Banks, Government Bonds, and Default: What do the Data Say?

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We analyze holdings of public bonds by over 20,000 banks in 191 countries, and the role of these bonds in 20 sovereign defaults over 1998-2012. Banks hold many public bonds (on average 9% of their assets), particularly in less financially-developed countries. During sovereign defaults, exposure to public bonds increases, especially for large banks. At the bank level, bondholdings correlate negatively with subsequent lending during sovereign defaults. This correlation is mostly due to bonds acquired in pre-default years. These findings shed light on alternative theories of the sovereign default-banking crisis nexus.

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1. Introduction

Recent events in Europe have illustrated how government defaults can jeopardize domestic bank stability. Growing concerns of public insolvency since 2010 caused great stress in the European banking sector, which was loaded with Euro-area debt (Andritzky (2012)). Problems were very severe for banks in troubled countries, which entered the crisis holding a sizeable share of their assets in their governments' bonds: roughly 5% in Portugal and Spain, 7% in Italy and 16% in Greece (2010 EU Stress Test). As sovereign spreads rose, these banks greatly increased their exposure to the bonds of their financially distressed governments (2011 EU Stress Test; see also Brutti and Sauré (2013)), leading to even greater fragility. As *The Economist* (December 17th, 2011) put it, "Europe's troubled banks and broke governments are in a dangerous embrace." A similar relationship between sovereign defaults and banks has been underscored also in earlier emerging economy crises (IMF (2002)).

Despite the importance of these phenomena, there is little systematic evidence on them. This paper fills this gap by offering a panoramic view of the link between public default, bank bondholdings, and bank loans. We use the BANKSCOPE dataset, which provides us with information on the bondholdings and characteristics of over 20,000 banks in 191 countries and 20 sovereign default episodes between 1998 and 2012. In contrast to recent work, which focuses on the European crisis, we consider both developed and emerging economies and ask:

1. Is banks' exposure to sovereign risk associated with lending? That is, do the banks that hold more public bonds exhibit a larger fall in loans when their government defaults?
2. Which banks, and in which countries, hold public bonds? Do banks hold bonds all of the time, or do banks mostly buy bonds in the run-up to and during sovereign defaults?

Our goal is to document robust stylized facts regarding these questions and not to identify causal patterns, which our data does not allow us to do. We organize our analysis, however, so as to assess the two leading channels that may lead to a fall in bank lending during sovereign defaults. The first is what we call the "demand channel". It states that during defaults the demand for credit goes down because these events occur together with recessions, devaluations, and other adverse shocks. Hence, it is not bondholdings or default *per se* that matter for lending;

rather, the drop in loans is due to bad economic conditions that reduce the demand for credit. The second, or "supply", channel holds instead that sovereign defaults lead to a fall in the supply of private credit over and above what could be accounted for by prevailing economic conditions. This can occur in two non-mutually exclusive ways: (1) banks holding government bonds suffer losses on their balance sheet during sovereign defaults, which forces them to deleverage and cut their lending; and (2) banks purchase government bonds during the default event, and such purchases "crowd out" new lending. Incentives for buying bonds during default crises can in turn be due to banks' risk appetite, to regulation or to financial repression. Regardless of the precise mechanism, the supply channel implies that during default crises lending should fall the most for banks holding more government bonds.

We run a large battery of empirical tests to assess the relative merits of these demand and supply channels. These include, among others, controlling for many aggregate economic shocks, allowing for differential exposure of banks to such shocks, and analyzing which banks become exposed to government bonds in the first place.

Our main findings are:

- During sovereign defaults, there is a large, negative and statistically significant correlation between a bank's bondholdings and its subsequent lending. A one dollar increase in bonds is associated with a 0.60 dollar decrease in bank loans during defaults. This result is very robust, and holds when controlling for any aggregate shock. Within *the same* defaulting country and default year, it is the banks most loaded with public bonds that subsequently cut their lending the most.
- Bank bondholdings are large (around 9% of assets), particularly for banks that make fewer loans in normal times and are located in countries that are less financially developed. Critically, bondholdings increase somewhat during default episodes, but the increase is concentrated in large banks (which are also more profitable). Thus, prima facie it is not the case that "bad" banks self-select into buying many bonds during default.

- Both the bonds held by banks well ahead of default and those purchased during crises are strongly and negatively correlated with lending during default. Strikingly, though, about 90% of the decline in lending is accounted for by pre-default bonds. The reason is that the latter account for the lion's share of bondholdings in our data.

As the paper discusses in detail, these results – which are extremely robust – provide useful information on the underlying economic hypotheses. In particular, they are hard to reconcile with a pure demand channel in which sovereign default and bank balance sheets do not matter. For instance, if the drop in lending was *only* caused by adverse demand shocks, it should tend to occur uniformly in all banks. However we find that, regardless of whether we control for aggregate shocks or not, sovereign default only matters for banks holding public bonds. The negative association between default and lending does appear to be uniquely mediated by bondholdings, which is not prima facie consistent with the demand channel.

Of course, it may be the case that banks holding many public bonds either expect or happen to face low credit demand during default. This is where our analysis of bank heterogeneity and of banks' demand for bonds proves useful. First, we find that the lending policy of banks holding many bonds appears to be very sensitive to default but not to key aggregate shocks such as recessions or devaluations. Second, we find that banks holding many bonds do not appear to be any worse than banks holding few bonds. If anything, the reverse is true. Finally, the fact that bonds held well before default are negatively associated with the drop in lending during default, further reduces the concern that bad banks may self-select into buying bonds during crises. Section 4 draws some implications of these findings for the sovereign default-banking crisis nexus.

Our paper is related to the literature studying the costs of public defaults. Quantitative models like Arellano (2008) find that, when calibrated to match the data, exclusion from financial markets is too short to account for the observed low frequency of defaults. In line with her findings, recent work posits that default is costly because it inflicts a "collateral damage" to the domestic economy. This damage arises because default is assumed to be nondiscriminatory, so that it hurts domestic bondholders, not only foreign ones (e.g., Broner and Ventura 2011). In

Gennaioli, Martin, and Rossi (2014), we built a model where nondiscriminatory defaults reduce the net worth of banks holding public bonds and hamper financial intermediation.[1] We also provided cross-country evidence that, following a public default, the decline in private credit is larger in those countries where the banking system holds more public bonds. In this paper, we substantially extend the evidence by using bank-level data, which enables us to take a granular look at the bondholdings-lending link.

In this regard, our paper complements existing evidence on the link between sovereign risk and private credit. Arteta and Hale (2008) show that defaults are accompanied by a decline in syndicated foreign credit to domestic firms. Borensztein and Panizza (2008) show that defaults are accompanied by larger contractions in GDP, and are therefore more costly, when they happen together with banking crises. In ongoing research, Baskaya and Kalemli-Ozcan (2014) also study the link from government solvency to the banking sector.[2]

The recent Eurozone crisis has fueled a broader interest in the spillover effects from sovereign risk to private credit. Acharya and Steffen (2014), for instance, discuss how purchases of risky sovereign bonds by Eurozone banks may have crowded out corporate credit. Acharya et al. (2014) provide more direct evidence of these effects. They analyze syndicated lending to European firms and find that those firms with higher exposure to periphery banks during the Eurozone sovereign debt crisis also exhibited a higher sensitivity of cash to cash flows, which is consistent with a tightening of financial constraints. In line with this interpretation, these firms experienced a lower growth of employment, sales and capital expenditure. Finally, Becker and Ivashina (2014) analyze the evolution of borrowing through bank loans relative to bonds and also conclude that sovereign bond purchases by banks in the European periphery led to a crowding-out of corporate lending. Our paper complements these findings by documenting a strong relationship between sovereign defaults, bank bondholdings and bank lending over a wide sample of defaults that includes both emerging and developed economies.

[1] Mengus (2013) has used a related model with nondiscriminatory default to study bank bailouts; Acharya and Rajan (2013) study the incentives of myopic governments to service their debts.

[2] In particular, they find that the 1999 Marmara earthquake in Turkey had a larger effect on lending by banks that were highly exposed to government debt.

The paper proceeds as follows. Section 2 describes the data. Section 3 presents the results on the basic correlation between bank bondholdings and loans during default (subsection 3.1); on the demand for government bonds by banks (subsection 3.2); and on the association between lending and the bonds bought well before default and during the default event itself (subsection 3.3). Section 4 concludes.

2. Data

We build a dataset that includes bondholdings and lending activity at the bank level, as well as a large set of bank-level characteristics and macroeconomic indicators that are meant to capture the state of a country's economy. We explain each of our data sources below.

2.1 BANKSCOPE Accounting Data

We obtain all the bank-level accounting data from the BANKSCOPE dataset, which contains information on the holdings of public bonds for 20,337 banks in 191 countries over the period 1998-2012 (99,328 bank-year observations). This dataset, which is provided by Bureau van Dijk Electronic Publishing (BvD), provides balance sheet information on a broad range of bank characteristics: bondholdings, size, leverage, risk taking, profitability, amount of loans outstanding, balances with the Central Bank and other interbank balances. The nationality of the bonds is not reported. We shall return to this last issue later on. The information in BANKSCOPE is suitable for international comparisons because BvD harmonizes the data.

All items are reported at book value, including bonds.[3] One advantage of book value estimates is that they play a key role in bank regulation, thus providing a natural candidate for shaping the bank's lending decisions. In the data, as we will see, bonds at book value indeed

[3] Even in developed economies, banks hold a large fraction of their government bonds in their banking book (which reports book values) rather than in their trading book (which is marked to market). For example, Acharya, Drechsler, and Schnabl (2013) report that EU banks hold on average 85% of their bonds in their banking book. The bulk of banks in our sample are located in emerging economies, in which the fraction of bonds held in a bank's trading book is likely to be even smaller than in the EU.

appear to matter. From an economic standpoint, book value accounting implies that variations in our bonds-to-assets ratio capture to a large extent variations in the relative quantity – as opposed to the value – of public bonds held by banks. In Section 2.6 below, we return to the implications of this fact for the interpretation of our findings.

We start with the full sample of banks in BANKSCOPE and examine their unconsolidated accounts. We construct our dataset by assembling the annual updates of BANKSCOPE.[4] We filter out duplicate records, banks with negative values of all types of assets, banks with total assets smaller than $100,000, and years prior to 1997 when coverage is less systematic. This procedure results in 99,328 observations of the bondholdings variable at the bank-year level over 1998-2012. For our regression analysis, we impose two additional requirements on the remaining banks: first, that we observe at least two consecutive years of data, so that we can examine the banks' changes in lending activity; and second, that data is available on all of the other main variables such as leverage, profitability, cash and short term securities, exposure to Central Banks, and interbank balances. Our constant-continuing sample for the regression analysis then consists of 7,391 banks in 160 countries for a total 36,449 bank-year observations. We take the location of banks to be the one reported in BANKSCOPE, which coincides with the location of the bank's headquarters. Commercial banks account for 33.2% of our sample; cooperative banks for 38.2%; savings banks for 20.6%; investment banks for 1.6%; the rest includes holdings, real estate banks, and other credit institutions.

2.2 Bondholdings Data

We now describe the bondholdings data, which is central to our analysis. The BANKSCOPE dataset has an established track record,[5] but the reliability of its measure of public bondholdings has not

[4]This strategy yields two advantages relative to obtaining all data at once from the web interface. First, we avoid the survivorship bias that would occur because the web interface does not retain accounting information on banks after they delist. Second, our strategy allows us to obtain a time series of all relevant variables, while in some cases the BANKSCOPE interface only keeps the most recent information. For example, the web interface reports only the most recent ownership structure (including any government ownership), and by assembling the annual updates we are thus able to obtain time variation in the ownership structure.

[5] See, for instance, Classens and Laeven (2004), and Kalemli-Ozcan, Sorensen, and Yesiltas (2012).

yet been scrutinized. To check the quality of this measure, we compare it to other data sources on bondholdings: the country-level measure of "banks' net claims on the government" from the IMF, and the bank-level data from the recent European Stress Test.

[Table I here]

Table I compares the BANKSCOPE data on bondholdings with the IMF measure. Given that the IMF reports banks' claims vis-à-vis their own government, this comparison allows us to evaluate the mismeasurement arising from the fact that BANKSCOPE does not break down bonds by nationality. Panel A contains the mean, the median, and the standard deviation of bondholdings (as a share of total assets) in the full BANKSCOPE sample. Mean bondholdings are at 9.3% of assets, while median bondholdings are approximately half as high. The standard deviation of bondholdings in the sample is also high.[6] Panel B reports somewhat lower figures for the constant-continuing sample, where we observe also the covariates and that we use in our regression analysis. Panel C reports the same information, but only for the subset of countries for which the IMF also reports banks' bondholdings. Panel D reports the IMF measure of "financial institutions' net claims to the government," computed as a share of total assets.[7] Mean, median and standard deviation of the IMF measure are close to the BANKSCOPE data.

Consistent with our prior expectations, holdings of foreign government bonds seem small in the emerging economies that constitute the bulk of our sample. Thus, we seem to be on rather safe grounds in assuming that the BANKSCOPE bonds are domestic. In fact, the IMF data gives a slightly higher mean bondholdings than BANKSCOPE, but measurement in the two datasets converges towards the end of the sample, particularly when examining the subsample of banks in countries covered by IMF. The discrepancy between IMF and BANKSCOPE data is likely due to

[6] The highest bondholdings in the sample are above 65% for selected banks in Argentina, Japan, and Venezuela in 2003; the lowest bondholdings are 0% (e.g., several U.S. banks).

[7] This variable reports commercial banks' holdings of securities plus direct lending minus government deposits. This measure has been used by Gennaioli, Martin, and Rossi (2014) and Kumhof and Tanner (2008).

the fact that the former also captures non-bond finance and to the fact that the banks used to compute the IMF measure may differ from those in BANKSCOPE.[8]

The IMF data cannot address the quality of the BANKSCOPE data on a bank-by-bank basis. We thus compare our measure of bondholdings to the one reported by the European stress test of 2010 and 2011. Crucially, the EU stress test reports information on the nationality of bonds. Table II reports bondholdings from the European stress tests of 2010 and 2011. Panel A of the table reports bondholdings for the full sample contained in the stress test, whereas Panel B reports bondholdings for the subset of the banks in the stress test sample that is contained in BANKSCOPE. The bondholdings reported by BANKSCOPE are shown in Panel C. The data from both sources are highly comparable. The bank-by-bank correlation between the bondholdings reported by BANKSCOPE and by the stress test is 80%. The small discrepancies between our measure and the stress test measure are thus most likely due to differences in the time at which the measurement itself took place.[9]

[Table II here]

The evidence is also reassuring concerning the nationality of bonds. Except for few outliers, even in highly integrated European markets, where domestic and foreign bonds are in many cases treated symmetrically by the regulatory framework, more than 75% of bank bondholdings correspond to domestic bonds.[10] This share is in all likelihood much larger in the subset of developing countries that provide most of our observations on sovereign defaults. In

[8] We further investigate this issue in our regression analysis by performing robustness tests in which we exclude countries where the IMF measure of bondholdings exceeds the BANKSCOPE measure by more than a given threshold. Our results are, if anything, even stronger.

[9] While BANKSCOPE also counts non-EU bonds, the bondholdings of European banks consist primarily of EU bonds – the very reason of the stress test in the first place.

[10] Indeed, the stress test reports banks' holdings of own government bonds equal to 5.49% of bank assets (Panel B), which represents three quarters of total bondholdings (7.94% of assets) as reported by BANKSCOPE for the same 79 bank-year pairs (Panel C). Note that we do not have total bondholdings from the stress test data, which only reports holdings of EU bonds. We can, however, limit ourselves to the stress test data and thus to all EU bonds held by EU banks. In this case, the proportion is even higher: Panel B shows that out of a total EU bondholdings of 6.75% of bank assets, a large 81.3% (5.49% of bank assets) represent own government bonds.

sum, the BANKSCOPE measure is a good proxy for the domestic public bonds held by banks around the world, and we use it as such in the rest of the paper.

Table III reports descriptive statistics on these bondholdings around the world. Panel A shows that in the full sample, in non-defaulting countries banks hold on average 9% of their assets in public bonds. Among countries that default at least once in our sample, this average is 13.5% in non-default years, and increases to 14.5% of bank assets during default years. Bondholdings are much larger in countries that are less financially developed, as the average bondholdings is 8.4% of assets in OECD countries and 12.4% in non-OECD countries. Numbers are similar, albeit somewhat smaller, in our constant-continuing sample (see Panel B).

[Table III Here]

2.3 Summary Statistics

We consider the distribution of bank characteristics in BANKSCOPE, focusing on: (i) bank size as measured by total assets, (ii) non-cash assets, measured as the investment in assets other than cash and other liquid securities, (iii) leverage as measured by one minus shareholders' equity as a share of assets, (iv) loans outstanding as a share of assets, (v) profitability as measured by operating income over assets, (vi) exposure to the Central Bank as measured by deposits in the Central Bank over assets, (vii) balances in the interbank market, and (viii) government ownership, a dummy that equals one if the government owns more than 50% of the bank's equity. To neutralize the impact of outliers, all variables are winsorized at the 1st and 99th percentile. Table IV provides descriptive statistics for these variables in our sample.

[Table IV here]

Panel A shows that there is a fairly large variation in bank characteristics within the BANKSCOPE sample. The average bank invests roughly 96% of its resources in non-cash assets (60% of which are loans, and the rest includes government bonds, debentures and other securities), obtains 91% of its financing in the form of debt, which includes deposits (for an average leverage ratio

assets/equity of about 10), and holds 3% of its assets in central bank reserves.[11] Table AI in the appendix reports the correlations between different bank characteristics in our sample. All correlations are statistically significant. Bank profitability is positively correlated with size, exposure to the central bank and interbank balances, while it is negatively correlated with non-cash assets, leverage, and loans outstanding.

2.4 Sovereign Default and Macroeconomic Conditions

We follow existing work and proxy for sovereign default with a dummy variable based on Standard & Poor's, which defines default as the failure of a debtor (government) to meet a principal or interest payment on the due date (or within the specified grace period) contained in the original terms of the debt issue. According to this definition, a debt restructuring under which the new debt contains less favorable terms to the creditors is coded as a default. The Greek bond swap of February of 2012, for instance, is identified as a default by Standard & Poor's because the retroactive insertion of collective action clauses was deemed to materially change the original contract terms. According to this definition, our sample contains 20 defaults of different duration in 17 countries.

In our robustness tests, we complement our analysis by using two alternative measures of sovereign default that cover dimensions not captured by the S&P dummy, namely: (i) a monetary measure of creditors' losses given default, i.e., "haircuts", from the work of Cruces and Trebesch (2013) and Zettelmeyer, Trebesch, and Gulati (2012), and; (ii) a market-based measure, whereby a country is defined to be in default if it is in default according to S&P, or if its sovereign bond spreads relative to the U.S. or German bonds exceed a given threshold (using extreme value theory, Pescatori and Sy (2007) identify such a threshold to be approximately 1000 basis points). As we show in Section 3, our results are robust to these alternative measures. In our main analysis we stick to the S&P dummy because measures of haircuts depend heavily on the assumptions one makes about counterfactuals (e.g., Sturzenegger and Zettelmeyer (2008)), and

[11] Panel B of Table III shows the characteristics of banks involved in the stress test. These banks are much larger and extend more loans than the median BANKSCOPE bank. They also have lower exposure to the Central Bank and to other banks. Leverage and cash are instead of similar magnitude to those observed in BANKSCOPE.

measures based on sovereign bond spreads require observing reliable data on secondary market trading, which limits our sample size.

Table AII of the Appendix reports the defaults in our sample.[12] There is a large variation in the size of defaulting countries and in the extent of bank coverage. A few countries such as Argentina, Russia, Nigeria, Kenya and Honduras have the lion's share of banks; at the other end of the spectrum, in eight defaulting countries our data covers five banks or less. One concern is that countries that are small and have few banks might drive our results. In our robustness tests we show that our results are robust to excluding these defaults.

Data on the macroeconomic conditions of the different countries is obtained from the IMF's International Financial Statistics (IFS) and the World Bank's World Development Indicators (WDI). Table AIII in the Appendix describes all variables. To measure the size of financial markets we use the ratio of private credit provided by money deposit banks and other financial institutions to GDP, which is drawn from Beck et al. (2000). This widely used measure is an objective, continuous proxy for the size of the domestic credit markets.

2.5 Sovereign Bond Returns

We also use measures for the realized and expected returns of sovereign bonds. Realized bond returns are obtained from the J.P. Morgan's Emerging Market Bond Index Plus file (EMBIG+) and from the J.P. Morgan's Global Bond Index (GBI) file (see Kim (2010) for a detailed description; see also Levy-Yeyati, Martinez-Peria, and Schmukler (2010)). These indices aggregate the realized returns of sovereign bonds of different maturities and denominations in each country. Returns are expressed in dollars. The index accounts for the change in the price of the bonds and assumes that any cash received from coupons or pay downs is reinvested in the bond. This data on returns

[12] To preserve space, Table AII only reports defaults for which we observe bank-level information in the constant-continuing sample. BANKSCOPE starts covering some defaulting countries such as Nicaragua, Paraguay and others only after their default events. For some other defaulting countries (Antigua in 2002-2003, Dominican Republic in 2005, Iraq in 2004, Madagascar in 1998-2002, Moldova in 2002, Pakistan in 1998-1999, and Yemen in 1999-2001), we do observe bondholdings for a number of banks but we do not observe other bank characteristics. For a full list of countries in default up to 2005 see Gennaioli et al. (2014) and Borensztein and Panizza (2008).

is available for 68 countries in our sample and it covers 7 default episodes in 6 countries (Argentina, Russia Greece, Cote d'Ivoire, Ecuador, and Nigeria), so that any exercise involving bond returns reduces sample size.

Table AIV in the Appendix contains descriptive statistics on realized bond returns. Countries that experience at least one default episode in the sample have average annual returns of 14.46%, as compared with 9.70% for countries that do not experience any defaults. Bond returns vary substantially over time. Figure 1 plots daily sovereign bond prices for six countries that experienced at least one default over 1998-2012. The Figure depicts a window centered on the day of the default, and bond prices are standardized to begin at 100.

[Figure 1 Here]

Across these six countries, bond prices exhibit a V-shaped pattern around sovereign defaults: prices deteriorate steadily in the four months prior to a default, they reach a minimum in the two months immediately after the default, and they recover thereafter.

Relative to realized bond returns, measuring expected returns is problematic. This variable is not directly observable and standard proxies such as yield-to-maturity are inappropriate during default. We construct our series of expected returns using a two-step process. In the first step, we regress returns on a set of country-specific economic, financial, and political risk factors:

$$R_{c,t} = \gamma_t + \beta_0 + \beta_1 Z_{c,t-1} + u_{i,c,t}, \qquad (1)$$

where $R_{c,t}$ is the realized return of public bonds in country c at time t, γ_t are time dummies (capturing variations in the global risk-free rate), and $Z_{c,t-1}$ is a vector of political, economic and financial risk ratings compiled by the International Country Risk Guide. These ratings provide a comparable measure of political, economic, and financial stability in many countries, and they have been shown to be strong predictors of bond returns (see e.g. Comelli (2012)).[13]

[13] More details are found at www.prsgroup.com.

We report the results of the first-stage estimation of Equation (1) in Table AV in the Appendix. As the first three columns show, there is a strong negative correlation between the risk ratings at time *t* and realized returns at time $t + 1$.[14] Because these ratings are decreasing in risk, this result is consistent with what one would expect from theory: higher bond returns compensate investors for higher economic, financial, and political risk. In the second stage of the procedure, we define expected returns as the fitted values of this first-stage regression.[15]

2.6 Book Value v. Market Value Measures of Bonds

As we pointed out, BANKSCOPE measures bondholdings at book value. It is important to discuss the effects that this may have on our empirical exercise. First, book values are critical for regulation and for bank operations and they are likely to be important determinants of bank lending. As a result, they are highly relevant for their own sake. Second, book value data is arguably better than market value data for analyzing the relationship between bondholdings and lending. Using market value data, it would be impossible to tell whether the negative correlation between bondholdings and bank lending is due to changes in the relative price of public bonds and loans or whether it actually reflects a decline in lending. It is true, though, that market values provide a more accurate economic measure of a bank's true exposure to government defaults. Insofar as we wish to assess the role of such exposure (rather than the role of book values per se), it is important to understand whether book values are likely to provide a good proxy for market values or not.

In normal times, away from default episodes, the price of bonds is fairly stable. As a result, book and market value measures during these times are likely to be similar to one another, both

[14] All three risk scores are suitable instruments for expected returns, as the F-test in the univariate regressions are close to 10 or above, mitigating concerns that the instruments are weak (see Stock and Yogo (2005)). By comparison, column (4) in Table AV presents the result of regressing government bond returns at *t* on returns at t-1. While there is also a negative and significant univariate correlation, the F-test is around 3, indicating that past government bond returns is likely to be a weak instrument. As a result, we do not use it in our analysis.

[15] Specifically, we use as instruments the economic score and the political score, and we include time dummies to capture variations in the global riskless rate. Column 5 of Table AV presents the results for the specification that we use in the empirical analysis as the first-stage estimation of the expected returns used in Table VIII, column 2. Our results in Table VIII are not sensitive to the choice of instruments within the three risk scores of the ICRG.

providing an accurate description of a bank's exposure to government default. This implies that we are on rather safe grounds when we assess the demand for bonds in normal times (Section 3.2) and the correlation between a bank's loans and the bonds it holds *well ahead* of default (Section 3.3).

Matters are trickier around default episodes, when the prices of public bonds and of other assets in the bank´s balance sheet vary substantially. Here book value measurement may over- or under-state the exposure of banks relative to market value measurement. In particular, the book value of bonds will tend to overstate the market value of bonds if during crises bond prices drop more than the price of other bank assets. Book values will instead understate market values if the reverse is true.

To see this formally, let q_t and p_t respectively denote the average market price of bonds and the average market price of all bank assets in year t. Suppose that time t is the time at which sovereign default risk materializes. Until time $t-1$, the economy is instead assumed to be in tranquil times. Then, the book value measure of bonds at t is $BV_t = \frac{q_{t-1}b_{t-1}+q_t\Delta b}{p_{t-1}a_{t-1}+p_t\Delta a}$. In this expression, b_{t-1} and a_{t-1} denote the quantities of bonds and bank assets in year $t-1$, while Δb and Δa are the quantity changes between years $t-1$ and t.[16] The bank's true risk exposure at t, measured using market values, is instead equal to $MV_t = \frac{q_t(b_{t-1}+\Delta b)}{p_t(a_{t-1}+\Delta a)}$. Under market value accounting, all assets are evaluated using current market prices. After some algebra, one can find that the two measures are linked as follows:

$$MV_t = BV_t\left[\left(\frac{p_{t-1}-p_t}{a_{t-1}+\Delta a}\right)\frac{a_{t-1}}{p_t}+1\right]-\left(\frac{q_{t-1}-q_t}{a_{t-1}+\Delta a}\right)\frac{b_{t-1}}{p_t}.$$

Inspection of this equation allows us to formally derive our previous claims. First, if the price of bonds and assets is fairly stable (i.e., $q_{t-1} \approx q_t$ and $p_{t-1} \approx p_t$) the measures of book and market value will tend to be similar. Thus, in tranquil times, the book value measure will provide

[16] Note that, precisely because until $t-1$ we are in tranquil times, we can safely assume that the average book values of bonds and other banks assets at $t-1$ are equal to the market prices q_{t-1} and p_{t-1} of these assets at $t-1$. In general terms, the average book value of assets is a weighted average of past market prices.

a good proxy of its market value counterpart. Second, whether the book market measure over- or under-estimates the market value measure during default episodes depends crucially on the fluctuation in the price of bonds relative to that of other assets held by banks. To see this, note that if a bank's book and market values of bondholdings roughly coincide during normal times, i.e., $BV_{t-1} \approx MV_{t-1}$, and there is a sovereign default in period t, the book value of bonds over-estimates their market value ($BV_t > MV_t$) if and only if:

$$\frac{BV_t}{BV_{t-1}} < \frac{(q_{t-1} - q_t)/q_{t-1}}{(p_{t-1} - p_t)/p_{t-1}}. \quad (2)$$

Thus, book value of bonds over-estimates their market value when the growth of the book value is lower than the drop in bond prices relative to the drop in asset prices. Intuitively, if the drop in the price of public bonds is larger than the drop in the price of other bank assets, there is a tendency for the market value of bonds to drop more than their book value. In this case, equation (2) is likely to hold and book value over-states market value. If instead the drop in bond prices is lower than the drop in the price of other assets, Equation (2) is likely to be violated and book value under-states market value.

To assess the problems of book value measurement during default, we compute the empirical proxy to each side of Equation (2) in our data. For each bank, we use the BANKSCOPE measure of bondholdings to compute the left hand side of the expression for the first year of default. As for the right hand side, we compute the numerator using our bond return index, while we assess the denominator by using the change in the bank's (quasi-) market value of assets, which is the sum of the bank's stock market capitalization and the book value of its liabilities, during the first year of default. Theory tells us that this last measure should in fact depend on the change in the market value of all bank assets. The change in the (quasi-)market value of assets indeed proxy for the change in the market value of all bank assets (reliable data on the change in the market value of bank liabilities are unfortunately unavailable for the main default episodes in our sample).[17]

[17] While this proxy is imperfect, as market values of debt might fall more than book values in a sovereign default, it is a standard proxy in the corporate finance literature whenever market values of debt are not observed.

Using this method, we compute empirical proxies for the right and left-hand sides of Equation (2) for a sample of 30 publicly listed banks in Argentina, Greece, Ecuador, and Indonesia in their first year of default. Figure 2 plots the difference between the computed LHS and the RHS of Equation (2) for these 30 banks, as a function of their bond-to-assets ratio.

[Figure 2 here]

Our quantification reveals two noteworthy aspects. First, according to our calculations, the LHS and RHS of the Equation (2) are fairly close to each other, indicating that the discrepancies between book and market values are unlikely to be very large. In our sample, the average estimation error is 0.14% of the banks' bonds-to-assets ratio (median 0.62%, standard deviation 2.73%): these are very small numbers. Second, in about two thirds of the cases the above inequality is violated, implying that the book measure of bank bondholdings actually underestimates banks' exposure to government bonds at market value. In the remaining one third of the cases, the opposite is true.

Critically, Figure 2 suggests that the inequality is mostly violated – and thus book values understate exposure to sovereign risk – for banks holding low levels of public bonds to begin with. Hence, book values mostly understate the exposure of banks having low levels of public bonds. As a result, dispersion in book values is likely to be larger than dispersion in market values of bondholdings. This suggests that, if anything, the coefficient on bondholdings in our loan regressions is likely to be lower than the one that would arise if loans were to be regressed on the market value of bonds.

In any case, we show in Section 3.3 that the negative correlation between bank bondholdings and lending during sovereign defaults is significant also when we restrict ourselves to average bondholdings held by banks in the years prior to a default. This is important because any discrepancies between book and market values are likely to be small when averaged over many "normal" or non-default years. As a result, as we conclude in Section 3.3, our findings on the relationship between bondholdings and bank lending are unlikely to be spuriously driven by our use of book values.

3. Results

We are now ready to present the main results of the paper. Section 3.1 reports results on the relationship between default, bondholdings and loans. Section 3.2 then reports results on banks' demand for bonds, in particular on the extent to which bonds are purchased in normal times relative to default years. Finally, Section 3.3 examines whether the relationship between bondholdings and bank lending during defaults is stronger for banks purchased in normal times or in default years.

3.1 Default, Bondholdings and Loans

As a first step, we use our data to assess the correlation between a bank's bondholdings and its lending during default events. Let $\Lambda_{\mathrm{i,c,t}}$ denote the change in loans over assets made by bank i in country c between time $t-1$ and t, and let $B_{i,c,t-1}$ denote the bonds to assets ratio of bank i at time $t-1$. Our most basic test consists in running the regression:

$$\Lambda_{\mathrm{i,c,t}} = \gamma_0 + \gamma_1 \cdot B_{i,c,t-1} + \gamma_2 \cdot Def_{c,t-1} + \gamma_3 \cdot Def_{c,t-1} \cdot B_{i,c,t-1} + \gamma_4 \cdot X_{i,c,t-1}$$
$$+\gamma_5 \cdot Def_{c,t-1} \cdot X_{i,c,t-1} + \gamma_6 \cdot X_{c,t-1} + \gamma_7 \cdot Def_{c,t-1} \cdot X_{c,t-1} + \mu_{i,c,t}, \qquad (3)$$

where $Def_{c,t-1}$ is a dummy variable taking value 1 if country c is in default at $t-1$ and value 0 otherwise, $X_{i,c,t-1}$ is a vector of bank characteristics, and $X_{c,t-1}$ is a vector of country characteristics. We run versions of Equation (3) that include a full set of country dummies, time dummies, and their interaction. Standard errors are clustered at the bank level throughout.[18]

A negative value of γ_2 indicates that, ceteris paribus, sovereign default is associated with a drop in lending by all banks. A negative value of $\gamma_3$indicates that, ceteris paribus, during default banks holding more government bonds extend fewer loans. Of course, the fact that lending of all or of certain banks falls during default does not per se imply that default *causes* the drop in lending. Both the drop in lending and sovereign default may be caused by a deterioration of the

[18]In a previous draft we clustered standard errors at the country level and obtained very similar results.

domestic economy, which reduces the demand for credit by firms and households. As we pointed out, our data does not allow us to perfectly measure this demand channel. However, in our analysis we assess the extent to which the information contained in our estimates supports demand or supply effects. To this end, we run a variety of specifications that allow us to: i) control for as many country-level shocks as our data allows us to do, and ii) to evaluate not one but several implications of our hypotheses.

Table V reports our estimates of Equation (3). Column (1) includes as explanatory variables only the total bondholdings of bank i in year $t-1$, $B_{i,c,t-1}$, as well as our sovereign default dummy, various bank-level controls, the realized return of bonds (which proxies for the severity of default), and their interactions. We do not include other country-level controls here because doing so drastically reduces the number of observations. The estimation highlights two important results. First, larger bondholdings are associated with fewer loans during default ($\gamma_3 < 0$). Second, default is followed by a drop in lending only for banks holding government bonds ($\gamma_2 = 0$). This latter finding already casts some doubts on the demand channel: if default only proxies for a drop in firms' demand for credit, it should be associated with a reduction of lending for all banks, including those holding zero bonds. By contrast, the data indicate that banks holding zero public bonds do not cut their lending during default, which is prima facie inconsistent with them experiencing an adverse demand shock at those times.

[Table V here]

There is however a subtler version of the demand-for-credit channel that is still consistent with column (1): banks holding more government bonds may happen to have more pro-cyclical investment opportunities, and/or they purchase more bonds in anticipation of such pro-cyclicality. Hence, they are more exposed to booms and busts in the demand for credit. Consistent with this possibility, the coefficient of bank bondholdings in column (1) is positive. Banks holding more government bonds have indeed more pro-cyclical lending policies: they make more loans outside of default, and fewer loans during default.

To assess the importance of this channel, we first introduce in column (2) time dummies in our regression, which control for global cycles. Results do not change. In column (3) we also introduce country dummies, which control for the possibility that in certain countries (e.g., the developing ones) banks hold more bonds and – at the same time – adopt more pro-cyclical lending policies. Again, coefficient γ_3 stays negative and significant, consistent with the possibility of a credit supply effect of default for banks holding many bonds. Crucially, in column (3) bondholdings are no longer associated with more lending outside of default events. Conditional on time-invariant country characteristics and on observable bank characteristics, bank bondholdings seem to matter only during default episodes. This evidence assuages concerns that the correlation between default and lending may simply reflect the greater pro-cyclicality of certain banks.

Column (4) presents a more stringent test, which includes in our regressions also the interaction of country and time dummies. By doing so, we effectively control for *any* country specific shocks such as recessions, exchange rate devaluations, etc., that may cause both a government default and a drop in the demand for credit. The inclusion of country*time dummies almost doubles the R-squared. Consistent with intuition, country specific time-varying shocks are important determinants of bank lending. At the same time, our main coefficient remains remarkably robust. Within *the same* defaulting country-year, it is the banks most loaded with government bonds that reduce their lending the most. This is confirmed in column (5) when we enlarge sample size by dropping bond returns from our regressions.

Our results so far show that default does not induce a drop in bank lending unless a bank holds public bonds. In particular, even after controlling for all country-specific time-varying shocks, the drop in bank lending during default increases in the bank's holdings of public bonds. One remaining concern with this result is that, within the same country-year, banks holding more public bonds may happen to have greater exposure to the country-level time-varying macro shocks. For instance, banks holding more government bonds may happen to be unhedged against a macro shock such as currency devaluation, so their lending might drop because of the devaluation and not because of the bonds they hold. To assess this possibility, Table VI includes

in the regressions of column (4) and (5) of Table V the interaction between bank bondholdings and two major macro factors: a country's GDP growth and its exchange rate devaluation relative to the U.S. dollar. The results are again consistent with the supply channel: the interaction between bank bondholdings and sovereign default remains negative, statistically significant, and its magnitude is remarkably stable. The R-squared in all columns is unchanged relative to that of columns (4) and (5) of Table V. Of the two macroeconomic shocks, only GDP growth has a significant (positive) effect on lending by banks holding more bonds.

[Table VI here]

We conclude this section by assessing in Table VII the robustness of our findings to different sample definitions and different definitions of sovereign default. Columns (1) and (2) show that our results are unchanged if we exclude the (few) government owned banks from our sample, for the behavior of these banks may be distorted by politics.[19] We next show that our results are not driven by "unimportant" defaults or by defaulting countries with just a few banks by: (i) excluding the smaller defaulting countries in our sample, both as measured by GDP per capita, and by the economic magnitude of the debt defaulted (Columns 3 and 4), and by; (ii) excluding defaulting countries with fewer than 5, 10, and 15 banks, respectively (Columns 5-10). Finally, we show that our results survive under different definitions of defaults such as: (i) the haircut measure of default constructed by Cruces and Trebesch (2013) and Zettelmeyer et al. (2012), which measures the severity of a default (Columns 11 and 12), and; (ii) the augmented

[19] We keep government owned banks in the main analysis of this section because its objective is to measure the empirical association between bondholdings and lending during sovereign defaults, regardless of whether this association stems from public or private banks. It is true that governments may induce public banks to purchase public bonds during a sovereign default (i.e., these banks are more prone to financial repression), but this possibility nonetheless falls in the "crowding out" mechanism of the supply channel. Moreover, to the extent that public banks are more likely to be compensated by the government – and their lending more likely to be encouraged – in the event of a default, it is also possible that the inclusion of these banks in the analysis dampens the association between bondholdings and lending. In any case, it is interesting to note that excluding government owned banks does not change our results, indicating that other forces are at play. This result is natural after one recognizes that we have relatively few government owned banks in our sample. We only lose 88 government-owned banks in column (1) and 169 in column (2) of Table VII, relative to columns (4) and (5) of Table V.

measure that adds to the S&P default dummy also events in which sovereign spreads exceed 1,000 basis points.[20] Our results are strikingly robust to all of these exercises.

[Table VII here]

In sum, the data show that during defaults there is a robust, strong, and negative correlation between a bank's bondholdings and its subsequent lending. Our results are consistent with the hypothesis that default directly induces banks holding many public bonds to cut credit supply. The results are instead harder to reconcile with the possibility that drops in lending occur exclusively because of a contemporaneous drop in the demand for credit by firms or households, or because banks holding many bonds are disproportionately hurt by adverse economic conditions. Quantitatively, the effects are large. Given that, during default years, bank loans are four times larger than bondholdings, our point estimates of 0.15 imply that a one-dollar increase in bonds translates into a 60-cent decrease in lending during default years.

This result raises two questions. First, given that public bonds seem so problematic when sovereign default strikes, it is important to understand which type of bank gets exposed to its government in the first place, as well as the timing of this exposure. In particular, do banks accumulate bonds during normal times or as default risk materializes? Second, is the drop in lending more associated with bonds bought in normal or in crisis times? Addressing these questions is useful for three reasons. First, it allows us to further scrutinize the merits of the supply vs. demand channel, by helping us understand whether it is seemingly "bad" banks that self-select into buying more public bonds during default years. Second, as we shall see, it allows us to further assess the role of book value measurement of public bonds. Third, and perhaps more interesting, it can also help us shed light on the mechanism through which the supply channel operates (e.g. deleveraging vs. crowding out).

[20] As discussed before, the paucity of data on spreads limits this exercise to the larger, economically more important defaults. In addition to the defaults in Argentina in 2001-2004, Russia in 1998-2000, Ukraine in 1998-2000, Greece in 2012, and Seychelles in 2010 identified also by S&P, the additional defaults we examine here are Ireland in 2011, Portugal in 2011 and 2012, Greece in 2011, and Ukraine in 2001.

3.2. Determinants of Banks' Bondholdings

The raw data presented in Section 2 provide two interesting facts regarding bondholdings: banks hold substantial amounts of public bonds in non-default years, particularly in developing countries, and they further increase their bondholdings during sovereign defaults. To study the determinants of these patterns, we estimate the following regression. Let $B_{i,c,t}$ denote the ratio of public bonds over assets held at time t by bank i located in country c. We think of $B_{i,c,t}$ as being chosen by banks in period $t-1$, so that $B_{i,c,t}$ is a function of the bank's balance sheet and of the state of the economy at time $t-1$.[21] We then run the regression:

$$B_{i,c,t} = \alpha_0 + \alpha_1 \cdot X_{i,c,t-1} + \alpha_2 \cdot X_{c,t-1} + \alpha_3 \cdot Def_{c,t-1} + \alpha_4 \cdot Def_{c,t-1} \cdot X_{i,c,t-1} + \\ + \alpha_5 \cdot Def_{c,t-1} \cdot X_{c,t-1} + \epsilon_{i,c,t}, \quad (4)$$

where $Def_{c,t-1}$ is our default dummy. We estimate (4) in specifications that include country dummies, time dummies, and their interaction. Standard errors are clustered at the bank level.

Vector $X_{i,c,t-1}$ includes bank characteristics that may affect the demand for bonds, such as loans outstanding (which proxies for a bank's investment opportunities), non-cash assets, exposure to central bank, interbank balances, profitability, size, whether or not the bank is owned by the government, and lagged bondholdings to control for persistence. Vector $X_{c,t-1}$ includes country-level factors that may affect the demand for bonds, such as financial development (as measured by Private Credit to GDP and banking crises), GDP growth, inflation, and exchange rate depreciation. We also control for the expected return of bonds $R^e_{c,t}$, which captures the expectation (at time $t-1$) of the time-t return of public bonds of country c. As explained in Section 2, we proxy this variable with the fitted value of realized returns when regressed on lagged country-specific risk factors (we estimate the two-stage model with GMM).

[21] The use of lagged independent variables is preferable to the use of independent variables that are contemporaneous to bondholdings for two reasons. First, bank-level explanatory variables are determined jointly with bondholdings within each year. As a result, a contemporaneous formulation of Equation (1) would suffer from severe endogeneity problems, and even from concerns that any documented correlation might reflect mechanically the balance sheet identity. Second, the bank does not observe the aggregate final state of the economy at t until the end of period t itself. As a result, the forecast of macro variables performed by the bank or by the market at time t will depend on the state of the economy as measured at time $t-1$.

Coefficients α_1 and α_2 respectively capture the effect of bank- and country-factors on a bank's holdings of public bonds when the government is not in default (i.e., in "normal times"). Coefficients α_3, α_4 and α_5 capture the change in the demand for bonds during default. In particular, the latter two coefficients allow for the possibility that such demand may change in a heterogeneous way across banks and countries. Equation (4) thus allows us to test whether bondholdings behave differently in years of default relative to all other years. For example, if $\alpha_3 > 0$, all banks tend to increase their bondholdings during default events.

Table VIII reports the estimates of different specifications of Equation (4). Column (1) estimates Equation (4) by including only time dummies. Consider first the demand for bonds in normal times, which is reflected in the estimated coefficients of bank and country characteristics (non-interacted with the default dummy). The estimation reveals two main features of bondholdings in normal times. First, they decrease with outstanding loans, presumably because banks with more investment opportunities do not need to store their funds in public bonds. Second, they are lower in countries with more developed financial sectors (i.e. those sustaining a high Private Credit/GDP ratio and not experiencing a banking crisis). Bonds held in normal times also seem to increase in bank size but, as we will see, this result is non-robust.

Consider now how the patterns of bondholdings change during default events. This is captured by the coefficient of the default dummy, both alone and interacted with bank and country characteristics. Some interesting properties stand out. First, the default dummy is insignificant. This fact indicates that the increase in bondholdings during default events that we documented in Section 2 does not occur uniformly across banks. Consistent with this notion, the interaction between bank size and the default dummy reveals that large banks disproportionally accumulate public bonds during default. We also find that banks making fewer loans do not increase their bondholdings during default. Finally, the increase in bonds during default years is more pronounced in countries with more developed financial sector, as proxied by a high Private Credit/GDP ratio.

[Table VIII here]

One concern with these estimates is that they may be contaminated by country level omitted factors, such as the supply of public bonds by the local government. [22] To control for these omitted factors, in Column (2) we introduce country dummies. We also include expected returns, which is an interesting variable to consider even though it reduces our sample size.[23] Our main findings are confirmed. Concerning the demand for bonds in normal times, the results confirm the role of outstanding loans. Financial development is instead non-robust to the introduction of country dummies. This is reasonable, as major differences in financial development are persistent across countries, and so their effect is absorbed by country dummies. The results on the demand for bonds during default years are also very robust. Large banks expand their demand for bonds during default years. We illustrate this finding in Figure 3 below, which plots the bondholdings of large banks (above-median total assets) and those of small banks (below-median total assets) for selected defaulting countries.

[Figure 3 here]

On the other hand, banks with fewer outstanding loans do not increase their bondholdings during default years. These findings have interesting implications for our assessment of the demand vs. supply channels of the decline in lending during default events. In particular, the evidence does not suggest that during default episodes government bonds end up being concentrated in "bad" banks. The reverse, if anything, seems to be true, given that large banks also tend to be more profitable (see Table AI in the Appendix).

One intriguing and novel result of Column (2) of Table VIII concerns expected returns. In normal times, expected bond returns are negatively and significantly correlated with bondholdings. Given that, as we saw, higher expected returns are a compensation for risk, this means that bondholdings during normal times tend to be higher when bonds are safest. Interestingly, the opposite is true during default events. The coefficient on the interaction

[22] It could be, for instance, that governments in poorer and less financially developed countries have higher debt levels for reasons that have nothing to do with the demand of bonds by banks. The inclusion of country dummies and country*time dummies allows us to mitigate these and other omitted variables concerns.

[23] Table AIV in the appendix reports the first stage estimation used to compute expected government returns, as well as a detailed discussion of the estimation results.

between expected returns and the default dummy is positive and swamps the negative effect of returns in normal times. Hence, bondholdings appear to increase in expected returns during sovereign defaults. This finding is consistent with the possibility that, during sovereign debt crises, banks demand public bonds precisely when they are risky.[24]

It must be noted, however, that some caution is needed when interpreting the coefficient on expected bond returns. Indeed, the extent of the increase in banks' exposure to sovereign risk when expected returns are high may be over-stated due to the book value measurement of bondholdings. This is because, as we discussed in Section 2.6, the book value of bonds may exceed their market value when bond prices drop a lot (and thus expected returns are high). Presumably, then, if we were to measure the increase in banks' exposure to government bonds at market values, its correlation with expected bond returns would in all likelihood be less dramatic than it seems from evaluating such exposure at book values.

As a final robustness check, Column (6) includes in our regression the interaction between country and time dummies to control for any country specific shock. This precludes us from controlling for the interaction between expected returns and default, but the exercise is nonetheless valuable to assess the robustness of the role of bank characteristics. Reassuringly, the effects of bank size (during default) and outstanding loans (in normal times) are very robust.

Overall, this section indicates that banks demand a sizeable amount of public bonds in normal times, particularly banks that have few investment opportunities and that operate in less financially developed countries. There is some accumulation of bonds during default years, which is on average about 3% of banks' assets.[25] This accumulation is very unequal across banks, and tends to occur in larger banks. In this respect, our data do not support the notion that bad banks may self-select themselves into buying bonds. Quantitatively, the effect of bank size is large. During a default year, for instance, banks in the lowest size decile decrease their bondholdings by 4.2% of assets, while banks in the highest decile increase their bondholdings by

[24] Acharya and Steffen (2013) and Brutti and Saure (2013) provide evidence in this regard for the recent European debt crisis.

[25] This figure is the difference between average bondholdings in the first three years after default, minus the average bondholdings in the three years before and up to a default.

4.5% of assets. Equipped with these results, we now assess the differential role played by bonds bought during normal times and during defaults in terms of their association with bank lending during default events.

3.3. Normal Times Bonds, Crisis Times Bonds, and Bank Lending

We now seek to assess the extent to which the negative correlation between bank lending and bondholdings is due to bonds bought during normal times or bonds bought during crises. We do so by running modified versions of Equation (3), in which we replace our measure of a bank's bondholdings $B_{i,c,t-1}$ with alternative measures that reflect the bonds bought by the bank in normal times and during defaults. While our dataset does not report how many bonds were bought by a bank in each default year, we exploit the time series dimension of the data to construct some proxies as described below.[26]

As a first and most intuitive step, we run a cross sectional version of Equation (3) in which we regress: the change in a bank's loans to assets ratio occurring during the first two years of default; on the bonds held by the same bank during the year *before* default took place. The regression includes country and year dummies, and the estimation results are reported in column (1) of Table IX. These results indicate that bonds held in the year before default have a strong negative association with changes in lending during the first two years of a default event. The point estimate of the coefficient is slightly more than twice as large as the magnitudes obtained in Table V, so on a per-year basis the result is close to the upper bound of our previous estimates.

[Table IX here]

One concern with the specification of column (1) is that a bank's purchases of bonds in the year prior to default may already reflect an increase sovereign risk, making it difficult to attribute such purchases to the bank's "normal times" demand for bonds. To address this possibility, we use in column (2) as our explanatory variable the average bondholdings held by

[26] It is important to note that the book value of bonds helps us in this task. If bonds were reported at market value, it would be impossible to disentangle changes in quantities of bonds from changes in their market price.

the bank in the three years prior to the onset of default. Interestingly, the estimated coefficient in column (2) is larger in magnitude and more tightly estimated than the coefficient in column (1). There may be two reasons for this. First, insofar as classical measurement error is present, average bondholdings are less subject to attenuation bias. Second, and consistent with the results in Section 3.2, banks choosing to buy many bonds when sovereign risk has materialized may be relatively stronger and thus more capable of making loans. This may give the misleading impression that the large bondholdings of these banks do not hurt their ability to lend. By focusing only on bonds held well before default, rather than on those that banks choose to buy as default risk increases, we reduce the impact of this source of endogeneity.

In sum, columns (1) and (2) indicate that bonds held by banks well before default are key to shaping the negative association between bonds and loans. The effects are quantitatively large: a 10% increase in the average level of bondholdings in the three years before default is associated with a 3.6% cumulative reduction in loans during the first two years in default. This result is consistent with a standard balance sheet effect, whereby losses on pre-existing public bonds reduce bank capital, forcing the bank to deleverage and cut lending.[27] Note, moreover, that the use of average bondholdings over a three-year period reduces any discrepancies between the book and market value of bonds, which confirms that these were not an important factor behind the main results of Section 3. We shall return to this point below.

The specifications of columns (1) and (2) have two shortcomings. First, their cross sectional nature does not allow us to control for a full set of country*time dummies. Thus, these estimates may still reflect demand rather than supply forces. Second, columns (1) and (2) do not allow us to assess the potentially important role of bonds accumulated in the run-up to and during the default itself. We address these concerns by running yet another specification of Equation (3), in which we decompose a bank's holdings of public bonds $B_{i,t}$ into: (i) a "normal-times" average component $b_{i,n,t}$ measuring a bank's average bondholdings in all non-default years up to year t, and; (ii) a "residual" component $b_{i,t} = B_{i,t} - b_{i,n,t}$, which captures any

[27] As these tests require consecutive bank data for a five-year window around a default, they effectively focus on large banks in large defaulting countries such as for example Argentina, Greece, and Ecuador.

differential take-up in public bonds relative to the normal-times average. We think of component $b_{i,n,t}$ as capturing a bank's normal demand for bonds in the course of its everyday activity, while residual $b_{i,t}$ captures any discrepancies from normal bonds, including those occurring during default that we documented in Section 4.[28]

Columns (3) and (4) report the estimation results. Column (3) introduces both components of bonds while controlling for country dummies, time dummies, bank controls, and expected returns, as well as for their interactions with default. Thus, column (3) effectively amounts to a 'decomposed version' of column (3) in Table V. Column (4) then fully controls for country specific shocks, by adding country*year fixed effects, so it effectively amounts to a decomposed version of column (5) of Table V. We obtain two important results.

First, higher normal-times bonds are indeed associated with significantly fewer loans during default events. Second, the interaction of the residual component of bonds and the default dummy is also negative and significant, indicating that banks holding abnormally many bonds during default years are systematically less likely to make new loans. This negative association is interesting because, as we documented in Section 3.2, the accumulation of public bonds during default years is not concentrated in low-quality banks. If anything, the reverse seems to be true. Thus, the drop in their loans during default is likely to be induced by the bonds that they hold, and not by a drop in their relative demand for credit.

Column (4) further assuages the concern that our results may be contaminated by country-level unobserved shocks to the demand for credit. The results are in fact extremely robust to the inclusion of country*time dummies. Furthermore, note again that neither measure of bondholdings matters for loans outside of default events. This implies that, controlling for observables and country dummies, it is unlikely that normal and time-varying bonds capture unobserved factors shaping the level or the pro-cyclicality of the demand for credit at the bank level.

[28] The effect of $b_{i,n,t}$ on loans during defaults could capture both the fact that default exerts an adverse balance sheet effect on banks with higher average bondholdings in normal times, and the fact that defaults reduce the appeal of bonds as liquid assets and this is costly for banks that normally use bonds for that reason.

The economic effects of both the normal-time and residual component of bondholdings are large. A 10% annual increase in the normal-time component of bondholdings within a defaulting country is associated with a reduction in lending equal to 2.1% of bank assets; and a 10% annual increase in the residual component of bondholdings within a defaulting country is associated with a decrease in lending equal to 2.0% of bank assets. The estimated marginal effects of the normal-time and the residual component of bondholdings on loans are thus similar in magnitude.

This last finding suggests, once again, that the book value of bonds can be used as a good proxy for their market value when interpreting our main results. Indeed, any discrepancies between book-value and market-value measurements are likely to be small for normal-time bonds as we have computed them here, which are averaged over various years. We can therefore interpret the coefficient on the normal-times component ($b_{i,n,t}$) as being unaffected by mismeasurement. But then our estimated coefficient for the time-varying component of bonds, which is in principle more subject to mismeasurement, is similar to that of the normal-times component. This suggests either that: (i) bank lending is driven by the book value, and not by the market value of bonds, or that; (ii) the discrepancy between both measures is not large enough to affect our estimates. Either option implies that book values are informative for understanding the link between sovereign defaults and bank lending.

Even though both components of bondholdings appear to have the same marginal effects on lending, one needs to take into account that normal-times bondholdings are substantially larger than residual bondholdings. In particular, within our sample of defaulting countries, average bank bondholdings during non-default years (13% of assets) represent 87% of their average bondholdings during default years (14.9% of assets). To grasp the full implication of this number, recall our previous result that a one-dollar increase in bonds is followed by a 60-cent drop in lending during a default. The relative sizes of both components of bondholdings imply that 90% of this drop in lending, namely 54-cents per extra dollar in bonds, is associated with the average bondholdings of banks before the default took place.

4 Conclusions

In a sample of 20 default episodes in 19 countries over 1998-2012 we document three robust facts about the sovereign default-banking crisis nexus. First, there is a strong negative correlation between a bank's holdings of government bonds and its loans during defaults. This correlation is hard to explain through a drop in credit demand; it is more consistent with the hypothesis that banks exposed to default contract their lending. Second, banks hold sizeable amounts of public bonds, both in normal times and during defaults, but the demand for bonds is state dependent: during default there is some accumulation of bonds in domestic banks, especially the large ones. Third, bonds bought during normal times and bonds bought during default years are both associated with a similar marginal reduction in lending. In our sample, though, bonds held in normal times explain the bulk of the post-default drop in loans.

Our bank-level worldwide evidence thus extends our own previous cross-country evidence (Gennaioli, Martin, and Rossi (2014)) and complements the recent findings on the European crisis (Acharya and Steffen (2013); Brutti and Saure (2013); Battistini, Pagano, and Simonelli (2013); Reinhart and Sbrancia (2011); Adelino and Ferreira (2014)), by suggesting that banks' bondholdings are critical to understanding the unfolding of default events and their transmission to the real economy. An important next step in this research agenda should be to deepen our analysis of banks' demand for bonds, in order to understand why banks become so exposed to sovereign defaults in the first place.

In this regard, existing theories provide two main views of bank bondholdings. The first one is the "liquidity view", which holds that banks demand safe bonds in the course of their regular business activity because they are useful as a store of liquidity (Holmstrom and Tirole (1998)). The second one is the "risk-taking view", which holds that banks maintain and even increase their bondholdings precisely when they are risky. This behavior could reflect banks' reaching for yield (Acharya and Steffen (2013)), or it could be their response to government moral suasion or bailout guarantees (Livshits and Schoors (2009), Broner et al. (2014), Farhi and Tirole (2014)).

Although our data is ill-suited to perfectly distinguish between these views, it is nonetheless tempting to attempt to interpret our findings through the lens of these theories. A general reading of our results suggests that both views have some relevance in our sample of developed and emerging economies. On the one hand, we have seen that in normal times banks demand bonds when these are safe and when investment opportunities are few, which is consistent with the liquidity story. On the other hand, during crises banks do accumulate bonds and this accumulation is concentrated in large banks, and when bonds are riskier. This resonates well with the risk-taking view. In turn, both bonds bought in normal times and bonds bought during default are associated with a drop in lending.

Critically, though, our data suggests that – at least in the default episodes that we consider – it is average bondholdings in non-default years that play a significantly larger role in accounting for bank lending during crises. This is primarily due to the fact that banks in our sample of defaulting countries hold many bonds in normal times (13.0% of assets), while the average increase in bondholdings during (or in the proximity of) crises is rather small by comparison (between 2% and 3%, depending on the time window considered).

This result does not of course imply that the accumulation of bonds during sovereign crises is unimportant, but carries two relevant implications. First, banks' demand for public bonds in normal times is a critical, albeit overlooked, determinant of the sovereign default-banking crisis nexus. Second, sovereign crises may be qualitatively different in emerging and advanced economies. In emerging economies, banks hold a large amount of bonds in normal times (12.7% of assets in non-OECD countries). It is only natural to expect that these bondholdings should generate a large fraction of the adverse effects of sovereign defaults on bank lending. In developed economies, however, banks hold fewer bonds in normal times (5% of assets in OECD countries). As a result, in these countries, banks' take-up of public bonds during crises is likely to be more important in relative terms.[29]

[29] The patterns of bondholdings in our sample confirm this hypothesis. In the defaults by emerging countries in our sample, such as for example Argentina and Russia, banks hold many bonds before the default; if anything, they slightly decrease their bondholding as default approaches and, after default happens, large banks accumulate even more bonds. By contrast, banks in Europe's more troubled economies held few bonds before 2008, but they

These considerations may have substantial implications for capital regulation. At a basic level, they suggest that the trade-offs associated to the risk-weighting of government bonds may be very different across countries. Such regulations may be beneficial for advanced economies, but less so for emerging markets. Because government bonds seem to be such an important part of bank portfolios in the course of their normal business activities, regulations to curb bank bondholdings in developing economies might impose a sizeable cost without adding much in terms of improved incentives. These considerations highlight how important it is to understand the determinants of bondholdings across banks and countries. We are still far from having a satisfactory understanding of this critical issue.

accumulated large quantities of them as sovereign risk increased. In our sample, bondholdings between 2008 and 2010 went from 4.4% to 12.3% in Greek banks; from 6.7% to 11% in Irish banks; and from 3% to 8.1% in Portuguese banks. Over the same period, the increase in bondholdings was much smaller in Spanish (from 4.6% to 6%) and Italian (from 11.8% to 12.4%) banks.

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Table I – Bank's Holdings of Government Bonds in Bankscope and IMF data, by year

The table reports summary statistics of bank bondholdings as a percentage of total assets for various samples over 1998-2012. Panel A reports statistics on the full Bankscope universe; Panel B reports statistics on the constant-continuing sample from Bankscope, defined as the sample for which data on other bank characteristics is available; Panel C reports bank-level statistics for the countries covered by the IMF; Panel D reports aggregate country-level statistics from the IMF.

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Overall
Panel A – Bankscope data by bank																	
Mean	8.63	7.14	7.39	7.06	7.08	7.93	8.33	8.24	8.50	8.11	7.69	7.86	8.42	11.13	11.31	11.45	9.28
Median	5.40	4.08	4.02	3.34	3.15	3.13	3.54	3.83	4.13	3.96	3.58	3.62	4.40	7.54	7.68	7.75	5.15
Std Dev	9.81	9.05	9.52	9.94	10.59	11.73	12.38	11.40	11.34	10.93	10.37	10.33	10.67	11.63	11.73	11.86	11.24
No banks	3,610	4,306	4,412	4,258	4,043	3,821	3,753	4,015	5,111	5,202	5,141	5,337	5,822	13,706	12,144	14,647	20,337
No countries	114	111	118	122	127	130	133	136	141	147	157	165	158	171	159	176	191
Panel B – Bankscope data by bank, Constant-Continuing Sample																	
Mean		6.74	6.24	5.79	5.49	6.21	6.94	6.39	6.48	6.06	5.57	5.65	6.82	6.39	7.79	8.59	6.67
Median		4.25	3.63	2.69	2.04	1.95	1.83	1.96	2.15	2.11	1.90	1.64	2.36	2.37	4.33	4.93	2.81
Std Dev		7.55	7.47	8.35	8.96	10.11	11.39	9.92	9.71	9.09	8.52	8.74	9.93	9.27	9.49	10.06	9.37
No banks		2,005	2,109	2,071	1,998	1,875	1,841	1,783	1,914	2,421	2,442	2,341	2,332	2,592	4,344	4,381	7,391
No countries		55	57	59	70	73	73	84	103	116	118	123	137	131	115	120	160
Panel C – Bankscope data by bank, countries covered by IMF																	
Mean		7.75	6.94	6.54	6.61	7.37	7.87	7.85	8.29	7.84	7.44	7.37					7.44
Median		4.35	3.93	3.19	3.01	2.93	3.26	3.72	4.04	3.82	3.41	3.31					3.51
Std Dev		9.65	8.95	9.35	10.07	11.24	12.05	11.10	11.21	10.74	10.23	10.00					10.48
No banks		1,544	4,092	3,962	3,782	3,535	3,457	3,662	4,663	4,739	4,653	4,683					12,772
No countries		53	64	65	116	118	118	120	120	121	121	120					128
Panel D – IMF data, by country																	
Mean		8.53	10.79	11.42	11.53	10.85	10.78	9.67	8.12	7.31	6.69	5.71	.				9.06
Median		7.05	8.17	8.38	8.44	7.37	7.90	7.15	6.16	5.10	4.51	3.78	.				6.22
Std Dev		11.63	14.16	14.56	15.44	15.79	14.86	14.11	14.02	12.51	11.50	11.51					13.85
No countries		53	64	65	116	118	118	120	120	121	121	120	.				128

Table II – Banks' Holdings of Government Bonds – Comparing the EU Stress Tests and Bankscope

The table reports summary statistics of bank bondholdings as a percentage of total assets for various samples over 2010-2011. Panel A reports statistics from the EU stress tests of 2010 and 2011 on the full sample of banks involved in the EU stress tests; Panel B reports statistics from the EU stress tests of 2010 and 2011 on the constant sample, defined as the sample for which data is available from both Bankscope and the EU stress tests; Panel C reports statistics from Bankscope on the constant sample; Panel D reports statistics from both Bankscope and EU stress tests on the constant sample for selected countries.

	Mean	Median	Std Deviation	No Countries	No Banks	No Obs.
Panel A – Full Sample						
E.U. Bonds	7.11	6.26	4.94	20	79	119
Own Bonds	5.39	4.61	4.78	20	79	119
PIIGS Bonds	3.52	2.02	4.15	20	79	119
Panel B –Constant Sample						
E.U. Bonds	6.75	6.06	4.57	18	57	79
Own Bonds	5.37	4.46	4.68	18	57	79
PIIGS Bonds	4.09	3.38	4.67	18	57	79
Panel C – Bankscope data, Constant Sample						
Bondholdings Bankscope	7.94	7.42	4.84	18	57	79
Panel D – Banks in Selected Countries, Constant Sample						
Greece						
E.U. Bonds	13.72	11.64	6.37	1	6	9
Own Bonds	12.87	10.78	6.84	1	6	9
PIIGS Bonds	12.90	10.78	6.83	1	6	9
Bondholdings Bankscope	16.05	14.89	6.43	1	6	9
Ireland						
E.U. Bonds	4.59	5.03	1.39	1	3	2
Own Bonds	2.32	2.18	0.43	1	3	2
PIIGS Bonds	2.83	2.89	0.81	1	3	2
Bondholdings Bankscope	8.12	7.59	1.49	1	3	2
Italy						
E.U. Bonds	7.06	7.00	1.94	1	5	10
Own Bonds	6.13	6.44	2.28	1	5	10
PIIGS Bonds	6.24	6.47	2.28	1	5	10
Bondholdings Bankscope	8.58	7.52	2.22	1	5	10
Portugal						
E.U. Bonds	5.58	4.74	2.75	1	4	5
Own Bonds	4.00	4.08	2.20	1	4	5
PIIGS Bonds	5.01	4.34	3.21	1	4	5
Bondholdings Bankscope	8.46	7.31	3.97	1	4	5
Spain						
E.U. Bonds	4.39	4.93	2.16	1	15	20
Own Bonds	4.04	4.75	2.03	1	15	20
PIIGS Bonds	4.27	4.93	2.16	1	15	20
Bondholdings Bankscope	5.48	6.09	3.02	1	15	20

Table III – Banks' Holdings of Government Bonds Around the World

The table reports summary statistics of the banks' holdings of government bonds, computed as a percentage of total assets. Panel A reports statistics on the Bankscope universe and Panel B on the constant-continuing sample. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

Panel A – Bondholdings – Bankscope population

	Overall	Overall			Defaulting Countries			Overall		
		Non-Default Cos	Default Cos	Diff.	Non-Default Yrs	Default Yrs	Diff.	OECD	Non-OECD	Diff.
Mean	9.28	9.06	13.77	-4.71***	13.51	14.49	-0.98**	8.43	12.39	-3.96***
Median	5.15	5.02	9.04		9.02	9.15		4.47	8.11	
Std Deviation	11.24	11.03	14.23		13.79	15.35		10.60	12.85	
No Banks	20,337	19,714	623		571	501		16,401	3,976	
No Countries	191	157	34		34	24		34	157	
No Bank-Year Obs.	99,328	94,744	4,584		3,359	1,225		78,118	21,210	

Panel B – Bondholdings – Constant-Continuing Sample

	Overall	Overall			Defaulting Countries			Overall		
		Non-Default Cos	Default Cos	Diff.	Non-Default Yrs	Default Yrs	Diff.	OECD	Non-OECD	Diff.
Mean	6.67	6.19	13.46	-7.27***	12.96	14.87	-1.91***	4.61	12.63	-8.02***
Median	2.81	2.57	9.50		8.89	11.17		1.92	8.79	
Std Deviation	9.37	8.84	13.21		12.94	13.87		7.13	12.12	
No Banks	7,391	6,935	456		414	264		5,334	2,058	
No Countries	160	144	27		26	17		32	128	
No Bank-Year Obs.	36,449	34,030	2,419		1,784	635		27,074	9,375	

Table IV – Descriptive Statistics

The table reports summary statistics of the main variables used in the empirical analysis. Assets is the total book value in million $ of intangible, tangible and other fixed assets;non-cash assets is total assets minus cash and due from banks, divided by total assets;leverage is one minus book value of equity (issued share capital plus other shareholders fund) divided by total assets; loans is total loans outstanding divided by total assets; profitability is operating income divided by total assets; exposure to central bank is total exposure to central bank divided by total assets; interbank balances is interest-earning balances with central and other banks divided by total assets; government owned is a dummy that equals one if the government owns more than 50% of the bank's equity. Panel A reports statistics on the Bankscope universe and Panel B on banks involved in the EU stress test of 2010. For details on the construction of all variables see Table AI in the Appendix.

Panel A – Bankscope, Constant-continuing sample

	Mean	Median	Std Deviation	No Countries	No Observations
Assets ($/M)	9,922.0	725.6	81,400.0	160	36,449
Non-cash assets	95.8	97.6	5.6	160	36,449
Leverage	91.0	93.3	8.4	160	36,449
Loans	57.1	60.0	17.0	160	36,449
Profitability	0.9	0.7	2.1	160	36,449
Exposure to Central Bank	3.3	1.5	4.9	160	36,449
Interbank Balances	12.2	9.2	12.5	160	36,449
Government Owned	2.5	0.0	15.7	160	36,449

Panel B – EU banks involved in the EU stress test 2010

	Mean	Median	Std Deviation	No Countries	No Observations
Assets ($/M)	394,000.0	130,000.0	618,000.0	18	79
Non-cash assets	97.6	98.3	1.9	18	79
Leverage	93.3	93.8	4.2	18	79
Loans	64.8	67.2	13.9	18	79
Profitability	-0.1	0.3	1.9	18	79
Exposure to Central Bank	1.7	1.0	1.9	11	40
Interbank Balances	5.9	4.7	4.7	18	79
Government Owned	0.0	0.0	0.1	18	79

Table V – Bondholdings, Sovereign Default, and Changes in Loans

The table presents coefficient estimates from pooled OLS regressions. The dependent variable changes in loans is computed as loans outstanding in year t minus loans outstanding in year t-1, divided by total assets. The main independent variable is bank bondholdings, computed as bondholdings divided by total assets. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the bank level using the Huber (1967) correction. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	(1)	(2)	(3)	(4)	(5)
Bank Bondholdings$_{t-1}$ *	-0.126**	-0.129**	-0.095*	-0.148**	-0.133***
Sovereign Default$_{t-1}$	(0.057)	(0.057)	(0.058)	(0.060)	(0.045)
Sovereign Bond Return$_{t-1}$ *	0.072***	0.068***	0.071***		
Sovereign Default$_{t-1}$	(0.014)	(0.015)	(0.015)		
Bank Bondholdings$_{t-1}$	0.032***	0.034***	0.009	0.009	0.002
	(0.009)	(0.009)	(0.011)	(0.011)	(0.016)
Sovereign Default$_{t-1}$	-0.038	-0.035	-0.019	-0.057	0.122**
	(0.026)	(0.025)	(0.024)	(35.69)	(0.055)
Sovereign Bond Return$_{t-1}$	0.005	0.011*	0.004		
	(0.005)	(0.006)	(0.007)		
Bank-Level Controls and Interactions?	Yes	Yes	Yes	Yes	Yes
Year Dummies?		Yes	Yes	Yes	Yes
Country Dummies?			Yes	Yes	Yes
Country x Year Dummies?				Yes	Yes
Constant	0.041**	0.030*	-0.026	-0.069	-0.280
	(0.018)	(0.018)	(0.021)	(283.3)	(178.6)
No Observations	14,074	14,074	14,074	14,074	27,408
No Banks	3,722	3,722	3,722	3,722	5,218
No Countries	60	60	60	60	158
R-squared	0.061	0.072	0.106	0.204	0.224

Table VI – Bondholdings, Country Shocks, and Changes in Loans

The table presents coefficient estimates from pooled OLS regressions. The dependent variable changes in loans is computed as loans outstanding in year t minus loans outstanding in year t-1, divided by total assets. The main independent variables are bank bondholdings, computed as bondholdings divided by total assets, GDP annual percent growth, and exchange rate devaluation, computed as percent change in the exchange rate with the US dollar. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the bank level using the Huber (1967) correction. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	(1)	(2)	(3)	(4)
Bank Bondholdings$_{t-1}$ *	-0.144**	-0.117**	-0.131*	-0.107*
Sovereign Default$_{t-1}$	(0.062)	(0.047)	(0.068)	(0.064)
Bank Bondholdings$_{t-1}$ *	0.156	0.285**		
GDP Growth$_{t-1}$	(0.140)	(0.137)		
Bank Bondholdings$_{t-1}$ *			-0.027	-0.025
Exchange Rate Devaluation$_{t-1}$			(0.040)	(0.039)
Sovereign Bond Return *	0.091		-0.010	
Sovereign Default$_{t-1}$	(0.077)		(0.059)	
Bank Bondholdings$_{t-1}$	0.001	0.003	0.008	0.013
	(0.012)	(0.009)	(0.011)	(0.008)
Sovereign Default$_{t-1}$	-0.109	0.092	0.124	0.141
	(0.119)	(0.322)	(0.088)	(10.935)
Bank-Level Controls and Interactions with Sovereign Default?	Yes	Yes	Yes	Yes
Bank-Level Controls and Interactions with GDP Growth?	Yes	Yes		
Bank-Level Controls and Interactions with Exchange Rate Devaluation?			Yes	Yes
Year Dummies?	Yes	Yes	Yes	Yes
Country Dummies?	Yes	Yes	Yes	Yes
Country * Year Dummies?	Yes	Yes	Yes	Yes
Constant	0.229	-0.040	-0.118	0.141
	(0.147)	(3.715)	(0.087)	(130.540)
No Observations	13,873	26,467	13,908	24,982
No Banks	3,649	4,967	3,646	4,645
No Countries	56	129	54	97
R-squared	0.205	0.214	0.205	0.204

Table VII – Bondholdings, Sovereign Default, and Changes in Loans: Robustness Tests

The table presents coefficient estimates from pooled OLS regressions. The dependent variable changes in loans is computed as loans outstanding in year t minus loans outstanding in year t-1, divided by total assets. The main independent variables are bank average non-default years bondholdings, computed as the average of bank bondholdings in all the non-default years prior to and including year *t–1* , bank time-varying bondholdings, computed as bank bondholdings minus bank average non-default years bondholdings. Largest defaults are Argentina's, Russia's Ukraine's and Greece's. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the bank level using the Huber (1967) correction. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	Exclude government owned banks		Largest defaults only		No defaults with <5 banks		No defaults with <10 banks		No defaults with <15 banks		Haircut measure of default		Spread or Default measure of default	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Bank Bondholdings$_{t-1}$ *	-0.101*	-0.128***	-0.195***	-0.231***	-0.096*	-0.132***	-0.150***	-0.160***	-0.150***	-0.179***	-0.242***	-0.256***	-0.129**	-0.156***
Sovereign Default$_{t-1}$	(0.058)	(0.047)	(0.060)	(0.060)	(0.058)	(0.046)	(0.057)	(0.046)	(0.057)	(0.047)	(0.081)	(0.067)	(0.052)	(0.054)
Sovereign Bond Return$_{t-1}$ *	0.075***		0.062***		0.071***		0.046***		0.045***		0.130***		0.062***	
Sovereign Default$_{t-1}$	(0.016)		(0.015)		(0.015)		(0.014)		(0.014)		(0.026)		(0.015)	
Sovereign Default$_{t-1}$	-0.021	-0.008	0.002	0.090	-0.007	0.225***	0.023	0.233***	0.023	0.174**	-0.044	0.179	-0.006	0.213
	(0.023)	(0.046)	(0.032)	(0.068)	(0.031)	(0.070)	(0.035)	(0.072)	(0.035)	(0.073)	(0.265)	(0.182)	(0.131)	(6.430)
Sovereign Bond Return$_{t-1}$	0.003		0.008		0.003		0.016**		0.017**		0.001		0.007	
	(0.007)		(0.008)		(0.007)		(0.007)		(0.007)		(0.007)		(0.007)	
Bank-Level Controls and Interactions?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Year Dummies?		Yes		Yes		Yes		Yes		Yes		Yes		Yes
Constant	-0.006	-0.032	-0.031	-0.109***	-0.025	0.040	-0.066**	0.089*	-0.056**	-0.154***	-0.035	-0.081	-0.024	0.191***
	(0.021)	(101.8)	(0.022)	(0.040)	(0.021)	(0.057)	(0.027)	(0.054)	(0.027)	(0.017)	(0.029)	(106.077)	(.)	(0.020)
No Observations	13,726	26,570	13,415	26,059	14,035	27,218	13,624	26,786	13,494	26,576	17,923	31,431	17,296	30,076
No Banks	3,634	5,049	3,388	4,729	3,532	4,923	3,445	4,835	3,396	4,784	5,343	6,768	5,396	
No Countries	60	158	55	147	58	151	55	148	54	147	61	160	56	160
R-squared	0.106	0.225	0.119	0.226	0.105	0.220	0.119	0.222	0.119	0.221	0.110	0.216	0.119	0.218

Table VIII– Banks' Demand for Government Bonds

The table presents coefficient estimates from pooled OLS regressions. The dependent variable is bank bondholdings, and it is computed as bondholdings divided by total assets. Size is the natural logarithm of total assets; non-cash assets is total assets minus cash and due from banks, divided by total assets; leverage is one minus book value of equity (issued share capital plus other shareholders fund) divided by total assets; loans is total loans outstanding divided by total assets; profitability is operating income divided by total assets; exposure to central bank is total exposure to central bank divided by total assets; interbank balances is interest-earning balances with central and other banks divided by total assets; government owned is a dummy that equals one if the government owns more than 50% of the bank's equity. Sovereign default is a binary variable that equals 1 if the sovereign is in default in year t-1 and 0 otherwise; GDP growth is natural logarithm of GDP in year t minus natural logarithm of GDP in year t-1; aggregate leverage is the country-year average of bank leverage; banking crisis is a binary variable that equals 1 if the country is in a banking crisis in year t-1 and 0 otherwise; private credit is the ratio of credit from deposit taking financial institutions to the private sector to GDP, expressed as a percentage; exchange rate devaluation is the percent change in the exchange rate with the US dollar. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the bank level using the Huber (1967) correction. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	(1)	(2)	(3)
Sovereign Default$_{t-1}$*	0.009**	0.011***	0.007***
Size$_{t-1}$	(0.004)	(0.003)	(0.003)
Sovereign Default$_{t-1}$*	-0.005	-0.042	-0.041
Loans$_{t-1}$	(0.036)	(0.037)	(0.029)
Sovereign Default$_{t-1}$ *		0.107***	
Expected Sovereign Bond Return$_{t-1}$		(0.029)	
Sovereign Default$_{t-1}$ *	0.168	1.758***	
GDP Growth$_{t-1}$	(0.207)	(0.432)	
Sovereign Default$_{t-1}$ *	0.042	0.172***	
Banking Crisis$_{t-1}$	(0.026)	(0.045)	
Sovereign Default$_{t-1}$ *	0.521***	2.048***	
Private Credit$_{t-1}$	(0.197)	(0.438)	
Sovereign Default$_{t-1}$	-0.142	-1.501***	-0.091*
	(0.166)	(0.344)	(0.055)
Size$_{t-1}$	0.001***	0.001	0.000
	(0.000)	(0.000)	(0.000)
Loans$_{t-1}$	-0.027***	-0.047***	-0.041***
	(0.005)	(0.007)	(0.004)
Expected Sovereign Bond Return$_{t-1}$		-0.027***	
		(0.008)	
GDP Growth$_{t-1}$	-0.179***	-0.134	
	(0.069)	(0.096)	
Banking Crisis$_{t-1}$	0.030***	0.022	
	(0.005)	(0.019)	
Private Credit$_{t-1}$	-0.023***	0.038**	
	(0.004)	(0.018)	
Other controls?	Yes	Yes	Yes
Year Dummies?	Yes	Yes	Yes
Country Dummies?		Yes	Yes
Country x Year Dummies?			Yes
No Observations	13,007	5,341	26,549
No Banks	2,896	2,103	5,124
No Countries	38	29	157
R-squared	0.800	0.739	0.814

Table IX – Bondholdings and Changes in Loans: Normal Times v Default Years Bonds

The table presents coefficient estimates from pooled OLS regressions. The dependent variable changes in loans is computed as loans outstanding in year t minus loans outstanding in year t-1, divided by total assets. The main independent variables are pre-default bank bondholdings, coimputed as bondholdings in the year prior to the first year of a sovereign default, divided by total assets; average pre-default bank bondholdings, computed as the average of bondholdings divided by total assets in the last three years prior to the first year of a sovereign default; bank average non-default years bondholdings, computed as the average of bank bondholdings in all the non-default years prior to and including year *t–1* , bank time-varying bondholdings, computed as bank bondholdings minus bank average non-default years bondholdings. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the bank level using the Huber (1967) correction. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	(1)	(2)	(3)	(4)
Pre-Default Bank Bondholdings	-0.281***			
	(0.080)			
Avg Pre-Default Bank Bondholdings		-0.361***		
		(0.028)		
Bank avg non-default years Bonds$_{t-1}$ *			-0.201**	-0.213**
Sovereign Default$_{t-1}$			(0.100)	(0.088)
Bank time-varying Bondholdings$_{t-1}$ *			-0.197***	-0.206***
Sovereign Default$_{t-1}$			(0.072)	(0.068)
Sovereign Bond Return$_{t-1}$ *			0.128***	
Sovereign Default$_{t-1}$			(0.031)	
Bank avg non-default years Bonds$_{t-1}$			0.035	-0.006
			(0.022)	(0.017)
Bank time-varying Bondholdings$_{t-1}$			0.029	-0.002
			(0.026)	(0.020)
Sovereign Default$_{t-1}$			0.052	0.075
			(0.070)	(0.143)
Sovereign Bond Return$_{t-1}$			0.003	
			(0.007)	
Bank-Level Controls and Interactions?	Yes	Yes	Yes	Yes
Year Dummies?	Yes	Yes	Yes	Yes
Country Dummies?	Yes	Yes	Yes	Yes
Country x Year Dummies?				Yes
Constant	0.780**	0.874**	-0.052*	0.027
	(0.275)	(0.272)	(0.028)	(93.0)
No Observations	105	105	13,347	26,006
No Banks	105	105	3,553	4,972
No Countries	5	5	60	158
R-squared	0.439	0.442	0.113	0.229

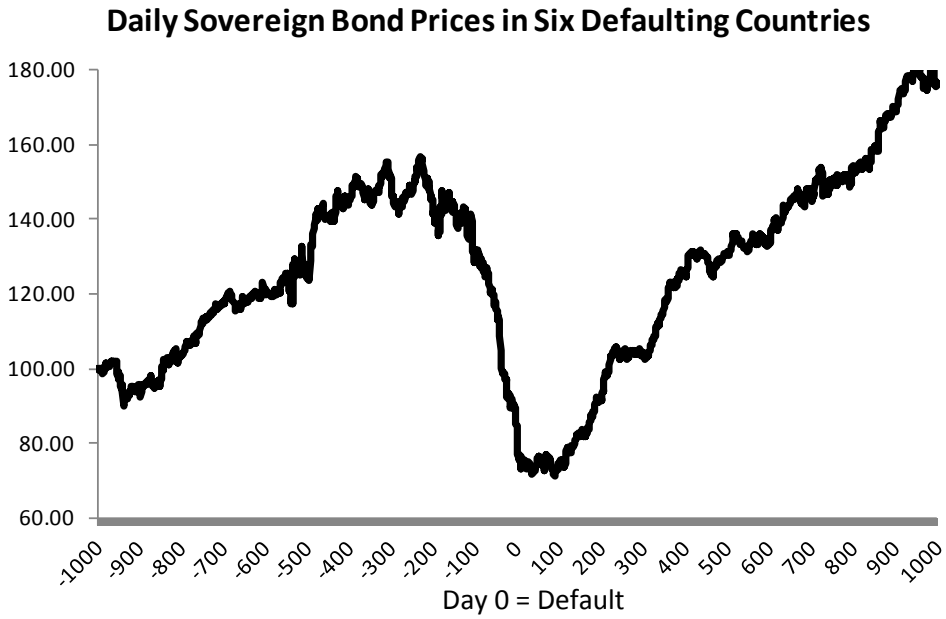

Figure 1. Sovereign Bond Prices in Defaulting Countries. The figure plots the average bond prices over 7 default episodes in 6 countries (Argentina 2001-2004, Russia 1998-2000, Cote d'Ivoire 2000-2004, Ecuador 1998-2000, Ecuador 2009, Nigeria 2002, Greece 2012), from day -1,000 to +1,000, whereby day 0 is the day in which default is announced.

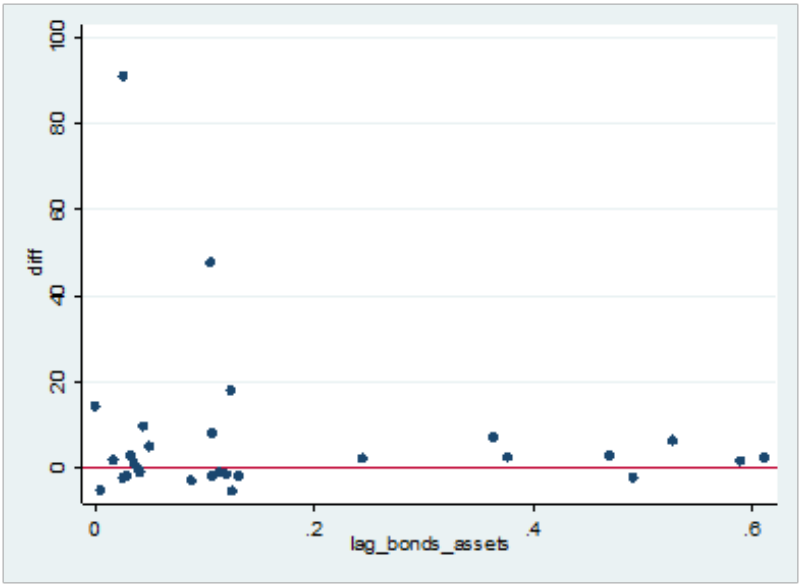

Figure 2. Book Value and Market Value Measurement in Default. The figure plots the empirical proxy for the quantity defined in Equation (2) for 30 banks in five defaulting countries (Argentina 2001-2004, Russia 1998-2000, Ecuador 1998-2000 and 2009, Greece 2012, Indonesia 1998-2000 and 2002). Above the horizontal line at 0 is the region where book value under-estimates the banks' exposure to government bonds at market value. Below the horizontal line at 0 the reverse occurs.

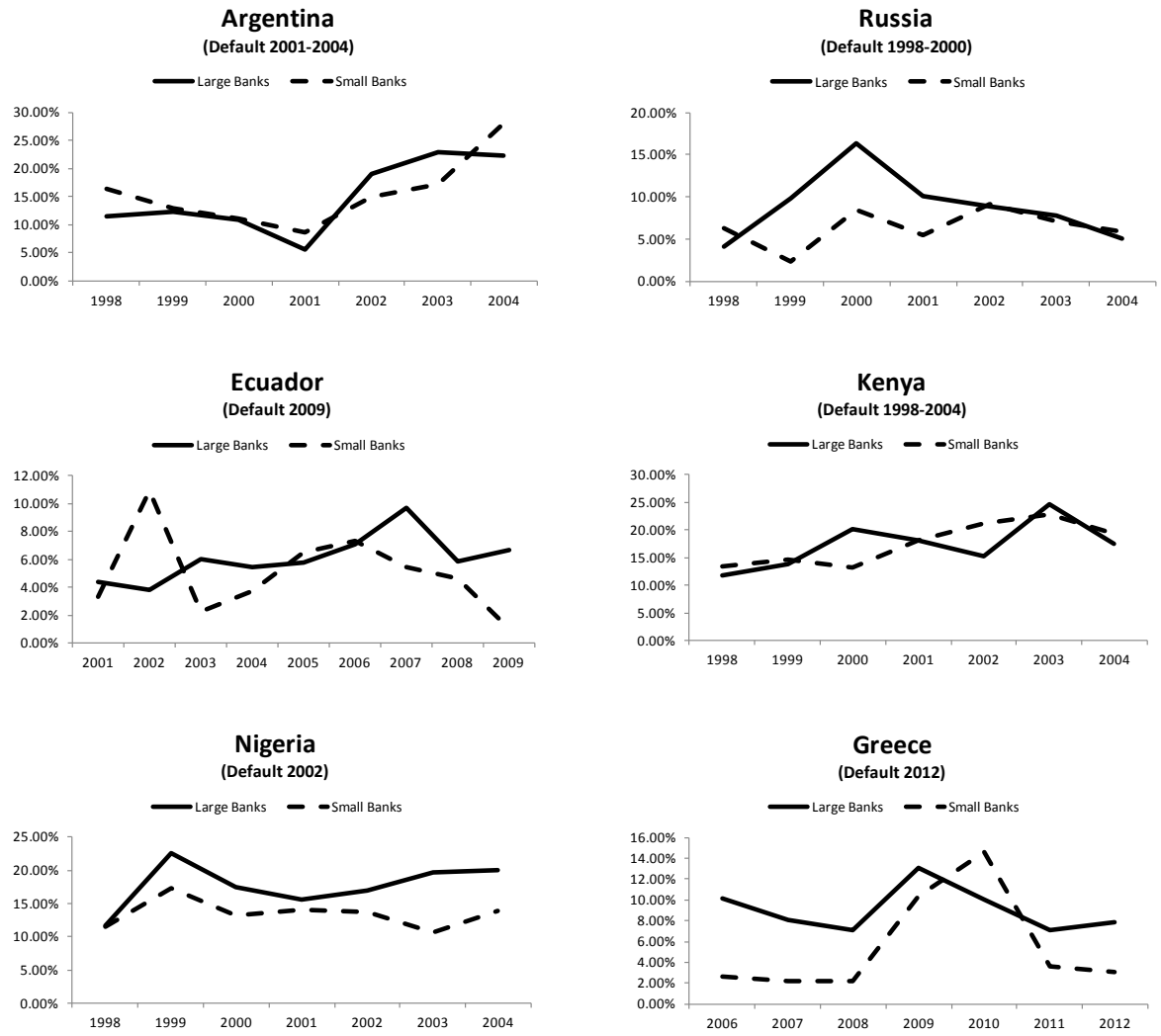

Figure 3. Bondholdings in Selected Defaulting Countries by Bank Size. The figure plots the average bondholdings by large (above-median total assets) and small (below-median total assets) banks in selected countries.

Appendix

This Appendix reports tables that are referred to in the main text. Table AI presents pair-wise correlations among the variables used in the analysis. Table AII lists the default events that we consider in our empirical analysis. Table AIII describes our variables and their sources. Table AIV reports descriptive statistics on realized sovereign bond returns.

Table AV presents results related to the estimation of Equation (1) in the paper, namely, the first stage of our estimation of expected sovereign bond returns, whereby realized sovereign returns are regressed on economic, financial, and political risk scores provided by the ICRG that in the literature have been found to predict sovereign returns.

The purpose of this exercise is very narrow, as we simply want to determine whether, in our sample, the country risk measures provided by the ICRG constitute valid instruments and can thus be used to construct our proxy of expected government bond returns. Our purpose is not to determine whether future government bond returns are predictable using current information publicly available to investors, which is discussed for example in Comelli (2012) and others. As a result, among other things, we are not concerned about the out-of-sample properties of our instruments.

Table AV present the results of the first stage estimation of sovereign returns. The first three columns present the univariate correlation of annual government bond returns at year t with the economic, political, and financial risk score measured at year t-1, respectively. The correlations are large and strongly statistically significant. A higher score implies less risk, so for example, a 1-percent increase in the economic risk score translates into a 0.31% lower government return; and a 1-percent increase in the economic risk score translates into a 0.27% lower government return.

Importantly for our purposes, the F-test in these three columns is very high, around 10 or higher, which suggests that our instruments are unlikely to be weak according to the 'rule-of-thumb' proposed by Stock and Yogo (2005). By comparison, column (4) present the result of regressing government bond returns at t on past returns at t-1. While there is also a negative and significant univariate correlation, the F-test is around 3, indicating that past government bond returns is a likely weak instrument, and as a result we do not use it in our analysis.

Column (5) presents the specification that we use in the empirical analysis as the first stage of Table V, in Columns 3 and 5. We use as instruments the economic score and the political score, and we include time dummies to capture variations in the global riskless interest rate. It turns out that our results in Table V are not sensitive to the choice of any combination of instruments, within the three risk scores of ICRG.

The remainder of the Table shows that in-sample predictability comes from both the cross section and the time series, that is, our coefficients of interest remain strongly significant when adding time dummies and country dummies; and our main specification is also robust to the inclusion of past returns as an additional explanatory variable.

Table AI – Pair-wise Correlations

The table reports pair-wise correlations among the main variables used in the empirical analysis. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	Bonds	Bank Size	Non-cashAssets	Leverage	Loans	Profitability	Exposure	Balances
Banks size	-0.063***							
Non-cash assets	-0.835***	0.202***						
Leverage	-0.141***	0.335***	0.207***					
Loans	-0.376***	0.016***	0.202***	0.238***				
Profitability	0.102***	0.059***	-0.071***	-0.286***	-0.100***			
Exposure to Central Bank	0.096***	0.209***	-0.374***	-0.218***	-0.231***	0.140***		
Interbank Balances	-0.136***	-0.087***	0.117***	-0.173***	-0.553***	0.061***	0.367***	
Government Owned	0.082***	0.141***	-0.026***	-0.031***	-0.073***	0.009***	0.027***	0.022***

Table AII – Default Episodes and Bank-Years in Default in our Sample

The table reports episodes of sovereign defaults over 1998-2012 for which we observe bank-level data from Bankscope. A default episode is an uninterrupted sequence of years in default by a country. Default S&P reports the years in which a country is in default according to the definition of sovereign default by Standard & Poor's, which is based on whether an outstanding debt issue is not repaid in full, or is renegotiated with worse terms for the creditors. Haircut is the average creditors' haircuts from the work of Cruces and Trebesch (2013) and Zettelmeyer, Trebesch, and Gulati (2012).Spread or Default considers countries with available data on sovereign spreads and reports the years in which a country is in default according to whether at least once in a given year the spreads of the sovereign bond with the corresponding U.S. or German bonds exceed a given threshold; or it is in default according to the S&P definition.

Country	Default S&P	Haircut	Spread or Default	No Bank-Years	No Banks
Argentina	2001-2004	76.8%	2001-2004	231	87
Ecuador	1998-2000; 2009	38.3%		8	8
Ethiopia	1998-1999	92.0%		2	1
Greece	2012	64.8%	2011-2012	12	9
Guyana	1998-2004	91.0%		20	3
Honduras	1998-2004	82.0%		79	21
Ireland			2011	7	7
Indonesia	1998-2000; 2002			17	13
Jamaica	2010			5	5
Kenya	1998-2004	45.7%		160	33
Nigeria	2002			41	41
Portugal			2011-2012	24	15
Russia	1998-2000	51.1%	1998-2000	40	31
Serbia	1998-2004	70.9%		2	2
Seychelles	2000-2002; 2010	56.2%	2010	1	1
Sudan	1998-2004			2	1
Tanzania	2004	88.0%		1	1
Ukraine	1998-2000	14.8%	1998-2001	17	8
Zimbabwe	2000-2004			6	3
No Banks				675	290
No Countries	17	12	7		
No Episodes	20	13	7		

Table AIII – Definition of the Variables used in the Analysis

Variable	Definition
Bank-level variables	
Assets	Total book value of intangible, tangible and other fixed assets. Source: Bankscope.
Bondholdings	Total holding of government securities, including treasury bills, bonds and other government securities, divided by total assets. Source: Bankscope.
Size	Natural logarithm of total assets. Source: Bankscope.
Non-cash assets	Total assets minus cash and due from banks, divided by total assets. Source: Bankscope.
Leverage	One minus book value of equity (issued share capital plus other shareholders fund) divided by total assets. Source: Bankscope.
Loans	Total loans outstanding divided by total assets. Source: Bankscope.
Profitability	Operating income divided by total assets. Source: Bankscope.
Exposure to Central Bank	Total exposure to central bank divided by total assets. Source: Bankscope.
Interbank Balances	Interest-earning balances with central and other banks, excluding impairment allowance, but including amounts due under reverse repurchase agreements, divided by total assets. Source: Bankscope.
Government Owned	Dummy variable that equals 1 if the government owns more than 50% of the bank's equity. Source: Bankscope.
Country-level variables	
Sovereign Default	Dummy variable that equals 1 if the sovereign issuer is in default. Sovereign default is defined as the failure to meet a principal or interest payment on the due date (or within the specified grace period) contained in the original terms of the debt issue. In particular, each issuer's debt is considered in default in any of the following circumstances: (i) For local and foreign currency bonds, notes and bills, when either scheduled debt service is not paid on the due date, or an exchange offer of new debt contains terms less favorable than the original issue; (ii) For central bank currency, when notes are converted into new currency of less than equivalent face value; (iii) For bank loans, when either scheduled debt service is not paid on the due date, or a rescheduling of principal and/or interest is agreed to by creditors at less favorable terms than the original loan. Such rescheduling agreements covering short and long term debt are considered defaults even where, for legal or regulatory reasons, creditors deem forced rollover of principal to be voluntary. Source: Standard & Poor's (2008).
Sovereign Bond Return	Index aggregating the realized returns of sovereign bonds of different maturities and denominations in each country. Returns are expressed in dollars. The index takes into account the change in the price of the bonds and it assumes that any cash received from coupons or pay downs is reinvested in the bond. Source: the J.P. Morgan's Emerging Market Bond Index Plus file (EMBIG+) for emerging countries; and the J.P. Morgan's Global Bond Index (GBI) file for developed countries.
GDP Growth	Logarithm of gross domestic product per capita (Atlas method). Source: World Development Indicators.
Exchange Rate Devaluation	Percent change in the exchange rate of the local currency relative to the U.S. Dollar. Source: International Monetary Fund, International Financial Statistics (September 2014).
Aggregate Leverage	Country-year average of bank-level leverage. Source: Bankscope.
Banking Crisis	Dummy variable that equals 1 if the country is experiencing a banking crisis. Banking crisis is defined as a situation in which the net worth of the banking system has been almost or entirely eliminated. Source: Caprio and Klingebiel (2001) and the updated data by Caprio et al. (2005).
Unemployment Growth	Annual percentage change in unemployment. Source: World Development Indicators (September 2008).
Inflation	Annual percentage inflation, GDP deflator. Source: World Development Indicators (September 2008).
Private Credit	Ratio of credit from deposit taking financial institutions to the private sector (International Financial Statistics lines 22d and 42d) to GDP (International Financial Statistics line 99b), expressed as a percentage. Line 22d measures claims on the private sector by commercial banks and other financial institutions that accept transferable deposits such as demand deposits. Line 42d measures claims on the private sector given by other financial institutions that do not accept transferable deposits but that perform financial intermediation by accepting other types of deposits or close substitutes for deposits (e.g., savings and mortgage institutions, post office savings institutions, building and loan associations, certain finance companies, development banks, and offshore banking institutions). Source: International Monetary Fund, IFS (September 2008).
Economic Score	Rating of economic risk that reflects indicators such as GDP, GDP growth, inflation, and current account balance. It ranges between 0 and 50, where 0 represents the highest risk. Source: ICRG (2013).
Political Score	Rating of political risk that reflects sociopolitical indicators including government stability, socioeconomic conditions, internal or external conflict, corruption, law and order, and public accountability. It ranges between 0 and 100, where 0 represents the highest risk. Source: ICRG (2013).
Financial Score	Rating of financial risk that combines variables such foreign debt as a share of GDP, foreign debt services as a share of exports, and exchange rate stability. It ranges between 0 and 50, where 0 represents the highest risk. Source: ICRG (2013).

Table AIV – Sovereign Bond Returns in Defaulting and non-Defaulting Countries

The table presents descriptive statistics of realized government bond returns.

	Default	No Default	OECD	No OECD	Overall
Mean	14.46%	9.70%	7.62%	11.61%	9.81%
Std Deviation	58.61%	19.76%	12.34%	26.47%	21.37%
Variance	34.35%	3.90%	1.52%	7.01%	4.57%
No Countries	6	70	27	43	70
No Country-year obs.	18	764	353	429	782

Table AV – First-Stage Estimation of Government Bond Returns

The Table presents results from the first stage estimation of government bond returns. The instruments are the economic score, a rating of economic risk provided by the ICRG and normalized to be between 0 and 1; the political score, a rating of political risk provided by the ICRG and normalized to be between 0 and 1; and the financial score, a rating of financial risk provided by the ICRG and normalized to be between 0 and 1. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction. *** indicates significance at the 1% level; ** indicates significance at the 5% level; * indicates significance at the 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic Score$_{c,t-1}$	-0.311***				-0.251**	-0.477**	-0.363*	-0.451**
	(0.090)				(0.110)	(0.202)	(0.224)	(0.196)
Political Score$_{c,t-1}$		-0.221***			-0.148*	-0.416**	-0.435**	-0.553***
		(0.075)			(0.081)	(0.185)	(0.184)	(0.205)
Financial Score$_{c,t-1}$			-0.270***				-0.198	
			(0.082)				(0.186)	
Return$_{c,t-1}$				-0.143*				-0.184**
				(0.078)				(0.076)
Constant	0.328***	0.257***	0.300***	0.121***	0.189**	0.515***	0.611***	0.896***
	(0.070)	(0.059)	(0.064)	(0.013)	(0.087)	(0.151)	(0.185)	(0.194)
Time dummies?					Yes	Yes	Yes	Yes
Country dummies?						Yes	Yes	Yes
F-test	12.02	8.69	10.91	3.37	11.37			
No Observations	766	766	766	719	766	766	766	712
R-squared	0.020	0.018	0.013	0.022	0.239	0.290	0.292	0.336