to this, a well-publicized particularity of the EA is the relative lack of safe-assets when compared to other developed economies. Broadly speaking, government debt of countries rated AAA in EA account for close to 20% of total GDP compared to the USA at 135%.[2] In this sense, only three EA countries benefit from the highest credit rank, leading to considerable financial stability consequences. Investors "flight to safety" in times of stress can work as a potent amplifying mechanism in an environment of safe-asset scarcity. Common European bonds, as those issued under the NextGen EU umbrella, could partially mitigate this shortfall.

The events after the global financial crisis have brought into question the risk-free nature of all EA member debt and triggered the debate around changes to its regulatory treatment. Some authors argue that they can no longer be perceived as risk-less and should therefore no longer receive a zero-risk weight (Hannoun, 2011). While individual country risk can be debatable and is inherently dynamic, the concentration of sovereign liabilities within a country under a common monetary union evidently presents a threat to overall financial stability and a larger regulatory challenge.

In this paper we assess the impact of proposed legislation on bank capital ratios and risk-weighted assets and address some potential consequences. We also

[2] As of May 2024.

combine elements of different proposals to analyse their implications. While we simulate bank's reaction to these measures in a partial equilibrium context, results help illustrate potential unforeseen side effects.

In particular, we simulate bank's reaction to proposed legislation by regulatory treatment, with special focus on capital concentration charges. By establishing bank's reaction functions through simple buy-sell algorithms, we determine potential rebalancing in their sovereign bond portfolio and their impact on bank profitability through a proxy for interest income. Lastly, we compare reactions under different maximizations functions and stress parameters as well as compare results against a bond portfolio which follows the ECB capital key.

The rest of the paper is as follows. Section 2 & 3 describe the current regulatory framework and different proposals raised, providing necessary context for the analysis. Section 4 simulates bank reactions to different regulatory proposals in normal times and during stress episodes. Section 5 concludes.

2. Current regulatory framework

2.1 Sovereign debt regulation

The current approach to the capital treatment of sovereign exposures in the Eurozone area in part responds to Pillar 1 requirements from Basel regulation.[3] As such, banks have a choice between using a standardized approach (SA) or using their own internal ratings-based model (IRB). A special carve-out clause referenced in both Basel regulation and European Capital Requirements Regulation (CRR)[4] allows the use of SA approach under IRB subject to certain conditions. In practice, this leads to a 0% risk-weight being applied to sovereign debt in the EA for all exposures to member states.

From a market risk perspective, the framework aims to provide coverage from interest rate risk derived from the mark-to-market of sovereign debt held in the

[3] We are just considering Pillar 1 (minimum capital and liquidity requirements). Given their more qualitative nature and differences among countries, we are not considering Pillar 2 (supervisory review) or Pillar 3 (disclosure requirements for market discipline).
[4] Art 54, Basel Committee (2006) and Art.114 and Art. 150 in CRR.

trading book. This also provides banks with a choice between a model-based approach or a more lenient standardized approach. A fundamental review of the framework is being envisioned under which value-at-risk (VaR) scenarios will be migrated to expected shortfall (ES) models which better capture the non-linearities and tail-risk present in the empirical data (ESRB, 2015). In addition, sovereign debt could be subject also to migration risk and would be included for the calculation of a potential Incremental Default Risk charge and no longer receive beneficial treatment under the SA approach (BCBS 2014 Consultative Document).

Besides, we should not forget that the leverage ratio provides a non-risk sensitive backstop to sovereign debt holdings. Under this ratio, banks must hold a minimum of eligible capital as a percentage of their total assets. Since sovereign holdings are included in the asset calculation, the leverage ratio provides a hard quantitative limit to sovereign holdings regardless of sovereign risk. Importantly, we must note that the Basel framework intended the leverage ratio to act as a "backstop" and reinforce the risk-based framework but not act as the main binding constraint during normal times[5].

On the liquidity front, sovereign debt rated AAA-AA is assigned the highest quality for the liquidity coverage ratio (LCR). A special carve-out exists for domestic sovereigns below AA rating which can also be included in the high-quality bucket. This responds to the high levels of liquidity of sovereign debt even under stress. Furthermore, sovereign debt is also treated under the most preferential bucket under legislation that defines the net-stable-funding ratio (NSFR).

2.2 Relevant policy discussions

Market turmoil derived from Covid-19 brought this discussion back to the forefront of the policy debate both from a macro- and micro-prudential perspective. In addition, policy responses to the pandemic, like state-backed

[5] https://www.bis.org/fsi/fsisummaries/b3_lrf.pdf

loan guarantee schemes have potentially altered and added a layer of complexity to the sovereign-bank nexus.

From an international perspective, the Basel Committee on Banking Supervision (BCBS) has been closely monitoring the topic. In January 2015 they set up a high-level task force in charge of reviewing the issue. While their 2017 publication "The regulatory treatment of sovereign exposures" did not include changes or policy recommendations, they voiced their commitment to revisiting sovereign capital regulation. Furthermore, they commented on the possibility of applying concentration charges to the risk-weight treatment of sovereign debt.

In Europe, the ESRB published a discussion paper assessing the impact of potential regulatory reforms on banks and insurance companies (ESRB 2015). The document analyses key legislation like removing the domestic carve-out, introducing a non-zero risk-weight floor and potential diversification requirements. Importantly, the ESRB quantifies the potential impact on additional capital requirements that would results from each measure.

The European Commission has also participated in the debate with an array of policies being considered, especially in relation to sovereign capital charges arising either from excess holdings, lack of diversification, or credit-risk related. Specific policy proposals have been put forth which we explain in detail in the following section.

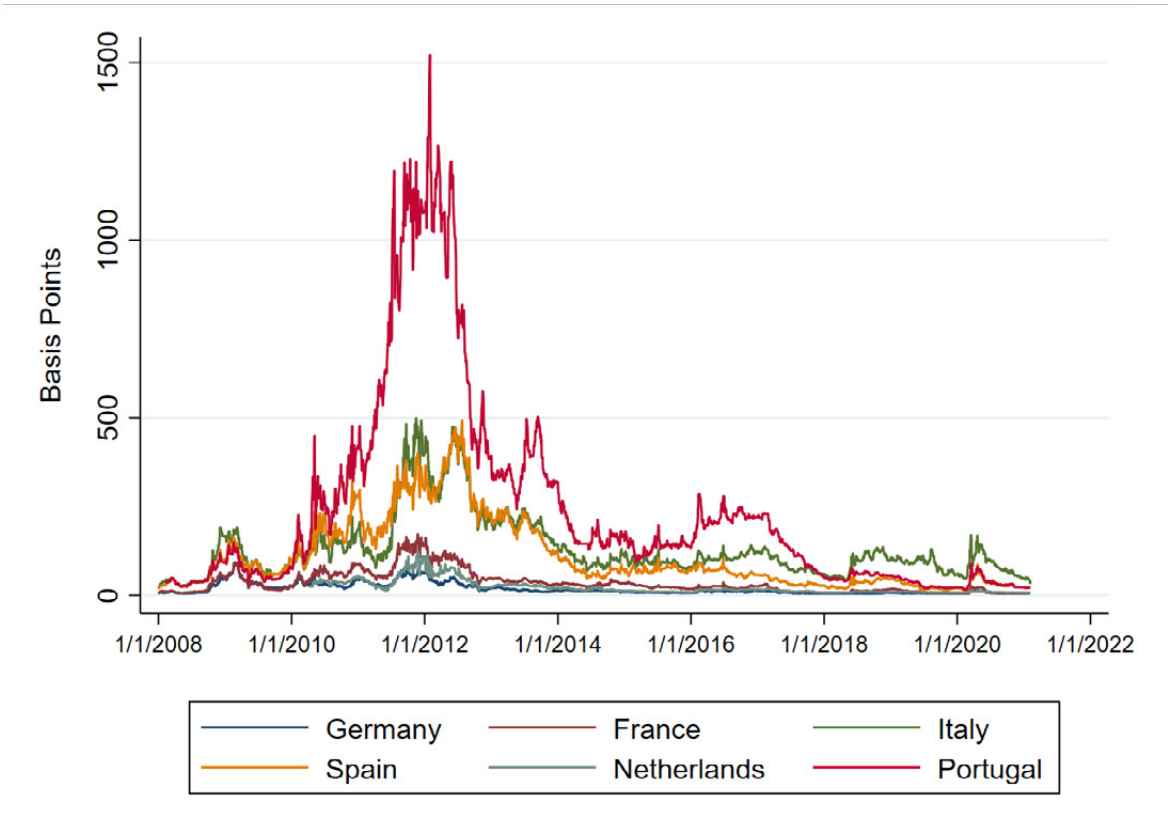
From a political economy standpoint, discussions on capital requirements for sovereign exposure have been linked to the advancement of other key items in the Banking and Monetary Union framework such as European Deposit Guarantee Scheme (EDIS).

The idea that some minimum level of diversification in bank's sovereign risk holdings in the Euro-Area reduces systemic risk seems to be prevalent among economists and the back-bone of the policy proposals discussed below. Despite this, a holistic understanding of the underlying conceptual underpinnings of this idea is necessary since different theoretical assumptions could lead to divergent policy implications.

Firstly, in practice, diversification of sovereign risk is generally limited because of the relatively low number of high-quality sovereign bonds outstanding. Sovereign debt in the EA shows a particular set of characteristics given a unique framework where a multitude of countries are issuing euro-denominated debt under a common currency and single central bank but lacking crucial elements to consider it as an optimal currency union, like a common fiscal policy. This structure affected the contagion and amplification dynamics experienced during the EA sovereign crisis of 2010. In Figure 2 below we can see how risk premia among peripheral countries exploded in relation to Germany which was perceived as a safe heaven. CDS spreads for the 5-year government bond of Italy, Spain and Portugal increased dramatically in comparison to similar maturity German bunds. In contrast, ECB intervention, improved regulation and the advances in the Banking Union –still pending to be completed-, among other factors, helped contain CDS spreads in 2020 despite the heightened uncertainty due to the Covid-19 shock. On this, the IMF (2024) finds that the intensity of the sovereign-bank nexus has moderated in many markets in the post-pandemic era.[6]

[6] Shocks to sovereign spreads impact national banks CDS spreads by less almost half compared to 2011-14.

Figure 2. European 5-year Credit Default Swaps
Basis Points



Source: Refinitiv

Secondly, there seems to be no over-arching agreement over diversification intrinsically reducing the probability of a systemic crisis event. For example, domestic exposures can act as a disciplinary device for governments. As a twin sovereign-banking crisis has larger negative consequences, home-bias can increase the cost of default for governments and acts as a deterrent (Gennaioli et al., 2018). Empirically, Craig et al. (2020), find that demanding banks to modify their holdings to increase their portfolio diversification may be ineffective in reducing portfolio risk, including tail risk. See also Alogoskoufis and Langfield (2019) who find that reforms focused on concentration could result in banks increasing their overall exposure to sovereign credit risk. Further empirical simulations show that focussing on diversification as a stand-alone measure is not enough, diversification must reduce or maintain total risk in order to have loss-absorbing properties (Bellia et al., 2019).

On the other hand, the amplification effect can be exacerbated by home-bias as countries with sovereigns that are more indebted or where banks have a larger exposure to their national sovereign, suffer larger feedback loop effects between the sovereign and the banking system (see Erce, 2015). Also, while significant progress has been made towards reducing contagion through the financial channel, less has been done to address the indirect (or real) channel (Bellia et al., 2019).

Just like home-bias, there is evidence to suggest that the sovereign-bank nexus also occurs between sovereigns and non-financial firms (eg, Angelini et al.,2014)). Policy responses to the pandemic, like state-backed loan guarantee schemes could have potentially strengthened this channel.

Furthermore, if banks' domestic sovereign debt holdings are too large, EDIS might result in de-facto sharing of fiscal risk as a common deposit insurance across national borders could lead to taxpayers in one EA country financing the insurance of depositors in others. On the other hand, without EDIS, contagion would be bi-directional as sovereign risk could impair an otherwise sound banking sector.

Lastly, EA banks compete for capital in international markets. All other key jurisdictions effectively apply a zero-risk weight to their national sovereign debt; in fact, this debate is globally perceived as an "European issue". Applying capital charges to European banks would further constrain EA profitability and exacerbate an uneven playing field.

3. Overview of policy proposals

Policy proposals to address the negative consequences ascribed to the sovereign-nexus can be split into two broad categories. The first one can be considered as non-regulatory options and relate to the creation of an EA-wide common safe asset while the second group is more closely aligned with the contents of this paper and represent "within" regulation options mostly referring to potential capital charges on sovereign debt. It is important to note that non-

regulatory does not mean independent, as it would be advisable that these proposals go hand-in-hand with a specific regulatory treatment of the common safe assets proposed. We start this section by describing non-regulatory options in order of less-to-more risk sharing and then continue analysing potential regulatory options, in this case in chronological order.

3.1 Description of some non-regulatory options that have also been suggested in the policy debate:[7]

- **National tranching (Wendorff and Mahle 2015)**: Sovereigns issue debt under different ranks of seniority called tranches. Payment to the lower tranches would be subordinated to prior payment on higher or "senior" tranches. To further diversify risk, an intermediate agent would buy these senior tranches from a range of countries and issue securities linked to the underlying cash-flows of the pool of sovereign debt.
- **European Safe Bonds – ESBies (Brunnermeier et al. 2017)**: Under this proposal a financial intermediary would buy a pool of sovereign debt weighted according to a pre-determined ratio (the ECB capital key has been proposed). This pool of assets would be financed by issuing securities under two tiers: European Safe Assets (ESBies) or European Junior Bonds (EJBies). This proposal is of similar nature to the one described above, but the process is reversed.
- **E-bonds (Monti, 2010 and Juncker and Tremonti, 2010):** This approach extends preferred creditor status to a financial intermediary created to buy sovereign bonds financed by the issuance of its own bonds similar to the functioning of the European Stability Mechanism (ESM). This intermediary would either buy debt in public markets or issue private loans to countries. Payments on its debt would come from the interest earned from these operations but could be backed up by the contributing

[7] Pros/cons and advantages/limitations of each option are not provided, as they fall outside the scope of this paper.

countries. Contrary to the ESM, this institution would operate in both periods of stress and normal times.

- **European Debt:** Debt issued under a EA budget based on state contributions or backed by an EA wide tax or a direct revenue source. This represents a full risk-sharing option and the creation of a complete European safe asset. Alogoskoufis et al. (2020) explain how an EA wide safe asset should include the following relevant features: i) high credit quality; ii) resilient to sovereign-specific shocks; iii) compatible with regulation and collateral eligibility standards. The authors also highlight that issuance should be of sufficient size and liquidity in order to have a meaningful impact on financial integration and stability. It could be said that the financing of the Next Generation EU programme was a first step in this direction.

3.2 Analysis of regulatory options

While it could be argued that the options from the previous section go more directly into the core of the problem, namely the absence of a truly EA-wide safe asset, they require significant political agreement. Under this scenario, prudential policy may work as a second best, at least for the banking sector. However, Capital Market Union would still be weighed down by this lack of a common safe asset. Regulatory options aim to curtail the concentration of sovereign risk in the banking system mostly through the application of risk-weights to sovereign exposures. Furthermore, regulatory options can be included in a broader legislative package that includes further advancement in other vital topics of EU banking integration such as EDIS, the Crisis Management and Deposit Insurance Directive and the finalization of common rules for the Capital Markets Union.

- **Non-zero sovereign risk floor (ESRB, 2015)[8]:** Under this proposal, all sovereign exposures would receive a fixed risk-weight penalization.

[8] This method has not been directly proposed by the ESRB (2015) but does appear as a potential regulatory framework in their discussion paper.

Capital requirements could be independent to portfolio composition and therefore proportional to total exposures or, on the other hand, they could be focused solely on national exposures and therefore include benefits from diversification. In this last case, increases in overall sovereign debt would only result in a capital charge if they were related to a bank's own country sovereign.

- **Removing the domestic carve-out (ESRB, 2015)**[9]: In their "Report on the regulatory treatment of sovereign exposures" the ESRB analyses the potential removal of domestic carve-out clause explained in Section I. While the report does not conclude with specific policy recommendations, this measure would lead to the application of standard risk ratings on sovereign exposures.
- **Sovereign concentration charges (Veron, 2017; BCBS 2017**): Capital charges on sovereign debt would be a function of marginal risk weights. Proposals currently have been calibrated to represent a step-wise function exempting sovereign exposures up to a certain percent of risk-weighted assets. Notably, important differences regarding proposed calibration have been seen in the literature. Veron (2017) states that exposures above 100 percent of Tier-1 should be "disincentivized" while those above 200 percent "effectively discouraged". He bases his calibration on making sure the financial system can sustain the impact of haircuts between 30-50 percent estimated from past sovereign debt restructuring events; however, he does not weigh the proposed ratios by the probability of a distress event materializing. On the other hand, the BCBS presents a significantly lower calibration but caveats that the ranges published are "just for illustrative purposes only".
- **The Eurozone Basket (Matthes and Rocholl, 2017) and European Safe Portfolio (Garicano, 2019).** Matthes and Rocholl aim to separate between the purpose of sovereign debt holdings. Under this

[9] Idem.

framework, holdings in proportion to the ECB capital key would be considered part of the regular functions of the banking system. As a consequence, they would be exempt from any capital provisions as they would be understood to be held by banks to be used as collateral in operations with the CB. Sovereign debt in excess of the proportional part of the respective country key would be capitalized under standard regulatory capital methods.

A similar approach was taken by Garicano under the framework of a "safe portfolio", where banks would face capital charges (or "concentration" charges), in proportion to the distance between their own sovereign debt portfolio and the "safe portfolio" which is considered to be the ECB capital key. Under this second approach, both excess exposure and lack of exposure penalize equally. This would provide a strong incentive for banks to migrate their exposures to the ECB capital key in what is considered by the author to be the basis of market-provided European Safe Assets without joint liability.

A combination of both capital requirements as concentration charges and credit risk has also been put forward, most notably by German ex-Finance minister Scholz in his "Position paper on the goals of the banking union". Integrating both proposals has also been contemplated by ESRB and BCBS, the latter when saying that both options can be combined.

3.3 Capital risk-weights as an incentive mechanism for diversification

The use of RWs to incentivise diversification in banks' sovereign debt holdings in the EA requires a conceptual motivation alongside a discussion over the selection of a "benchmark portfolio".

RWs are commonly used with a double purpose: i) to set loss absorbency capacity within the financial system; and ii) to shape banks' incentives. The characteristics of sovereign bonds and their relationship with country risk do not make them a great instrument on which to use RWs for loss-absorbency. But,

they could be used as an incentive mechanism to benefit diversification and penalise excessive (or undue) concentration in domestic sovereign debt.

In essence, the RWs-based scheme would be intended to work closer to the idea of a Pigouvian tax on banks' sovereign debt holdings. The objective is to make banks internalise the social costs associated with excessive concentration in their sovereign debt holdings. In this case, such social costs would be tied to increasing risks for the EA associated to an exacerbated sovereign-bank nexus resulting from insufficient diversification in banks' sovereign debt holdings. Such regulation could help in the completion of the banking union and would also help immunize banks to idiosyncratic country-specific shocks. Bank risk would better reflect Euro-Area risk, the same level at which monetary, regulatory, and supervisory policy is issued.

In this sense, the mechanism would work in the following way. Insufficient diversification in banks' sovereign debt holdings leads to increases in sovereign-bank nexus which represent higher social costs for the EA from amplification and contagion dynamics in times of stress. This higher social costs would be internalized by the banking system through appropriately calibrated risk-weights. Despite this, it is important to note that this nexus still exists regardless of banks' sovereign debt holdings.

A broader discussion beyond the scope of this paper is the appropriateness of different 'diversification benchmarks'. The ECB Capital key is the proposed reference in the ESBies to determine the share assigned to each national sovereign debt in the pool of EA sovereign debt and is the most common reference used in the applied literature, but it may not be the optimal portfolio from risk-return standpoint (also see Craig et al., 2020).

Importantly, Brunnermeier et al. (2017) calculated that in an adverse scenario, a pooled portfolio (based on ECB capital key weights) would have an expected loss rate of just under 4%, requiring legal seniority to certain tranches to make an AAA bond, therefore highlighting how the diversification towards the ECB capital key could be insufficient in itself.

Positively, moving bank portfolios to more closely reflect the ECB capital key does allow for an easier transition to a market-based European Safe Assets (see Garicano, 2019) since purchases by FI would match commercial banks and CB balance sheet.

4. Empirical analysis and bank simulation

4.1 Initial evaluation

In this section we run an empirical analysis of the impact of the different regulatory proposals described above would have on banks' risk-weighted assets and CET1 capital ratios. We use balance sheet data from the 2023 EBA Transparency exercise disclosures on sovereign exposures and other assets. We use total gross carrying amount of direct on balance sheet exposures for sovereign debt holdings as of June 2023. [10]

In Table 1 below we show current sovereign exposure by country where the bank is domiciled (Y-axis) and the nation of exposure (X -axis). As can be seen, the diagonal, which represents the same country of origin and exposure shows the highest level of concentration clearly highlighting home-bias among EA members.

Interestingly, the table also reveals insights into banks capital allocation decisions and subsidiary exposures. For example, Belgian and Portuguese banks have over 10 percent of their Tier 1 capital invested in French sovereign debt. Dutch, and Italian banks have slightly 10 percent of Tier 1 capital invested in German sovereign debt. In this sense, banks seem to be both arbitraging in search for yield between sovereign debt exposures given the common zero risk-weights as well as implicitly choosing their de-facto safe asset.

[10] item 2023810. We exclude banks with over 1,000 percent exposure of sovereign debt to Tier 1 Capital.

Table 1. Heatmap of Sovereign Exposures as a Percentage of Tier 1 Capital.

Percent, %

Country of Bank	Country of Exposure																
	AT	BE	CY	DE	EE	ES	FI	FR	GR	IE	IT	LI	LU	MT	NL	PT	SI
AT	33.4	2.2	0.0	5.2	0.1	0.8	0.1	2.9	0.0	0.5	1.7	0.3	0.5	0.1	0.5	0.2	2.1
BE	2.2	94.6	0.0	3.0	0.3	7.5	0.2	12.2	0.0	3.4	4.2	1.5	1.4	0.1	0.7	0.7	2.3
CY	1.2	2.0	62.6	0.5	0.0	2.4	0.0	2.2	0.0	0.0	1.2	0.0	4.0	0.0	0.0	0.0	0.0
DE	4.5	3.8	0.1	66.6	0.0	6.2	2.5	8.3	0.8	0.8	16.0	0.0	0.4	0.0	1.5	0.6	0.2
EE	3.0	5.4	0.0	0.0	20.7	0.0	0.1	1.8	0.0	0.0	0.0	31.0	0.0	0.0	0.0	0.0	0.0
ES	0.1	3.8	0.0	0.5	0.0	127.1	0.2	2.8	0.0	0.1	27.4	0.0	0.7	0.0	0.0	6.0	0.0
FI	0.3	1.2	0.0	4.0	0.2	0.0	2.5	0.2	0.0	0.0	0.0	0.1	0.0	0.0	1.1	0.0	0.0
FR	0.8	7.0	0.0	7.3	0.0	5.0	3.5	101.4	0.3	0.8	10.2	0.0	2.0	0.2	1.4	1.4	0.2
GR	0.2	6.6	5.4	3.3	0.0	14.3	0.0	1.7	152.1	0.0	32.2	0.1	3.3	0.0	0.0	2.2	0.0
IE	0.2	2.3	0.1	5.3	0.0	15.0	0.0	6.1	0.1	16.2	26.1	0.0	1.3	0.0	0.3	0.9	0.0
IT	6.0	2.8	0.0	13.4	0.0	23.6	0.5	13.3	0.0	1.0	162.0	0.0	0.3	0.0	0.7	2.4	0.6
LI	0.2	0.9	0.0	2.8	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0
LU	0.7	23.4	0.0	5.8	0.0	17.4	0.0	26.6	0.0	1.3	1.0	0.5	32.8	0.0	0.8	1.0	0.3
MT	12.8	13.5	1.4	40.7	0.3	10.7	0.0	13.6	0.0	3.4	16.3	1.6	7.6	108.8	5.0	1.1	2.6
NL	3.8	19.0	0.0	12.0	0.0	4.3	3.3	6.2	0.0	0.2	1.6	0.0	3.4	0.0	33.8	0.0	0.0
PT	4.6	16.4	0.1	10.9	0.0	50.0	0.0	30.9	0.0	10.2	5.7	0.1	1.3	0.0	2.4	114.1	0.6
SI	5.0	7.2	0.5	2.7	0.3	2.6	0.1	5.4	0.0	2.9	1.4	0.8	0.4	0.3	2.7	2.3	30.0

Source: EBA 2023 Transparency Exercise. Data as of June 2023

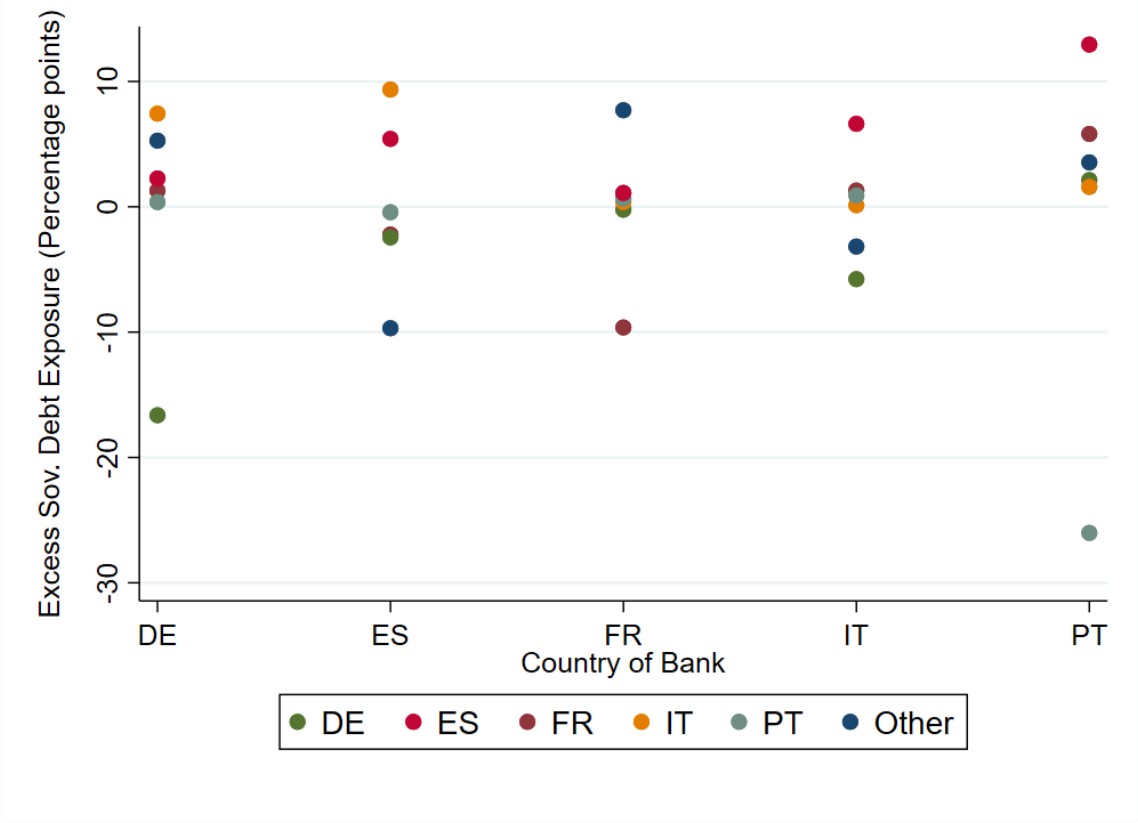
Importantly, Table 1 can also reflect cross-country ownership. For example, a bank with a subsidiary in another Eurozone country, should presumably have exposure to that foreign country's sovereign debt. This would be reflected at an aggregate level and would be just a consequence of the bank exposure to that jurisdiction that is "backed" with local sovereign debt. Since the EBA reports consolidated data, we cannot split the data at a subsidiary level to determine a more granular composition of sovereign holdings and capital. This represents a limitation to the analysis in this paper.

To better understand this limitation, we can use the geographical break-down of assets and compare this with sovereign debt exposure.[11] A broadly similar relative geographical exposure of assets and sovereign debt would suggest the existence of a cross-country subsidiary. On the contrary, a disproportionate exposure to sovereign debt compared to the underlying asset exposure would suggest the bank is engaging in portfolio-optimizing behavior. To illustrate this point, Figure 3 represents excess exposure to sovereign debt compared to assets.[12] On aggregate, the tenure of sovereign debt of all the countries banking sectors depart from the geographical split of their activities suggesting banks are also using other considerations to decide on their sovereign investments abroad. In particular, this seems to be the case for Germany and Portugal where the range of deviations seems to be the highest.

[11] We use EBA item 2320501: "Original Exposure (SA and IRB)" as a proxy for underlying asset exposure.

[12] Excess exposure is defined as the difference between the share of sovereign exposure to a country (country *i* sovereign divided by total sovereign) minus the share of asset exposure to the same country (assets in country *i* divided by total assets).

Figure 3. Excess sovereign debt exposure compared to asset exposure by Country
Percentage points



Source: EBA 2023 Transparency Exercise. Data as of June 2023

4.2 Assessing the impact of regulatory proposals

In order to assess the potential impact of the different regulatory proposals we run a static balance sheet analysis based on the different set of scenarios:

- Fixed risk weights: Applying a 4 percent or 6 percent risk weight to national sovereign exposures.
- Risk-based weights: Applying risk-weights based on Fitch credit rating. We use the low and the high end of BCBS illustrative example (BCBS, 2017 and Table 2).

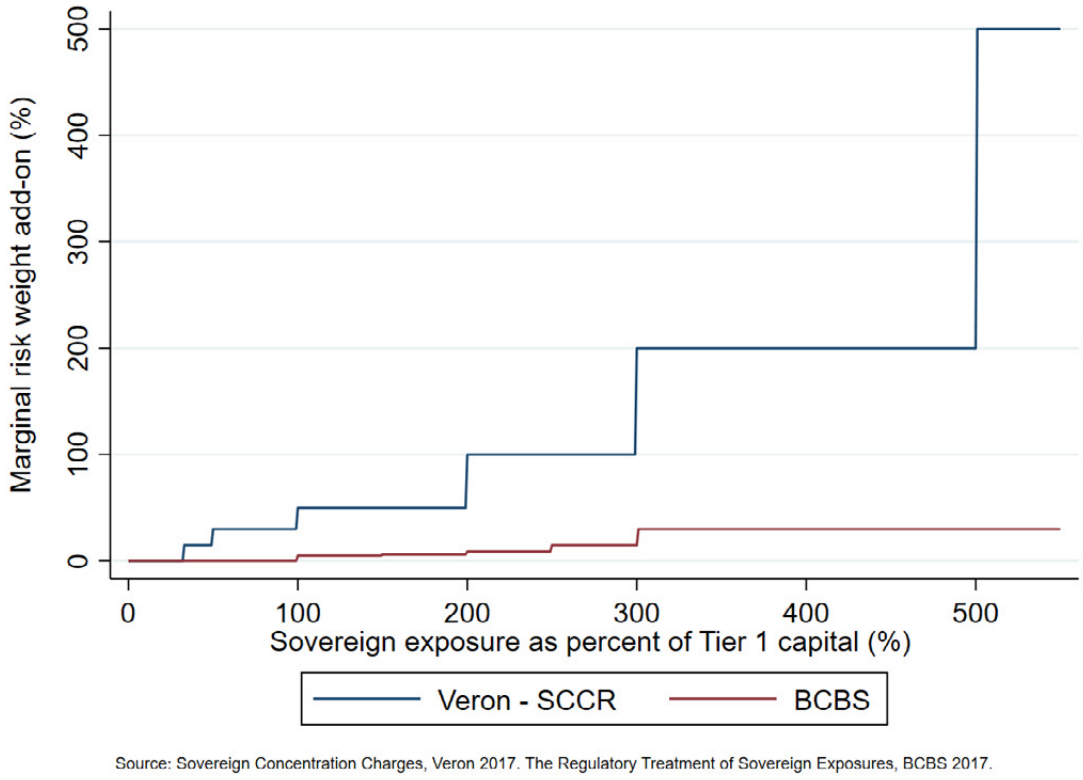
Table 2. Marginal Risk Weights Comparison
Percent

	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Standard Approach	0%	20%	50%	100%	150%	100%
BCBS Illustrative Proposal	[0-3%]	[0-3%]	[4-6%]	[7-9%]	[7-9%]	[7-9%]

Source: Sovereign Concentration Charges (Veron 2017), The Regulatory Treatment of Sovereign Exposures (BCBS 2017)

- Concentration charges: We use marginal risk weights following Veron (2017) and the BCBS (2017). The path of concentration charges based on sovereign exposure as percent of Tier 1 capital can be seen in Figure 4.

Figure 4. Marginal Risk Weights Comparison
Percent



Source: Sovereign Concentration Charges (Veron 2017), The Regulatory Treatment of Sovereign Exposures (BCBS 2017)

Importantly, our analysis in this section is based on static-balance sheets and does not take into account potential shifts in asset allocation from banks to respond to portfolio rebalancing. In that sense, this can be seen as a picture of how the banking system would look today before any of the proposals were implemented.

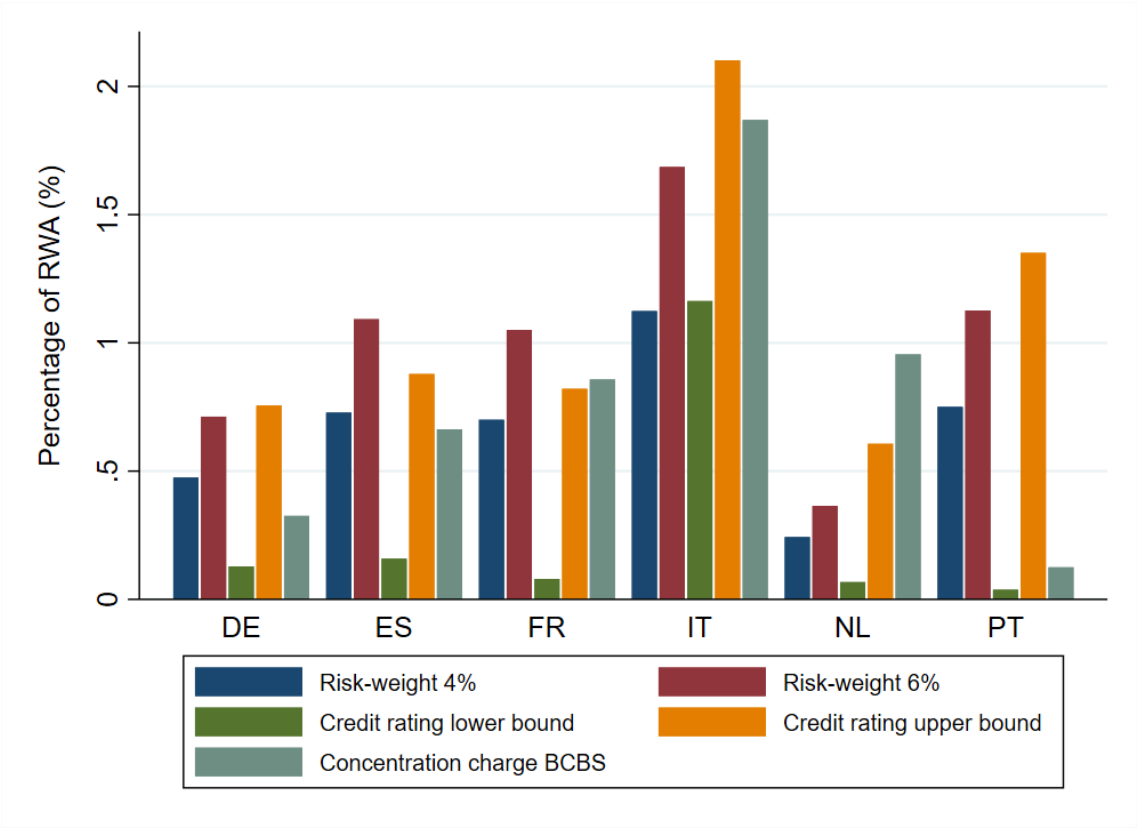
4.2.1 Impact on RWA

We calculate the percentage change in RWA by type of regulatory treatment in Figure 5 below. This is simply the direct increase resulting from applying each of the proposed measures to sovereign debt divided by total aggregate RWA of each country as of June 2023.

Some general trends stand out among the 6 largest EA countries from an aggregate perspective. For countries with investment grade national debt, the lower marginal risk weight of credit rating proposal has the lowest impact. This

excludes Italy which is significantly impacted by this measure by around 1 percent of RWA, as BBB debt would have a 4 percent risk-weight. Concentration charges following the BCBS illustrative example seems to be the most punitive for the Netherlands. A flat 6 percent risk weight on national sovereign holdings has the highest impact for Spain and France while the upper bound proposal based on credit rating risk-weights has the strongest impact for Germany, Italy, and Portugal. We exclude the impact of concentration charges following Veron from the chart below given its disproportionate impact compared to the rest of the measures.

Figure 5. Aggregate Impact on RWA by type of regulatory treatment
As a percentage of total RWA

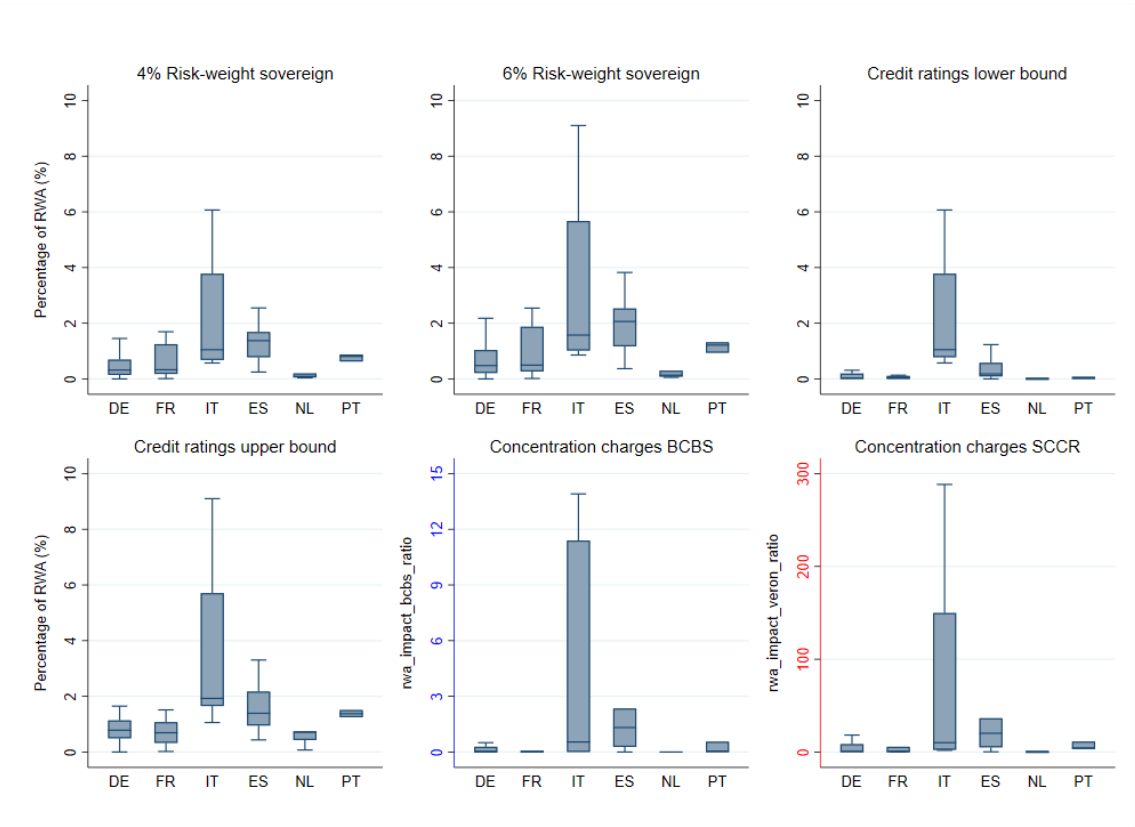


Source: EBA Transparency Exercise , Authors Calculations. Data as of June 2023.

From a bank-level perspective we include the main descriptive statistics (min, max, mean, 25th and 75th percentile) in the box and whiskers plot below (see Figure 6). We see how most proposals have an individual impact between 1 to

10 percent of RWA with a very high dispersion between and within countries. Notably, concentration charges following BCBS has roughly 1.5 times the range of other proposals, mostly attributable to relatively stronger impact on Italian banks. Finally, adding calibrations based on Veron (2017) could lead to double or triple digit impacts for many banks.

Figure 6. Bank-level Impact on RWA by type of regulatory treatment
As a percentage of total RWA



Source: EBA Transparency Exercise , Authors Calculations. Data as of June 2023.
Note: Excludes outliers defined as values outside 1.5 times the interquartile range (25th to 75th percentile).

4.2.2 Impact on CET 1

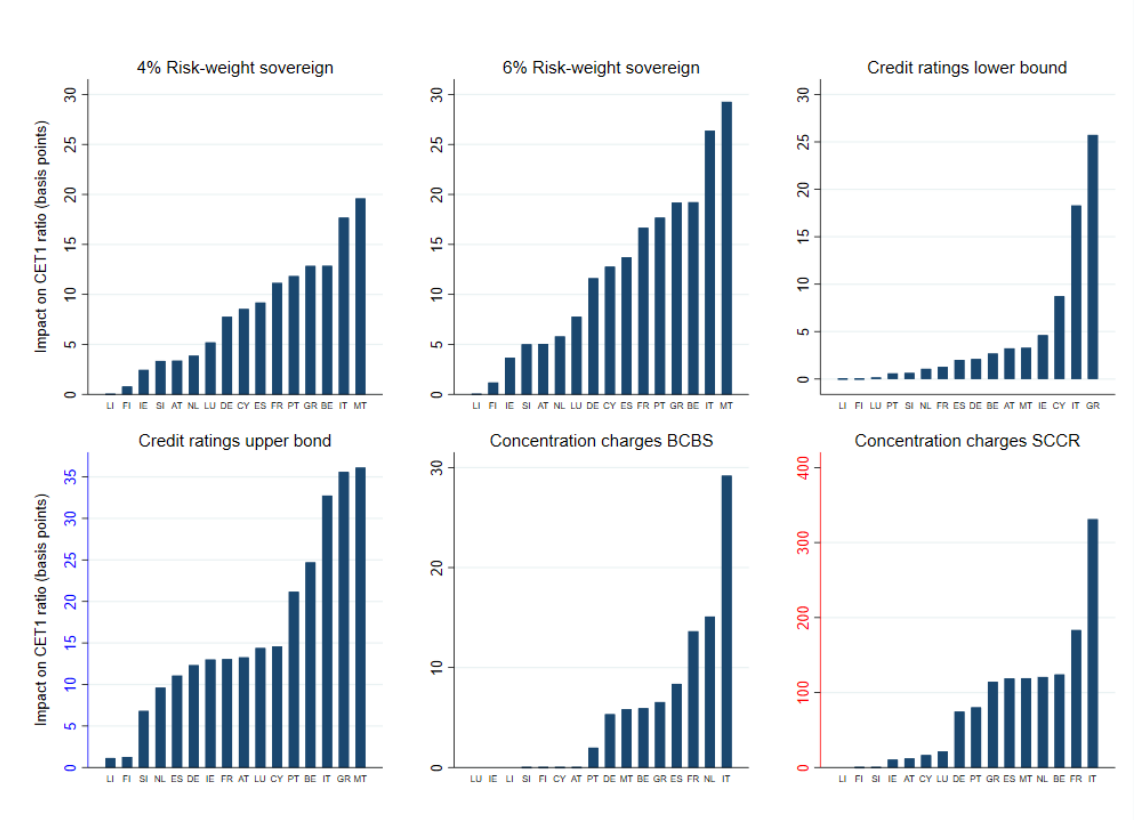
We translate RWA impacts into CET 1 ratio following a simple formula:

$$CET\ 1\ impact = \frac{CET1}{RWA} - \frac{CET1}{RWA + Incremental\ RWA}$$

Given our mapping from RWA impacts to CET 1 ratio, the general trends observed above are somewhat equivalent from a CET 1 perspective. Despite this, we would highlight that proposed regulation has on aggregate a negative impact of between 5 – 35 basis points on CET1 ratio (excluding Veron's

concentration charges). In Figure 7 below we plot the impacts for 16 EA countries.

Figure 7. Aggregate Impact on CET1 by type of regulatory treatment
Impact on CET1 ratio (basis points)



Source: EBA Transparency Exercise , Authors Calculations. Data as of June 2023.

4.3 Dynamic impact on bank portfolios

Capital concentration charges (the latest regulatory option analysed in the previous section) could pose a strong catalyst for banks to rebalance their sovereign debt portfolio.

In this section we present a simulation exercise to illustrate the effects that this policy option could have on banks' portfolio rebalancing behaviours and also for sovereign bond markets. As usual in this kind of exercises, results should be taken in perspective, as we simulate individual bank behaviour by establishing an algorithm that determines certain conditions or guidelines under which banks buy and sell sovereign bonds. We caveat that results are highly dependent on these conditions, but the aim is to establish empirically based ranges for the impact of the regulatory proposals from Section 3 in a more realistic framework

where banks' balance sheets are not static but dynamically respond to minimize the impact from regulation.

4.3.1 Bank simulation data

We use bond prices across 6 different maturities for European bonds to match EBA Transparency Exercise disclosure where longer-term maturities are proxied with a 10-year bond for simplicity.[13] We take average bond yields across 2023 as our baseline for returns. Volatility is defined as the standard deviation of the yield during the same time-frame. We decided to use a one-year window since this would better represent current trade-offs for banks given the large changes in yields over the last decade. Furthermore, since the exercise represents a decision that must be taken at a determined point in time, this would give a more current view of how bank portfolios would react. We use BCBS marginal risk weights as our starting point and focus the simulation on only 10 EA countries.

4.3.2 Bank simulation algorithm.

Our buying and selling algorithm work as follow:

- **Selling rule:** We assume banks sell all bonds that would generate a capital concentration charge. Bank's goal is to minimize RWA for every given level of returns, so the optimal decision would be to sell bonds for a given country above 100 percent of Tier 1 Capital. The decision rule minimizes RWA proxied for a sovereign bond portfolio as the sum of concentration charges (CC) times sovereign bond holdings (SB) across all countries (I) and maturities (m)

$$\textbf{Sell rule}: \boldsymbol{argmin} \sum_{\boldsymbol{m=1}}^{\boldsymbol{7}} \sum_{\boldsymbol{i=1}}^{\boldsymbol{I}} \left(\boldsymbol{CC_{i,m}} \times \boldsymbol{SB_{i,m}} \right)$$

for every given level of returns

- **Buying rule: Option 1.** We assume banks aim to maximize returns on their sovereign portfolio and will therefore buy bonds with the highest yields until they will have to incur in a capital concentration charge. We assume maturity profile remains constant.

$$\textbf{Option 1}: \textbf{argmax} \sum_{\boldsymbol{m=1}}^{\boldsymbol{7}} \sum_{\boldsymbol{i=1}}^{\boldsymbol{I}} \left(\boldsymbol{Yield_{i,m}} \times \boldsymbol{SB_{i,m}} \right)$$

[13] Maturities are 3m, 1y, 2y, 3y, 5y, and 10y.

Assuming maturity profile stays the same and subject to:

$$\sum_{m=1}^{7} \boldsymbol{SB_i} \leq \boldsymbol{Tier1\ Capital}$$

No capital concentration charge is incurred.

- **Buying rule: Option 2.** Banks buy the bonds with the highest risk-adjusted returns within the same maturity bucket. We proxy risk adjusted returns by using the Sharpe ratio; dividing the current yield by its standard deviation over the past 4 quarters. We assume a zero-risk free rate. For simplicity, we calculate each bond Sharpe ratio in isolation and do not aim maximize the Sharpe ratio at a portfolio level.

$$\boldsymbol{Option\ 2: \mathrm{argmax} \sum_{m=1}^{7} \sum_{i=1}^{I} \left(Sharpe_{i,m} \times SB_{i,m}\right)}$$

Assuming maturity profile stays the same and subject to:

$$\sum_{m=1}^{7} \boldsymbol{SB_i} \leq \boldsymbol{Tier1\ Capital}$$

No capital concentration charge is incurred.

- **Buying rule: Option 3.** Banks' goal is to reduce risk and avoid volatility. Banks will buy bonds with the lowest level of volatility during the stress period defined above. We assume maturity profile remains constant.

$$\boldsymbol{Option\ 3: argmin \sum_{m=1}^{7} \sum_{i=1}^{I} \left(Variance_{i,m} \times SB_{i,m}\right)}$$

Assuming maturity profile stays the same and subject to:

$$\sum_{m=1}^{7} \boldsymbol{SB_i} \leq \boldsymbol{Tier1\ Capital}$$

No capital concentration charge is incurred.

- **ECB capital key:** Banks buy and sell sovereign bonds in order to replicate the capital key assuming, as in the previous cases, that the size of the sovereign portfolio does not change.

$$\boldsymbol{ECB: \sum_{i=1}^{I} (ECB\ key_i \times Sovereign\ Exposure)}$$

4.3.3 Bank simulation results: changes in bond holdings

Under our simulation framework, there would be large swings in bank sovereign exposure to offset any concentration charge. Figure 8 takes the banking system's aggregate exposure by country as of June 2023 and subtracts the final amount of holdings after the simulation. The result is scaled by each country's GDP. A positive number represents that current holdings are above the simulated ones while a negative number indicates that current exposure is below simulated values post regulation.

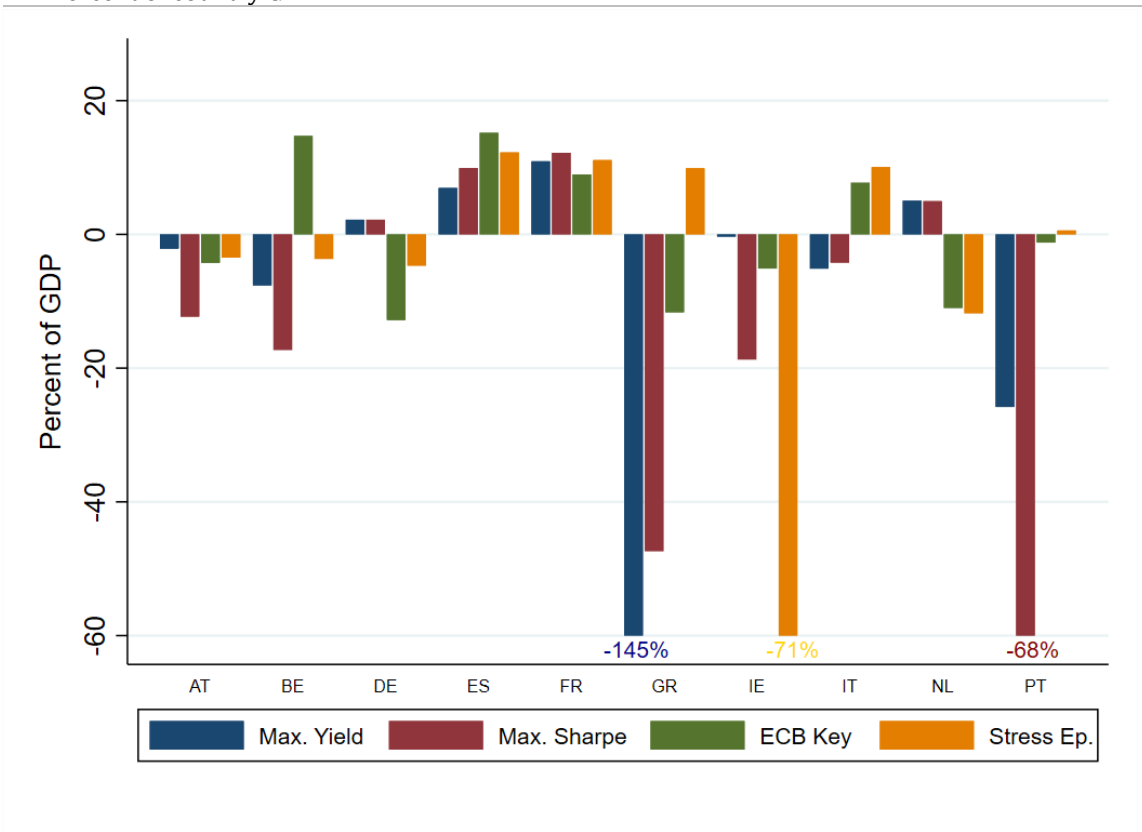
By construction, bank balance sheets remain flat, so total sovereign exposure is constant before and after the simulation both at an individual level and in aggregate. Despite this, the relative and absolute country exposure changes pre- and post-regulation. In practice, this means that overall exposure from the EU banking system to Country A can change, ultimately leading to increased or decreased demand for the respective sovereign bond.

From this dynamic perspective, and even considering very simple reactions rules (the selling and buying algorithms explained before), impacts are considerable. In other words, the impact on banks' overall capital requirements when changing current regulatory treatment for sovereign debt holdings may well look relatively low when seen in isolation and from a static perspective. But, when portfolio adjustments are considered, even small changes can trigger sizeable adjustments in portfolios compositions in order to optimise their balance sheet from both a regulatory and a risk-return perspective. This means that, in the case of imposing concentration charges, banks for which this regulatory treatment is binding (ie: their sovereign debt holdings lie above the Tier 1 capital thresholds) could adjust by implementing large changes in their relative sovereign bond portfolio in order to maximise their overall position according to the different criteria we simulate in the exercise.

From an aggregated country perspective results show:

- Current holdings of French and Spanish debt are larger than those that would result in all of the simulated scenarios, while those of Ireland and Austria are lower.
- Under the scenario where banks aim to maximize yields or buy the bonds with the highest Sharpe ratio, banks would also reduce the holdings of German and Dutch bonds and they would increase those of Italy and Belgium.
- On the contrary, bonds holdings of German and Netherlands bonds would increase if the optimal portfolio were the ECB capital key and those of Italy and Belgium would diminish.

Figure 8. Sovereign debt post simulation
Percent of country GDP



Source: EBA Transparency Exercise, Bloomberg L.P., Authors Calculations

Note: A positive number represents that current holdings are above the simulated ones while a negative number indicates that current exposure is below simulated values post regulation

4.3.4 Bank simulation results: Interest income impact

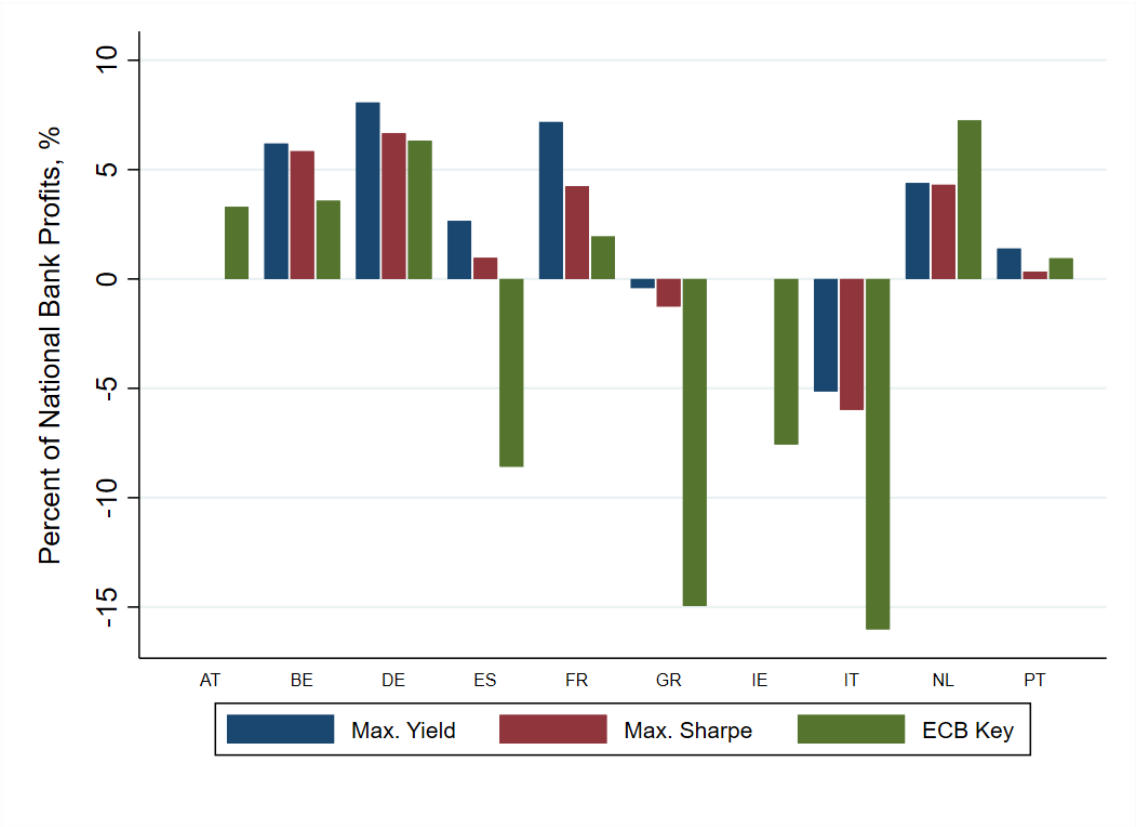
In addition to changes in the composition of bank balance sheets, there is also an interest income impact on the profit and loss statement derived from changes in sovereign holdings as post-simulation portfolios will have different average yields.

For this section, exposures are aggregated across maturities and the 5-year government bond yield for every country is used as a proxy for average returns.[14] Total exposures are multiplied by the average bond yield to determine interest income form each country exposure at each bank.

Almost by construction, our algorithm based on a yield maximizing decision process would increase interest income across all countries except for Italy and Greece who would have to sell high-yielding national debt in exchange for lower yielding foreign debt (see Figure 10).[15]

When banks are set to buy bonds with highest Sharpe ratios, results are similar but at a smaller scale. Lastly, following the ECB key would lead to significant interest income losses for banks across Spain, Greece, Ireland, and Italy. The losses could amount to as much as 15 percent of the current interest income generated by the sovereign bond portfolio.

Figure 9 Interest Income post simulation
EUR bn



Source: Bloomberg L.P., Authors Calculations.

Note: Returns are proxied using a portfolio of 5-year government bonds.

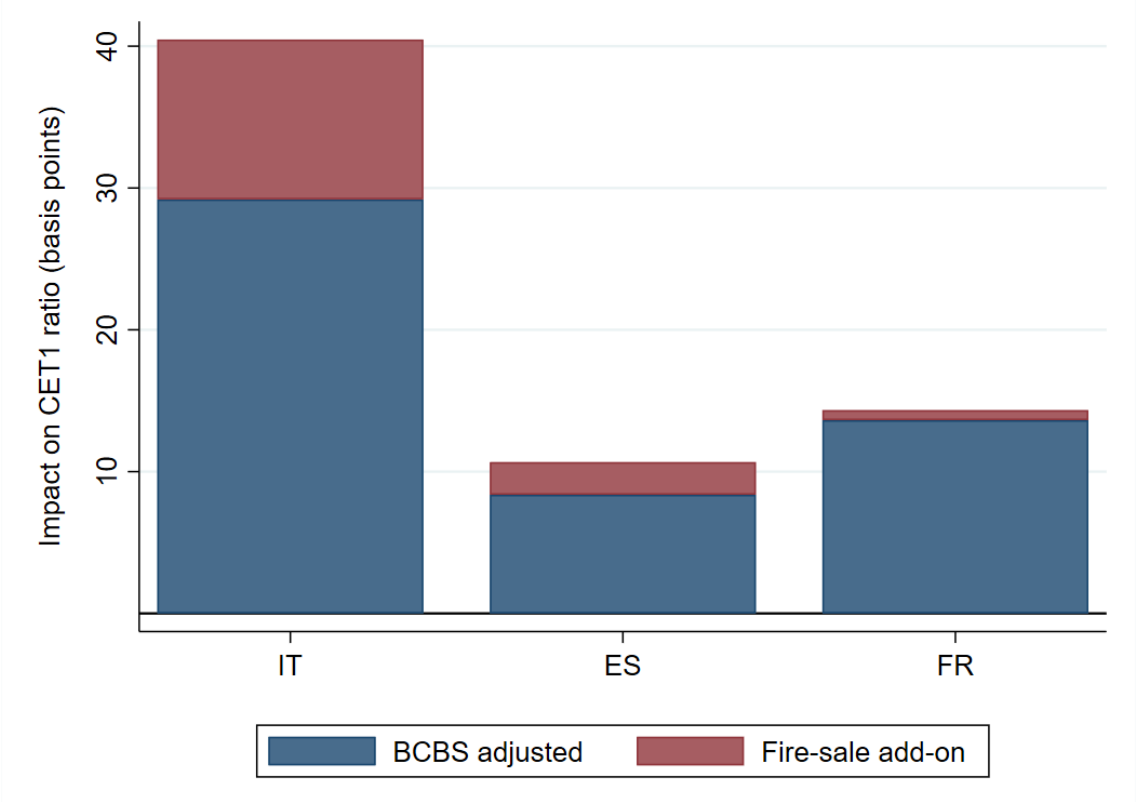
[14] Average maturity for sovereign portfolio across banks is close to 6 years, with median at 6.2 years.
[15] In addition, Austrian and Irish banks would not sell any debt under these scenarios, so no change would occur.

4.4 Bank simulation results: Confidence crises

Regulatory concentration charges could also have consequences beyond the simple concentration charges simulated in section 4.2 as regulatory limits could lead to loss of confidence by investors on the sustainability of the public debt in certain EA countries, leading to a sharp drop in demand. In this scenario, we assume non-national banks would curtail their exposure to countries considered to be riskier. Given the focus of this paper is in the banking system, we assume this excess supply would be absorbed by national banks.

We simulate a scenario where the loss of confidence of non-national banks would lead to them selling their exposure to Italian, Spanish and French bonds. We assume 50 percent of the sold sovereign bonds would be absorbed by national banks proportionally to their asset size. Then we calculate potential capital concentration charges under the new sovereign portfolio compared to our static analysis in section 4.2 As can be seen in Figure 9, the on aggregate impact would range from over 10 basis points in Italy, just under 2.5 basis points in Spain and less than 1.0 basis points for France.

Figure 9 Aggregate Impact on CET1 from confidence crisis
Impact on CET1 ratio (basis points)



Source: EBA Transparency Exercise , Authors Calculations. Data as of June 2023.

5. Conclusions

Credit institutions invest in domestic sovereign debt for well-founded economic reasons. Specifically, these markets tend to be the deepest and broadest in each jurisdiction, making public debt an ideal instrument to maintain the liquidity reserves necessary to operate safely. Furthermore, sovereign debt default events are extremely rare, especially in the case of developed economies, which is why they tend to constitute the economy's safest asset. This means that their price not only reflects the structural characteristics of that economy (potential growth, macroeconomic risk, etc.) but also constitutes the risk-free interest rate from which the profitability of the rest of the financial instruments is determined, therefore constituting the most valuable collateral. This makes public debt a particularly attractive instrument in situations of uncertainty and when the economy is in recessionary phases of the business cycle. Given the lack of lending opportunities in terms of risk-return, entities can also try to exploit the difference in profitability that they present compared to their main funding source, deposits.

However, holdings of public debt on bank balance sheets can also give rise to vulnerabilities, as result of the transmission of risks between the sovereign and banks. This vulnerability materialized after the global financial crisis in what was called the sovereign debt crisis of the euro area, affecting banks. The interaction of the crisis with the institutional deficiencies within the European monetary area, which lacks a common safe asset, made the sovereign-bank link especially dangerous.

The institutional reforms implemented in the Eurozone and the European Union since then, the Basel 3 profound review of banking regulation and the implementation by central banks unconventional monetary policies have prevented a crisis of the same nature from being repeated in recent years despite the multiple disturbances that the financial system has suffered, even although they implied notable support from fiscal policy. However, some academics and practitioners at the European level consider that this vulnerability is still present. In this respect, there is consensus in considering that the first order solution to mitigate this vulnerability is to complete the Monetary Union in Europe; in particular, to create a risk-free common European asset that could be the European collateral. This is also a critical element for the success of the Capital Markets Union.

Other solutions, such as the proposals based on reconsidering the treatment that the risk weight of these portfolios receives, which is zero, in accordance with Basel 3 could be considered second order and they could have relevant side effects. In fact, in this work, an evaluation has been carried out of the implications that the different proposed regulatory measures could have, both

from the point of view of credit institutions and of the sovereign debt markets of the euro area themselves. In fact, the implications are not negligible and could affect significantly the bond markets of several countries and the behavior of the banks.

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