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SOVEREIGN EXPOSURES OF EUROPEAN BANKS: IT IS NOT ALL DOOM

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Sovereign exposures of European banks: it is not all doom.

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Abstract

In this paper we investigate whether or not observed changes in the composition of the sovereign bond portfolios of European banks are determined by a risk-return trade-off. Banks have been shown to disproportionally invest in bonds issued by their domestic sovereign, causing a negative bank-sovereign doom loop. Several motivations for such behavior have been demonstrated in the extant literature, such as e.g., search for yield or moral suasion, which from an investment perspective all involve some degree of irrational behavior. We depart from this approach and investigate the risk-return trade-off in the bank sovereign bond portfolios. We use data from all stress tests and transparency exercises conducted by the EBA between 2011 and 2018 for a sample of 76 European banks. Using the Sharpe ratio for the risk-return assessment, we find that over the entire period banks' investments and divestments of sovereign bonds are characterized by rational risk-return considerations. Moreover, both bond risk (measured by the standard deviation of bond returns) as well as sovereign risk (sovereign CDS spreads) are negatively related to bond buying, implying that, on average, banks do not engage in excessive risk-taking behavior in their sovereign bond portfolios. Our main conclusion is that over the 2011-2018 period banks may have exhibited spells of excessive risk behavior in their sovereign bond buying, but over the entire period their sovereign bond investments exhibit a sound risk-return trade-off. These findings have implications for policy initiatives to tackle concentrations in sovereign bond holdings by European banks.

JEL classification: G11; G18; G21; G28.

Keywords: Sovereign Exposures; Risk Return; Securities portfolio; Bank balance sheet.

All remaining errors are our own.

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1 Introduction

In this paper we investigate whether or not observed changes in the composition of the sovereign bond portfolios of European banks are determined by a risk-return trade-off. The average European bank holds 15% of its assets in the form of securities, of which sovereign bonds constitute the main category. Next to their natural role as liquid investments, sovereign bonds possess a number of additional advantages for European banks. Member States' bonds carry a zero risk weight in the calculation of capital requirements, high-quality (sovereign) bonds are eligible for compliance with the LCR rules, and these bonds serve as collateral for access to the ECB's regular refinancing operations as well as the LTRO programs. Yet, banks have been accused to disproportionally invest in bonds issued by their home sovereign, especially in periods of sovereign stress. It is argued that some banks have build up excessive exposures, thereby creating a potential doom loop between European banks and their sovereigns and exacerbating the risk of contagion between sovereigns and banks (De Bruyckere, Gerhardt, Schepens, and Vander Vennet, 2013; Stângă, 2014). As a consequence, regulators and supervisors have proposed approaches to tackle the home bias by, e.g., imposing capital requirements on sovereign bond holdings or implementing diversification obligations in the sovereign bond portfolios of banks (Lenarcic, Mevis, and Siklos, 2016).

Designing an adequate regulatory response to the sovereign bond issue requires the identification of the motives behind these investments. The existing literature has proposed several hypotheses to explain why banks allocate their holdings into certain sovereign bonds: banks may search for yield or engage in carry trade behavior (Acharya and Steffen, 2015; Altavilla, Pagano, and Simonelli, 2017), banks may be subject to moral suasion by their home sovereign (Horváth, Huizinga, and Ioannidou, 2015; De Marco and Macchiavelli, 2016; Ongena, Popov, and Van Horen, 2019), or they can engage in a flight-to-safety (Buch, Koetter, and Ohls, 2016). A common characteristic of these motivations is that they involve some degree of irrational behavior by the banks. This paper takes a step back to first principles and analyzes whether or not bank sovereign bond investments in the period 2011-2018 are compatible with a rational risk-return trade-off.

Finding that banks consider the risk-return dimension is not necessarily incompatible with the alternative hypotheses treated in the literature. Therefore we diligently classify the risk-return implications of the hypotheses in order to establish which explanations are compatible with the observed risk-return patterns. Moreover, banks may exhibit temporary deviations from rational investment behavior due to a search for yield or moral suasion in certain periods of stress. Yet policy should be guided by the longer-term underlying motives for bank bond investing.

Dealing with risk-return considerations, also in sovereign bond portfolios, has become even more important since the sovereign crisis in Europe. In the period before the crisis, banks and other investors generally considered sovereign bonds risk-free investments. Apart from a small default risk premium related to the rating or a small liquidity premium, the spreads of most sovereign bonds compared to the German Bund benchmark were of a low magnitude. However, the sovereign debt crisis showed that bonds of distressed countries do carry a counterparty risk since the bonds of the countries later indicated as GIIPS exhibited widening spreads, requiring forceful action by the ECB and in some cases a bailout organized by the EFSF/ESM. Moreover, the search for yield or carry-trade in which some banks got involved backfired, e.g. Dexia bank had to be bailed out a second time in 2012 partly because of its excessive exposure to Greek bonds. Also, political events may lead to the resurfacing of a sovereign risk premium in countries deemed at risk. The case of Italy is a considered as a prominent example, since political uncertainty and the threat of non-compliance with the European budgetary framework prompted bond investors to require a substantial risk premium. Such experience should incentivize banks to diversify their sovereign exposures in order to avoid costly fire-sale losses. Hence, banks should not only focus on return but also take into account the risk dimension. The question we address is whether or not the evolution of European banks' sovereign bond portfolios is compatible with a rational risk-return trade-off over the post-crisis period. Deviations from such behavior may justify the introduction of rules aiming to reduce portfolio risk or imposing diversification.

To perform our analysis, we use data on sovereign bond holdings from the transparency exercises, capital exercises and stress tests performed by the European Banking Authority between 2011 and 2018. From these exercises we obtain data on the stock of sovereign exposures of the largest 76 European banks to 22 EU sovereigns at a semi-annual frequency. We investigate the motives why banks decide to increase or decrease their exposure to sovereign debt of EU member states, and specifically focus on the risk-return trade-off of the sovereign bonds. We capture the risk-return trade-off in several ways, primarily the Sharpe ratio and its components, as well as the CDS spread and yield to maturity (YTM) of the bonds. In order to control for bank or sovereign unobserved heterogeneity, we progressively saturate the model with bank-time fixed effects, sovereign fixed effects, and bank-sovereign fixed effects. This allows us to disentangle the return and risk drivers of sovereign bond investments by the banks.

The main findings can be summarized as follows. Over the entire post-crisis period, we find that European banks manage their sovereign bond portfolios within a sound risk-return framework. European banks take into account the risk-return trade-off of bonds: a one-standard deviation increase in the Sharpe ratio of a sovereign bond is associated with an increase of the exposure to that sovereign bond of 0.065 to 0.11 percent of the total sovereign portfolio value which accounts for 26% to 44% of the average change to an exposure. This effect is not dependent on bank characteristics but, contrary to the moral suasion story, we do find that banks in the periphery take the risk-return trade-off into account more for periphery sovereign bonds.

The analysis in this paper contributes to the prolific literature on the bank/sovereign loop in Europe. We investigate the entire post-2011 period rather than focusing on specific episodes, such as LTRO allocations or the QE era, or on subsets of banks as is done in, e.g., moral suasion papers dealing with banks from distressed countries. Moreover, we exploit the full set of regulatory disclosures on sovereign bond holdings in the framework of the stress tests and transparency exercises conducted by the EBA. The findings contribute to the policy discussion on the appropriate measures to tackle excessive bond concentrations in European banks. Our paper is also related to the portfolio allocation literature pioneered by Markowitz (1952), and, for example, analyzed in the context of mutual fund managers by Daniel, Grinblatt, Titman, and Wermers (1997) and Kacperczyk, Sialm, and Zheng (2005). In this paper, we focus on investment decisions of a different type of investor (banks) with a specific universe of investments (sovereign bonds). Therefore, the paper is also related to the literature analyzing the return commonalities in sovereign bonds, such as Leote de Carvalho, Dugnolle, Xiao, and Moulin (2014), Fontana and Scheicher (2015) and Zaremba and Czapkiewicz (2017), who find evidence of low-risk anomalies in government bonds and strong momentum effects in their returns.

The rest of the paper is organized as follows. In Section 2 we elaborate on the motivation and hypotheses. In Section 3 we discuss our methodology and data, followed by the results in Section 4, robustness tests in Section 5, before we conclude in Section 6.

2 Motivation and hypotheses

Banks have for a long time had a dominant position in the sovereign debt markets. Although other institutional investors, such as pension funds, have gained prominence, banks remain main holders of sovereign paper. Typically banks are expected to hold diversified portfolios of sovereign securities, both in terms of maturities and geographical composition. Yet, as in the case of other types of securities, there is a well-documented tendency towards home bias in bond holdings (Coeurdacier and Rey, 2013). In euro area countries, banks frequently hold between 20% and 30% of the outstanding debt of the domestic sovereign in normal times (Lenarcic et al., 2016). In some periods, typically associated with sovereign stress, banks have increased their exposures to the home sovereign. This was especially visible during the sovereign debt crisis in the euro area. Moreover, the large liquidity injections (LTRO) by the ECB aimed at restoring the liquidity of the banking system caused a build-up of domestic sovereign exposures especially in peripheral countries (Crosignani et al., 2019)

Regulators are aware that the tight linkage between sovereign and bank balance sheets magnified the severity of the European sovereign debt crisis. As a consequence, reform efforts have been undertaken at the institutional level. The bail-in requirement in the Bank Recovery and Resolution Directive (BRRD) in principle renders bailout by the sovereign impossible, replacing it with a mandatory bail-in of private creditors. In the framework of the Banking Union, mechanisms for the orderly unwinding of systemic banks have been introduced, to be administered by the Single Resolution Board. Simultaneously, backstop mechanisms such as a Single Resolution Fund and an ESM loan facility for bank sector restructuring have been established. Yet, no regulatory measures to constrain sovereign exposures at the bank level have yet been enacted. Several proposals have been launched, such as the introduction of a non-zero weighting scheme for sovereign securities for the calculation of bank capital requirements and the imposition of limits for sovereign exposures (Lenarcic et al., 2016). The objective of such measures would be to incentivize banks to diversify their sovereign bond holdings.

Our hypothesis is that diversification is the natural investor behavior of banks in sovereign bond investments. Why would banks diversify their sovereign bond holdings? There are regulatory motives as well as economic considerations.

On the regulatory front, several mechanisms are in play. First banks need to maintain adequate liquidity in order to withstand shocks in deposit or other funding markets. Supervisors monitor the liquidity position of banks, and government securities are an important source of (secondary) liquidity because they can be sold easily in secondary markets. In the post-crisis period, the liquidity rules have been strengthened by Basel 3 in the form of a liquidity coverage ratio (LCR). The LCR obliges banks to hold sufficient high-quality liquid assets (HQLA) and sovereign securities constitute the main part of these HQLA. Since a substantial fraction of banks had to build up their HQLA in order to comply with the gradual monitoring and later enforcement of the LCR, acquiring a diversified portfolio of eligible sovereign bonds was necessary for European banks. Second, banks need to comply with stricter capital regulation under Basel III, which forces them to manage the risk of their assets. Government bonds are a straightforward investment class to adapt the risk-weighted assets when a bank becomes capital constrained. Lenarcic et al. (2016) argue that restructuring bank assets towards holding more sovereign bonds alleviated capital pressure and allowed some banks to comply with the new rules without resorting to more expensive capital raising or engage in deleveraging. Third, rational banks may anticipate rulemaking in the area of sovereign concentrations. Policymakers agree that completing the Banking Union is important not only for severing the link between banks and sovereigns but also to establish a pan-Eurozone banking market and stimulate cross-border bank consolidation. However, several countries, especially some of the core countries of the euro area, have made it clear that a common deposit guarantee fund, which is the necessary third pillar of such a Banking Union (next to supervision and resolution), is only politically feasible when bank risk is sufficiently contained. Therefore all policy initiatives aimed at completing the Banking Union contain proposals to limit concentrated exposures of banks to sovereigns by implementing exposure limits or capital charges (see e.g. Bénassy-Quéré et al. (2018)). As a result, banks have the incentive to diminish large exposures to their home or other sovereigns in anticipation of explicit restrictions. Hence diversification would be a rational anticipation of the future regulatory environment.

Diversification does have a solid economic rationale. First, sovereign securities are essential assets in the banks' management of their capital adequacy and liquidity profile. The securities of most European sovereigns are considered as low risk, hence they can be used to de-risk the balance sheet and aid banks in complying with Basel-type risk-weighted capital ratios. Kirschenmann, Korte, and Steffen (2017) report that the 'sovereign subsidy' in terms of reduced capital needs was substantial for European banks. Government securities are also the most important asset class used as collateral in refinancing operations with the central bank in the form of repurchase agreements. Since banks need constant access to interbank borrowing and to the facilities offered by the ECB, maintaining a diversified pool of government bonds is essential for securing such access.

Second, when considered from a risk perspective, more diversification of sovereign exposures would make banks more resilient to shocks in the credit quality of sovereigns. In the recent past, gambling has backfired. Some banks which had engaged in carry trade behavior (see Acharya and Steffen (2015)) failed subsequently and were only rescued with costly bailouts, causing public discontent. Also, political events may cause the resurfacing of a sovereign risk premium in sovereign bond yields. Such cases should incentivize banks to diversify their sovereign exposures in order to avoid fire-sale losses. Hence, banks may use the composition of their sovereign holdings as a signaling device to market participants about their asset risk profile. This feature has gained prominence since the EBA regularly publishes the sovereign exposures of systemic European banks in the framework of its stress tests and transparency exercises. If better sovereign bond portfolio diversification improves the perceived risk profile of the banks, it may also lead to lower funding costs. Hence, as important government bond investors, banks have clear economic incentives to apply a risk-return trade-off in the management of their sovereign portfolio.

The motives for banks to hold a diversified sovereign bond portfolio lead to the following hypotheses that we investigate in the empirical analysis. The main hypothesis is that banks will apply a risk-return trade-off in the management of their sovereign bond portfolio. We expect sovereign bond investments to be positively related to the Sharpe ratio, which is a common metric to capture the risk-return trade-off in asset allocation decisions. In terms of return, the hypothesis is that increases in sovereign bond exposures will be positively affected by the bonds' return, but only when they are not associated with higher bond risk, measured as the standard deviation of bond returns over the investment horizon. Finally, the hypothesis of risk reduction conjectures that bank bond investments will be associated with lower bond risk or lower sovereign CDS spreads, consistent with banks divesting exposures to high-risk sovereigns. Obviously, the prediction that bank sovereign portfolio reallocations on average will be driven by risk-return considerations over the post-crisis periods does not exclude that this rational behavior may have been reversed in distress periods. But over the entire post-crisis era, the hypothesis is that banks revert to rational investor behavior, driven by regulatory and economic rationales. If this hypothesis stands up to empirical scrutiny, this would have implications for the appropriate regulatory approach to the issue of bank-sovereign links.

3 Methodology and data

To test our hypotheses, we estimate the following specification:

$$\Delta \text{Exp}_{i,s,t} = \beta_1 \text{risk-return trade-off}_{s,t} + \beta_2 \text{Controls}_{i,s,t} + \epsilon_{i,s,t} \qquad (1)$$

where $\Delta \text{Exp}_{i,s,t}$ is defined as the (change in) exposure to sovereign bonds of sovereign s, by bank i, at time t; where the risk-return trade-off is captured at the level of the sovereign bond s at time t; and Controls capture bank- and sovereign-level control variables.

The risk-return trade-off is captured in several ways. First, we use the annualized Sharpe ratio of the bond, calculated using daily returns on 10-year zero coupon sovereigns. We also include the regressions in which we split the Sharpe ratio in its individual components to see which component (return or risk) drives purchasing behavior. Second, we use the yield to maturity on 10-year zero coupon bonds as a proxy for the expected return and add the 5-year CDS spreads on sovereign bonds, in order to capture the (tail) risk of a default on sovereign debt.

To control for the business model of banks, we include various bank-level variables which might determine purchasing behavior. We include the log of total assets as a measure of bank size. Large banks may be diversified geographically and for that reason may be less prone to a home bias in their investment portfolio.

Capital adequacy is proxied by the unweighted equity-to-assets ratio. The expected influence of capital on sovereign bond holdings is mixed. A bank with a high capital ratio may want to protect its franchise value by lowering the riskiness of its assets, hence low-risk sovereign bonds may be attractive. On the other hand, well capitalized banks have the ability to take risk and this may incentivize them to invest in riskier assets and avoid sovereign bonds. It is important to note that sovereign bonds carry a zero risk weight in the calculation of the banks' capital requirements since all countries have taken advantage of the zero-risk exception for sovereign bonds. Bank capital may also be related to the risk-taking behavior of banks. Banks engaging in excessive risk taking are typically characterized by low capital ratios (see e.g. Altunbas et al. (2012); Berger and Bouwman (2013); Jiménez et al. (2014); Vazquez and Federico (2013); Lamers et al. (2019); Heider et al. (2019)).

The ratio of non-performing loans (NPL) to total loans is included to account for the risk profile of the banks' loan portfolios. The expectation is that banks with a more risky loan portfolio have the incentive to lower their risk profile by, e.g., investing more in low-risk sovereign securities. However, risky banks may elect to gamble and increase their risk by divesting low-risk sovereign exposures and/or increasing exposures to high-risk sovereigns.

The loan-to-deposit ratio (LDR) is considered to be a measure of both liquidity risk and interest rate risk. When a bank has a high LDR, part of the funding for its loan portfolio comes from non-deposit, and hence potentially more volatile, sources. This may incentivize the bank to hold sovereign bonds which are eligible for refinancing operations both with the central bank and via financial markets (e.g. repos).

The proportion of cash and reserves at the central bank in total assets is an indicator of the core liquidity position of a bank. Since sovereign bonds are the closest substitute for very liquid assets, the expectation is that this variable will exhibit a negative sign in explaining bank sovereign bond holdings. When a time lag is considered, we expect that banks with excess cash will invest it in sovereign securities in subsequent periods.

We also include a number of fixed effects to control for unobserved heterogeneity. Since we are dealing with a multidimensional panel we can also include pairwise fixed effects. Our baseline specification includes bank fixed effects and time fixed effects to control for bank-specific and time-specific determinants in purchasing behavior. In later regressions we also include bank $\times$ time pairwise fixed effects, and our most strict specification includes bank $\times$ sovereign fixed effects, in which we control for the fact that some banks have a preference for purchasing certain sovereigns (for instance due to home bias, or the geographical network of the bank).

The data set is a combination of several data sources on the bank and sovereign level for the period 2011:H2 to 2018:H1. We use sovereign debt exposures of 76 banks in 22 EU countries. Below we describe each data source in more detail.

Data on sovereign bond holdings are obtained from the EBA European Union-wide capital exercises, stress tests and transparency exercises. All the data are constructed based on the supervisory reporting data that is obtained through the FINREP and COREP reporting of the banks and is made publicly available on the website of the EBA. In the different exercises data is provided on gross carrying amounts of debt for a varying sample of the largest European banks.[1] The gross carrying amount of bonds is further subdivided by either the issuing country, the maturity or the accounting portfolio of the exposure. The data is reported at a semiannual frequency and spans from 2011:H2 to 2018:H1 with a data gap at 2014:H1. For the period 2015:H2 there is an overlap between the transparency exercise and stress test conducted in 2016. Since the transparency exercises are reported at more regular intervals compared to the stress test, we use the data from the transparency exercise to ensure consistency through time. To have

[1] The gross carrying amount represents a combination of exposures appraised at either fair value or at amortised cost. Since only a few exercises give data on the different accounting portfolios, we can not adjust for this difference in accounting treatment. Therefore we make the assumption that all exposures are at amortised cost as is done in previous literature (see, e.g., Altavilla et al., 2017; Buch et al., 2016). In Section 5 we add a regression to test the validity of this assumption and find that the accounting treatment of the exposures has no significant impact on our results.

a consistent number of observations across countries over time, we focus on exposures towards EU countries.

Data on sovereign bond holdings is used to measure the (change in) exposure in different ways, each capturing different considerations regarding the asset allocation within a bank's sovereign portfolio.

First, we measure whether bank i invests in or divests from sovereign s between time t and $t-1$ by creating an indicator variable that takes on a value -1 if a bank divests from the sovereign, a value of 1 if a bank chooses to invest in the sovereign, or 0 if the bank chooses neither to invest or divest:

$$\begin{cases} -1, & \text{if } \text{Exp}_{i,s,t} - \text{Exp}_{i,s,t-1} < 0 \\ 0, & \text{if } \text{Exp}_{i,s,t} - \text{Exp}_{i,s,t-1} = 0 \\ 1, & \text{if } \text{Exp}_{i,s,t} - \text{Exp}_{i,s,t-1} > 0 \end{cases} \tag{2}$$

this measure captures the extensive margin of the bank's decision, as it focuses only on whether a banks chooses to increase its sovereign holdings in a particular sovereign, whether it chooses to diminish its holdings, or whether it chooses not to change its holdings. Note that this measure does not take into account the relative size of the investment or divestment.

Second, we compute three further measures of the change in sovereign exposures that take the intensive margin of investment in the sovereign into account. Following Ongena et al. (2019), we measure the change in holdings of bank i in sovereign s between time t and $t-1$ as a percentage of the total sovereign debt portfolio of the bank at time $t-1$:

$$\frac{\text{Exp}_{i,s,t} - \text{Exp}_{i,s,t-1}}{\sum\limits_{s=1}^{S} \text{Exp}_{i,s,t-1}} \tag{3}$$

which captures the increase in the sovereign exposure relative to the size of the total sovereign debt portfolio of a bank. As such, it reflects the *within-sovereign portfolio* asset allocation of banks. Another way to measure the relative size of the change in exposure is to compute a logarithmic change in sovereign bond holdings at the bank-sovereign level:

$$\ln\left[\frac{\text{Exp}_{i,s,t}}{\text{Exp}_{i,s,t-1}}\right] \tag{4}$$

capturing the relative increase in the size of the sovereign exposure between time $t-1$ and

t. Equation 4 reflects the *within-exposure* asset allocation of banks.[2] Our final measure is the change in weight that the sovereign exposure has in the total sovereign debt portfolio of the bank between time period t and period $t-1$:

$$\frac{\text{Exp}_{i,s,t}}{\sum_{s=1}^{S} \text{Exp}_{i,s,t}} - \frac{\text{Exp}_{i,s,t-1}}{\sum_{s=1}^{S} \text{Exp}_{i,s,t-1}} \tag{5}$$

capturing to what extent the weights in the portfolio have changed between $t-1$ and t.

Our preferred measure of the change in exposure is Equation 3. For a bank with a total sovereign portfolio of 100 million euro at $t-1$, an increase for one of its sovereign exposures from 2 million euro at time $t-1$ to 4 million euro at time t would be registered as a 2 percent increase in the exposure to that country using Equation 3. While the other measures are relevant to capturing the asset allocation decisions of banks, we need to be careful with the interpretation of Equations 4 and 5 as these give the same weight to large and small exposure increases. For instance, the increase in a sovereign exposure from 2 million euro to 4 million euro would be registered as a 69 percent increase, even though the exposure only accounts for 2 percent of the new sovereign bond portfolio. Similarly, using the measure in Equation 5 would also lead the increase to be registered as a 1 percent increase in the exposure to that country, but, ceteris paribus, it would also decrease the exposure to all other sovereigns as their weight in the portfolio at time t goes down. Table 1 gives an illustration of how the different measures alter under a few hypothetical situations. [3]

Summary statistics for the different exposure measures are given in Panel A of Table 2. The mean of the within-sovereign portfolio change of 0.25% shows that on average the sovereign exposure portfolios of banks have grown over time. This slow average build-up comes with spells of large increases and decreases of the exposure to a specific country. Similar large increases and decreases are observed for both other definitions of the change

[2]The within-exposure change could also be determined as $\frac{\text{Exp}_{i,s,t}-\text{Exp}_{i,s,t-1}}{\text{Exp}_{i,s,t-1}}$. However this definition would result in a high skewness of the measure. By using the logarithmic return we obtain a more symmetric series at the cost of losing 525 observations where an exposure is reduced to zero.

[3]Note that unlike previous papers that have looked at, e.g., home bias (see e.g. De Marco et al., 2018; Horváth et al., 2015, etc.), we do not consider the weight (level) of the exposure separately as this mainly reflects previous choices regarding the build-up of exposures instead of new asset allocation considerations. In unreported analyses, we use the weight in the portfolio instead of the change in weight as dependent variable and find evidence of home bias in holdings of sovereign bonds, but our the risk-return variables are not significant for the reason that the simple weight does not capture new asset allocation considerations.

in exposures. As a check, the sum of all weights in the portfolio should always be 1, such that the average of its change should be zero. For the level we find that on average 4.55% (i.e. 1/22 countries) of the portfolio is invested in a specific country, but more interesting, this level can vary from not investing in a specific country to being fully concentrated in only one country.

[Insert Table 1 near here]

Data on different risk-return variables are obtained from Thomson Reuters Datastream. Since the EBA data does not contain the maturity decomposition in every exercise, we use the 10-year zero-coupon sovereign bond rate as the representative rate for the bond portfolio, similar to, e.g., Buch et al. (2016). We obtain this data on a daily basis and average the yield to maturity out over each biannual period to match the frequency of the EBA data. The EU countries for which we could not obtain 10-year bond yields were dropped from the sample so that we cover a total of 22 countries.[4] The other risk-return variables are obtained through transformation of the bond yield series. First, the yield series is transformed into a bond price series, taking into account daily holding period returns (HPR) as in equation 6.

$$\begin{aligned} \mathrm{P}_{s,t} &= 100 \times \left(1 + \frac{\mathrm{YTM}^{10y}_{s,t}}{100}\right)^{\frac{1}{10}} \\ \mathrm{P}^{HPR}_{s,t} &= \mathrm{P}_{s,t} + \mathrm{P}_{s,t-1} \times \left(\left(1 + \frac{\mathrm{YTM}_{s,t-1}}{100}\right)^{\frac{1}{252}} - 1\right) \end{aligned} \tag{6}$$

Realised return data are constructed by annualizing (considering 252 trading days in a year) the average of the log-return of the bond price series over each biannual period. In the same manner the realised volatility is obtained as the annualized standard deviation of the return series. The Sharpe ratio, being our main variable of interest can then be obtained by taking the ratio of the realized return and the realized volatility over each biannual period. Finally we also use the 5 year sovereign CDS rates to capture default risk of the country, which are extracted from Datastream.

[4] The 10-year sovereign bond yields could not be obtained for Cyprus (CY), Estonia (EE), Latvia (LV), Luxembourg (LU), Slovenia (SI) and Croatia (HR). The full list of countries thus consists of Austria (AT), Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Lithuania (LT), Malta (MT), the Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Spain (ES), Sweden (SE) and the United Kingdom (UK).

The evolution over time of the Sharpe ratios for the 22 EU countries is given in figure 1. We observe some stylized facts across time and across regions. First, there is a large variation in the Sharpe ratio ranging at times from -3.5 to 4.7 at others. Second, for the Core and Nordic/IE/UK regions, the evolution over time is homogeneous across countries. In the Peripheral and CEEC regions the variation is much more heterogeneous. Last, the mean over time of the Sharpe ratios is similar for all countries, with 0.39 (CZ) being the lowest and 1.52 (IE) being the highest mean Sharpe ratio. Further summary statistics are given in Panel B of table 2. The average realized return over all 22 countries is 6.7%, accentuating the persistent drop in yields since the sovereign debt crisis. Furthermore we find large differences in the yield to maturity across countries, with a low for Germany at 0.03% and a high for Greece at 25.7%. This gives banks ample opportunity to invest in high-yielding sovereigns at a higher risk, or in safe sovereigns with a lower associated yield.

[Insert Figure 1 near here]

Data on the bank balance sheet variables at the consolidated level are obtained from S&P Global Market Intelligence. The data is extracted at a biannual frequency to match the frequency of the bond holding data. Where a bank balance sheet variable is not available, it is substituted by the value of the most recently available data point before this point in time. All bank variables are lagged one period and winsorized at the 1^{st} and 99^{th} percentile. The bank variables are matched with the sovereign exposures from the EBA data based on the LEI codes that accompany the EBA data. To enhance consistency in the selected bank sample, we use a total number of 76 banks for which we have the highest data availability. Panel C in table 2 gives summary statistics for the bank-level variables. The sample includes the largest banks in the EU as shown by the size of total assets. Equity-to-assets ranges from 14.5% for the well-capitalized banks to 0.8% for the extremely under-capitalized banks, revealing a significant difference in the risk taking behavior of banks in our sample. This is further emphasised by the wide range of non-performing loans, which variable runs from 0.5% up to 59.4% at the worst times for the riskiest banks. On average the banks in our sample fund their loan portfolio with deposits and have a cash buffer of 11.0%. The profitability is on the lower side, with the pre-tax return on assets averaging 0.11% over time and across banks.

Merging the different data sources gives us a multidimensional panel varying over bank, sovereign and time dimensions. After applying all filters we have 76 banks with exposures to 22 EU countries at 13 points in time for which summary statistics can be found in the different panels of Table 2.

[Insert Table 2 near here]

4 Results

To test the hypothesis that banks take into account the risk and return dimensions of sovereign bonds when managing the portfolio, we estimate equation 1 using different measures of (the change in) sovereign exposure. Each table is structured in three parts for the different risk-return measures. Columns (1)-(3) show the results for the Sharpe ratio, columns (4)-(6) the results for the return and the volatility of the returns and columns (7)-(9) the results for the yield to maturity. Furthermore each set of columns is saturated with different fixed effects. In columns (1), (4) and (7) we use bank, sovereign and time fixed effects, in order to control for possible unobserved heterogeneity in each of the 3 dimensions separately. In columns (2), (5) and (8) we add bank-time fixed effects to absorb all bank-level heterogeneity in determining investments or divestments. In columns (3), (6) and (9) we add bank-sovereign fixed effects allowing us to exploit only the time variation within a bank-sovereign pair. We begin by analyzing the extensive margin before turning our attention to the intensive margin.

Table 3 shows the results from estimating equation 1 for the extensive margin of the within-sovereign portfolio change. The extensive margin takes on the values -1 or +1 for a decrease or respectively an increase of the within-sovereign portfolio change or 0 when there is no change. This variable can be interpreted as the decision management takes whether or not to invest in or divest a certain sovereign. The table is structured in three parts for the different risk-return proxies. Our main variable of interest is the Sharpe ratio because it captures the risk-return trade-off in bank bond investments. Columns (1) and (2) in Table 3 show that the decision to invest in a sovereign bond is significantly positively associated with the Sharpe ratio, indicating that banks operate as rational investors. In terms of economic significance, a 1-standard-deviation increase in the Sharpe ratio (=1.526) translates into a 4.1% higher likelihood that the holding of the sovereign increased. When the bank-country fixed effects are added in column (3), the coefficient on the Sharpe ratio remains positive and significant, confirming the hypothesis that banks act as rational investors, even when controlling for a preference that they might have to invest in a specific country. When we consider the components of the Sharpe ratio in columns (4)-(6) we find that the probability of investing in a bond loads positively on the bond return and negatively on the volatility of the bond returns and both effects are statistically significant. This implies that banks not only consider the return of the bonds in which they invest, but they also avoid sovereign bonds with a higher risk, consistent with a riks-return trade-off. Columns (7)-(9) show the results when using the YTM as risk-return measure. The YTM has a significantly negative coefficient even when controlling for the risk of the sovereign as proxied by the CDS spread. This finding strengthens the view that banks act as rational investors and that they exhibit forward looking behavior. As De Marco et al. (2018) note, when investors expects a higher future YTM on a sovereign bond, this translates into a lower expected future bond price and thus a lower bond return. Banks avoid to invest in bonds of which they expect the YTM to rise and therefore a higher YTM will be associated with a lower exposure. A 1-standard-deviation increase in the YTM of a sovereign (=2.858) is associated with a 3.0 to 9.3% lower likelihood of increasing the holding of that sovereign. These findings are not compatible with the search for yield hypothesis, according to which banks would only take the yield into account when selecting a bond to invest in. The CDS spread of the sovereign is added to all regressions to control for the perceived default risk of the sovereign. We find that the coefficient is negative and significant confirming that banks are risk averse when deciding in which bonds to invest. The coefficient for the home country dummy is insignificant, implying that over the entire period when banks decide to invest in a country or not, the home bias consideration is less important then the risk-return consideration.

The results show that banks take the risk and return profile of sovereign bonds into account when deciding whether or not to invest in a country. The decision to invest in a country is however only the first step in the portfolio selection process. When the decision to invest in a country has been made, the second decision is how much to invest in that country.

[Insert Table 3 near here]

In Table 4 we present the results from estimating equation 1 for the intensive margin of the within-sovereign portfolio change. Whereas the extensive margin only explains the selection of a sovereign bond, the intensive margin also accounts for the amount of the investment in a sovereign bond. The results corroborate the findings in Table 3. Columns (1)-(3) show a positive and significant coefficient for the Sharpe ratio, implying that when deciding how much to invest in a sovereign, the risk-return trade-off is taken into consideration. A 1-standard-deviation increase in the Sharpe ratio of a sovereign bond is associated with an increase in the bond holding by 0.065% to 0.11% of the total sovereign portfolio. This corresponds with a range of 26 to 44% of the average change in the within-sovereign portfolio measure (= 0.248%). The regressions for the separate components of the Sharpe ratio show that the amount invested in a sovereign loads positively on the bond return and negatively on the volatility of the bond returns and both are significant. This implies that when deciding on the amount to invest in a sovereign, banks consider the return of the bonds in which they invest, whilst avoiding bonds with a higher risk. The CDS spread is again negative and significant, even when including the volatility of the bond, confirming that up and above symmetric investment risk, banks avoid investing in countries with a high tail risk or default risk. In contrast to the insignificant negative coefficient of the home bias dummy in the regression for the extensive margin, we now find a positive coefficient that is significant for columns (2), (5) and (8). This result in combination with the insignificant coefficient for the home dummy in Table 3 implies that over the whole period an investment in the home country has no preference over an investment in other countries, but when the choice to invest in the home country is made, the size of the investment is larger than that in other countries. However, we avoid drawing any conclusion from this as it is not robust to a change in the dependent variable as we show in section 5. For the bank control variables we find a negative and significant coefficient for total assets implying that larger banks on average increased their sovereign holdings less than smaller banks. Bank capital is not found to have a significant impact. Likewise we do not find significant results for the NPL/Loans variable. The positive and significant coefficient of the loans to deposit ratio confirms our hypothesis that banks with a higher LDR in the previous period need to fund (part of) their loan portfolio with potentially more volatile non-deposits. This might incentivize the bank to hold sovereign bonds which are eligible for refinancing operations with the central bank or the financial markets. The positive and significant coefficient for the lagged cash to total assets implies that sovereign bonds can be used as a substitute for very liquid assets. When we run the regression with contemporaneous bank variables, the coefficient of cash to total assets becomes negative and significant, further supporting the substitution hypothesis.

The results so far indicate that banks are taking risk-return considerations into account when deciding in which countries and how much they invest. The finding that the coefficient on the volatility of bond returns is significantly negative is compatible with risk-avoiding behavior, but not with a search for yield or a moral suasion explanation.

The evolution of the Sharpe ratio over time and across countries shown in figure 1 demonstrates that the Sharpe ratio is time-varying. Different countries exhibit different Sharpe ratios over the period, implying that no country is permanently considered to represent the best risk-return trade-off. The implication is that, given the finding that banks target a positive Sharpe ratio in their bond investments, this will lead to more diversification in bank sovereign bond portfolios over time, which is the outcome desired by regulators and supervisors.

Combined these results are consistent with the hypothesis of sound risk-return behavior by banks in the sovereign bond investment decisions over the 2011-2018 period.

[Insert Table 4 near here]

4.1 Risk-return considerations after the introduction of UMP

Over the period between 2011 and 2018, the ECB directed various programs under it's non-standard measures. From 21 December 2011 until 26 February 2015 the ECB engaged in LTRO I and II, which were followed by TLTRO I, II and III in June 2014, March 2016 and March 2019 respectively. Under the programs, banks could obtain additional credit against adequate collateral. Among the eligible assets for collateral were securities issued by the public sector of countries in the Eurosystem. Besides the refinancing operations, the ECB conducted the public sector purchase programme (PSPP) between March 2015 and December 2018. Under this programme the Eurosystem organized net purchases of public sector securities in alignment with the ECB capital key. It is possible that these programs directly or indirectly changed the behavior of banks over the sample period. For instance, due to the eligibility of all Eurosystem sovereign bonds as collateral, banks could have purchased more cheap and thus higher-yielding bonds. This could distort the effect of the risk-return trade-off and be more consistent with the search for yield hypothesis. Therefore we add a time dummy that is 1 for the period after June 2014 and interact the post 2014 dummy with our risk and return measures, thereby testing for a change in the relation over time. (see e.g. Heider et al. (2019)).

Table 5 reports the results for the intensive margin. Columns (1)-(3) show the results for the Sharpe ratio. We find that the previously obtained result on the risk-return dimension is mainly driven by the post-2014 period. Only in the within dimension (column (3)) the coefficient of the pre-2014 period appears significant. For the separate components in columns (4)-(6), we find that the positive loading on the realized return is only significant in the within dimension, where it increased after 2014. For the realized volatility, we find an attenuation of the negative coefficient post-2014. The results indicate that since the introduction of the PSPP, the changes to banks' sovereign exposures are associated with a positive risk-return trade-off and that the realized return was an important driver in this association. For the YTM in columns (7)-(9) we find that the coefficient increased significantly after the PSPP started and even turns positive, which implies that banks increasingly searched for the higher yielding bonds in an environment of low interest rates. It is important to note that this increased search for yield is combined with a decreased risk aversion. In columns (1)-(3) and (6) we find that the loading on the CDS rate increased after the introduction of the PSPP.

[Insert Table 5 near here]

4.2 Different behavior for different regions

A second aspect of the time period is the sovereign debt crisis during the years 2010-2012. Due to the heterogeneous impact this had on different regions within the euro area, we investigate whether there was also a different impact for the risk-return trade-off. We split the sample between GIPS countries, which were hit hardest, and other countries, both for the banks and for the sovereign exposures they hold. The analysis is performed in one step by interacting our variable of interest with regional dummies for both the bank and the exposure.

Table 6 presents the results of the regression for the regional split. Our main interest is to see if banks invest differently based on the location of their home country. The results for the Sharpe ratio are given in columns (1)-(3). The coefficient of the interaction term $\text{BANK}_{GIPS} *$ Sharpe ratio indicates that the exposures of banks located in the GIPS region are significantly less associated with a risk-return trade-off than their counterparts in the non-GIPS region. However, when the exposure is towards a GIPS sovereign, we find that the association reverses as shown by the positive significant coefficient of the $\text{SOV}_{GIPS} * \text{BANK}_{GIPS} *$ Sharpe ratio interaction term. For a bank located outside of the GIPS region, we do not find a difference in treatment of exposures to a GIPS sovereign as given by the insignificant coefficient of $\text{SOV}_{GIPS} *$ Sharpe ratio. We can conclude from these results that there is substantial heterogeneity in the way banks take the risk-return trade-off into account, based on their location. Specifically, banks located in a GIPS region do not seem to take the risk-return trade-off into account when investing in a non-GIPS sovereign. Other motives such as diversification or flight-to-safety might be at play (Buch et al., 2016).

Column (6) of table 6 gives the result for the separate factors of the Sharpe ratio with bank-country fixed effects included. These components of the Sharpe ratio shed more light on the results obtained in columns (1)-(3). We find that the largest contribution comes from the realized return component, especially in the within dimension in column (6). In general, an increase in the exposure to a country is associated with a positive realized return. If the exposure is to a GIPS country, the association with the realized return is significantly lower. For banks located in the GIPS region, the association is exactly the opposite. The association with the realized return is significantly higher for exposures to a GIPS sovereign.

[Insert Table 6 near here]

To enhance the interpretation of the coefficients for the different interactions, we add Table 7 with the combined effects for each region for the regression of the model including bank-country fixed effects. We find that the investments of banks in the non-GIPS region are associated with a risk-return trade-off as well for the non-GIPS as for the GIPS sovereign bonds. For banks located in the GIPS region, we find that they are only considering risk-return measures when investing in GIPS sovereign bonds.

[Insert Table 7 near here]

4.3 Impact of bank business model characteristics

In table 8 the interactions of the Sharpe ratio with different balance sheet characteristics are taken. The motivation here is that managerial decisions on other parts of the balance sheet might force banks to take a more rational approach towards their sovereign bond portfolio. The results show that only the interaction with the level of equity in the balance sheet is significant. It indicates that a bank that takes the risk-return trade-off into account when investing in sovereign bonds, is on average associated with a higher level of equity and thus as a more risk averse bank. The non-interacted bank control variables remain the same as in the baseline model for the intensive margin.

[Insert Table 8 near here]

5 Robustness

In this section we test if the results from our analysis hold under different specifications.

To test the impact of the calculation of the change in the exposure, we use two different definitions for the change as explained above in section 3. Table 9 gives the result when the change is calculated as a growth measure, in the same way as logarithmic returns are calculated. In this way of calculating changes, we should pay attention to the higher weight that it will give to absolute changes to small exposures over changes to large exposures. The results are shown in table 9. Again, these results are in line with the baseline specification. However columns (4)-(6) show that there is a larger loading on the volatility than before. This heightened significance could indicate that banks pay more attention to volatility when they invest in countries that only constitute a smaller portion of the sovereign bond portfolio.

[Insert Table 9 near here]

The second alteration to the definition of the dependent variable is by defining it as the difference between the percentage held in a bond in the current period and the percentage held in the same bond in the previous period. The results in Table 10 corroborate the previously obtained results. The coefficient of the home dummy is no longer significantly positive. As before under the extensive case, the coefficient for the YTM becomes significantly negative. For the Sharpe ratio and its separate components, we find the same direction and significance as for our baseline specification.

[Insert Table 10 near here]

Finally we test whether our results might be driven by a mechanical effect due to accounting rules forcing banks to adjust the value of sovereign holdings when the fair value has increased. In the transparency exercises of 2016, 2017 and 2018 the EBA provided data on the accounting classification of the sovereign bond holdings. Exposures are classified as either "Held for trading", "Designated at Fair Value through P&L", "Available-for-sale", "Loans and receivables" and "Held-to-maturity investments". The first three categories should be accounted at fair value (FV), whereas the last two categories are treated at amortised cost (AC). For each bank we average over the available periods the percentage of the portfolio that is allocated at amortised cost. With all the averages we can construct a dummy indicating all banks that have above median amortised cost accounting. Table 11 shows the results for the baseline model where the risk-return measures are interacted with the above median amortised cost dummy. We find that there is no significant difference between both groups of banks, implying that the findings are not driven by mere accounting rules and thus repricing of the sovereign exposures.

[Insert Table 11 near here]

Our findings show that banks take risk-return considerations into account when deciding in which sovereigns and how much they invest. These findings are compatible with optimizing investor behavior in a mean-variance framework. Over the longer term such behavior will push the composition of bank sovereign bond portfolios towards the optimal frontier. This is compatible with economically rational investor behavior but also with the anticipation of potential sovereign diversification requirements that regulators might impose. In that sense, the findings are compatible with moral suasion, not from governments, but from supervisors.

6 Conclusion

In this paper we investigate whether or not observed changes in the composition of the sovereign bond portfolios of European banks are determined by a risk-return trade-off. Banks have been shown to disproportionally invest in bonds issued by their domestic sovereign, causing a negative bank-sovereign doom loop. Several motivations for such behavior have been demonstrated in the extant literature, such as e.g., search for yield or moral suasion, which from an investment perspective all involve some degree of irrational behavior. We depart from this approach and investigate the risk-return trade-off in the bank sovereign bond portfolios. We use data from all stress tests and transparency exercises conducted by the EBA between 2011 and 2018 for a sample of 76 European banks. Using the Sharpe ratio for the risk-return assessment, we find that over the entire period banks' investments and divestments of sovereign bonds are characterized by rational risk-return considerations. Moreover, both bond risk (measured by the standard deviation of bond returns) as well as sovereign risk (sovereign CDS spreads) are negatively related to bond buying, implying that, on average, banks do not engage in excessive risk-taking behavior in their sovereign bond portfolios. Our main conclusion is that over the 2011-2018 period banks may have exhibited spells of excessive risk behavior in their sovereign bond buying, but over the entire period their sovereign bond investments exhibit a sound risk-return trade-off. These findings have implications for policy initiatives to tackle concentrations in sovereign bond holdings by European banks.

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Figures and tables

Table 1: Illustration of different exposure measures

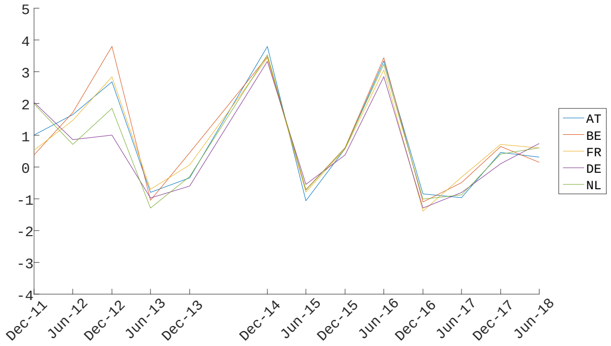
Increase:

Exp_{t-1}	Exp_t	(A)	(B)	(C)	Exp_t	(A)	(B)	(C)
30	60	30%	69%	0%	140	110%	154%	40%
20	40	20%	69%	0%	10	-10%	-69%	-15%
20	40	20%	69%	0%	20	0%	0%	-10%
2	4	2%	69%	0%	4	2%	69%	0%
28	56	28%	69%	0%	26	-2%	-7%	-15%
100	200	100%	347%	0%	200	100%	147%	0%

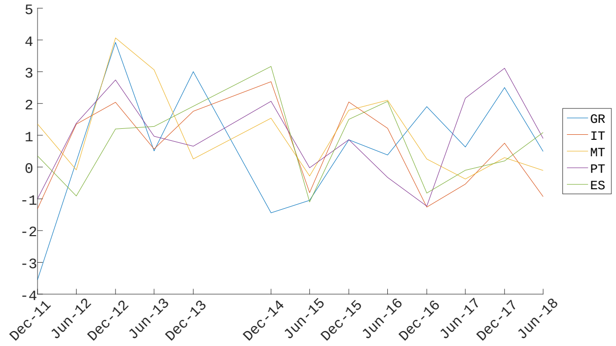
Decrease:

Exp_{t-1}	Exp_t	(A)	(B)	(C)	Exp_t	(A)	(B)	(C)
30	15	-15%	-69%	0%	0	-30%	-Inf	-30%
20	10	-10%	-69%	0%	5	-15%	-139%	-10%
20	10	-10%	-69%	0%	15	-5%	-29%	10%
2	1	-1%	-69%	0%	1	-1%	-69%	0%
28	14	-14%	-69%	0%	29	-1%	4%	30%
100	50	-50%	-347%	0%	50	-50%	-233%	0%

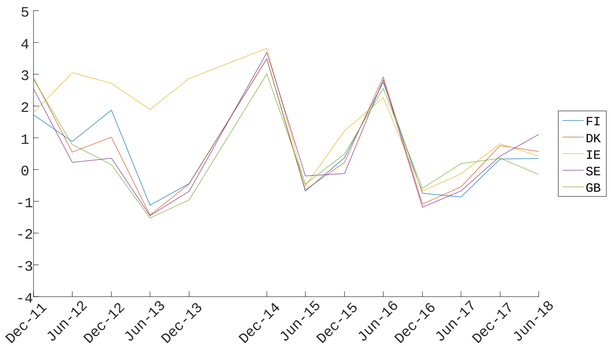
This table illustrates how the exposure measures described in Section 3 diverge under different changes to the sovereign portfolio. Measure (A) represents the change to the sovereign exposure relative to the size of the total sovereign debt portfolio at time $t-1$. (B) represents the logarithm of the size to the sovereign exposure at time t relative to its size at time $t-1$. (C) represents the difference between the weights of the exposure in the total sovereign debt portfolio at times t and $t-1$.



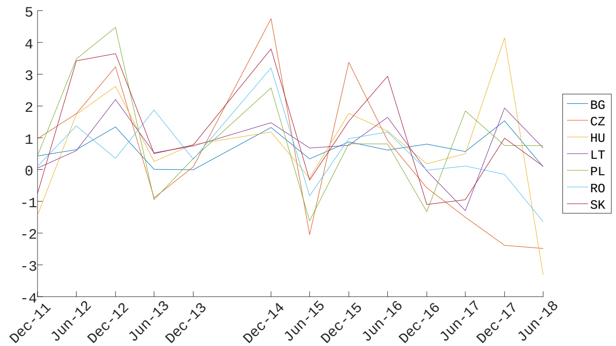
(a) Core



(b) Periphery



(c) Nordic/IE/UK



(d) CEEC

Figure 1: This figure plots the evolution of Sharpe ratios over time for different regions within the EU.

Table 2: Descriptive statistics

Statistic	*Count*	*Mean*	*SD*	*Min*	*Max*
Panel A: Exposure measures					
Within-sovereign portfolio	15158	0.248	9.310	−96.960	688.218
Within-exposure	7855	1.034	128.032	−1803.048	1564.620
Change in weight	15048	−0.000	2.706	−82.044	76.211
Exposure level	17160	4.545	15.328	0.000	100.000
Panel B: Return-risk measures					
Sharpe ratio	17402	0.751	1.526	−3.545	4.748
Real. return	17402	6.748	25.097	−204.729	266.249
Real. volatility	17402	10.998	15.107	2.390	165.452
YTM	17402	2.867	2.858	0.026	25.681
$CDS_{Sovereign}$	17402	7.656	45.464	0.077	370.305
Panel C: Bank controls					
Ln(TA)	17402	19.011	1.459	15.267	21.485
Equity/Total Assets	17402	6.388	2.643	0.794	14.539
NPL/Loans	16720	11.750	12.803	0.531	59.356
Loans/Deposits	17336	118.862	37.030	30.975	234.307
Cash/Total Assets	17292	10.956	6.382	1.803	38.855
Pre-tax ROA	17402	0.105	0.688	−4.913	1.284

This table in Panel A descriptive statistics for the different exposure measures. Panel B shows the descriptive statistics for the return-risk measures. Panel C show the descriptive statistics for the bank variables.

Table 3: Baseline model for extensive margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home	-0.037	-0.036		-0.043	-0.041		-0.040	-0.039	
	[-0.919]	[-0.919]		[-1.049]	[-1.045]		[-0.993]	[-0.988]	
Sharpe ratio	0.027***	0.027***	0.030***						
	[4.561]	[4.798]	[4.842]						
Real. return				0.001***	0.001***	0.001***			
				[3.135]	[3.098]	[3.342]			
Real. volatility				-0.004***	-0.004***	-0.005***			
				[-8.089]	[-8.335]	[-8.527]			
YTM							-0.032***	-0.032***	-0.034***
							[-6.304]	[-6.487]	[-6.446]
$CDS_{Sovereign}$	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.000	-0.000	-0.000
	[-3.277]	[-3.585]	[-3.081]	[-3.840]	[-4.164]	[-3.915]	[-1.116]	[-1.333]	[-1.091]
Ln(TA)	-0.070		-0.070	-0.070		-0.070	-0.070		-0.070
	[-1.175]		[-1.167]	[-1.178]		[-1.172]	[-1.176]		[-1.169]
Equity/Total Assets	0.014**		0.014**	0.014**		0.014**	0.014**		0.014**
	[2.477]		[2.531]	[2.476]		[2.535]	[2.468]		[2.524]
NPL/Loans	0.000		0.000	0.000		0.000	0.000		0.000
	[0.139]		[0.139]	[0.140]		[0.139]	[0.140]		[0.139]
Loans/Deposits	0.001		0.001	0.001		0.001	0.001		0.001
	[1.406]		[1.391]	[1.411]		[1.397]	[1.411]		[1.396]
Cash/Total Assets	0.010***		0.010***	0.010***		0.010***	0.010***		0.010***
	[3.290]		[3.276]	[3.296]		[3.284]	[3.295]		[3.281]
Pre-tax ROA	0.019		0.019	0.019		0.019	0.019		0.019
	[1.590]		[1.584]	[1.594]		[1.592]	[1.593]		[1.589]
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	0.021	0.068	-0.003	0.023	0.070	-0.000	0.022	0.069	-0.002
$\bar{R}^2_{within}$	0.003	0.002	0.004	0.005	0.005	0.006	0.004	0.003	0.005
No. of obs	14,432	15,158	14,410	14,432	15,158	14,410	14,432	15,158	14,410

This table shows regression results for the baseline model. The dependent variable is the extensive margin of the percentage change in a sovereign exposure relative to the size of the total sovereign debt portfolio. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 4: Baseline model for intensive margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home	0.415	0.446*		0.412	0.443*		0.414	0.445*	
	[1.468]	[1.658]		[1.455]	[1.645]		[1.463]	[1.653]	
Sharpe ratio	0.043***	0.045***	0.053***						
	[3.010]	[3.254]	[3.618]						
Real. return				0.002**	0.002***	0.002***			
				[2.565]	[2.577]	[3.224]			
Real. volatility				-0.003**	-0.003**	-0.005***			
				[-2.250]	[-2.377]	[-4.218]			
YTM							-0.015	-0.016	-0.020
							[-1.024]	[-1.139]	[-1.407]
$CDS_{Sovereign}$	-0.001**	-0.001***	-0.001***	-0.001***	-0.001***	-0.002***	-0.001**	-0.001**	-0.001**
	[-2.424]	[-2.624]	[-2.620]	[-2.831]	[-3.030]	[-3.183]	[-1.982]	[-2.133]	[-2.080]
Ln(TA)	-0.310**		-0.310**	-0.310**		-0.310**	-0.310**		-0.310**
	[-1.997]		[-2.001]	[-1.997]		[-2.002]	[-1.997]		[-2.000]
Equity/Total Assets	0.024		0.024	0.024		0.024	0.024		0.024
	[1.305]		[1.413]	[1.306]		[1.417]	[1.305]		[1.412]
NPL/Loans	-0.004		-0.004	-0.004		-0.004	-0.004		-0.004
	[-0.955]		[-0.971]	[-0.955]		[-0.971]	[-0.955]		[-0.971]
Loans/Deposits	0.005***		0.005***	0.005***		0.005***	0.005***		0.005***
	[3.346]		[3.334]	[3.348]		[3.337]	[3.347]		[3.334]
Cash/Total Assets	0.025***		0.025***	0.025***		0.025***	0.025***		0.025***
	[3.211]		[3.300]	[3.210]		[3.299]	[3.210]		[3.298]
Pre-tax ROA	-0.003		-0.003	-0.003		-0.003	-0.003		-0.003
	[-0.070]		[-0.076]	[-0.070]		[-0.076]	[-0.070]		[-0.075]
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	0.019	0.045	0.019	0.018	0.044	0.019	0.018	0.044	0.019
$\bar{R}^2_{within}$	0.004	0.003	0.002	0.003	0.003	0.002	0.003	0.003	0.002
No. of obs	14,432	15,158	14,410	14,432	15,158	14,410	14,432	15,158	14,410

This table shows regression results for the baseline model. The dependent variable is the intensive margin of the percentage change in a sovereign exposure relative to the size of the total sovereign debt portfolio. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 5: Baseline model by time period

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home	0.417	0.448*		0.414	0.445*		0.417	0.447*	
	[1.475]	[1.666]		[1.463]	[1.653]		[1.473]	[1.663]	
Sharpe ratio	0.010	0.013	0.020						
	[0.389]	[0.497]	[0.748]						
Post2014*Sharpe ratio	0.067**	0.066**	0.062*						
	[2.120]	[2.129]	[1.898]						
Real. return				0.001	0.001	0.001			
				[1.234]	[1.244]	[1.149]			
Post2014*Real. return				0.002	0.002	0.003**			
				[1.252]	[1.195]	[2.103]			
Real. volatility				-0.005**	-0.005***	-0.006***			
				[-2.378]	[-2.616]	[-3.269]			
Post2014*Real. volatility				0.004	0.004*	0.002			
				[1.615]	[1.827]	[0.962]			
YTM							-0.013	-0.015	-0.022
							[-0.794]	[-0.935]	[-1.414]
Post2014*YTM							0.061**	0.066***	0.045*
							[2.512]	[2.836]	[1.861]
$CDS_{Sovereign}$	-0.001**	-0.001**	-0.001**	-0.001	-0.001	-0.001	0.000	0.000	-0.000
	[-2.250]	[-2.443]	[-2.380]	[-1.111]	[-1.138]	[-1.282]	[0.032]	[0.140]	[-0.197]
Post2014*$CDS_{Sovereign}$	0.002***	0.002***	0.001**	0.001	0.001	0.001	-0.001	-0.001	-0.001
	[3.148]	[2.880]	[2.466]	[1.303]	[1.063]	[0.727]	[-0.834]	[-1.058]	[-1.614]
Bank controls	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	0.019	0.045	0.020	0.019	0.045	0.020	0.018	0.044	0.019
$\bar{R}^2_{within}$	0.004	0.003	0.003	0.004	0.003	0.002	0.003	0.003	0.002
No. of obs	14,432	15,158	14,410	14,432	15,158	14,410	14,432	15,158	14,410

This table shows regression results for the baseline model where the risk/return measures are interacted with a time dummy splitting the sample in a pre- and post-2014 period. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 6: Baseline model by regional origination

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SOV_{GIPS}*$BANK_{GIPS}$	0.291	0.209		0.648***	0.637***		0.508**	0.546**	
	[1.602]	[1.185]		[3.325]	[3.321]		[2.069]	[2.284]	
Sharpe ratio	0.033*	0.052***	0.041**						
	[1.776]	[2.927]	[2.135]						
SOV_{GIPS}*Sharpe ratio	0.024	-0.000	0.023						
	[0.847]	[-0.016]	[0.821]						
$BANK_{GIPS}$*Sharpe ratio	-0.077***	-0.128***	-0.070***						
	[-3.983]	[-3.812]	[-3.612]						
SOV_{GIPS}*$BANK_{GIPS}$*Sharpe ratio	0.447***	0.506***	0.493***						
	[3.902]	[4.337]	[4.137]						
Real. return				0.001	0.004*	0.002			
				[0.297]	[1.758]	[0.540]			
SOV_{GIPS}*Real. return				-0.001	-0.004	-0.001			
				[-0.228]	[-1.586]	[-0.427]			
$BANK_{GIPS}$*Real. return				-0.011***	-0.023***	-0.010***			
				[-3.811]	[-4.176]	[-3.364]			
SOV_{GIPS}*$BANK_{GIPS}$*Real. return				0.018***	0.029***	0.019***			
				[5.151]	[4.796]	[4.938]			
Real. volatility				-0.003	-0.005*	-0.002			
				[-0.900]	[-1.688]	[-0.861]			
SOV_{GIPS}*Real. volatility				0.000	0.003	-0.002			
				[0.081]	[0.794]	[-0.780]			
$BANK_{GIPS}$*Real. volatility				0.003	0.010**	0.004			
				[0.834]	[2.135]	[1.229]			
SOV_{GIPS}*$BANK_{GIPS}$*Real. volatility				-0.007	-0.015***	-0.005			
				[-1.518]	[-2.711]	[-1.035]			
YTM							-0.052	-0.053	-0.022
							[-1.269]	[-1.386]	[-0.469]
SOV_{GIPS}*YTM							0.035	0.039	-0.020
							[0.904]	[1.077]	[-0.445]
$BANK_{GIPS}$*YTM							-0.087***	-0.063*	-0.212***
							[-3.182]	[-1.797]	[-4.890]
SOV_{GIPS}*$BANK_{GIPS}$*YTM							0.097**	0.056	0.311***
							[2.114]	[1.090]	[5.071]
$CDS_{Sovereign}$	0.018	0.021	0.031	0.019	0.015	0.019	0.061	0.073	0.036
	[0.422]	[0.524]	[0.649]	[0.407]	[0.346]	[0.372]	[0.997]	[1.262]	[0.488]
SOV_{GIPS}*$CDS_{Sovereign}$	-0.018	-0.021	-0.032	-0.019	-0.016	-0.020	-0.061	-0.073	-0.036
	[-0.431]	[-0.536]	[-0.671]	[-0.416]	[-0.358]	[-0.392]	[-0.998]	[-1.266]	[-0.495]
$BANK_{GIPS}$*$CDS_{Sovereign}$	-0.044	-0.081**	-0.058	-0.021	-0.043	-0.027	0.043	-0.044	0.189***
	[-1.594]	[-2.073]	[-1.400]	[-0.628]	[-1.028]	[-0.556]	[0.986]	[-0.808]	[2.615]
SOV_{GIPS}*$BANK_{GIPS}$*$CDS_{Sovereign}$	0.041	0.077**	0.056	0.017	0.039	0.025	-0.047	0.041	-0.191***
	[1.470]	[1.987]	[1.359]	[0.513]	[0.939]	[0.509]	[-1.073]	[0.749]	[-2.651]
Bank controls	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	0.025	0.051	0.025	0.021	0.048	0.021	0.020	0.046	0.020
$\bar{R}^2_{within}$	0.010	0.010	0.008	0.006	0.006	0.004	0.005	0.004	0.003
No. of obs	14,432	15,158	14,410	14,432	15,158	14,410	14,432	15,158	14,410

This table shows regression results for the baseline model where the risk/return measures are interacted with dummies for the regional origination of both the sovereign exposure and the bank. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 7: Total impact of split by regional origination

Bank	Sovereign	Sharpe ratio	Real. ret.	Real. vol.
Non-GIPS	Non-GIPS	0.041**	0.002	-0.002
		[2.13]	[0.54]	[-0.86]
	GIPS	0.064***	0.000	-0.005***
		[2.79]	[0.54]	[-4.08]
GIPS	Non-GIPS	-0.029*	-0.009***	0.002
		[-1.91]	[-3.30]	[0.74]
	GIPS	0.487***	0.009***	-0.006
		[4.23]	[4.19]	[-1.62]

This table shows the total impact of the risk/return measures for the different combinations of regional origination. The coefficients and t-statistics are derived for the model with bank-country fixed effects, i.e. columns (3) and (6) in table 6. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 8: Baseline model by business model

	(1)	(2)
Home	0.417	
	[1.475]	
Sharpe ratio	-0.056	-0.037
	[-0.281]	[-0.182]
Ln(TA)*Sharpe ratio	0.001	0.001
	[0.101]	[0.078]
Equity/Total Assets*Sharpe ratio	0.012**	0.013**
	[2.207]	[2.184]
NPL/Loans*Sharpe ratio	-0.002	-0.001
	[-1.460]	[-1.224]
Loans/Deposits*Sharpe ratio	-0.000	-0.000
	[-0.135]	[-0.205]
Cash/Total Assets*Sharpe ratio	0.003	0.002
	[1.342]	[0.858]
Pre-tax ROA*Sharpe ratio	-0.007	-0.009
	[-0.370]	[-0.453]
Ln(TA)	-0.300*	-0.300*
	[-1.889]	[-1.892]
Equity/Total Assets	0.016	0.016
	[0.889]	[0.952]
NPL/Loans	-0.002	-0.002
	[-0.393]	[-0.500]
Loans/Deposits	0.006***	0.006***
	[3.485]	[3.447]
Cash/Total Assets	0.025***	0.026***
	[3.128]	[3.302]
Pre-tax ROA	0.011	0.012
	[0.298]	[0.332]
$CDS_{Sovereign}$	-0.001**	-0.001**
	[-2.367]	[-2.558]
Country fixed effects	Yes	-
Bank fixed effects	Yes	-
Time fixed effects	Yes	Yes
Bank-Country fixed effects	-	Yes
$\bar{R}^2$	0.019	0.020
$\bar{R}^2_{within}$	0.004	0.002
No. of obs	14,432	14,410

This table shows the regression results for the baseline model where the risk/return measures are interacted with the bank balance sheet variables. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 9: Robustness test: model for within-exposure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home	-1.927	-1.753		-3.425	-3.159		-3.045	-2.793	
	[-0.849]	[-0.724]		[-1.500]	[-1.309]		[-1.319]	[-1.148]	
Sharpe ratio	2.735**	3.248**	2.786**						
	[2.049]	[2.450]	[1.961]						
Real. return				0.045	0.069	0.109			
				[0.361]	[0.552]	[0.819]			
Real. volatility				-1.222***	-1.301***	-1.169***			
				[-6.429]	[-6.814]	[-5.282]			
YTM							-10.431***	-11.140***	-9.822***
							[-7.543]	[-7.973]	[-6.109]
$CDS_{Sovereign}$	-0.185***	-0.209***	-0.168**	-0.143**	-0.165**	-0.158**	-0.039	-0.048	-0.047
	[-2.739]	[-3.072]	[-2.171]	[-2.240]	[-2.554]	[-2.123]	[-0.610]	[-0.748]	[-0.621]
Bank controls	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	0.014	0.050	-0.025	0.027	0.065	-0.014	0.027	0.065	-0.015
$\bar{R}^2_{within}$	0.004	0.005	0.004	0.018	0.021	0.014	0.018	0.021	0.014
No. of obs	7,355	7,831	7,292	7,355	7,831	7,292	7,355	7,831	7,292

This table shows the regression results for the model where the dependent variable is substituted by the simple percentage change of a sovereign exposure. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 10: Robustness test: model for change in weight

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home	-0.058	-0.074		-0.063	-0.079		-0.061	-0.076	
	[-0.396]	[-0.500]		[-0.430]	[-0.532]		[-0.414]	[-0.517]	
Sharpe ratio	0.028***	0.025***	0.030***						
	[3.208]	[2.836]	[3.210]						
Real. return				0.001**	0.001**	0.001**			
				[2.252]	[2.209]	[2.434]			
Real. volatility				-0.004***	-0.004***	-0.004***			
				[-3.842]	[-3.859]	[-4.371]			
YTM							-0.028***	-0.029***	-0.027***
							[-2.743]	[-2.797]	[-2.776]
$CDS_{Sovereign}$	-0.000*	-0.000*	-0.000	-0.001**	-0.001**	-0.000*	-0.000	-0.000	-0.000
	[-1.734]	[-1.819]	[-1.158]	[-2.169]	[-2.203]	[-1.699]	[-0.512]	[-0.536]	[-0.045]
Bank controls	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	-0.005	-0.033	-0.043	-0.004	-0.032	-0.043	-0.004	-0.033	-0.043
$\bar{R}^2_{within}$	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.000
No. of obs	14,322	15,048	14,300	14,322	15,048	14,300	14,322	15,048	14,300

This table shows the regression results for the model where the dependent variable is substituted by the change in the weight of a sovereign exposure. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.

Table 11: Robustness test: model by accounting portfolio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Home	0.419	0.449*		0.415	0.446*		0.418	0.448*	
	[1.480]	[1.669]		[1.467]	[1.657]		[1.475]	[1.665]	
Sharpe ratio	0.041**	0.043**	0.050***						
	[2.339]	[2.277]	[2.741]						
Above median AC*sharpe ratio	0.003	0.005	0.006						
	[0.158]	[0.188]	[0.253]						
Real. return				0.002**	0.002**	0.002***			
				[2.146]	[2.322]	[2.706]			
Real. volatility				-0.003**	-0.003**	-0.004***			
				[-2.108]	[-2.339]	[-3.029]			
Above median AC*real.return				0.000	-0.000	0.000			
				[0.272]	[-0.152]	[0.181]			
Above median AC*real.volatility				0.000	0.000	-0.001			
				[0.069]	[0.234]	[-0.309]			
YTM							-0.015	-0.016	-0.016
							[-0.961]	[-1.006]	[-0.987]
Above median AC*YTM							-0.001	-0.002	-0.008
							[-0.040]	[-0.119]	[-0.400]
$CDS_{Sovereign}$	-0.001	-0.001*	-0.001***	-0.001**	-0.001**	-0.001***	-0.000	-0.001	-0.001***
	[-1.630]	[-1.911]	[-4.395]	[-2.341]	[-2.507]	[-5.172]	[-1.410]	[-1.600]	[-3.764]
Above median AC*CDS	-0.001*	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.000
	[-1.674]	[-1.464]	[-0.588]	[-1.583]	[-1.366]	[-0.540]	[-1.284]	[-1.101]	[-0.358]
Bank controls	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Country fixed effects	Yes	Yes	-	Yes	Yes	-	Yes	Yes	-
Bank fixed effects	Yes	-	-	Yes	-	-	Yes	-	-
Time fixed effects	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Bank-Time fixed effects	-	Yes	-	-	Yes	-	-	Yes	-
Bank-Country fixed effects	-	-	Yes	-	-	Yes	-	-	Yes
$\bar{R}^2$	0.019	0.045	0.019	0.018	0.044	0.019	0.018	0.044	0.019
$\bar{R}^2_{within}$	0.004	0.003	0.002	0.003	0.003	0.002	0.003	0.003	0.002
No. of obs	14,432	15,158	14,410	14,432	15,158	14,410	14,432	15,158	14,410

This table shows the regression results for the baseline model where the risk/return measures are interacted with a dummy representing the banks with an above median share of amortised cost accounting in the sovereign bond holdings. * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. t-statistics between brackets.