# Conditional asymmetries in the sovereign-bank nexus*

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**Abstract**

We estimate the time-varying skewness of European banks stock and sovereign bond returns using quantile methods. We obtain a negative relationship between sovereigns and banks return asymmetries, which we relate to the safe haven features of sovereign debt. However, this feature reverses for peripheral European countries (GIIPS). Furthermore, although better capitalized and less risky banks tend to offer less negatively skewed stock returns, these benefits do not reach similarly strong GIIPS-headquartered banks. Finally, we identify a risk premium related to sovereign negative skewness for both large financial and non-financial European firms, which is stronger for firms headquartered in GIIPS.

**Keywords:** Banks; sovereign bonds; conditional asymmetry; negative risk premium.

**JEL:** G12, G15, G21.

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# 1 Introduction

The European financial and sovereign debt crises have generated interest in the tight relationship between financial sector and sovereign credit risk, or the so-called sovereign-bank nexus. In some countries, the risk originated in the financial sector, which then spilled over to the sovereigns, and returned to the financial sector through their balance sheets. Meanwhile, in other countries, sovereign debt was the source of fragility, which was then transmitted to the financial sector. Regardless of the source, however, the twin crises have emphasised the linkages that exist between banks and sovereigns.

While several papers have focused on studying the transmission of risk between sovereign bond and bank returns (see e.g., Acharya and Steffen (2015), Brutti and Sauré (2015), Kallestrup et al. (2016), and Altavilla et al. (2017)), almost all of them focus on studying the effects of these risk spillovers on the conditional mean/volatility of the distributions of bank and bond returns. Yet the twin crises have emphasised the role of asymmetries in bank and bond distributions, respectively. Indeed, the more popular risk measures devised in response to the crises have focused on the tails of the conditional distribution of returns (see e.g., Adrian and Brunnermeier (2016), Giglio et al. (2016), Brownlees and Engle (2016), and Acharya et al. (2017)), where extremely negative events occur. Moreover, a long tradition in asset pricing has studied the impact of return skewness on investors' decision-making (see e.g., Harvey and Siddique (2000) and Ghysels et al. (2016)). To the extent that financial and non-financial firms' values are negatively affected by sovereign tail events, it is reasonable to surmise that these firms pay a premium to attract investors. Unfortunately, there has been little work on this topic. We fill the gap in this paper by providing a comprehensive empirical study of the conditional asymmetries of bank and bond returns. In this light, we make the following four contributions.

First, we utilise a simple measure of conditional return asymmetry that is robust to outliers, and more importantly, is able to capture time variations in the conditional distribution of bank and bond returns. The measure is based on the relative difference between the 75th (and 25th) conditional quantile and the conditional median of bank and bond returns, respectively. The intuition behind the measure is simple: if at period $t$, the interquartile range is not centered at the median, then the return distribution is asymmetric. This measure, which traces its origins to Bowley (1920), has been used to characterise the distribution of stock returns (see, e.g., Kim and White (2004) and more recently, by Ghysels et al. (2016)). To compute this measure, we estimate a flexible quantile model that takes into account the linkages between bank and bond returns uncovered by previous literature. We calculate the conditional return asymmetries of bank equity and bond returns, and study their time series properties. We document substantial, time-varying conditional asymmetries in both bank equity and sovereign bond returns. Remarkably, our conditional asymmetry measures display wide variation in turbulent periods, such as the Dot-com bubble, the onset of the financial crisis, and the height of the European sovereign debt crisis.

Second, to further understand the dynamics and co-movement of the estimated conditional asymmetry measures, we estimate three time series regressions. The first two regressions are primarily motivated by the wide literature that studies co-movements between bank and sovereign bond returns (see e.g, Acharya and Steffen (2015) and Kallestrup et al. (2016)). In the first regression, we investigate whether the time variation in conditional bank asymmetries is related to conditional sovereign bond asymmetries. We find that there is a negative correlation between bank and sovereign bond asymmetries, which is related to the role of sovereign bonds as "safe haven" investments. We analyse in the second regression whether banks have a positive exposure to the conditional asymmetries of the peripheral sovereign bond returns. We show that indeed, bank return asymmetries for non-peripheral banks are positively correlated with the conditional asymmetries of peripheral bonds. This suggests the presence of a contagion effect from peripheral bonds to non-peripheral banks. The third regression documents a negative relationship between bank conditional asymmetries and volatility fluctuations, which is consistent with the "leverage effect" findings in the asymmetric GARCH literature.

Third, we examine the extent to which these conditional asymmetries can be explained by macroeconomic and financial fundamentals. In this regard, we consider a set of bank balance sheet variables (see e.g., Altunbas et al. (2017) and Gandhi and Lustig (2015)) that are known to explain bank stock returns. We find that variables related to capital adequacy (such as the Tier 1 capital ratio) are relevant predictors of bank conditional asymmetry. More importantly, however, we show that sovereign conditional asymmetry is a strong predictor of bank conditional asymmetry. In particular, there is a negative relationship between sovereign skewness and future bank skewness. Moreover, there is a positive relationship between future bank skewness and peripheral sovereign skewness, which further underscores the sovereign-bond nexus. We also find that variables that related to leverage (such as the reserves-to-GDP ratio) help predict future sovereign bond asymmetry.

Finally, we study the economic implications of conditional asymmetries in an asset pricing setting. In particular, we ask whether financial and non-financial firms in the Eurostoxx 600 pay a premium for negative sovereign conditional asymmetry. To do so, we consider cross-sectional asset pricing tests; in particular, we implement a two-pass regression procedure (see Cochrane (2009) for an exposition). The first-pass (time series regression) results indicate a clear, negative relationship between sovereign conditional asymmetries and firm stock returns. The second-pass (cross-section regression) results suggest the existence of a sovereign skewness risk premium. More importantly, our results also suggest that firms headquartered in a country with a weak sovereign have to pay a premium to investors. These results further emphasise the existence of two nexuses: that between sovereigns to financial firms, and that between non-financial firms to sovereigns.

**Related Literature.** The sovereign-bank nexus has been at the forefront of the academic and policy debate. In particular, the theoretical literature has focused on modelling the link between banks and the sovereign. Gennaioli et al. (2014) focus on modelling the Greek-style crisis, i.e., a crisis which originates from the inability of the government to finance public debt, which then is transmitted to the financial sector. Meanwhile, Bolton and Jeanne (2011) study how sovereign crises are spread throughout the banking sector through an integrated banking system. Finally, Acharya et al. (2014) model the two-way feedback loop between sovereigns and banks. Our paper is related to this literature to the extent that one can think that the linkages captured by our flexible quantile model are a reduced-form representation of the models shown here, without taking a precise stand on the mechanisms involved. Moreover, to the extent that our sovereign and bank conditional asymmetry measures capture the tail risk events during the crisis, our empirical results can be thought of as a quantification of the transmission of risk between sovereigns and bonds at the tails.

This paper is also related to a wide empirical literature that aims to understand the linkages between sovereigns and banks. Several of these papers use sovereign and bank credit default swap (CDS) data (e.g., Kallestrup et al. (2016)) or bank balance sheet information (e.g., Acharya and Steffen (2015), Altavilla et al. (2017) and Gennaioli et al. (2018)) to quantify the transmission of risk from sovereigns to banks (and vice-versa). A common conclusion of these papers is that exposures to sovereign debt, both of own country and foreign, are a major determinant of bank risk. Our results, which use bank equity and sovereign bond return data, are consistent with these papers, and extend them by showing that these exposures result in changes to the conditional asymmetries of bank and bond return distributions. More importantly, we show that financial firms price sovereign conditional asymmetry. The analysis in this paper is also linked to empirical work that studies the transmission of risk from sovereigns to non-financial firms (e.g., Augustin et al. (2018) and Bedendo and Colla (2015)). Compared to these papers, we also show that non-financial firms pay a premium for negative sovereign conditional asymmetry.

A closely related paper to ours is that of Mäkinen et al. (2018), who use bank asset returns from 15 countries to uncover a risk premium that is related to implicit sovereign guarantees, which is intimately tied to sovereign risk. Our paper differs from theirs in the following two aspects. First, we use measures of conditional asymmetry that captures the transmission of risk from banks to public debt (and vice-versa). Because of this, we are able to find that banks pay a premium for negative sovereign conditional asymmetry, regardless of its headquarters. Moreover, in line with their result, we show that negative sovereign conditional asymmetry matters all the more for the GIIPS. Second, the empirical analysis we pursue also considers non-financial firms. The results of our paper that peripheral firms are penalised just for being in a country with a weak sovereign are in line with their result that the risk premium they find does not exist for safe-haven countries.

Finally, our paper is related to work that has aimed to understand the implications of conditional asymmetries for asset pricing and portfolio choice decisions (see e.g., Mencía and Sentana (2009), Conrad et al. (2013), and Ghysels et al. (2016)). Compared to these papers, we focus on the role of asymmetries in the sovereign-bank nexus, which, to the best of our knowledge, has not been explored.

The rest of the paper is organised as follows. In Section 2, we describe the data and provide some descriptive statistics. Section 3 describes the quantile-based model that underlies the rest of the analysis in this paper, and examines the dynamics and the co-movements between conditional bank and sovereign bond return asymmetries. We estimate panel regressions to study the link between conditional return asymmetries and economic fundamentals in section 4. Section 5 explores the cross-sectional asset pricing implications of negative sovereign conditional asymmetry. Finally, we conclude in section 6.

# 2 Data and descriptive statistics

## 2.1 Data sources

We construct a dataset with information obtained from Datastream and Bloomberg to compute bank equity returns and sovereign bond returns. The information covers the period from January 3, 2001 to November 6, 2013, which includes both tranquil and crisis periods. The data comprises the 27 major cross-border listed banks in Europe, a list of which is provided in section 1 of the Supplemental Material. Out of the banks in the sample, ten are headquartered in peripheral countries, while 17 are headquartered outside. There are 14 countries represented in the dataset; ten are in the Eurozone[1], while the remaining countries are Denmark, Sweden, Switzerland, and the United Kingdom.

We compute weekly bank equity returns $y_{t,B_i}$ from publicly available equity prices in Datastream.[2] Meanwhile, we construct euro-denominated sovereign bond returns for the countries in the dataset by a first-order approximation; to construct this, we use ten-year weekly sovereign bond yields obtained from Datastream and bond duration data obtained from Bloomberg. More formally, we denote by $Dur_{t,S_j}$ the duration, and by $Z_{t,S_j}$, the yield on the ten-year sovereign bond of country $j$. First, we compute for the modified duration of the bond, $ModD_{t,S_j}$ as

$$ModD_{t,S_j} = \frac{Dur_{t,S_j}}{\left(1 + Z_{t,S_j}/100\right)}$$

We then calculate weekly sovereign bond returns, $y_{t,S_j}$ from the following formula:

$$y_{t,S_j} = -ModD_{t-1,S_j} \cdot \left(Z_{t,S_j} - Z_{t-1,S_j}\right)$$

We calculate the euro-denominated returns of non-Euro area banks and sovereign bonds by converting the relevant variables into euros using spot exchange rate data

[1] The Euro area countries included in the sample are the GIIPS countries, Austria, Belgium, France, Germany, and the Netherlands.

[2] We compute weekly returns as some equity prices were illiquid during certain periods.

obtained from the Pacific Exchange Rate database. Finally, we obtain economic and financial variables for the analyses in sections 4 and 5 from Datastream and Eurostat. We describe the specific variables that we use in the respective sections.

### 2.2 Descriptive statistics

Table 1 provides the descriptive statistics for the returns of the GIIPS and the German sovereign bonds.[3] Panel A shows mean weekly bond returns during the entire sample period. We find that Greece and Portugal exhibit negative returns and the highest variances, followed by Ireland. German bond returns, on the other hand, exhibit positive daily returns with small variances.

[Table 1 about here.]

Panel B (Panel C) reports bond return correlations between 2001 and 2006 (2007 to 2013). As can be observed, bond returns were positively correlated prior to the sovereign debt crisis; this suggests that investors perceived these bonds as similar despite major economic differences. As the crisis unfolded, however, the bond return correlations between the different GIIPS countries declined, while for some countries, this return correlation became negative. This result shows the divergence within the eurozone, and the so-called flight-to-quality effects. It also holds for other sovereign bonds, which we can observe from Tables 5 and 6 of the Supplemental Material.

Finally, Tables 7 and 8 of the Supplementary Material present summary statistics of bank returns before and after the crisis. As can be observed, prior to the crisis, the vast majority of European banks exhibited positive returns with small variances. During the crisis, however, the returns of the majority of the banks became negative with large variances.

## 3 Distributional linkages between sovereign and bank returns

We are interested in studying the dependence over time and in quantifying the asymmetry of the conditional distributions of bank and bond returns in Europe. Our approach

[3] The summary statistics of all the bond returns, and the corresponding correlation matrices, are in the Supplementary Material.

to study these is through quantile regression, which provides the advantage of being robust to distributional assumptions and potential outliers (see Koenker (2005) for a monograph). Furthermore, the flexibility of our modelling approach allows us to capture interactions between different bank and bond returns over time. We discuss the quantile model that we estimate in the first subsection.

The quantile model we specify permits the recovery of robust measures of conditional asymmetry, which we describe in the second subsection. We then show the results of the autoregressive model, and the estimates of conditional asymmetry, and describe their time series properties. Finally, we investigate the dynamics and co-movements of the conditional asymmetry measures. In particular, we look at whether there is a negative relationship between conditional asymmetry and volatility, which has been documented by Ghysels et al. (2016) in the context of international portfolios.

## 3.1 Model specification and estimation

We consider the following system of equations that belongs to the family of quantile vector autoregressive models studied by White et al. (2015) to characterise the conditional distribution of bank and sovereign bond returns:

$$\mathbf{q}_{t,B}(\theta) = \mathbf{c}_B(\theta) + \nu_1(\theta)\mathbf{y}_{t-1,B} + \mathbf{A}_{bs}(\theta)\mathbf{y}_{t,S} + \nu_2(\theta)\mathbf{q}_{t-1,B}(\theta) + \mathbf{B}_{bs}(\theta)\mathbf{q}_{t-1,S}(\theta), \quad (1)$$

$$\begin{aligned}\mathbf{q}_{t,S}(\theta) &= \mathbf{c}_S(\theta) + \phi_1(\theta)\mathbf{y}_{t-1,S} + \mathbf{A}_{sb}(\theta)\mathbf{y}_{t,B} + \mathbf{A}_{ss}(\theta)\mathbf{y}_{t,S} \\ &\quad + \phi_2(\theta)\mathbf{q}_{t-1,S}(\theta) + \mathbf{B}_{sb}(\theta)\mathbf{q}_{t-1,B}(\theta) + \mathbf{B}_{ss}(\theta)\mathbf{q}_{t-1,S}(\theta). \quad (2)\end{aligned}$$

In this model, $\mathbf{q}_{t,B}(\theta)$ ($\mathbf{q}_{t,S}(\theta)$) is the vector of $\theta$-th quantiles of banks (sovereign bond) returns and $\theta \in (0, 1)$. The matrices $\mathbf{A}_{bs}(\theta)$, $\mathbf{A}_{sb}(\theta)$ and $\mathbf{A}_{ss}(\theta)$ measure contemporaneous dependence between between $\mathbf{y}_{t,B}$ and $\mathbf{y}_{t,S}$. Meanwhile, the matrices $\mathbf{B}_{bs}(\theta)$, $\mathbf{B}_{sb}(\theta)$ and $\mathbf{B}_{ss}(\theta)$ capture autoregressive dynamics. Controlling for the lagged quantiles not only enables us to take into account the entire past history of the variables in the regressions, which makes it preferable over a quantile model with a finite number of lags. Moreover, the model also allows us to capture time-varying features of the return distributions, such as conditional asymmetries. Hence, (1) and (2) permit an analysis of the evolution of the conditional quantile functions, and in turn, the conditional distribution, over time.[4]

[4] Notice that while very flexible, this model follows a GARCH(1,1)-like process as in Bollerslev (1986).

We parametrise the matrices that capture contemporaneous dependence and autoregressive dynamics as sparse to highlight the relevant linkages that have been found in the academic literature.[5] In addition, we employ a panel structure, by which each effect has a common coefficient across the cross-section of banks and bonds, respectively. The dimensions of $\mathbf{A}_{bs}(\theta)$, $\mathbf{A}_{sb}(\theta)$ and $\mathbf{A}_{ss}(\theta)$ (and similarly, $\mathbf{B}_{bs}(\theta)$, $\mathbf{B}_{sb}(\theta)$ and $\mathbf{B}_{ss}(\theta)$) are $n \times m$, $m \times n$, and $m \times m$, as there are $n$ banks and $m$ bonds in the sample. We consider different coefficients depending on whether the countries are members of the GIIPS or not. In addition, we allow German sovereign bonds and banks to have an additional impact on all other banks and countries. The developments in the German market have been widely perceived as a relevant fear gauge during the crisis, as noted by Acharya and Steffen (2015) and Angeloni and Wolff (2012), among others. For instance, flight-to-quality movements out of crisis-hit markets and into German assets have been common at the points when the crisis aggravated. These restrictions, however, do not prevent us from estimating the coefficients of asymmetry in the conditional distributions.

To focus the discussion, we describe the parameters that are in the contemporaneous matrices, as those that capture autoregressive dynamics are parametrised in the same manner. Firstly, we outline the effects that enter $\mathbf{A}_{bs}(\theta)$:

- GIIPS bond returns to non-GIIPS bank returns: $\alpha$.
- German bond returns to non-German bank returns: $\beta$.
- Own bond effect to banks headquartered in the country:$\gamma$ on the cells of non-GIIPS banks and $\tau$ for GIIPS banks' returns.

Secondly, the effects captured in $\mathbf{A}_{sb}(\theta)$ are summarised as:

- GIIPS banks to non-GIIPS bond returns: $\eta$.
- German banks to non-German bond returns: $\omega$.
- Effect of banks headquartered in a country to their own sovereign bond: $\kappa$ on the cells of non-GIIPS bonds and $\pi$ for GIIPS bonds.

[5] While the restrictions that we impose in this paper do not emanate from a particular structural model of the sovereign-bank feedback loop, they are compatible with several models of the feedback loop, such as those by Acharya et al. (2014) and Gennaioli et al. (2013).

Lastly, $\mathbf{A}_{ss}(\theta)$ only contains the contemporaneous effect of GIIPS bonds on non-GIIPS bonds ($\psi$). Figure 1 illustrates graphically the effects that we investigate.[6]

[Figure 1 about here.]

To provide a simple example, consider a version of quantile models (1) and (2) with only three countries, each having one bank. The countries are a non-GIIPS country, Germany, and a GIIPS country, ordered in this way in the matrices. Then, we have

$$\mathbf{A}_{bs}(\theta) = \begin{bmatrix} \gamma & \beta & \alpha \\ 0 & \gamma & \alpha \\ 0 & \beta & \tau \end{bmatrix}, \mathbf{A}_{sb}(\theta) = \begin{bmatrix} \kappa & \omega & \eta \\ 0 & \kappa & \eta \\ 0 & \omega & \pi \end{bmatrix}, \mathbf{A}_{ss}(\theta) = \begin{bmatrix} 0 & 0 & \psi \\ 0 & 0 & \psi \\ 0 & 0 & 0 \end{bmatrix}.$$

There are two main challenges involved in estimating the parameters of the quantile models (1) and (2) above. First, the quantile process must be stationary. Second, the recursive nature of the specification makes estimating the model via the usual simplex algorithm (see Koenker (2005) for an exposition) less tractable. In this regard, we estimate a smoothed version of the "check" function for quantile regression, and impose a stationarity condition, which we outline in section 3 of the Supplemental Material. We estimate the parameters of interest from $\theta = 0.05$ to $\theta = 0.95$, which allows us to characterise the conditional distributions of bank and bond returns, $f_{B|S}(\mathbf{y}_{t,B}|\mathbf{y}_{t,S}, I_{t-1})$ and $f_{S|B}(\mathbf{y}_{t,S}|\mathbf{y}_{t,B}, I_{t-1})$, respectively.

## 3.2 A robust measure of conditional asymmetry

A particular statistic that we are interested in is the asymmetry of the conditional distributions of bank and bond returns. There are several reasons why one might be interested in measuring the degree of return asymmetries. For example, in the aftermath of the Great Recession, several measures of systemic risk were proposed (such as CoVaR by Adrian and Brunnermeier (2016) and Marginal Expected Shortfall by Acharya et al. (2017)) that focused on the tails of the conditional distributions of bank returns. Furthermore, there is a large tradition in empirical asset pricing that looks at the importance of conditional asymmetries in explaining not only the cross-section of stock returns

[6]Notice that in the restrictions we impose, we do not allow for bank-to-bank linkages. While this might be potentially important, there is empirical work (e.g., Brutti and Sauré (2015)) that shows that these linkages do not matter for the transmission of sovereign risk. We estimated a model that allows for bank-to-bank linkages, and we find the same results as Brutti and Sauré (2015). Estimation results are available upon request.

(see e.g., Harvey and Siddique (2000) and Conrad et al. (2013)), but also the portfolio allocation of investors (see e.g., Mencía and Sentana (2009) and references therein).

The most popular measure of asymmetry is skewness, which is calculated as the sample analogue of the normalised third moment of returns: $S(y_{t,k}) = E(y_{t,k} - \mu)^3/\sigma^3$, where $k \in \{B_i, S_j\}$. However, it is well-known that estimates based on sample averages are sensitive to outliers. This has prompted researchers to look for alternative measures of skewness that are not based on sample estimates of the third conditional moment.

One such measure is the Bowley (1920) measure of skewness, which, when modified in the context of calculating conditional measures, we define as the following[7]:

$$\widehat{CA}_{t,k} = \frac{q_{t,k}(\theta) + q_{t,k}(1-\theta) - 2q_{t,k}(0.5)}{q_{t,k}(1-\theta) - q_{t,k}(\theta)} \tag{3}$$

where $\theta = 0.25$. As can be observed, the conditional asymmetry measure (3) captures skewness in the interquartile range with respect to the median. These measures are robust to outliers, as the quantiles are not affected by them. Moreover, these measures are unit independent (due to the normalisation), and assure that the values are between -1 and 1. Recovering these measures is straightforward after running the quantile regressions in (1) and (2), as we can calculate them simply by computing the predicted conditional quantiles implied by these regressions.

From now on, we will define conditional asymmetry in terms of $\widehat{CA}_{t,B_i}$ and $\widehat{CA}_{t,S_j}$. We will calculate conditional asymmetry in this section, and study its properties in the subsequent sections.

## 3.3 Results

### 3.3.1 Quantile autoregressive model results

Table 2 presents the results for the bank quantile model, equation (1), for selected quantiles of the distribution. From the table, we find that there is contemporaneous dependence between bond and bank returns. In particular, we find that there is a positive and significant exposure from the peripheral sovereign bonds across the distribution of non-GIIPS bank returns. In contrast, non-German banks have a negative and statistically significant exposure to the German bond return. In both cases, the coefficients remain

[7] Kim and White (2004) modify the Bowley (1920) measure of skewness to study asymmetry of stock returns. Meanwhile, Ghysels et al. (2016) utilise the same measure to study portfolio allocation in international stock markets.

relatively constant across quantiles. The results that we obtain here are consistent with those obtained by Acharya and Steffen (2015) and Kallestrup et al. (2016), among other papers, and substantially extends them by showing that the transmission of risk from sovereigns to banks is propagated throughout the entire distribution of returns.[8] Turning to own sovereign bond effects, we find that there does not appear to be contemporaneous dependence from non-peripheral sovereign bonds to their corresponding bank returns, except at the extreme left tail. The opposite is true, however, for peripheral sovereign bonds, which appear to have a positive and significant dependence throughout the entire conditional distribution.

[Table 2 about here.]

We now turn to the coefficients associated to the lagged quantiles. As can be observed, the estimation results suggest that the GIIPS bond effect is positively significant and persistent at the extreme tails of the conditional distribution of bank returns. While the contemporaneous effect is flat across quantiles, these more persistent effects remain relevant at the tails. Meanwhile, the German bond effect continues to be negative and significant over time, as can be observed from the parameter estimates. Turning to the own bond effects, we interestingly find that this effect for non-GIIPS countries is negative and significant at the two tails. The analogous effect for peripheral countries, however, turns out to be statistically insignificant, though it carries the same positive sign as the contemporaneous effect. These results suggest that dependence between bond and bank returns for peripheral countries is mainly contemporaneous, while the same effect is only introduced to non-peripheral countries through lags.

Finally, Table 9 of the Supplementary Material shows empirical results for the bond quantile model, equation (2). As can be observed, there does not appear to be a strong transmission of risk from bank to bond returns.

#### 3.3.2 Estimates of conditional asymmetry and its properties

As is clear from the skewness measure defined in (3), to compute the conditional asymmetry measures, we need estimates of the 25th, 50th and 75th quantiles. To do so, we

[8] Moreover, in a related paper, Brutti and Sauré (2015) show that financial sector linkages are a major factor in the transmission of sovereign credit risk.

recover them from the estimated conditional quantile models (1) and (2), and plug those estimates into the formula above.

[Figure 2 about here.]

Figure 2 plots the kernel densities of the conditional asymmetry estimates of bank equity returns and sovereign bond returns. First, we discuss the results for Figure 2a, the kernel densities for bank asymmetries. We plot the kernel densities for peripheral and non-peripheral banks. As can be observed from the figure, we find that the kernel density for non-GIIPS banks is less dispersed than that for GIIPS banks. Moreover, we find that the kernel density for the non-GIIPS banks has thinner tails, consistent with the idea that extreme events occur more frequently for banks that are headquartered in countries with weak sovereigns. The second panel, meanwhile, Figure 2b, plots the unconditional densities for bond asymmetries. In the figure, the difference between peripheral and non-peripheral bonds is more obvious. In particular, we find that the kernel density for peripheral bonds is more skewed to the left.

[Figure 3 about here.]

However, the kernel densities do not portray the evolution of the conditional asymmetry measures over time. Figure 3 plots the quarterly conditional asymmetry estimates for average banks and bonds throughout the sample periods. Looking at Figure 3a, we find that the conditional asymmetry measures for banks co-move together, though the magnitudes differ for non-GIIPS and GIIPS banks. We also find that there are periods wherein the conditional asymmetries are negative, which mainly occur at crucial periods in financial markets, like the Dot-com bubble in 2003, the financial crisis in 2008, and the height of the European sovereign crisis in 2011. The second panel, Figure 3b shows that in general, peripheral and non-peripheral sovereign bonds do not co-move together; rather, they tend to move in opposite directions. Lastly, Figure 3c plots the conditional asymmetry measures between a bank and the sovereign bond of the country the bank is headquartered, which in this case, are the non-GIIPS bank and bond in the previous figures. As can be observed from the figure, there appears to be a clear divergence between bank and bond conditional asymmetries, which we will further explore in the next subsection.

#### 3.3.3 Co-movements in conditional asymmetries of bond and bank returns

It is natural to ask the degree to which the time variation in the conditional asymmetry in the distribution of bank returns is due to fluctuations in sovereign bond returns. In other words, can we trace these fluctuations to a sovereign factor? As we have seen in the previous section, the distributions of bank returns are affected by different factors that can be country-specific (such as their own sovereign bond returns), or because of risks that come from other sovereigns.

In this regard, we first estimate the following model:

$$\widehat{CA}_{t,B_i} = \alpha + \beta \widehat{CA}_{t,S_j} + \varepsilon_{t,B_i} \tag{4}$$

where $\widehat{CA}_{t,B_i}$ and $\widehat{CA}_{t,S_j}$ are the estimated conditional asymmetries of bank return $i$ and sovereign return $j$ where the bank is headquartered, at the quarterly frequency. Apart from providing a simple procedure that shows the co-movements between bond and bank returns, an alternative interpretation of the model is that of a single factor model where the source of asymmetries in the distribution of bank returns is that of country-specific factors. We estimate this regression with quarterly conditional asymmetry measures instead of weekly measures to be consistent with subsequent regressions where we will link them with macroeconomic or bank-related variables.

Table 3 presents the results of this regression. Looking at the first column, there is a negative and significant relationship between the conditional asymmetry of banks and the sovereign in the country in which they are headquartered in; that is, banks have a negative and signficant exposure to their own sovereign bond. This is not surprising, as this relationship reflects the role played by sovereign bonds as "safe havens". Thus, positive (negative) skewness in the sovereign market tends to be observed when the equity market is generating more negative (positive) skewness as a result of investors leaving (returning to) the equity market. We then analyse whether the relationship changes for banks headquartered in peripheral countries by introducing an interaction between GIIPS and the conditional asymmetry measure. As the results in the second column of Table 3 indicate, there is indeed a significantly less negative exposure of the peripheral banks to the peripheral bonds. This is a first indication that no safe haven effect is observed for sovereign bonds from GIIPS countries, as these bonds were not perceived as sufficiently safe by investors during the European sovereign crisis. Moreover, the negative and significant coefficient on the GIIPS dummy points to a fixed penalty for banks headquartered in the GIIPS countries. We will further explore this issue in subsequent sections.

[Table 3 about here.]

We then study the presence of spillovers from peripheral sovereign bonds to banks that are not in peripheral countries. To do this, we augment specification (4) and project the conditional asymmetry measures of each of the peripheral sovereign bonds interacted with a dummy that is equal to one if the bank is not headquartered in the peripheral country considered. That is, we estimate the following model:

$$\widehat{CA}_{t,B_i} = \alpha + \beta\widehat{CA}_{t,S_j} + \gamma\widehat{CA}_{t,S_k}\mathbf{1}(j \notin GIIPS) + \delta\widehat{CA}_{t,S_{DE}}\mathbf{1}(j \notin DE) + \varepsilon_{t,B_i} \tag{5}$$

where $k \in \{GR, IE, IT, PT, ES\}$. Note that we also include as a regressor the conditional asymmetry measure for the German sovereign bond, interacted with a dummy that is equal to one if the bank is not headquartered in Germany. This allows us to test the hypothesis that German sovereign bonds were seen as "safe haven" assets, in particular during the sovereign debt crisis.

[Table 4 about here.]

Table 4 presents the results of this estimation. As can be observed from the first to the fifth column, each of the peripheral sovereign bonds (with the exception of Portuguese bonds) has a positive and significant co-movement with the conditional asymmetry of bank returns, consistent with the evidence that has been shown by Acharya and Steffen (2015), among others. We go beyond previous results by showing that not only does the mean of the returns co-move together, but also, and more importantly, the conditional asymmetries co-move as well. The German bond conditional asymmetry measure is highly negative and significant as well, which is consistent with the presence of flight-to-quality effects during the European sovereign debt crisis (Beber et al. (2009)). Notice that the own-country conditional asymmetry measures become insignificant in these regressions, which suggest that risk exposures are more related to movements in the peripheral sovereign bonds. When all bonds are considered jointly, as in column 6 of the table, we find that almost all of the peripheral bonds asymmetries have a positive and signficiant relationship, except for Portugal, which has a negative and significant coefficient. The coefficient on German sovereign bond asymmetry is negative and significant, as well as the own sovereign bond asymmetry. Because there is a high degree of collinearity among the peripheral sovereign bonds, we conduct another regression wherein we first conduct a principal component analysis of the GIIPS sovereign bond return asymmetries, and extract the first principal component to use as a regressor. As the results in column 7 of the table indicate, we find a positive and significant relationship between the first principal component and bank conditional asymmetry, suggesting that indeed, there are spillovers from the peripheral sovereign bond returns to bank returns, particularly at the tails of the distribution. The own sovereign bond and the German sovereign bond asymmetry measures remain to be negative and significant in this estimation.

#### 3.3.4 Conditional asymmetry and volatility

Finally, it might be of interest to consider the relationship between conditional asymmetry and volatility of bank returns. Is it the case that there is more negative skewness in periods of high volatility? One can think that, if the so-called "leverage effect" does exist, then we are indeed capturing conditional asymmetry of bank returns. To this end, we estimate the following model:

$$\widehat{CA}_{t,B_i} = \alpha_i + \beta \widehat{Vol}_{t,B_i} + \varepsilon_{t,B_i} \tag{6}$$

where $\widehat{Vol}_{t,B_i}$ is constructed using the interquartile range, which is defined as the difference between the 25th and the 75th conditional quantile functions of the estimated model (1) for bank returns.[9] Though there are several measures of conditional volatility that are extant in the literature, we prefer to utilise one that contains the same information as that of the conditional asymmetry of bank returns.

[Table 5 about here.]

Table 5 presents the results of the regression. The results in the first column indicate that there is a negative relationship between skewness and volatility. This result is consistent with the leverage effect results from the asymmetric GARCH literature. To

[9] We have estimated the same regression with alternative estimates of volatility computed from an estimated GARCH(1,1) model for each of the banks in the sample. The results are similar to what we show here. Results are available upon request.

determine if there are differences between banks headquartered in GIIPS countries, we augment specification (5) with an interaction between whether a bank is headquartered in a GIIPS country, and the corresponding conditional volatility measure. Overall, the relationship between $\widehat{CA}_{t,B_i}$ and $\widehat{Vol}_{t,B_i}$ remains negative and significant. However, the combined impact of the GIIPS dummy and the coefficient on $\widehat{Vol}_{t,B_i}$ for GIIPS shows that banks from the countries more affected by the European sovereign crisis generate equity returns with more negative asymmetry, similar to the penalisation found in Table 3. We will later assess whether this is due to some fundamental features of GIIPS banks, or whether this is a penalisation for operating in countries with weaker sovereign bonds.

# 4 Economic determinants of conditional asymmetries

In the previous section, we related the conditional asymmetry of banks to bonds and to fluctuations to volatility. While these results allow us to understand the time series and co-movement properties of our conditional asymmetry measures, they do not provide much insight on the economic determinants. That is, can we trace the co-movements in bank and bond asymmetries to fluctuations in economic and financial fundamentals?

We investigate in this section whether $\widehat{CA}_{t,B_i}$ and $\widehat{CA}_{t,S_i}$ can be explained by a set of predetermined state variables. The selection of economic and financial state variables are mainly motivated by results in previous empirical studies which investigate the predictors of the conditional mean of bank and bond returns, respectively (e.g., Gandhi and Lustig (2015) for bank returns and Hilscher and Nosbusch (2010) for sovereign bond returns). As most of these predictive variables are observed at a quarterly frequency, our approach in this paper is to study whether variables observed in quarter $t-1$ can predict conditional asymmetry in quarter $t$.

We proceed by estimating the following panel regression:

$$\widehat{CA}_{t,k} = \alpha + \mathbf{X}'_{t-1,k}\beta + e_{t-1,k} \tag{7}$$

where $k \in \{B_i, S_j\}$ and $\mathbf{X}_{t-1,k}$ is a vector of state variables. We consider different state variables depending on whether the left-hand side variable is $\widehat{CA}_{t,B_i}$ or $\widehat{CA}_{t,S_j}$. We run the pooled regression across banks (or countries) and across time, using the quarterly estimates of the conditional asymmetry measure, which is estimated from the quantile model in section 3. Additional information about the estimations we perform are provided in each subsection. We provide the definitions of the variables used in the estimation, and the corresponding sources, in the appendix.

## 4.1 Determinants of bank conditional asymmetry

We describe the following bank-level variables that we consider as determinants of model (7) for $\widehat{CA}_{t,B_i}$.[10] In particular, we construct variables that are related to capital structure, asset structure and bank performance.

We consider the Tier 1 capital ratio as a measure of capital structure. There are two opposite potential effects on the relationship between capital and bank risk. On the one hand, the higher the capital reserves of a bank, the greater capacity it has to withstand losses. Higher capital levels can also result in banks becoming more prudent in screening potential borrowers, which leads to less bank risk taking behavior (e.g., Mehran and Thakor (2011)). On the other hand, higher capital requirements can lead to excessive risk-taking. As underscored in the corporate finance literature, agency problems between shareholders and managers can lead to excessive risk-taking by managerial risk-seeking. These papers conclude that increasing leverage (by reducing capital requirements) mitigates this problem, as informed debt holders might force the bank managers to become more prudent (e.g., Diamond and Rajan (2001)).

Bank size can be an important determinant of bank risk and systemic importance, as shown by Gandhi and Lustig (2015)[11] and Altunbas et al. (2017) recently. Large banks may face different incentives to take on risk than small banks because of the "too-big-to-fail" problem, or due to wider possibilities for portfolio diversification. In the estimations, asset size is the logarithm of the total assets of the banks in the data. Another variable that we consider as a measure of asset structure is the loans-to-assets ratio, which summarises how much of the activity of the bank is invested in traditional roles.

As a measure of bank profitability, we consider return on equity, which we calculate as the quarterly ratio of total net income of the bank and shareholder equity. Finally, we consider the non-performing-loans to total bank loans ratio as a measure of bank

[10] The summary statistics of the variables we use here are in the appendix corresponding to this section.

[11] Gandhi and Lustig (2015) show that the bank returns of the largest US banks ranked by size are smaller than small and medium bank stocks. They argue that these results are consistent with a size factor that is a measure of bank-specific tail risk.

performance. As highlighted in the global financial crisis, non-performing loans can be seen as a measure of a bank's level of default on its asset side, and can be thought of as a measure of a subsequent banking crisis' severity, when aggregated to the whole banking system. This is because a rising share of non-performing loans in a bank's loan portfolio reflects losses from previously granted loans that might affect the liquidity and profitability of banks.

To compute the aforementioned variables, we use information from SNL Financial that spans the first quarter of 2008 to the last quarter of 2013. We introduce bank and quarter fixed effects to control for unobserved bank and time variation. The standard errors in our regressions are clustered by bank and quarter.

[Table 6 about here.]

Table 6 presents the results of the regressions, where we also include as additional predictors the conditional asymmetry measures of the sovereign bond where bank $i$ is headquartered, the first principal component of the conditional asymmetry measures of the GIIPS sovereign bonds, and the conditional asymmetry measure of the German sovereign bond. We first focus on the results in the first column, which is the basic specification. We find that larger asset size results in more negative bank return conditional asymmetry in period $t$. Our findings extend the results of Gandhi and Lustig (2015) by showing that not only do larger banks (in terms of size) have lower returns, but also that their return distributions change shape (i.e., become more negatively skewed). Meanwhile, the coefficient on the Tier 1 ratio is positive and significant. This result is consistent with the first of the two views discussed earlier; that is, the higher capital reserves the bank has, the less likely it engages in risk taking behaviour. The non-performing loans ratio turns out to be negative and significant as well, supporting the view that this is an indicator of bank risk. Looking at the conditional asymmetry measures, we find that the results are quite similar to the regressions in section 3.3.3 of the paper. That is, there is a negative relationship between own sovereign skewness (and German bond skewness for non-German countries) and future bank skewness. In contrast, higher skewness of GIIPS bond returns yields higher bank skewness at time $t + 1$ for non-GIIPS countries. Again, this reflects how the peripheral sovereign bonds lost their status as a safe investment during the crisis. In addition, it shows that tensions in the GIIPS affect banks in both GIIPS and non-GIIPS countries.

We then look at whether there is an additional effect for banks headquartered in GIIPS countries. To do so, we augment the specification by interacting the bank-level variables with an indicator for GIIPS-headquartered banks. As the second column of Table 6 indicates, the main determinant of bank conditional asymmetry is the Tier 1 ratio. Specifically, there is a positive and significant relationship between the Tier 1 ratio and bank conditional asymmetry. However, this effect disappears for banks headquartered in peripheral countries, as the negative coefficient in the interaction of the Tier 1 ratio and the indicator for GIIPS-headquartered banks cancels the effect of the general coefficient on the Tier 1 ratio. The conditional asymmetry measures still retain the same coefficients, although with less power for the own sovereign skewness measure. These imply that bond conditional asymmetry measures are strong predictors of future conditional asymmetries of banks, which underscores the sovereign-bank nexus.

In sum, the regressions in this subsection indicate that sovereign skewness is a signficant predictor of future bank skewness. Moreover, variables that are related to banks' capital adequacy (such as the Tier 1 ratio) are relevant indicators of future bank risk. However, banks from GIIPS countries with stronger Tier 1 ratios do not seem to enjoy the positive effects observed for banks from core countries on their skewness. This is already a sign of potential stigma for GIIPS banks due to the sovereign-bank nexus. We will dig further on this issue in Section 5.

## 4.2 Determinants of bond conditional asymmetry

We now discuss the determinants of model (7) for sovereign bonds, $\widehat{CA}_{t,S_j}$. In particular, we introduce variables that describe leverage and volatility, as these have been shown to be relevant determinants of sovereign credit risk (Ericsson et al. (2009)).

To compute measures of a country's indebtedness, we follow Hilscher and Nosbusch (2010), Reinhart and Rogoff (2010) and Dieckmann and Plank (2012) by utilising the country's debt-to-GDP ratio and reserves-to-GDP ratio. The rationale for including the reserves-to-GDP ratio is due to its interpretation as a measure of a country's ability to pay its foreign debt. We provide two variables that measure volatility. In particular, we compute local stock market volatility by computing an 18-month rolling volatility of the stock market return of each country in the sample. We also follow Hilscher and Nosbusch (2010) and compute an 18-month rolling volatility of the terms of trade of each country in the sample. To further impose discipline, and to include variables that describe local market conditions, we also use the aggregate bank skewness, calculated as the average of the conditional asymmetry measures of the banks headquartered in country $j$, weighted by each bank's size, and the changes in a country's terms-of-trade, which is defined as the percentage change of the country's export-to-imports ratio over the past five years, following Hilscher and Nosbusch (2010).[12]

We describe the sources for the variables that we utilise in the appendix corresponding to this section. We introduce country and quarter fixed effects to control for unobserved country and time variation. The standard errors in our regressions are clustered by country and quarter.

[Table 7 about here.]

Table 7 shows the corresponding regression results. We find that a higher reserves-to-GDP ratio results in higher sovereign skewness. This result is consistent with the idea of the country being able to better pay off its sovereign debt (Dieckmann and Plank (2012)). The change in the terms of trade variable is also positive and significant, which suggests that the better is the country's performance in trade markets (suggested by higher exports), the better is the country's economic health. In contrast to Hilscher and Nosbusch (2010), we do not find that the volatility in the country's terms of trade is stastistically significant. However, the sign associated to the coefficient is negative, which is in line with their findings that terms of trade volatility is a significant factor in determining sovereign risk. Finally, we find that aggregate bank skewness has a negative and significant relationship with sovereign bond skewness.

To determine whether there is an additional effect for peripheral sovereign bonds, we augment the specification by interacting the country variables with an indicator for whether a sovereign is a peripheral country or not. As the second column of Table 7 indicates, it appears that the reserves-to-GDP ratio continues to be a determinant of conditional bond asymmetry. Meanwhile, the changes in the terms of trade becomes more relevant for GIIPS countries than it is for non-GIIPS countries. We also find, however,

[12] In regressions not shown here, we also included other measures that describe local market conditions, such as the effective exchange rate of the Euro, the European industrial production index, and the European Fama-French factors, following Longstaff et al. (2011) and Acharya and Steffen (2015). As these variables are collinear with the quarter effects, we do not include them in the final specification. The results that we obtain are pretty similar, even when removing quarter effects.

that stock market volatility becomes negative and significant, in line with economic intuition. This relationship turns out to be positive for peripheral sovereign countries, however. Finally, aggregate bank skewness appears to be negative and significant, but only for peripheral countries. Overall, these results indicate that variables related to leverage are highly significant predictors of sovereign credit risk.

# 5 Do firms pay a premium for sovereign skewness?

The previous sections showed that bank and sovereign bond returns not only are skewed and time-varying, but that there is also a negative relationship between bank and sovereign skewness. As stressed earlier, this suggests that in periods of financial market stress, investors leave the equity markets to invest in sovereign debt, which may be perceived to be safer. However, such a negative relationship does not seem to hold for countries undergoing a sovereign crisis. This strong interconnectedness between bank and sovereign risk is known as the sovereign-bank nexus. Many authors argue that this nexus is due to the domestic sovereign holdings in banks balance sheets (see Altavilla et al. (2017)).[13]

The results from the previous sections document that this nexus indeed exists. However, our findings so far do not shed light on the extent to which it is actually driven by banks domestic sovereign exposures or to other factors. Specifically, the sovereign-bank nexus may go well beyond banks domestic sovereign holdings. Banks are also exposed to sovereign tensions through their linkages to the real economy, since eventually those tensions usually reflect problems on the whole economy. In this sense, some recent papers have also found that there is a transmission of risk from sovereigns to non-financial firms (see e.g., Augustin et al. (2018) and Bedendo and Colla (2015)). If this is the case, it would be a confirmation that the sovereign-bank nexus is also driven by common exposure to the real economy, since the sovereign debt holdings by non-financial firms are negligible. We explore this possibility by assessing whether both financial and non-financial firms need to pay a sovereign skewness premium to attract investors, and whether this premium is more intense for GIIPS. In particular, we conduct cross-sectional asset pricing tests. Instead of forming portfolios, however, we resort to examining indi-

[13] In fact, this discussion has given rise to a Basel Committee discussion paper on the possibility to change the regulatory treatment of sovereign exposures.

vidual stocks. As emphasized by recent work by Ang et al. (2017) and Chordia et al. (2015), the use of individual stocks as opposed to forming portfolios improves the statistical efficiency of the estimation of pricing models. We outline the methodology we pursue below.

## 5.1 Methodology

As is well known, under no arbitrage, excess returns $rx_{t,j}$ have zero price and thus satisfy the Euler equation $E(m_{t+1}rx_{t+1,j}) = 0$, where $m_{t+1}$ is the stochastic discount factor (SDF). If the SDF is linear in the factors, the equation implies a beta pricing model. In particular,

$$E(rx_{t+1,j}) = \boldsymbol{\lambda}'\boldsymbol{\beta}_j \tag{8}$$

in which the $\lambda$'s are the factor risk prices and the $\beta_j$'s are the factor loadings. We estimate these quantities via a two-pass regression procedure, as the factor of interest (i.e., sovereign skewness) is not tradeable (Cochrane (2009)).

The first pass regression is a time series regression of each stock's excess return on a vector of risk factors:

$$rx_{t,j} = \alpha_j + \mathbf{f}_t'\boldsymbol{\beta}_j + \varepsilon_{t,j}, \quad \text{for } t = 1, \ldots, T, j = 1, \ldots, J \tag{9}$$

where $\mathbf{f}_t$ is a vector of risk factors, $\alpha_j$ is the risk-adjusted return on the stock, and $\boldsymbol{\beta}_j$ is the vector of exposures to the risk factors. In the second pass, we take the time series average of the excess returns $\overline{rx}_j = \frac{1}{T}\sum_{t=1}^{T} rx_{t,j}$, and perform the following cross-sectional regression of the average returns on the estimated beta's:

$$\overline{rx}_j = \widehat{\boldsymbol{\beta}_j}'\boldsymbol{\lambda} + a_j, \quad \text{for } j = 1, \ldots, J \tag{10}$$

where $a_j$ is the associated cross-sectional pricing error associated with each stock $j$.

In this section, we study whether financial and non-financial firms that are constituents of the Eurostoxx 600 pay a premium for negative sovereign conditional asymmetry, and whether it is stronger for GIIPS-headquartered firms. We identify 94 financial firms and 392 non-financial firms that are headquartered in the countries that are part of our sample, and calculate, for each firm, the excess return on the corresponding equity prices. We then divide the financial and non-financial firms into two groups, and perform the two-pass regression procedure on each group separately.

We consider two sets of estimations. In the first set, we consider a five-factor SDF. We describe in more detail the variable definitions, and the corresponding sources, in the appendix. The first factor is the market factor ($Market$), which is defined as the difference between the return on the Eurostoxx 600 and the overnight interest rate spread. The second and the third factors are the bond market ($Term$) and the credit ($Credit$) spreads. The bond market spread is defined as the difference between the ten-year and the two-year Treasury rates of each country in the sample. Meanwhile, the credit spread is the difference between ten-year A rated Eurozone corporate bond yields and the 10-year German sovereign bond yield. The term spread can be thought of as a measure of business cycle risk; meanwhile, the credit spread can be thought of as a measure of corporate default risk. Moreover, as Mäkinen et al. (2018) notes, both of these variables can be thought of as measures of bank profitability and risk. The fourth factor is the $TED$ spread, which is the difference between the three-month Euribor and the three-month Euro overnight interest rate swap. One interpretation of the $TED$ spread is that of a measure of stress in the interbank market, which then is related to funding and overall market liquidity. The fifth factor is the estimated sovereign conditional asymmetry measure $\widehat{CA}_{t,s_j}$ of the country the firm is headquartered in. Meanwhile, in the second set of estimations, we consider not only these factors, but also their interaction with a dummy variable for whether the firm is headquartered in a peripheral country or not. The rationale behind this is to understand whether indeed, there is an additional penalisation for being headquartered in a GIIPS country.[14]

## 5.2 Results

Before presenting the results of the second-pass regression, we first present the results of a panel regression that mimics the first-pass regression (9). In particular, we estimate the following model:

$$rx_{t,j} = \alpha + \mathbf{f}_t'\boldsymbol{\beta}_j + \varepsilon_{t,j} \tag{11}$$

with firm and quarter fixed effects to control for unobserved variation across firms and time. We compute standard errors that are clustered by firm and quarter.

[Table 8 about here.]

[14] While one can work with the Fama and French (1993) factors, not all of these factors are available for the countries in our sample.

Table 8 shows the estimation results. We first focus on the first two columns, that describe the result for financial firms. We find that financial firms load positively on $Market$ and $Term$, and load negatively on the $Credit$. We also find that financial firms load negatively on sovereign conditional asymmetry, which is consistent with the flight-to-quality interpretation that we have argued earlier. Once we introduce the interaction with the GIIPS dummy, we find that for all financial firms, only $Market$ and the sovereign skewness have significant loadings; the rest are significant, but mostly for GIIPS financial firms. We also find that the interaction between sovereign skewness and GIIPS is positive and significant.

We next describe the results for non-financial firms, which are on the third and fourth columns of the table. Again, we find that non-financial firms load positively on $Market$ and $Term$, and negatively on $Credit$ and sovereign conditional asymmetry. Notice, however, that non-financial firms load positively on $TED$. Perhaps, what this result suggests, is that, when risk increases in financial markets, investors flock to non-financial firms that are not directly affected by interbank market stress. Looking at the results in the fourth column, we find that even after introducing the GIIPS dummy, the factors retain their specific loadings. Moreover, the only significant factors that are interacted are that of the credit spread and of sovereign conditional asymmetry.

[Table 9 about here.]

We now look at the results of the second-pass regression (10), which are outlined in Table 9. We first discuss the result of the second-pass regression for financial firms, which are on the first and second column. As the results indicate, the risk price of sovereign skewness is negative and statistically signficant at the 1 percent level, suggesting that indeed, skewness is priced by financial firms. Moreover, the negative coefficient, coupled with the loading on the sovereign skewness coefficient, suggests that financial firms need to pay a sovereign risk-related premium to investors holding their equity. Looking at the second column, we observe that the coefficient related to the GIIPS indicator is positive and significant; this coefficient suggests that financial firms have to pay a premium to investors just for being headquartered in a country that has a weak sovereign. Looking at the other factors, however, we find that only the market is statistically significant, with a positive risk price.

Finally, we look at the third and fourth columns, which present the results for non-financial firms. We find that, similar to financial firms, non-financial firms have a negative risk price associated with sovereign conditional asymmetry, which is reflected in the price of risk for these firms. Remarkably, even non-financial firms that are headquartered in GIIPS countries are penalised, as can be seen from the positive coefficient on the GIIPS indicator in column 4. Though we do not directly look at the real channel of the sovereign-bank nexus, this result suggests that the nexus also exists for non-financial firms. Our approach does not allow us to empirically disentangle whether this nexus for non-financial firms is due to spillovers from financial to non-financial firms or to common exposures to sovereign risk through the real economy. However, as constituents of the Eurostoxx 600, the non-financial companies in our sample are generally large firms, which normally have direct access to the international markets. Hence, the results we obtain appeal to the second hypothesis (i.e. the nexus with sovereign risk operating through the real economy). Looking at the other factors, we find that in the specification without the interactions, only the term spread is not priced. However, the inclusion of the GIIPS dummy and the interaction terms results in all of the factors being priced by non-financial firms.

# 6 Conclusions

While there are several papers that study the sovereign-bank nexus, empirical research that aims to understand the distributional linkages between sovereign and bank returns has been relatively scarce. We contribute to the literature by studying the evolution of the conditional distributions of bank and bond returns over time. In particular, we focus on conditional asymmetries of bank and bond returns, given their particular importance during the recent financial crisis.

Using a large panel of European bank and sovereign bond returns, we estimate measures of conditional asymmmetry via an approach that is robust to outliers and distributional assumptions. We find significant dynamics over time, a negative correlation between sovereign bond and bank return asymmetries, a positive correlation between asymmetries of peripheral sovereign bond returns and bank returns of non-peripheral countries, and a negative correlation between conditional bank asymmetry and conditional volatility. These findings have significant implications for asset pricing, some of which are explored in this paper. Specifically, we study if known economic and financial variables can predict conditional skewness of bank and bond returns. Our estimation results indicate that variables that related to bank's financial health are relevant indicators of future bank risk; the same result holds for sovereign risk. More importantly, we find that sovereign skewness is a significant predictor of bank skewness. Armed with these results, we finally show that both financial and non-financial firms pay a premium for negative sovereign conditional asymmetry. Peripheral firms pay a higher premium, which appears to remain regardless of the level of sovereign asymmetry.

The empirical results of our paper suggest that both financial and non-financial firms are penalised because of their links with the sovereign. From this perspective, the main policy question is whether there are mechanisms that can break the "diabolical" loop between sovereign debt and the financial conditions faced by domestic firms. Given that both financial and non-financial firms are affected by this loop, solutions affecting the financial system might be less effective than more comprehensive ones. Speficically, the goal could be to try to weaken the link between sovereign debt and domestic firms to the same extent as the situation in which US firms are unlinked from the state they are headquartered in. Currently, there are different proposals, but some of them face substantial challenges unless more decisive steps toward European integration are taken.

However, a recent proposal that has gained traction in both academic and policy circles is the creation of a European benchmark bond (Brunnermeier et al. (2017)), which can potentially substitute national sovereign debt as a reference for pricing assets. Should such a proposal be approved, and with appropriate regulations (ESRB (2018)), it will help facilitate financial stability by replacing national sovereign debt as the reference for pricing national assets, while at the same time, imposing prudent fiscal policy.

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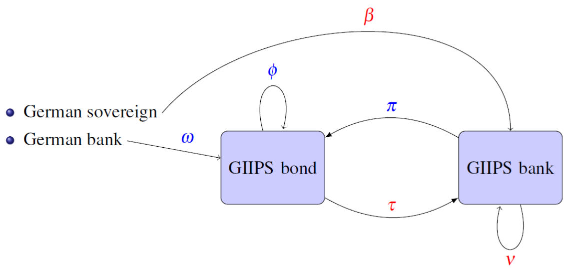
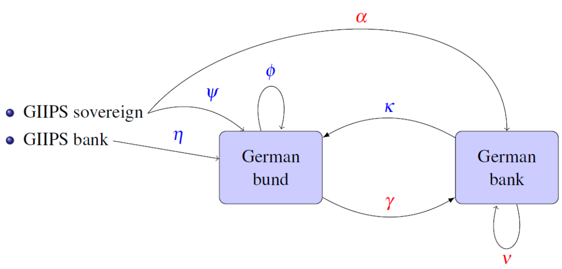
# Figures

Figure 1: Distributional linkages between bond and bank returns

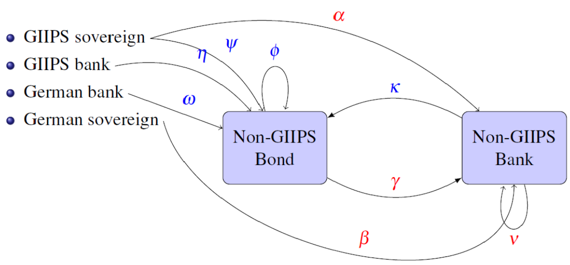
(a) GIIPS banks and sovereigns




(b) German banks and sovereigns



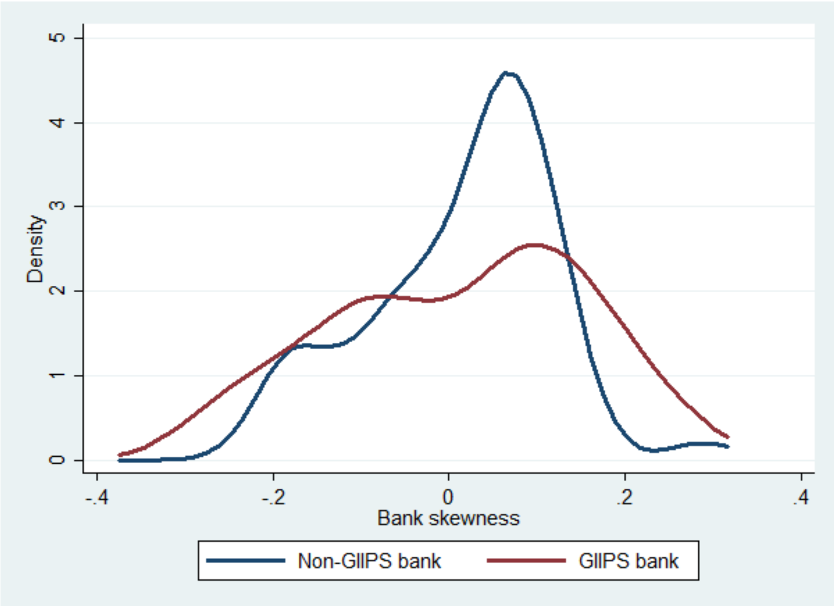

(c) Non-GIIPS, non-German banks and sovereigns



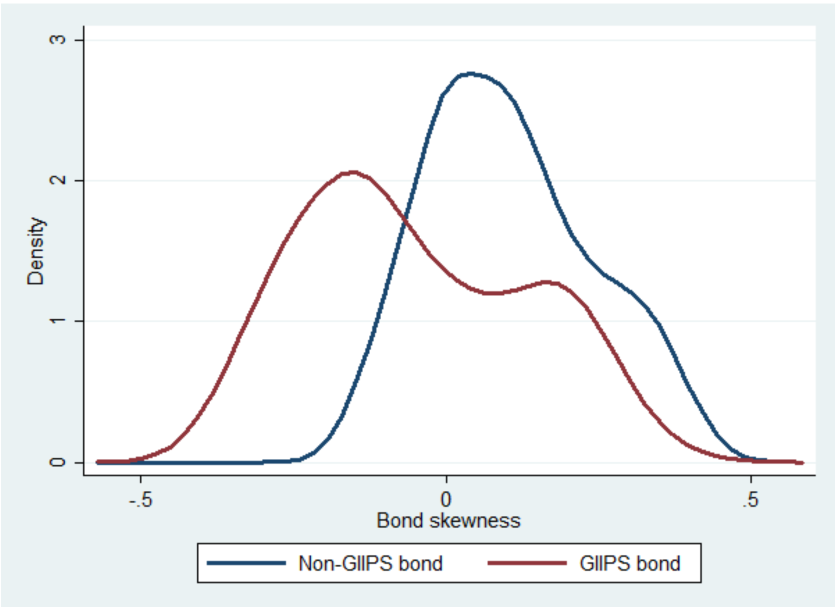

Note: This figure illustrates the linkages between bond and bank returns that are of interest, which we use to parameterise the quantile functions estimated in the paper. Each subfigure illustrates the linkages relevant to the group of banks and sovereigns labelled below it. The red parameters correspond to those of the bank equation (1) blue parameters correspond to the parameters of the bond equation (2).

Figure 2: Densities of conditional asymmetry estimates, Q12001-Q32013

(a) Bank stock returns



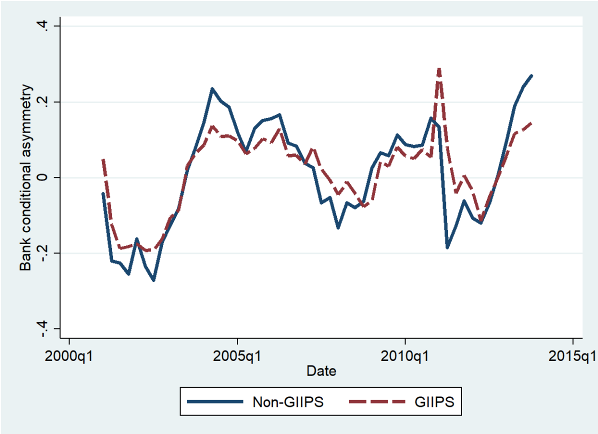

(b) Sovereign bond returns



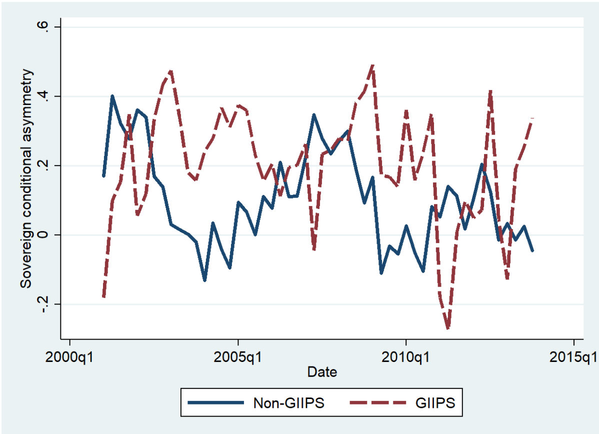

Note: The first panel plots the densities of the conditional asymmetry estimates $\widehat{CA}_{t,B_i}$ for Non-GIIPS and GIIPS banks, respectively. The second panel plots the densities of the conditional asymmetry estimates $\widehat{CA}_{t,S_j}$ for Non-GIIPS and GIIPS bonds, respectively. These are estimated from the conditional quantile model (1) and (2).

Figure 3: Conditional asymmetry estimates, quarterly frequency, Q12001-Q32013

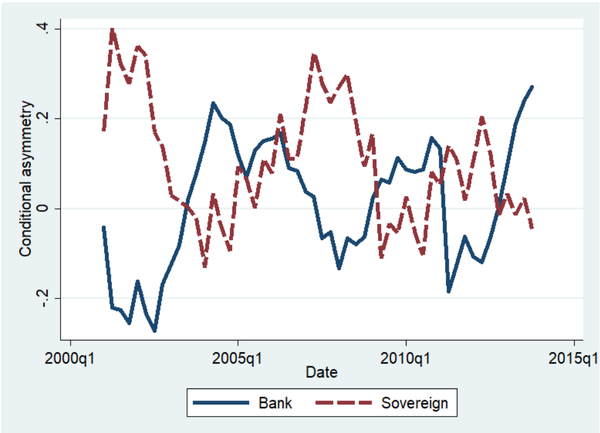
(a) Bank stock returns




(b) Sovereign bond returns




(c) Co-movements between bank stock returns and sovereign bond returns




Note: The first panel plots the conditional asymmetry estimates $\widehat{CA}_{t,B_i}$ for the average Non-GIIPS and GIIPS bank, respectively. The second panel plots the conditional asymmetry estimates $\widehat{CA}_{t,S_j}$ for the average Non-GIIPS and GIIPS bond, respectively. The third panel plots the conditional asymmetry measures of a bank and the associated sovereign bond of the country where the bank is headquartered. These are estimated from the conditional quantile model (1) and (2).

# Tables

Table 1: Descriptive statistics, sovereign bond returns

*Panel A: Descriptive statistics of sovereign bond returns*

| | Mean | Std. Dev. | Minimum | Median | Maximum |
|---|---|---|---|---|---|
| Greece | -0.003 | 1.697 | -8.685 | 0.008 | 38.569 |
| Ireland | 0.002 | 0.326 | -2.274 | 0.019 | 2.349 |
| Italy | 0.003 | 0.209 | -1.009 | 0.007 | 1.625 |
| Portugal | -0.002 | 0.404 | -2.783 | 0.005 | 2.235 |
| Spain | 0.001 | 0.238 | -1.032 | 0.01 | 1.95 |
| Germany | 0.008 | 0.171 | -0.551 | 0.018 | 0.584 |

*Panel B: Sovereign bond return correlations (2001-2006)*

| | Greece | Ireland | Italy | Portugal | Spain | Germany |
|---|---|---|---|---|---|---|
| Greece | 1 | | | | | |
| Ireland | 0.967 | 1 | | | | |
| Italy | 0.960 | 0.939 | 1 | | | |
| Portugal | 0.970 | 0.953 | 0.953 | 1 | | |
| Spain | 0.977 | 0.949 | 0.959 | 0.978 | 1 | |
| Germany | 0.981 | 0.964 | 0.971 | 0.974 | 0.981 | 1 |

*Panel C: Sovereign bond return correlations (2007-2013)*

| | Greece | Ireland | Italy | Portugal | Spain | Germany |
|---|---|---|---|---|---|---|
| Greece | 1 | | | | | |
| Ireland | 0.133 | 1 | | | | |
| Italy | 0.166 | 0.431 | 1 | | | |
| Portugal | 0.182 | 0.334 | 0.516 | 1 | | |
| Spain | 0.088 | 0.774 | 0.397 | 0.319 | 1 | |
| Germany | -0.194 | 0.068 | 0.039 | -0.053 | 0.103 | 1 |

Note: Panel A of the table provides summary statistics for weekly GIIPS and German sovereign bond returns. Panel B of the table shows the correlations between the sovereign bond returns from 2001 to 2006. Panel B of the table shows the correlations between the sovereign bond returns from 2007 to 2013.

Table 2: Quantile autoregressive model estimates, bank model

| | Quantile | | | | |
|---|---|---|---|---|---|
| | 5 | 25 | 50 | 75 | 95 |
| | Contemporaneous Parameters | | | | |
| GIIPS bonds to | 0.078** | 0.087*** | 0.090*** | 0.090*** | 0.082*** |
| non-GIIPS banks | (0.031) | (0.01) | (0.014) | (0.011) | (0.011) |
| German bond | -2.763*** | -2.345*** | -2.108*** | -2.323*** | -2.315*** |
| to non-German banks | (0.292) | (0.256) | (0.223) | (0.232) | (0.242) |
| Own bond effect | 1.206*** | 0.118 | 0.042 | -0.200 | 0.068 |
| for non-GIIPS | (0.232) | (0.201) | (0.172) | (0.189) | (0.177) |
| Own bond effect | 0.232 | 1.133*** | 1.077*** | 1.144*** | 0.877*** |
| for GIIPS | (0.244) | (0.223) | (0.169) | (0.148) | (0.136) |
| autoregressive term | -0.016 | -0.027** | -0.048*** | -0.065*** | -0.035** |
| | (0.011) | (0.011) | (0.007) | (0.016) | (0.014) |
| | Autoregressive Parameters | | | | |
| GIIPS bonds to | 3.666*** | 0.476** | 0.473 | 0.539** | 1.535*** |
| non-GIIPS banks | (0.684) | (0.146) | (0.405) | (0.165) | (0.194) |
| German bond | -4.685*** | -3.088*** | -1.892*** | -2.486*** | -3.643*** |
| to non-German banks | (0.632) | (0.886) | (1.637) | (0.796) | (0.568) |
| Own bond effect | -3.776*** | -2.311*** | -0.553 | -1.401*** | -3.876*** |
| for non-GIIPS | (0.480) | (0.458) | (0.892) | (0.218) | (0.414) |
| Own bond effect | 0.302 | 0.866 | 0.792 | 0.706 | 0.540 |
| for GIIPS | (2.584) | (0.586) | (2.579) | (0.668) | (0.716) |
| Constant | -2.349*** | -0.466*** | 0.054 | 0.952*** | 2.070*** |
| | (0.200) | (0.111) | (0.032) | (0.099) | (0.182) |

Note: The table provides regression results for the bank equation (1), the quantile vector autoregressive model. The dependent variables in these regressions are bank returns. The first column corresponds to the effect of interest. The second to the last columns correspond to a particular quantile. All regressions were under the time period from January 3, 2001-November 6, 2013, except for Greece, Ireland and Portugal. Standard errors are in parentheses, and are computed by using a sandwich formula as outlined in White et al. (2015). Significance levels are indicated by the following: *** - 1%,** - 5%, * - 10%.

Table 3: Relationship between bank stock and sovereign bond return asymmetries

| | (1) | (2) |
|---|---|---|
| | Conditional bank asymmetry | |
| $\widehat{CA}_{t,S_j}$ | -0.1029*** | -0.5234*** |
| | (0.0154) | (.0304) |
| $1(GIIPS)$ | | -0.2536*** |
| | | (.0327) |
| $\widehat{CA}_{t,S_j} \cdot 1(GIIPS)$ | | 0.7417*** |
| | | (0.0496) |
| Constant | -0.0308*** | -0.0214*** |
| | (0.0079) | (0.0070) |
| $R^2$ | 0.0727 | 0.2999 |
| Observations | 1,404 | 1,404 |

Note: This table presents the results of a regression of the conditional asymmetry of bank returns ($\widehat{CA}_{t,B_i}$) on the conditional of sovereign bond returns of the country where the bank is headquartered ($\widehat{CA}_{t,S_j}$) and a constant. The first column corresponds to the regression in equation (4). The second column corresponds to an augmented regression that includes an interaction between sovereign skewness and an indicator for whether the bank is in a GIIPS country. Newey-West standard errors (4 lags) in parentheses. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

Table 4: Conditional bank stock return asymmetry and the peripheral sovereign bonds

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Conditional bank asymmetry | | | | | | |
| $\widehat{CA}_{t,S_j}$ | -0.0146 | 0.0195 | 0.0024 | -0.0600*** | -0.0050 | -0.0400* | -0.0773*** |
| | (0.0148) | (0.0164) | (0.0169) | (0.0206) | (0.0176) | (0.0213) | (0.0079) |
| $\widehat{CA}_{t,S_{GR}}$ | 0.0974*** | | | | | 0.0472** | |
| | (0.0167) | | | | | (0.0239) | |
| $\widehat{CA}_{t,S_{IE}}$ | | 0.1095*** | | | | 0.1974*** | |
| | | (0.0165) | | | | (0.0409) | |
| $\widehat{CA}_{t,S_{IT}}$ | | | 0.0892*** | | | 0.4532*** | |
| | | | (0.0167) | | | (0.0744) | |
| $\widehat{CA}_{t,S_{PT}}$ | | | | 0.0208 | | -0.7834*** | |
| | | | | (0.0194) | | (0.0567) | |
| $\widehat{CA}_{t,S_{ES}}$ | | | | | 0.0814*** | 0.2070** | |
| | | | | | (0.0173) | (0.1049) | |
| $\widehat{PCA}_t$ | | | | | | | 0.0240*** |
| | | | | | | | (0.0028) |
| $\widehat{CA}_{t,S_{DE}}$ | -0.6207*** | -0.6249*** | -0.6279*** | -0.6279*** | -0.6298*** | -0.5102*** | -0.5526*** |
| | (0.0189) | (0.0176) | (0.0176) | (0.0167) | (0.0176) | (0.0165) | (0.0165) |
| Constant | -0.1190*** | -0.1479*** | -0.1335*** | -0.0788*** | -0.1273*** | -0.0857*** | -0.0587*** |
| | (0.0121) | (0.0139) | (0.0142) | (0.0176) | (0.0148) | (0.0186) | (0.0045) |
| $R^2$ | 0.506 | 0.502 | 0.496 | 0.482 | 0.491 | 0.605 | 0.544 |
| Obs. | 1,404 | 1,404 | 1,404 | 1,404 | 1,404 | 1,404 | 1,404 |

Note: This table presents the results of a regression of the conditional asymmetry of bank returns ($\widehat{CA}_{t,B_i}$) on the conditional asymmetry of sovereign bond returns of the country where the bank is headquartered ($\widehat{CA}_{t,S_j}$), the conditional asymmetry of peripheral sovereign bond returns interacted with a dummy variable for a bank not being a member of that country ($k \in \{GR, IE, IT, PT, ES\}$), and a constant. Newey-West standard errors (4 lags) in parentheses. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

Table 5: Conditional asymmetry and volatility of bank stock returns

| | (1) | (2) |
|---|---|---|
| | Conditional bank asymmetry | |
| $\widehat{Vol}_{t,B_i}$ | -0.0675*** | -0.0768*** |
| | (0.0040) | (0.0033) |
| $1(GIIPS)$ | | -0.2001*** |
| | | (0.0446) |
| $\widehat{Vol}_{t,B_i} \cdot 1(GIIPS)$ | | 0.0288*** |
| | | (0.0081) |
| Constant | 0.3066*** | 0.3718*** |
| | (0.0215) | (0.0172) |
| $R^2$ | 0.507 | 0.545 |
| Observations | 1,404 | 1,404 |

Note: This table presents the results of a regression of the conditional asymmetry of bank returns ($\widehat{CA}_{t,B_i}$) on volatility of the bank ($\widehat{Vol}_{t,B_i}$), computed as the difference between the conditional 75th ($\widehat{q}_{t,B_i}(0.75)$) and 25th quantiles ($\widehat{q}_{t,B_i}(0.25)$) of the bank's return. The second column corresponds to an augmented regression that includes an interaction between bank conditional volatility and whether the bank is in a GIIPS country. Newey-West standard errors (4 lags) in parentheses. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

Table 6: Determinants of conditional bank stock return asymmetry

| | (1) | (2) |
|---|---|---|
| | Conditional bank asymmetry | |
| $Size$ | -0.0654* | -0.1161 |
| | (0.0350) | (0.0716) |
| $Size \times \cdot 1(GIIPS)$ | | 0.0935 |
| | | (0.0964) |
| $Tier1$ | 0.0079*** | 0.0178*** |
| | (0.0019) | (0.0035) |
| $Tier1 \times \cdot 1(GIIPS)$ | | -0.0143*** |
| | | (0.0042) |
| $NPL$ | -0.1289** | -0.8416 |
| | (0.0619) | (1.1906) |
| $NPL \times 1(GIIPS)$ | | 0.7228 |
| | | (1.1889) |
| $ROE$ | 0.0001 | -0.1148 |
| | (0.0013) | (0.2743) |
| $ROE \times 1(GIIPS)$ | | 0.1141 |
| | | (0.2743) |
| $LOA$ | 0.0279 | 0.0015 |
| | (0.0640) | (0.1481) |
| $LOA \times 1(GIIPS)$ | | -0.0275 |
| | | (0.1537) |
| $\widehat{CA}_{t-1,S_j}$ | -0.1618*** | -0.1148* |
| | (0.0564) | (0.0626) |
| $\widehat{PCA}_{t-1,GIIPS}$ | 0.0185*** | 0.0236*** |
| | (0.0028) | (0.0034) |
| $\widehat{CA}_{t-1,S_{DE}}$ | -0.3739*** | -0.3682*** |
| | (0.0391) | (0.0363) |
| Bank fixed effects | Y | Y |
| Quarter fixed effects | Y | Y |
| Observations | 621 | 621 |
| $R^2$ | 0.3103 | 0.3265 |

Note: This table presents the results of a regression of the conditional asymmetry of bank returns at time $t$ ($\widehat{CA}_{t,B_i}$) on bank-level variables and sovereign conditional asymmetry variables that are observed in time $t-1$. The bank-level variables are asset size ($Size$), which is the logartihm of bank assets, the Tier 1 ratio (*Tier1*), the non-performing loans ratio ($NPL$), the return to equity ratio ($ROE$), and the loans-to-assets ratio ($LOA$). We also introduce the conditional asymmetry measures for own country sovereign, the first principal component for GIIPS sovereign bonds (for non peripheral countries), and the German bond skewness (for non-German countries). The second column corresponds to an augmented regression that includes an interaction between bank-level variables and whether the bank is in a GIIPS country. Standard errors are clustered by bank and quarter. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

Table 7: Determinants of conditional sovereign bond asymmetry

| | (1) | (2) |
|---|---|---|
| | Conditional sovereign bond asymmetry | |
| $Debt/GDP$ | -0.0002 | -0.0237 |
| | (0.0025) | (0.0159) |
| $Debt/GDP \times 1(GIIPS)$ | | 0.0202 |
| | | (0.0159) |
| $Reserves/GDP$ | 0.0707* | 0.0913*** |
| | (0.0372) | (0.0142) |
| $Reserves/GDP \times 1(GIIPS)$ | | -0.2151 |
| | | (1.4614) |
| $\Delta ToT$ | 0.0073*** | -0.0041 |
| | (0.0023) | (0.0060) |
| $\Delta ToT \times 1(GIIPS)$ | | 0.0130* |
| | | (0.0070) |
| $\sigma_{ToT}$ | -0.0171 | -0.0168 |
| | (0.0196) | (0.0330) |
| $\sigma_{ToT} \times 1(GIIPS)$ | | -0.0138 |
| | | (0.0365) |
| $\sigma_{Stock}$ | 0.4609 | -0.9925*** |
| | (0.5842) | (0.1570) |
| $\sigma_{Stock} \times 1(GIIPS)$ | | 3.3543*** |
| | | (0.5808) |
| $\widehat{CA}_{t-1,j}$ | -0.2155*** | -0.1363 |
| | (0.0626) | (0.0780) |
| $\widehat{CA}_{t-1,j} \times 1(GIIPS)$ | | -0.3790* |
| | | (0.1777) |
| Country fixed effects | Y | Y |
| Quarter fixed effects | Y | Y |
| Observations | 392 | 392 |
| $R^2$ | 0.3769 | 0.5076 |

Note: This table presents the results of a regression of the conditional asymmetry of bond returns at time $t$ ($\widehat{CA}_{t,S_j}$) on country-level variables observed in time $t-1$. The country-level variables are the debt-to-GDP ratio ($Debt/GDP$), the reserves-to-GDP ratio ($Reserves/GDP$), the change in a country's terms of trade ($\Delta ToT$), the volatility of a country's terms of trade ($\sigma_{ToT}$), stock market volatility ($\sigma_{Stock}$), and aggregate bank skewness for country $j$ ($\widehat{CA}_{t-1,j}$). The second column corresponds to an augmented regression that includes an interaction between country-level variables and whether the bank is in a GIIPS country. Standard errors are clustered by bank and quarter. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

Table 8: Panel estimates of the first-pass equity regressions for Eurostoxx 600 firms

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Excess returns | | | |
| | Financial firms | | Non-financial firms | |
| Market | 0.9985*** | 1.0048*** | 0.0417*** | 0.0374*** |
| | (0.0063) | (0.0076) | (0.0029) | (0.0031) |
| Term spread | 0.0258** | -0.0018 | 0.0196*** | 0.0148*** |
| | (0.0101) | (0.0079) | (0.0042) | (0.0044) |
| Credit spread | -0.0492** | -0.0018 | -0.1391*** | -0.1182*** |
| | (0.0208) | (0.0251) | (0.0105) | (0.0118) |
| TED spread | 0.0136 | -0.0177 | 0.1605*** | 0.1585*** |
| | (0.0383) | (0.0447) | (0.0171) | (0.0186) |
| Sovereign skewness | -0.1065*** | -0.1665*** | -0.2119*** | -0.2694*** |
| | (0.0194) | (0.0303) | (0.0137) | (0.0157) |
| Market * GIIPS | | -0.0393*** | | 0.0070 |
| | | (0.0146) | | (0.0085) |
| Term spread * GIIPS | | 0.0961*** | | 0.0139 |
| | | (0.0118) | | (0.0131) |
| Credit spread * GIIPS | | -0.1194*** | | -0.0415* |
| | | (0.0449) | | (0.0244) |
| TED spread * GIIPS | | 0.1451* | | -0.0405 |
| | | (0.0794) | | (0.0453) |
| Sovereign skewness * GIIPS | | 0.1056*** | | 0.1597*** |
| | | (0.0378) | | (0.0316) |
| Constant | 0.0320 | 0.0075 | 0.2443*** | 0.2248*** |
| | (0.0249) | (0.0287) | (0.0127) | (0.0133) |
| Firm fixed effects | Y | Y | Y | Y |
| Quarter fixed effects | Y | Y | Y | Y |
| Observations | 3,570 | 3,570 | 15,474 | 15,474 |
| $R^2$ | 0.9724 | 0.9727 | 0.1254 | 0.1292 |

Note: This table presents the results of a panel regression that is similar to the first-pass regression (9). The dependent variable is the excess return on the stocks of financial and non-financial firms in the Eurostoxx 600. The factors we consider are the market, the bond market (Term) spread, the credit market (credit) spread, the TED spread, a measure of interbank liquidity, and the estimated conditional sovereign asymmetry measure, $\widehat{CA}_{t,S_j}$. The first two columns correspond to results for financial firms, while the third and fourth columns correspond to results for non-financial firms. Standard errors are clustered by bank and quarter. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.

Table 9: Second-pass equity regressions for Eurostoxx 600 firms

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Excess returns | | | |
| | Financial firms | | Non-financial firms | |
| Market | 0.0822** | -0.0023 | 0.0741*** | 0.0663*** |
| | (0.0391) | (0.0486) | (0.0203) | (0.0199) |
| Term spread | 0.0161 | 0.0382 | 0.0212 | 0.0267** |
| | (0.0348) | (0.0380) | (0.0136) | (0.0134) |
| Credit spread | 0.0035 | -0.0510 | -0.1060*** | -0.1127*** |
| | (0.0321) | (0.0352) | (0.0203) | (0.0202) |
| TED spread | 0.0066 | -0.0019 | -0.0424*** | -0.0454*** |
| | (0.0189) | (0.0252) | (0.0145) | (0.0144) |
| Sovereign skewness | -0.0183*** | -0.0649*** | -0.0707*** | -0.0781*** |
| | (0.0040) | (0.0110) | (0.0058) | (0.0059) |
| GIIPS indicator | | 0.0593** | | 0.0847*** |
| | | (0.0292) | | (0.0144) |
| Market * GIIPS | | -0.0750 | | -0.2051 |
| | | (0.1633) | | (0.1399) |
| Term spread * GIIPS | | -0.0461 | | -0.1914* |
| | | (0.1135) | | (0.0980) |
| Credit spread * GIIPS | | 0.3253*** | | 0.3087** |
| | | (0.0855) | | (0.1195) |
| TED spread * GIIPS | | 0.0598 | | 0.0765 |
| | | (0.0437) | | (0.0610) |
| Sovereign skewness * GIIPS | | 0.0556** | | 0.0670*** |
| | | (0.0243) | | (0.0177) |
| Observations | 94 | 94 | 398 | 398 |
| $R^2$ | 0.3023 | 0.5400 | 0.3838 | 0.4527 |

Note: This table presents the results of the second-pass regression (10). The dependent variable is the excess return on the stocks of financial and non-financial firms in the Eurostoxx 600. The factors we consider are the market, the bond market (Term) spread, the credit market (credit) spread, the TED spread, a measure of interbank liquidity, and the estimated conditional sovereign asymmetry measure, $\widehat{CA}_{t,S_j}$. The first two columns correspond to results for financial firms, while the third and fourth columns correspond to results for non-financial firms. Standard errors are corrected for potential correlation across firms. *** $p < 0.01$, ** $p < 0.05$, *$p < 0.1$.