Journal of Empirical Finance 74 (2023) 101417

Contents lists available at ScienceDirect

Journal of Empirical Finance

journal homepage: www.elsevier.com/locate/jempfin

# Bond issuance and the funding choices of European banks: The consequences of public debt☆

Michela Rancan [b], Jessica Cariboni [c], Kevin Keasey [d], Francesco Vallascas [a,*]

[a] Durham University Business School, Durham University, Mill Hill Lane, DH1 3LB, UK
[b] University of Milan, Italy
[c] European Commission, Joint Research Centre (JRC), Italy
[d] Leeds University Business School, The University of Leeds, UK

ARTICLE INFO

*JEL classification:*
G21
G28
H63

*Keywords:*
Bank bonds
Sovereign debt
European banks
Regulation

ABSTRACT

European banks raise less funds in the bond market when there is a larger public debt in their national economies and this is reflected in lower leverage. We exploit numerous sources of heterogeneity in our data to demonstrate this result is driven by a crowding out effect from the public arena and not by a sovereign risk channel or political influence. The crowding out effect is stronger for less internationally active or smaller banks, and in banks characterized by more traditional business models. Our findings indicate that additional capital requirements on sovereign bond holdings can also influence bank funding composition via a decrease in the demand for sovereign bonds by the banking industry. The specific effect of these regulatory initiatives is critically dependent on bank characteristics.

## 1. Introduction

The European sovereign debt crisis is an example of how the public debt European banks acquire in the bond market can generate risks of financial instability via the asset side of the bank balance sheet (Acharya et al., 2014; Brunnermeier et al., 2016; Fiordelisi et al., 2020). These negative effects observed during the European sovereign crisis have stimulated the regulatory debate on introducing a more penalized treatment of sovereign bond holdings in the computation of bank capital requirements and/or adopting limits on a bank's exposure to sovereign debt (Basel Committee on Banking Supervision, 2017; Craig et al., 2020; Lenarčič et al., 2016).[1] These

☆ The content of this article does not reflect the official opinion of the European Commission. Responsibility for the information and views expressed therein lies entirely with the authors.We thank Mascia Bedendo, Danilo Mascia, Marina Brogi for their numerous helpful comments and suggestions. We also thank participants of the Workshop on European Banking Union and Financial Distress held at the University of Cagliari, and participants of the European Economics and Finance Society (EEFS) 2015, Brussels, and of the International Risk Management (IRMC), Conference, Luxembourg 2015, for their constructive comments on preliminary versions of this paper.

* Corresponding author at: Durham University Business School, Durham University, Mill Hill Lane, DH1 3LB, UK.
*E-mail address:* francesco.vallascas@durham.ac.uk (F. Vallascas).

[1] For instance, the discussion paper of the Basel Committee, published in 2017, indicates the possibility of removing the use of the Internal Rating Based Approach to compute bank capital requirements for sovereign exposures and the introduction of positive standardized risk weights for most sovereign exposures in the banking and trading books. This would result in an increase of the amount of capital banks should hold for their sovereign portfolios. Further, the document raises the possibility of introducing marginal risk weight add-ons for most sovereign exposures with the purpose of mitigating the sovereign concentration of risk in bank balance sheets.

https://doi.org/10.1016/j.jempfin.2023.101417
Received 8 September 2022; Received in revised form 13 June 2023; Accepted 28 August 2023
Available online 31 August 2023

changes have been endorsed by European policy makers since 2015 (see, Juncker et al., 2015).

However, as documented by the European Central Bank, European banks not only hold a significant amount of sovereign bonds (9% of total assets in 2020), with a large share issued by the national government (Horvath et al., 2015; Saka, 2020), but also employ debt securities to fund around 17% of their assets. We suggest these asset and liability features of European banks can lead the proposed regulatory changes to have significant funding implications with further consequences on bank stability that have been largely overlooked. These implications are related to the potential decrease in the demand for sovereign bonds by banks under the new regulatory regime and to the interrelationships between the demand and supply of public sector and private sector debt as shown in studies on non-financial firms (Demirci et al., 2019; Graham et al., 2014).

We build on the arguments above and examine whether the presence of public debt in a European economy influences bank bond issuance and how this influence varies across banks. We use a sample of 313 banks located in 17 countries (EU 15 countries, plus Norway and Switzerland) representing more than 80% of European banking assets and including 7706 bond issues.

The economic rationale for our analysis can be summarized as follows. Regulatory initiatives that discourage banks from buying public debt can result in a larger supply of government debt in the market. This excess supply can increase the expected return on government bonds and on other debt securities that are close substitutes. As a result, banks might be crowded out of (some segments of) the credit markets as they are forced to reduce the quantity of their costlier debt (Graham et al., 2014). In this respect, in the case of banks, bonds are a debt type that can be affected by the effects envisaged by these mechanisms. Indeed, private investors might see bank bonds as a more direct substitute for government debt as compared to more bank-specific types of debt (such as deposits) that are attractive for their monetary function. In such a case, banks would then face a shortfall in bond funding induced by the decreased demand by private investors. Possible bond funding shortfalls, jointly with the decrease in sovereign bond holdings, could force banks to significantly adjust their funding structures, with the effect of not only changing their debt composition but, more importantly, of also reducing their leverage.

Nevertheless, we also argue and document that not all types of banks are equally exposed to the funding consequences highlighted above. The proposed regulatory interventions might then lead to heterogenous effects across banks operating in the same banking system. In particular, as shown below, several bank characteristics, related to security expertise, direct access to private investors and cross-selling activities, can mitigate the impact of the crowding out effect on bank bonds (Ağca and Celasun, 2012; Lepetit et al., 2008; Papaioannou and Karagozoglu, 2017).

We conduct our analysis by employing a double hurdle model (Blundell and Meghir, 1987; Jones, 1989; Moffatt, 2005). This model has the key advantage of giving joint estimates of the drivers of the participation of banks in the bond market and of the drivers of the amount banks issue (our main focus). This distinction is important because, if present, a crowding out effect should materialize in the *quantity equation,* by forcing banks to raise less funds in the bond market even if they are willing to participate in the same market. Furthermore, Drukker (2017) documents this type of model is robust to endogenous selection in the issuance decision and consequently in the choice to participate in the bond market.

We start by showing that a greater public debt over GDP in the economy does not affect the probability that banks issue bonds while it reduces the amount of funds banks raise in the bond market. This result, therefore, is consistent with a crowding out effect on bank bonds. We confirm our finding when we include additional country controls and account for changes in capital regulation, when we estimate our model at the country level or employ a first-difference model to control for time invariant sources of unobserved heterogeneity. Additionally, as in the case of non-financial firms (Demirci et al., 2019; Graham et al., 2014; Huang et al., 2018), and consistently with the presence of a crowding out effect that reduces the amount of debt raised by banks, we show that bank leverage decreases when the public debt to GDP ratio increases. In other words, the crowding out effect results in European banks holding more equity to counterbalance the competitive pressure of government securities on the bond market.

Endogeneity might still be a possible concern with our analysis due to banks adjusting the amount of bonds issued to factors (we do not control for) that are correlated with the public debt to GDP ratio. Although we recognize that it is extremely challenging to completely rule out this concern, we make several attempts to mitigate it. In particular, we use alternative settings based on the control function approach and instrumental variables that aim to capture sources of variation in the public debt to GDP ratio unrelated to the activity of banks in the bond market (Papke and Woolridge, 2008). We find that our key results are confirmed.

Other possible explanations for our results, which are not accounted for by studies on non-financial firms but can be particularly pertinent in the case of banks, are sovereign risk and political forces. In terms of sovereign risk, a larger public debt in an economy might indicate a higher country risk that negatively affects investors' perceptions of the riskiness of bank bonds and increases funding costs, thus lowering the amount of bonds raised by banks (Acharya et al., 2014 ; Brunnermeier et al., 2016). While our baseline analyses control for direct proxies of sovereign risk (such as sovereign ratings or credit spreads in government bonds) that should lower the chances of capturing a sovereign risk channel via the Public Debt/GDP ratio, we further rule out this channel by exploiting sources of heterogeneity in our findings due to: i) public debt ownership; and ii) typologies of bonds. Specifically, we document stronger results when the domestic, and not the international, public debt is higher. This is consistent with the evidence that the domestic component of public debt leads to the crowding out effect, while the international component of this debt is a key indicator of sovereign risk (Ağca and Celasun, 2012). Furthermore, again in line with the crowding out explanation, we show that our results are driven by senior (and not subordinated) bonds that tend to be more comparable with government bonds and expose investors to less risks than subordinated debts.

A second alternative explanation of our results refers to the influence of political forces on banks. Political influence induces European banks to hold more domestic sovereign bonds (Becker and Ivashina, 2018) and this influence leads to an increase in sovereign bond holdings especially during periods of higher sovereign risk (Horvath et al., 2015; Ongena et al., 2019). Accordingly, our results might also be consistent with political influence leading European banks to buy domestic sovereign bonds in countries with

higher public debt in exchange for preferential access to central bank funding, with the consequence of lowering the need for banks to issue bonds.

To test the validity of the interpretation above, we explore heterogeneity in our results using proxies of political influence on banks that we construct on the basis of bank state ownership (Becker and Ivashina, 2018), sovereign bond holdings (Horvath et al., 2015; Ongena et al., 2019), political affiliations of board members (Becker and Ivashina, 2018) and sovereign risk in the domestic economy (Ongena et al., 2019). We do not observe in any of these tests that our results are stronger when the political influence on banks is plausibly higher. Instead, we observe stronger results for banks characterized by lower government ownership or smaller sovereign bond holdings when sovereign risk is lower. Jointly, these results are more consistent with the view that banks have a greater exposure to a crowding out effect when more of the supply of government debt is absorbed by other investors (and less so by the banking system).

Having documented evidence in support of a crowding out effect in bank bond issuance, and its consequences on bank leverage, we next explore if there are bank characteristics that can mitigate, at least in part, this effect. These tests offer the possibility to depict a more comprehensive picture of the potential funding implications stemming from rules that could reduce the demand for government securities by the banking industry.

Initially, we focus on characteristics related to bank business models that should reflect bank access to a broad range of investors and their expertise in security issuance. We begin by showing that our results are stronger for less internationally active banks, that plausibly target primarily domestic investors and have less access to international investors via foreign subsidiaries and branches. This finding is, therefore, consistent with the evidence on the importance of the domestic component of public debt in driving the crowding out effect.

Next, we account for the fact that many banks have direct expertise in selling securities and in security issuance and design. Accordingly, they frequently operate in security markets. This expertise can then be exploited to mitigate the competitive impact of the supply of government bonds and to lower overall issuance costs that are triggering the crowding out effects on private debt. Furthermore, European banks engage in cross-selling activities across business lines (Lepetit et al., 2008). This cross-selling increases the influence of banks on the demand for their securities by private investors and gives banks the opportunity to act on the pricing of other banking services to cross-subsidize bond issuance. Along these lines, we find European banks with more traditional business models, that are less likely to have a broad expertise in security markets and might operate in a smaller number of business lines with less cross-selling capabilities, are more affected by the crowding out effect.

Finally, we look at the impact of bank size on our results. Large banks tend to be internationally active and have more expertise in terms of pricing, marketing and placement in the primary market than smaller banks. Additionally, ceteris paribus, large banks have lower funding costs than other banks because of implicit bailout guarantees (Admati et al., 2018; Baron, 2020) and benefit from economies of scale (Hughes and Mester, 2013). The reduced funding cost for large corporations is not observed in non-banks (Acharya et al., 2016). Therefore, the expected increase in funding costs due to the crowding out effect should be less penalizing for large banks. Furthermore, large European banks show high market power (Fernandez de Guevara et al., 2005) and this offers greater flexibility in setting the prices of their deposit products (Drechsler et al., 2017; Li et al., 2019). Accordingly, large banks might transfer part of the increase in bond funding costs to depositors. In line with these arguments, and against the evidence in Demirci et al. (2019) for non-financial firms, we show that the impact of the Public Debt/GDP on the issuance of bank bonds is stronger when banks are smaller.

Overall, our analysis implies that imposing restrictions on sovereign bond holdings by banks potentially has stability implications not only via the composition of the asset side of a bank's balance sheet, as expected by the proponents of these rules, but also via the composition of the liability side and the amount of debt a bank can raise. Indeed, these regulatory interventions might reduce bank leverage and might mitigate aggressive expansionary strategies with potential further positive effects in terms of bank stability. The entire impact that the potential decrease in leverage might have on banks is, however, difficult to anticipate by policy makers and regulators given the contrasting theoretical views on the business consequences of higher bank equity ratios (see, for instance, Thakor, 2014). Furthermore, these potential funding effects are influenced by bank and banking system characteristics. This heterogeneity can lead to competitive implications within the banking industry that are also difficult to anticipate.

Our study contributes to the literature on bank bonds and, more generally, on bank funding choices. Early studies on bank bonds focus on the risk-sensitivity of the cost of subordinated debts (Flannery and Sorescu, 1996; Iannotta, 2006; Sironi, 2003). More recently, this literature investigates the factors influencing bank bond issuance by focusing on the importance of bank-specific characteristics such as private information disclosure (Covitz and Harrison, 2004), bank capitalization (van Rixtel et al., 2015), financial reputation (Camba-Mendez et al., 2014), and hedging currency exposure (González, 2016). Studies on the broader funding choices by banks show capital regulation is not binding and bank capital structure is affected by factors similar to those of financial firms (Berger et al., 2008; Dinger and Vallascas, 2016; Gropp and Heider, 2010). We focus instead on the implications of public debt on bank bond issuances and funding choices, and highlight how our results relate to capital requirements for sovereign exposures.

Our analysis is also related to papers on non-financial firms studying the effect of government funding policy on borrowing costs (Bedendo and Colla, 2015; Borisova and Megginson, 2011), debt maturity structure (Badoer and James, 2016; Greenwood et al., 2010), aggregate leverage and investment policies (Graham et al., 2014; Huang et al., 2018), and firm leverage (Demirci et al., 2019). Our analysis is the first to extend the existing evidence on the crowding out effect to banks, and to document key specificities related to typologies of banks.

Finally, we complement the literature on sovereign risk and banking. This literature shows sovereign rating changes affect both bank credit ratings (Williams et al., 2013) and bank stock returns (Correa et al., 2014). Sovereign tensions are associated with higher bank funding costs (Albertazzi et al., 2014) and a contraction in lending (Acharya et al., 2018; Gennaioli et al., 2014; Popov and Van Horen, 2015). In contrast, we document the influence of public finances on bank funding policies and shows this influence is unlikely to

be the result of a sovereign risk channel.

## 2. Sample, econometric model and variables

### 2.1. Sample selection

We employ a sample of European listed and delisted banks (located in the EU15, Norway or Switzerland) over the period from 1990 to 2008. Our sample period stops in 2008 to avoid the influence of major crises, the effects of changes in European capital regulation due to the adoption of Basel III from January 2014, and the impact of wider stress tests conducted from 2014 (Melis and Weissenberg, 2019). Furthermore, the focus on this sample period avoids contamination effects due to credit easing measures employed by the ECB from June 2014 (Altavilla et al., 2020).

We extract annual accounting data for the population of listed and delisted firms classified as banks by Bloomberg via their industry classification system and operating in our sampled countries.[2] Bloomberg allows us to construct a longer time series, for a large sample, than other commercial databases on European Banks (such as Bankscope). We then merge the accounting data with market data drawn from Datastream International via the ISIN code or via the SEDOL code when the ISIN code was unavailable. We identify around 400 banks with data simultaneously available in Bloomberg and Datastream. The intersection of available balance sheet data (from Bloomberg) and market data (from Datastream) restricts the sample to 313 banks and 2651 bank-year observations. Using data from the European Banking Federation (Statistical Annex -EBF, 2014), we quantify that our sample represents about 85% of the total assets of the banking systems in the selected countries. Notably, the average bank in our sample is heavily involved in lending and deposit-taking (as documented by the summary statistics reported in Table 2 and discussed in Section 3) and as a result its primary business focus is on commercial banking.

Next, we extract the population of bank bond issuances in the sampled countries from Thomson One Banker. This is the conventional data source in studies on security issuance (see Badoer and James, 2016; Erel et al., 2012). The data provide information on bond type, maturity and rating. We use SEDOL codes to merge our bank sample with bond issuance data. Following Badoer and James (2016), we exclude from our sample of bonds i) asset-backed securities, ii) secured or guaranteed debt, and iii) perpetual bonds and instruments that are hybrid/like shares. Our final sample includes 7706 bond issues from 1990 to 2008, belonging to 142 unique issuers. Table A1 in the Online appendix reports the yearly distribution of issues and banks by country.

Finally, in the case of banks a primary focus on bonds is a more refined setting than focusing on leverage if we aim to identify a crowding out effect. Indeed, private investors might not see most bank debts as being substitutes for government bonds. Instead, these bank debts are payment instruments (i.e., deposits) or are provided by other banks (i.e., interbank deposits), as tools to manage (very) short-term liquidity needs. Furthermore, bank capital structure choices might be more directly affected by factors related to the regulatory framework than bond issuance. Nevertheless, in additional tests we also present evidence for the equity ratio of banks to make our analysis more directly comparable with non-banking studies.

### 2.2. Sample characteristics

Panel A of Table 1 reports the distribution of bond issues and banks by year. Over the full sample period, approximately a third of the total number of bank-year observations refers to bond issuances. On an annual basis the ratio between the number of issuers and the total number of banks in the sample ranges from a minimum of about 18% in 1990 to a maximum of about 38% in 2004. The ratio then declines to about 28% in 2008. This latter value is close to the percentage of banks relying on the bond market in the years immediately preceding the global financial crisis. The yearly number of issues per issuing bank changes substantially over time with a minimum of approximately 3 in 1990 to a maximum of approximately 16 in 2008. As shown in columns (7) and (8), the average bond maturity is approximately five years and the average amount raised is approximately $197 m. The large majority of the issues (88% of those with a rating) are rated with an average credit risk between AA and A by S&P or Moody's.

As shown in Panel B of Table 1, where we report the distribution of issuers by the number of issues, around 10% of the banks in the sample are particularly active (issuing more than 20 times over the sample period) in the bond market.

Finally, it is important to note that our sample of issuances is equivalent to about 73% of the total bank debt issuance (including a wider selection of debt securities than bonds and private firms) as identified by another database (Dealogic) in 2008. In addition, bonds issued by unlisted banks that are not included in our analysis have low liquidity and transparency and, consequently, are less likely to represent an alternative to government debt in the portfolio of investors.

### 2.3. Econometric model

We employ a double hurdle model, introduced by Cragg (1971), to estimate the relationship between a bank's activity in the bond market and a country's public debt to GDP ratio. In our empirical tests, the use of a double hurdle model implies bond issuance by banks is the result of two outcomes. The first outcome refers to the entrance of banks in the bond market (*participation outcome*) and the

[2] Banks are identified as a sub-group of the broad financial industry on the basis of their business focus defined by sources of revenue, operating income, assets and by market perception (see here for details, http://www.bbhub.io/indices/sites/2/2016/01/633470877_INDX_GFI_WP_151022.pdf).

**Table 1**
Sample distribution
This Table displays the number of bond issues, the number of banks in the sample and the number of issuers (banks that have completed at least one debt issue in a given year). Columns 7 and 8 report the average maturity (in years) and the average amount (in millions of dollars). Panel B shows the distribution of issuers by the number of issues.

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|
| **Panel A: Distribution of Debt Issuance and Banks** | | | | | | | |
| Year | Number of Issues | Number of Bank Observations | Number of Issuers | Issuers/Banks (%) | Issues/ Issuers | Average Maturity | Average Amount |
| 1990 | 63 | 121 | 22 | 18.18% | 2.86 | 5.1 | 49.87 |
| 1991 | 154 | 123 | 30 | 24.39% | 5.13 | 3.9 | 31.34 |
| 1992 | 149 | 144 | 32 | 22.22% | 4.66 | 3.6 | 28.81 |
| 1993 | 261 | 169 | 43 | 25.44% | 6.07 | 5.4 | 63.83 |
| 1994 | 287 | 172 | 51 | 29.65% | 5.63 | 3.9 | 115.41 |
| 1995 | 183 | 171 | 54 | 31.58% | 3.39 | 7.8 | 93.22 |
| 1996 | 307 | 172 | 49 | 28.49% | 6.27 | 4.3 | 193.72 |
| 1997 | 268 | 190 | 45 | 23.68% | 5.96 | 5.2 | 96.96 |
| 1998 | 278 | 184 | 52 | 28.26% | 5.35 | 5.9 | 107.05 |
| 1999 | 346 | 186 | 61 | 32.80% | 5.67 | 3.8 | 131.98 |
| 2000 | 443 | 189 | 63 | 33.33% | 7.03 | 4.4 | 199.87 |
| 2001 | 500 | 179 | 59 | 32.96% | 8.47 | 3.8 | 222.11 |
| 2002 | 356 | 165 | 52 | 31.52% | 6.85 | 5 | 173.2 |
| 2003 | 450 | 161 | 58 | 36.02% | 7.76 | 5.3 | 349.79 |
| 2004 | 572 | 167 | 64 | 38.32% | 8.94 | 5.4 | 305.06 |
| 2005 | 698 | 178 | 66 | 37.08% | 10.58 | 5.5 | 299.15 |
| 2006 | 728 | 183 | 67 | 36.61% | 10.87 | 5.6 | 356.12 |
| 2007 | 851 | 182 | 59 | 32.42% | 14.42 | 3.6 | 521.65 |
| 2008 | 812 | 179 | 51 | 28.49% | 15.92 | 5.5 | 395.93 |
| Total | 7706 | 3215 | 978 | 30.42% | 7.88 | 4.9 | 196.58 |

| **Panel B: Distribution of Issuers by the Number of Issues** | | |
|---|---|---|
| Number of Issues per Issuing Bank | N. | % |
| 1 | 249 | 28.79 |
| 2 | 157 | 18.15 |
| 3 | 78 | 9.02 |
| 4 | 52 | 6.01 |
| 5 | 35 | 4.05 |
| 6 | 29 | 3.35 |
| 7 | 29 | 3.35 |
| 8 | 19 | 2.20 |
| 9 | 15 | 1.73 |
| 10 | 17 | 1.97 |
| 11 | 10 | 1.16 |
| 12 | 11 | 1.27 |
| 13 | 11 | 1.27 |
| 14 | 12 | 1.39 |
| 15 | 13 | 1.50 |
| 16 | 10 | 1.16 |
| 17 | 10 | 1.16 |
| 18 | 3 | 0.35 |
| 19 | 5 | 0.58 |
| 20 | 8 | 0.92 |
| >20 | 92 | 10.64 |
| Total | 865 | 100.00 |

second concerns the amount they raise (*quantity outcome*) conditional on the first outcome. Thus, both outcomes can lead to a zero amount being issued. In contrast, when both hurdles are passed, we observe a positive amount of bonds being issued.

The described empirical setting has some benefits as compared to potential alternatives, especially in the context of an investigation of the crowding out effect. Differently from the double hurdle model, the Tobit model (Tobin, 1958) fails to capture factors that make a bank more or less likely to participate in the bond market. Moreover, in a Tobit model the participation decision and the quantity decision are assumed to have the same set of determinants with the same sign and magnitude. As documented in Section 3.1, this is not always the case. A further alternative is the Heckman selection model (Heckman, 1979). However, it does not allow for the possibility that observed zeros are the result of the quantity decision. Whereas, in a double hurdle model the quantity decision may lead to a zero amount. This is important for an investigation of the crowding out effect since a large supply of government bonds should have an impact primarily on the quantity outcome by increasing the possibility that banks are unable to raise bonds (in spite of showing an issuance probability larger than zero). Additionally, Drukker (2017) documents that this type of model is robust to endogenous

selection without the need to rely on instruments. This selection problem could also emerge in econometric settings that look directly only at quantity decisions by participating banks. Ultimately, the double-hurdle model allows us to make jointly use of issuing and non-issuing banks and consequently avoid any selection bias arising from the removal of some specific banks from the analysis.[3]

We report summary statistics for the dependent variables in Panel A of Table 2 and we observe a large share of zeros in our sample distribution. This offers support to our empirical setting.

More formally, two separate stochastic processes determine a double hurdle model. The participation equation is defined as:

$$d_{i,t} = \begin{cases} 1 & \text{if } d^*_{i,t} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

$$d^*_{i,t} = \alpha'\left(Public\ Debt_{j,t-1} \,/\, GDP_{j,t-1}\right) + \gamma' x_{j,t} + \delta' w_{i,t-1} + YEAR + u_{i,t} \tag{2}$$

where $d^*_{i,t}$ is a latent participation variable taking the value 1 if bank $i$ participates in the bond market at time $t$, and 0 otherwise, $Public\ Debt_{j,t-1}/GDP_{j,t-1}$ is the variable measuring the relative size of public debt, described in Section 2.4, $x_{j,t}$ is a vector of country controls and country dummies referring to country $j$, $w_{i,t-1}$ is a vector of bank characteristics, $\alpha$, $\gamma$ and $\delta$ are vectors of parameters, YEAR are time dummies, and $u_{i,t}$ is a normal standard error term. The public debt to GDP ratio (and bank characteristics) is lagged one year to mitigate simultaneity and endogeneity biases (Panizza and Presbitero, 2014). The quantity equation is defined as:

$$y_{i,t} = \begin{cases} y^*_{i,t} & \text{if } y^*_{i,t} > 0 \text{ and } d^*_{i,t} > 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

$$y^*_{i,t} = exp\left(\beta'\left(PublicDebt_{j,t-1} \,/\, GDP_{j,t-1}\right) + \vartheta' x_{j,t} + \theta' w_{i,t-1} + YEAR + v_{i,t}\right) \tag{4}$$

where $y^*_{i,t}$ denotes a positive level of bonds issued only if the bank participates in the bond market ($d_i = 1$) and issues a positive amount ($y^*_{i,t} > 0$), $\beta$, $\vartheta$ and $\theta$ are vectors of parameters, and $v_{i,t}$ is the error term that is assumed to be normally distributed.[4] We estimate the two equations with standard errors clustered at the bank level to control for the presence of within-firm correlation.

The double hurdle model allows us to estimate three types of marginal effects. The first is the marginal effect of an explanatory variable $x_j(w_i)$ on the issuance probability. It refers, therefore, to the impact of $x_j(w_i)$ on the participation equation. Taking, for instance, the sovereign exposure of a country as an example, the marginal effect describes how an increase in sovereign debt influences the probability a bank enters the bond market. The other two marginal effects refer to the quantity of bonds issued by a bank. More precisely, the second marginal effect captures the impact of an explanatory variable $x_j$ on the amount issued - conditioning on the fact a bank has decided to issue bonds ($y_i > 0$). This reflects, therefore, how the quantity issued by banks is affected by a certain variable and is driven by participating banks. The third marginal effect measures the impact of $x_j$ on the unconditional expected value of $y_i$, that is affected by both the estimates of the participation and quantity equations.

### 2.4. Public debt and other country determinants of bond issuances

Our main measure of the importance of public debt in a country is the ratio between public debt and GDP (**Public Debt/GDP**) as in Ağca and Celasun (2012). As shown in Panel B of Table 2, this variable has an average value of approximately 66%, but there is significant heterogeneity across countries and over time. For instance, Belgium and Italy show a ratio of public debt to GDP consistently above 90%, while other countries report a large increase over the sample period. Specifically, in 1990 France and Germany show a ratio close to 35% and 37%, respectively, while in 2008, for both countries it was above 65%.

Fig. 1 shows the evolution of the average of the Public Debt/GDP ratio over the sample period and the average values of our two dependent variables. The key message of this Figure is that the quantity of bank bonds tends to increase in periods where the Public Debt/GDP ratio decreases, while there is not an obvious relationship with the participation variable.[5]

In addition to the Public Debt/GDP ratio, we include other country controls, shown in Panel B of Table 2. A first critical control is a direct proxy for sovereign risk. Indeed, a larger public debt could be simply interpreted as an indicator of a deterioration in a country's solvency that can affect the risk profile of bonds issued by banks. In other words, a decrease in bank bond issuance when public debt increases might be simply the effect of a higher sovereign risk making it more costly for banks to raise funding. Omitting to control for direct proxies of sovereign risk would then make it problematic to disentangle an interpretation of our findings based on the crowding

[3] It is important to note, however, that in unreported tests, we find that our results are not significantly influenced by banks that never issue or by the empirical approach we have selected. For instance, we obtain similar results when we employ a Tobit model using the sample of banks issuing at least once during the sample period or when we focus only on observations with a positive value of bond issuance in a given year by employing an OLS model.

[4] While the econometric setting permits the determinants in the two equations to differ, as explained in the following two sections, we opt to include the same set of controls in the participation and quantity equations.

[5] In a chart reported in the Online Appendix (Figure A1), we show that the sample period is characterized by both variation in the average public debt and in the average GDP.

**Table 2**
Summary statistics
This Table provides a descriptive overview of the data. All bank controls, with the exception of Deposit Growth and Government Support, are lagged one period. All variables are winsorized at the 1% level. The sample period is from 1990 to 2008.

| Variable | Description | N | Mean | Median | St. Dev. | 5 Pct. | 95 Pct. |
|---|---|---|---|---|---|---|---|
| **Panel A: Dependent Variables** | | | | | | | |
| Issuer | A dummy variable equal to one if a bank has issued bonds in a given year | 2651 | 0.3263 | 0.0000 | 0.4689 | 0.0000 | 1.0000 |
| Amount Issued/ TA | Total amount issued divided by total assets (%) | 2651 | 0.5596 | 0.0000 | 1.3672 | 0.0000 | 3.7686 |
| **Panel B: Explanatory Variables** | | | | | | | |
| Public Debt/ GDP | Public debt divided by national GDP (%) | 2651 | 65.6122 | 59.4000 | 26.9451 | 28.5000 | 113.6000 |
| Sovereign Rating | Categorical variable that takes the value of 1 (highest grade) to 4 (lowest grade) based on the S&P Government rating | 2651 | 1.5315 | 1.0000 | 0.7090 | 1.0000 | 4.0000 |
| GDP Growth Rate | Real yearly growth rate of national GDP (%) | 2651 | 1.7387 | 1.7930 | 1.6833 | −1.2824 | 4.1952 |
| Inflation | Inflation rate measured by the consumer price index (%) | 2651 | 2.5469 | 2.2150 | 1.4741 | 0.6380 | 5.2440 |
| Interbank Rate | 3-month LIBOR rate (%) | 2651 | 5.0211 | 4.2600 | 3.2034 | 1.5600 | 12.2100 |
| Euro | Dummy variable that is 1 for the years in which a country belongs to the EMU | 2651 | 0.4425 | 0.0000 | 0.4968 | 0.0000 | 1.0000 |
| Banking Crisis | Dummy variable that is 1 in the banking crisis periods (Babecky et al., 2014; and the European System of Central Banks (ESCB) Heads of Research) | 2651 | 0.1762 | 0.0000 | 0.3810 | 0.0000 | 1.0000 |
| Size | Log of total assets in millions of Euro | 2651 | 9.8081 | 9.7044 | 1.9074 | 6.8092 | 13.2667 |
| Deposits | Customer deposits divided by total assets (%) | 2651 | 50.4878 | 51.8130 | 21.3173 | 11.7233 | 85.1565 |
| Deposit Growth | Yearly growth of deposits (%) | 2651 | −0.6550 | −1.5704 | 15.3917 | −19.9840 | 19.6192 |
| Loans | Loans divided by total assets (%) | 2651 | 59.2367 | 59.5297 | 18.9783 | 23.4040 | 86.8389 |
| Equity Ratio | Equity divided by total assets (%) | 2651 | 7.0155 | 6.0367 | 4.2979 | 2.6794 | 14.5044 |
| ROA | Net income divided by total assets (%) | 2651 | 0.6660 | 0.5925 | 0.6951 | 0.0047 | 1.8660 |
| Bank Rating | Categorical variable that takes the value of 1 (upper grade) to 4 (speculative grade or missing) based on the worst available bank rating from S&P, Moody's and Fitch Group | 2651 | 2.7229 | 3.0000 | 1.2235 | 1.0000 | 4.0000 |
| Charter Value | Market to book value of equity | 2651 | 1.3033 | 1.1897 | 0.8296 | 0.1410 | 2.8932 |
| Asset Risk | Annualized stock return volatility computed yearly by using daily stock returns multiplied by the equity ratio | 2651 | 0.0249 | 0.0161 | 0.0321 | 0.0023 | 0.0729 |
| Government Support | Dummy variable that is 1 if a government intervened to sustain a bank, including a government guarantee on new bond issuance | 2651 | 0.0072 | 0.0000 | 0.0844 | 0.0000 | 0.0000 |

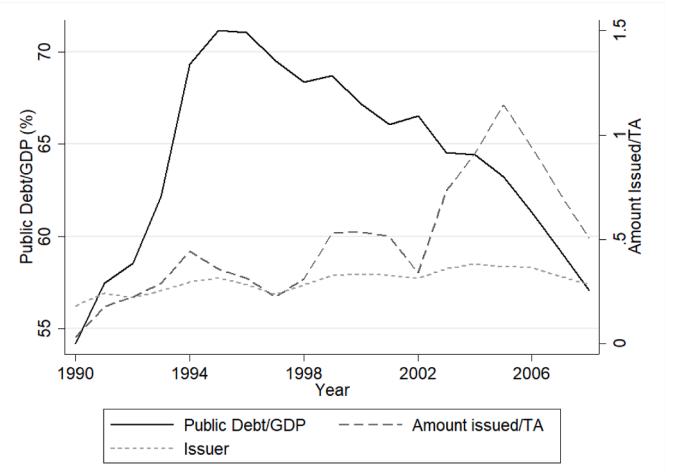


**Fig. 1.** Evolution of public debt/GDP and bank activity in the bond market.
This Figure shows the evolution of the average of the Public Debt/GDP ratio over our sample period, the average values of the ratio between the yearly bank bonds issued scaled by total bank assets (Amount issued/TA) and the yearly ratio between the number of issuers over the number of banks (Issuer).

out effect from an interpretation based on sovereign risk. As a main measure of sovereign risk we use a numerical transformation of the S&P ratings with larger values signaling higher sovereign risk.[6] In additional tests, reported in the Online Appendix, we employ an alternative measure based on the government spread computed as the difference between domestic government bonds and US government bonds with a maturity of 10 years.

We further control for the real GDP growth rate (**GDP Growth Rate**) and the inflation rate (**Inflation**). Given the pro-cyclicality of the banking business (Behn et al., 2016), banks should be more active in the bond market in periods of high economic growth and high inflation (Covitz and Harrison, 2004). Nevertheless, Erel et al. (2012) find bond issuance by non-financial firms is countercyclical, especially for better credit quality issuers, in line with "flight-to-quality" and "credit crunch" arguments (Holmstrom and Tirole, 1997). If investors perceive banks as being less risky than non-financial firms, bank bond issuance could be countercyclical.

The three-month Libor rate controls for the interbank rate (**Interbank Rate**). Higher interbank rates signal a higher bank funding cost and should lead to a decline in bond financing. A further control is a dummy equal to one in banking crisis periods (**Banking Crisis**), as defined by Babecký et al. (2014).[7] Banking crises raise concerns over bank stability and often impose deleveraging on banks (Dinger and Vallascas, 2016), thus lowering a bank's activity in the bond market. Finally, we include a dummy (**Euro**) equal to one when a country joins the European Monetary Union. The adoption of the Euro should facilitate access to the bond market (Hale and Obstfeld, 2016).

### 2.5. Bank-Specific explanatory variables

Panel C of Table 2 shows bank-level controls. We include the log of a bank's total assets (**Size**) measured in millions of Euros. Larger banks should have lower costs of entry in the bond market and, consequently, a larger issuance probability. The effect of size is less clear in the quantity equation. The favorable entry conditions could induce large banks to issue more frequently but with relatively smaller amounts than small banks. However, large banks have more debt capacity and this might increase the amount issued (Berger et al., 2008).

We also control for the customer deposits to total asset ratio (**Deposits**) and the yearly growth rate in customer deposits (**Deposit Growth**). If bonds are substitutes for more conventional funding sources (Camba-Mendez et al., 2014), these variables should be negatively related with participation and the amount issued. The loan to asset ratio (**Loans**) controls for bank asset composition and the ratio between equity and total assets (**Equity Ratio**) for capital adequacy. An increase in the former might increase participation in the bond market and the amount issued, as loans are illiquid assets with longer-term maturity and raising bonds can keep maturity mismatch under control. A stronger capital adequacy reduces the risk-premium required by bank creditors and hence should favor participation and the quantity of bonds issued (Thakor, 2014).

We include bank profitability (**ROA**) and credit rating (**Bank Rating**), based on a numerical conversion of issuer ratings of the three major rating agencies (Fitch, Moody's, and S&P), with higher values denoting a lower credit quality. Higher profitability and credit quality should increase issuing probability and bond quantity. The ratio between the market value and the book value of equity (**Charter Value**) accounts for growth opportunities that might increase the need for bond financing. We control for bank risk via the yearly volatility of a bank's daily stock returns multiplied by the equity ratio (**Asset Risk**). Riskier banks should have a lower probability of issuing bonds and amount raised because of higher funding costs. Finally, we add a dummy variable equal to one from the moment a bank received government support (**Government Support**) in the 2007–2009 crisis.[8] If investors see rescued banks as more likely to benefit from future rescue policies, these banks should have greater access to the bond market because of a lower cost of funding.

## 3. Empirical results

### 3.1. Baseline specification

The first two columns of Table 3 present the regression results for the participation and quantity equations. Both equations include country and year dummies and are estimated with standard errors clustered at the bank level.[9] To enhance our understanding of the impact of the public debt to GDP ratio (and other country and bank characteristics) in driving bank bond issuance, we report the marginal effects (in columns (3) to (5) of Table 3) described in the previous section.

We find that the ratio between public debt and GDP has a negative and significant effect on the amount of funds raised by banks in the bond market but not on participation. Hence, while banks located in countries with larger debt exposure have a similar participation in the bond market as other banks, they raise a lower amount of funds. The reported marginal effect in column (4) implies that an increase of 1 p.p. in the public debt to GDP ratio reduces the yearly value of bank bond issuance per unit of assets by about 10% of

[6] The variable takes the value of 1 for the highest government rating (AAA) to 4 for the lowest government rating (A) of our sample. Our results are not particularly sensitive to the type of sovereign rating we employ.

[7] Babecký et al. (2014) compile crisis dates from influential papers, including Kaminsky and Reinhart (1999), Laeven and Valencia (2013) and Reinhart and Rogoff, (2013), complemented and checked by the ESCB Heads of Research.

[8] To construct this dummy, we use reports compiled by the Italian bank Mediobanca (2011).

[9] The Online Appendix shows our results remain similar if we cluster standard errors in alternative ways or repeat our analysis after including 5-years buckets × country fixed effects to control for country-specific time trends (Table A3).

**Table 3**
Bank Bond Issuance and Public Debt
This Table reports the results of the double hurdle model on bank activity in the bond market. The participation equation models the yearly probability that a bank issues bonds, while the quantity equation models the quantity issued once a bank has decided to participate in the market. **Public Debt/GDP** is the ratio between public debt and national GDP, **Sovereign Rating** is a categorical that takes the value of 1 (highest grade) to 4 (lowest grade) based on the S&P Government rating, **GDP Growth Rate** is the yearly growth rate of national GDP, **Inflation** is the inflation rate measured by the consumer price index, the **Interbank Rate** is the three-month Libor rate, **Euro** is a dummy variable equal to one after a country has joined the Monetary Union, **Banking Crisis** is a dummy variable equal to one if a country has suffered from a banking crisis (as defined by Babecky et al., 2014) in a given year, **Size** is the log of bank assets in millions of Euro, **Deposits** is the ratio between bank customer deposits and total assets, **Deposit Growth** is the annual growth rate of bank deposits, **Loans** is the ratio between total loans and bank assets, the **Equity Ratio** is the ratio between total equity and total assets, **ROA** is measured as net income divided by total assets, **Charter Value** is the market value of equity divided by the book value of equity, **Bank Rating** is a categorical variable that takes the values of 1 (upper grade) to 4 (speculative grade or missing) based on the worst available bank rating from S&P, Moody's and Fitch Group, **Government Support** is a dummy variable equal to one if a bank has received state aid during the global financial crisis, **Asset Risk** is the annualized stock return volatility computed yearly with daily stock returns multiplied by the equity ratio. Standard errors, robust to heteroscedasticity and clustered at the bank level, are reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

| | | | Marginal Effects | | |
|---|---|---|---|---|---|
| | Participation Equation (1) | Quantity Equation (2) | Prob. of Issuing (3) | Exp. Amount issued \| $Y>0$ (4) | Average Marginal Effects (5) |
| Public Debt/GDP | 0.0078 | **−0.0184**** | 0.0017 | **−0.0822**** | −0.0061 |
| | (0.007) | **(0.008)** | (0.002) | **(0.039)** | (0.011) |
| Sovereign Rating | −0.2327* | 0.1789 | −0.0517* | 0.7995 | −0.1102 |
| | (0.135) | (0.190) | (0.030) | (0.839) | (0.204) |
| GDP Growth Rate | −0.0960*** | −0.0100 | −0.0213*** | −0.0447 | −0.1114** |
| | (0.035) | (0.048) | (0.008) | (0.213) | (0.055) |
| Inflation | −0.0587 | −0.0618 | −0.0130 | −0.2759 | −0.1118 |
| | (0.061) | (0.085) | (0.014) | (0.382) | (0.104) |
| Interbank Rate | −0.0768* | 0.0707 | −0.0171* | 0.3160 | −0.0272 |
| | (0.041) | (0.057) | (0.009) | (0.284) | (0.071) |
| Euro | 0.7554*** | 0.2470 | 0.1679*** | 1.1035 | 1.0084*** |
| | (0.251) | (0.266) | (0.055) | (1.261) | (0.365) |
| Banking Crisis | −0.7385*** | −0.2569 | −0.1641*** | −1.1479 | −0.9980*** |
| | (0.156) | (0.208) | (0.034) | (0.950) | (0.260) |
| Size | 0.4155*** | −0.3358*** | 0.0923*** | −1.5002*** | 0.1841** |
| | (0.052) | (0.052) | (0.010) | (0.429) | (0.074) |
| Deposits | −0.0078* | −0.0133*** | −0.0017* | −0.0595*** | −0.0189*** |
| | (0.004) | (0.004) | (0.001) | (0.017) | (0.006) |
| Deposit Growth | −0.0001 | −0.0063** | −0.0000 | −0.0283** | −0.0051 |
| | (0.002) | (0.003) | (0.001) | (0.013) | (0.003) |
| Loans | 0.0111** | 0.0227*** | 0.0025** | 0.1012*** | 0.0298*** |
| | (0.005) | (0.006) | (0.001) | (0.036) | (0.009) |
| Equity Ratio | −0.0460 | 0.0249 | −0.0102 | 0.1112 | −0.0300 |
| | (0.028) | (0.042) | (0.006) | (0.193) | (0.052) |
| ROA | 0.1292 | 0.2128 | 0.0287 | 0.9509 | 0.3065* |
| | (0.086) | (0.157) | (0.019) | (0.710) | (0.163) |
| Charter Value | 0.1529 | 0.0461 | 0.0340 | 0.2059 | 0.2011 |
| | (0.110) | (0.120) | (0.024) | (0.527) | (0.160) |
| Bank Rating | −0.1422** | 0.0993 | −0.0316** | 0.4439 | −0.0753 |
| | (0.064) | (0.063) | (0.014) | (0.312) | (0.094) |
| Government Support | 0.1243 | 0.3712 | 0.0276 | 1.6584 | 0.4256 |
| | (0.275) | (0.596) | (0.061) | (2.694) | (0.554) |
| Asset Risk | 0.7366 | −3.2759 | 0.1637 | −14.6373 | −1.7798 |
| | (4.082) | (6.401) | (0.907) | (28.751) | (7.255) |
| Constant | -4.2653*** | 3.2795*** | | | |
| | (1.039) | (1.106) | | | |
| Observations | 2651 | 2651 | 2651 | 2651 | 2651 |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Country FE | Yes | Yes | Yes | Yes | Yes |

the sample mean.

In terms of control variables, higher interbank rates, lower bank ratings and periods of banking crises negatively influence participation but not the quantity of bonds raised. Additionally, participation has increased with the Euro adoption that has increased financial integration (Hale and Obstfeld, 2016). A couple of variables have similar effects in the two equations. For instance, in both equations, we observe a positive impact of Loans and a negative impact of Deposits. Some peculiarities emerge in terms of bank size. Smaller banks are less likely to issue bonds but raise a larger amount per unit of assets. The choice of small banks to raise relatively large amounts while limiting participation in the bond market might be aimed at reducing issuance costs.

The Online Appendix shows that our key result holds when we measure the influence of government debt on banks via the ratio

between public debt and the total assets of the banking system or the ratio between public debt and bank credit to the private sector (Table A4).[10]

Ultimately, we find that the amount of bonds raised by European banks is negatively associated with the public debt to GDP ratio. This result offers support for the presence of a crowding out effect of public debt on bank bonds.

### 3.2. Additional tests

#### 3.2.1. Controlling for changes in capital regulation

It could be argued that the changes in capital regulation over our sample period matter for bond issuance by affecting the debt capacity of a bank and the related choice of how much debt to raise in the bond market. Although country and year fixed effects should, at least partially, filter out the effects of these regulatory changes, we conduct additional tests to account for capital regulation. We show these tests in Panels A and B of Table 4.

First, we employ the information on regulatory capital interventions compiled by the European Central Bank across European countries and available at https://www.ecb.europa.eu/pub/research/working-papers/html/mapped.en.html to include dummies that control for within-country variation in capital requirements over our sample period. We generate two dummy variables at the country level. The first takes the value of one for the period following the adoption of policy instruments that have increased capital requirements under Basel I. The second takes a value of one if these interventions occurred under the Basel II regime. Adding these additional controls in Panel B does not change our results.

Second, in Panel B, we include country×regulatory regime fixed effects. To this end, we consider three main regimes: i) the original Basel I regime (1990–1997); ii) the Basel I regime after the inclusion of capital requirements for market risk (1998–2006); and iii) the Basel II regime (2007–2008). Using this setting, we still find our results hold.

#### 3.2.2. Additional country controls

To further rule out a potential omitted variable bias, we next extend the baseline specifications by controlling for the degree of competition within the domestic banking market. Allen et al. (2011) argue that in perfectly competitive markets, banks are more likely to opt for a larger equity ratio. In addition, in the presence of a larger number of banks competing to raise funding in the bond market, the average amount of bonds raised might significantly decline. Panel C of Table 4 reports the results where we measure competition via the market share of the three largest banks in a country (available from 1997 from the WorldBank Financial Development database). We do not find any change in the impact of the public debt to GDP ratio on the quantity equation.

In Panel D we then account for the differences in corporate taxation and financial liberalization across the sampled countries. Specifically, in countries with higher corporate income tax rates banks might opt for more debt than equity, thus becoming more active in the bond market (see Schepens, 2016, for a similar argument). To account for any tax effect, we control for the basic corporate tax rates taken from the OECD database. Furthermore, the regulatory setting where banks operate might also reduce the freedom banks have in raising debt. We include an index of financial reforms taken from Abiad et al. (2010) and updated by Omori (2022), with higher values indicating more liberalized financial systems. The results confirm a negative impact of the public debt to GDP ratio on the quantity equation and a lack of impact in terms of participation.

#### 3.2.3. Alternative econometric settings

Panel A of Table 5 shows our result holds when we estimate the model at the country level, wherein the dependent variable in the quantity regression is the total amount of bonds issued by the sampled banks in a country divided by the total bank assets in this country.[11] Panel B controls for sources of unobserved time-invariant heterogeneity through a first-difference approach (namely, all variables are observed as the difference between time *t* and time *t-1*). This specification also confirms our key finding.

Finally, in Panel C we focus on the funding structure of bank. We build on the evidence based on aggregate data (Demirci et al., 2019; Graham et al., 2014) and firm level data (Demirci et al., 2019), for non-financial firms documenting a negative relationship between public and corporate sector leverage. We conduct our analysis using initially the equity ratio as the dependent variable and then focus also on the ratio between customer deposits and total assets. This allows us to understand if banks in highly indebted countries hold more equity, as is the case for non-financial firms, or also replace bonds with alternative debt instruments. For each variable we initially estimate models with bank fixed effects (identified as a key explanatory factor of capital structure choices in the banking industry, see, for instance, Gropp and Heider, 2010) to account for unobserved time invariant bank heterogeneity and then report pooled OLS regressions (with country fixed effects). Each set of regressions includes bank controls (size, rating, charter value, ROA) and country controls (sovereign rating, GDP growth, inflation, interbank rate, Euro, banking crisis). We cluster standard errors at the bank level.

The first two columns of Panel C show the results for the equity ratio using fixed effects and the OLS specifications, respectively. We find that the public debt to GDP ratio is positively associated with bank equity ratios. This result holds in column (3), where we also control for lagged values of asset risk and interbank deposits as further explanatory variables. From columns (4) to (6) we report the

[10] Table A2 in the Online Appendix reports summary statistics of these alternative measures and other additional variables employed in further tests.

[11] The model includes country and bank controls, and country and year fixed effects. We measure bank controls using aggregate bank data in our sample by country and cluster standard errors at the country level.

**Table 4**
Controlling for capital regulation and other country characteristics
This Table reports the results of the double hurdle model on bank activity in the bond market that employs alternative definitions of the importance of public debt in the economy and alternative sample compositions. The participation equation models the yearly probability that a bank issues bonds, while the quantity equation models the quantity issued once a bank has decided to participate in the market. **Public Debt/GDP** is the ratio between public debt and national GDP. **Basel I policy instruments** is a dummy equal to one for years in which tightening policy instruments concerning Basel I minimum capital requirements entered into force onwards, **Basel II policy instruments** is a dummy equal to one for years in which tightening policy instruments concerning Basel II minimum capital requirements entered into force onwards. **Market Concentration** is the assets of the three largest commercial banks divided by the total commercial banking assets, **Financial Liberalization** is a composite index capturing all aspects of the liberalization of the financial system based on Abiad et al. (2010) and Omori (2022), **Corporate Income Tax Rate** is the combined corporate income tax rate. All models include the set of controls reported in Table 2 and time and country dummies. Standard errors, robust to heteroscedasticity and clustered at the bank level, are reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

| | | | Marginal Effects | | |
|---|---|---|---|---|---|
| | Participation Equation (1) | Quantity Equation (2) | Prob. of Issuing (3) | Exp. Amount issued \| $Y>0$ (4) | Average Marginal Effects (5) |
| **Panel A: Controlling for Minimum Capital Requirements Policy Instruments** | | | | | |
| Public Debt/GDP | 0.0095 | **−0.0161**** | 0.0021 | **−0.0842**** | −0.0028 |
| | (0.007) | **(0.008)** | (0.001) | **(0.042)** | (0.011) |
| Basel I policy instruments | 0.0325 | −0.0765 | 0.0072 | −0.3992 | −0.0276 |
| | (0.113) | (0.174) | (0.025) | (0.897) | (0.179) |
| Basel II policy instruments | 0.5061** | 0.3397 | 0.1117** | 1.7718 | 0.8459** |
| | (0.223) | (0.326) | (0.049) | (1.653) | (0.359) |
| Observations | 2651 | 2651 | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel B: Controlling for Country × Regulatory Regime Fixed Effects** | | | | | |
| Public Debt/GDP | −0.0081 | **−0.0196***** | −0.0014 | **−0.0995***** | **−0.0233**** |
| | (0.006) | **(0.006)** | (0.001) | **(0.035)** | **(0.010)** |
| Observations | 2651 | 2651 | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes |
| Country × Reg. Regime FE | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel C: Controlling for Banking Market Concentration** | | | | | |
| Public Debt/GDP | −0.0009 | **−0.0189**** | −0.0002 | **−0.0933**** | −0.0184 |
| | (0.008) | **(0.009)** | (0.002) | **(0.046)** | (0.013) |
| Market Concentration | 0.0002 | 0.0049 | 0.0000 | 0.0233 | 0.0046 |
| | (0.004) | (0.005) | (0.001) | (0.026) | (0.007) |
| Observations | 1876 | 1876 | 1876 | 1876 | 1876 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel D: Controlling for Financial Liberalization and Corporate Tax Rate** | | | | | |
| Public Debt/GDP | 0.0080 | **−0.0163**** | 0.0018 | **−0.0796**** | −0.0042 |
| | (0.007) | **(0.008)** | (0.001) | **(0.040)** | (0.010) |
| Financial Liberalization | −0.0846 | 0.0618 | −0.0187 | 0.3014 | −0.0431 |
| | (0.053) | (0.063) | (0.012) | (0.316) | (0.077) |
| Corporate Income Tax Rate | −0.0063 | 0.0192 | −0.0014 | 0.0936 | 0.0083 |
| | (0.013) | (0.017) | (0.003) | (0.086) | (0.023) |
| Observations | 2624 | 2624 | 2624 | 2624 | 2624 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |

results for the ratio between customer deposits and total assets. The public debt to GDP ratio does not enter any of these models with a significant coefficient. Additional unreported tests document a similar non-result when we use the ratio between interbank deposits and total assets as the dependent variable.

In general, in line with the crowding out perspective a larger public debt in the national economy is accompanied by lower bank leverage. This finding, jointly with the evidence reported earlier on bond issuance, indicates that regulatory initiatives that affect the demand for sovereign bonds by banks can have stability implications not only via the asset side of the bank balance sheet, but also via the liability side.

**Table 5**
Alternative econometric approaches
This Table reports the results of the impact of public debt on bank funding via additional models. **Panel A** presents country-level evidence and **Panel B** first-difference analysis at the bank level. The set of controls includes the variables shown in Table 2. **Panel C** shows linear models on the impact of public debt on a bank's funding structure. **Equity Ratio** is the ratio between total equity and bank' assets. **Deposit Ratio** is the ratio between bank customer deposits and total assets. **Public Debt/GDP** is the ratio between public debt and national GDP. The set of controls in regressions 1–3 (4–6) includes Size, Deposit Ratio (Equity Ratio), ROA, Charter Value and country controls. Regressions 3 and 6 include Asset risk and Interbank Ratio. Standard errors, robust to heteroscedasticity and clustered at the bank level, are reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

**Panel A: Country Based Analysis**

| | (1) Participation Equation | (2) Quantity Equation | (3) Prob. of Issuing | (4) Exp. Amount Issued | (5) Average Marginal Effect |
|---|---|---|---|---|---|
| Public Debt/GDP | 0.0138 | **−0.0096**** | 0.0021 | **−0.0091**** | −0.0028 |
| | (0.010) | **(0.005)** | (0.002) | **(0.004)** | (0.006) |
| Observations | 285 | 285 | 285 | 285 | 285 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |

**Panel B: First Difference Model**

| | (1) Participation Equation | (2) Quantity Equation | (3) Prob. of Issuing | (4) Exp. Amount Issued | (5) Average Marginal Effect |
|---|---|---|---|---|---|
| $\Delta$(Public Debt/GDP)$_{t-1,t-2}$ | −0.0003 | **−0.0307**** | −0.0001 | **−0.0791**** | −0.0159 |
| | (0.011) | **(0.013)** | (0.003) | **(0.037)** | (0.023) |
| Observations | 2084 | 2084 | 2084 | 2084 | 2084 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |

**Panel C: Funding Structure Model**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | | **Equity Ratio** | | | **Deposit Ratio** | |
| | Fixed Effect Model | OLS +Country FE | OLS +Country FE | Fixed Effect Model | OLS +Country FE | OLS +Country FE |
| Public Debt/GDP | **0.0257**** | **0.0389**** | **0.0221**** | 0.1105 | 0.1359 | 0.0469 |
| | **(0.014)** | **(0.015)** | **(0.009)** | (0.083) | (0.098) | (0.077) |
| Observations | 2624 | 2624 | 2099 | 2624 | 2624 | 2102 |
| R-squared | 0.3172 | 0.4568 | 0.5694 | 0.1294 | 0.4662 | 0.5958 |
| Country & Bank Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank FE | Yes | No | No | Yes | No | No |
| Country FE | No | Yes | Yes | No | Yes | Yes |

### *3.2.4. Mitigating endogeneity*

Despite our result being robust to numerous alternative specifications and econometric settings, the use of the lag value of the Public Debt/GDP ratio in our analysis might still not be sufficient to rule out biases due to simultaneity and/or omitted variables. For instance, it might be argued that banks adjust their funding strategies and the amount of bonds issued to factors (we do not control for) that correlate with the lag value of Public Debt/GDP. As a result, bank issuance and government debt could be jointly determined due to factors, other than our explanatory variables.

Although we recognize that it is extremely challenging to completely rule out endogeneity in our analysis, we make several attempts to mitigate this issue and present empirical settings where Public Debt/GDP is considered endogenous. As we are dealing with a non-linear model, we use a control function approach to address endogeneity (Papke and Woolridge, 2008). This approach requires us, as a first step, to regress the lag value of Public Debt/GDP on the exogenous variables and a set of instruments. In the second step, we add the residuals from the first stage regression as an explanatory variable in the double-hurdle model to control for endogeneity (Woolridge, 2010). A significant coefficient on the residuals would indicate the presence of endogeneity in our initial setting and would remove the bias in our initial estimates due to this endogeneity.

The main challenge of the highlighted approach is the identification of appropriate instruments; namely, variables that influence Public Debt/GDP but are unrelated to the dependent variables (once all the explanatory variables included in the analysis are taken into account). In this respect, the evolution of public spending, jointly with the ability of the government to collect tax revenues, is a key determinant of government borrowing and there are numerous theoretical arguments of what drives the accumulation of this borrowing in a country. In particular, these theories place emphasis either on the importance of macro shocks or on the political economy of public debt (Yared, 2019). Initially, we employ as instruments two variables that should affect public debt via their (indirect) effects on public spending and that are tightly linked with the political economy view of public debt accumulation.

Specifically, we use: i) a dummy equal to one for the years when government elections take place at the country level (**Election**); and ii) the life expectancy at birth in years in each country (**Life Expectancy**).[12]

The electoral cycle should promote public policies that expand public debt (Alesina and Passalaqua, 2015). In fact, political turnover creates incentives for boosting public spending to gain popularity by the current party in power (Yared, 2019). Evidence of a political business cycle has been documented in developed countries, including euro-area countries (Efthyvoulou, 2012; Golinelli and Momigliano, 2006). Life expectancy proxies for the demographic dynamic, which poses a challenge to debt sustainability via an aging population (Kamiguchi and Tamai, 2019; Pan and Wang, 2012). In fact, a higher life expectancy should increase the public financing needed for the domestic pension system and for the health system. In the political economic theories of debt accumulation, this public spending is facilitated by the time inconsistency problems associated with the demographic effects of an increase in life expectancy. A greater importance is assigned to the present rather than to the future by aging households and this inconsistency results in public debt increases over time (Yared, 2019).

Panel A of Table 6 reports the results. The first stage regression shows the instruments are significant and with the expected (positive) sign. Notably, we measure the instruments at time *t-2*, as such it becomes even less likely they directly affect the dependent variables at time *t*. As the residuals from the first regression are an estimated regressor, we obtain the degree of significance of the explanatory variables in the second-stage regression by bootstrapping the standard errors via 1000 replications (Wooldridge, 2010). The second stage regression confirms our result, though the (marginal) significance of the residuals from the first stage regression casts some doubts on the fact that the ratio between public debt and GDP is conditionally, strictly exogenous.

The key assumption underpinning the results in Panel A is that the two instruments do not have any impact on the activities of banks in the bond market apart from the effects they have via the ratio between public debt and domestic GDP. We next critically discuss what can undermine the validity of this assumption for each instrument we employ and present alternative approaches. Although each approach might have some limitations, if they jointly point to the same conclusion, it seems implausible that endogeneity is strongly biasing our results.

First, political elections might be driven by financial crises and then correlate with the funding choices of banks. To account for this, in Panel B we replace Election as instrument with the amount of military expenditure per capita (obtained from https://www.sipri.org/databases/milex) similarly to Demirci et al. (2019). This instrument enters the first stage regression with the expected positive sign while the second stage regression confirms our main findings.

Second, it might be argued that the exclusion restrictions do not necessarily hold for our variable Life Expectancy due to its potential correlation with a number of other economic outcomes that can jointly affect public debt and the decision of banks to issue bonds (see, Acemoglu and Johnson, 2007). In this respect, although we remove contamination effects due to the possible relationship between life expectancy and economic growth via the inclusion of the GDP growth rate as a control, there could be other time-varying country factors that we are omitting and are biasing our results. For instance, Acemoglu and Johnson (2007) document that an increase in life expectancy contributes to increasing population size. In turn, a larger population could influence the demand for bank credit, with a consequent increase in the funding needs of banks. Additionally, an increase in population size can expand the labor force with an impact on productivity and innovation, with again potential effects on how banks operate.

To overcome the above limitations, we proceed in two ways. In Panel C we extend the analysis shown in Panel A by adding two country controls taken from the WorldBank dataset: a) the growth in the ratio between domestic credit and country GDP (to account for changes in the demand for bank loans); and b) the log transformation of the labor force to account for the confounding effects due to productivity and innovation. The addition of these controls is important as the underlying identification assumption is that the instruments are uncorrelated with the dependent variables once the effects of the explanatory variables is considered. We find that our results remain unchanged. Next, in Panel D we replace Life Expectancy, from the specifications in Panel B, as an instrument and use the ratio of natural disaster costs over government spending (available at https://public.emdat.be/data) that should influence public debt by generating unexpected non-discretionary costs for the public finances. This alternative setting also confirms our main findings.

### *3.3. Ruling out alternative explanations*

The following tests intend to exclude alternative interpretations of our results. We begin by presenting additional results that go against the sovereign risk channel as the main driver of our findings. We next build on the analyses of Becker and Ivashina (2018) and Ongena et al. (2019) and present further investigations to rule out the influence of political factors driving our findings.

#### *3.3.1. Further tests to rule out the Sovereign risk channel*

The fact we control for sovereign risk in our analysis should exclude that the impact of Public Debt/GDP on bank bond issuance is simply the consequence of a country's default risk. In this section we further provide evidence against this alternative explanation by building on the fact that the crowding out channel and the sovereign risk channel produce different predictions on how our results should vary by i) public debt ownership; and ii) bond typologies.

More specifically, cross-country evidence for non-financial firms points towards a crowding out effect due to domestic (and not international) public debt (Demirci et al., 2019). Instead, the international component is seen as an indicator of sovereign risk since

[12] Election is constructed using the European Election Database collected by the Norwegian Centre for Research Data and integrated with the Database for Political Institutions (https://publications.iadb.org/en/database-political-institutions-2017-dpi2017). Life expectancy is from the World Bank (World Development Indicators).

**Table 6**
Bank bond issuance and public debt – mitigating endogeneity
This Table reports the results of the double hurdle model on bank activity in the bond market where **Public Debt/GDP** is considered endogenous. We employ the control function approach to control for endogeneity. In the first stage regression (column (1)) Public Debt/GDP is regressed on the set of variables in Table 3 and two instruments: a dummy equal to one for years of government elections in a country (**Election**); ii) the years of life expectancy at birth in a country (**Life Expectancy**). Alternative instruments are the amount of military expenses per capita (**Military Expenses**) and the ratio of disaster costs over general government spending (**Natural Disaster Costs**). As additional controls the model includes the growth rate of domestic credit to private sector as percentage of GDP (Domestic Credit Growth) and the logarithm of the labor force (**Labor Force**). The residuals from the first-stage regression are then used as an additional control in the Double Hurdle Model. The participation equation models the probability that a bank issues bonds in a given year, while the quantity equation models the quantity issued once a bank has decided to participate in the market. Public Debt/GDP is the ratio between public debt and national GDP. The models include the set of controls reported in Table 2. We employ bootstrap standard errors with 1000 replications reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

**Panel A: Instrumental Variable Regressions based on Indirect Proxies of Public Spending**

| | **IV-1 stage** | **IV-2 stage** | | **Marginal Effects: 2 stage** | | |
|---|---|---|---|---|---|---|
| | (1) Public Debt/ GDP | (2) Participation Equation | (3) Quantity Equation | (4) Prob. of Issuing | (5) Exp. Amount Issued | (6) Average Marginal Effects |
| Public Debt/GDP | | 0.0114 | **−0.0080*** ** | 0.0025 | **−0.0368*** ** | 0.0060 |
| | | (0.068) | **(0.002)** | (0.015) | **(0.013)** | (0.072) |
| Election | **0.5092*** ** | | | | | |
| | **(0.195)** | | | | | |
| Life Expectancy | **4.7500*** ** | | | | | |
| | **(1.709)** | | | | | |
| Residuals | | −0.0037 | −0.0175** | −0.0008 | −0.0808** | −0.0176 |
| | | (0.069) | (0.008) | (0.015) | (0.039) | (0.072) |
| Observations | 2624 | 2624 | 2624 | | | |
| Controls | Yes | Yes | Yes | | | |
| Country & Year FE | Yes | Yes | Yes | | | |

**Panel B: Instrumental Variable Regressions – Replacing Election as an Instrument**

| | **IV-1 stage** | **IV-2 stage** | | **Marginal Effects: 2 stage** | | |
|---|---|---|---|---|---|---|
| | (1) Public Debt/ GDP | (2) Participation Equation | (3) Quantity Equation | (4) Prob. of Issuing | (5) Exp. Amount Issued | (6) Average Marginal Effects |
| Public Debt/GDP | | 0.0016 | **−0.0080*** ** | 0.0004 | **−0.0373*** ** | −0.0045 |
| | | (0.002) | **(0.002)** | (0.000) | **(0.013)** | (0.003) |
| Military Expenses | **0.0033*** | | | | | |
| | **(0.002)** | | | | | |
| Life Expectancy | **5.7091*** ** | | | | | |
| | **(1.541)** | | | | | |
| Residuals | | 0.0018 | −0.0137* | 0.0005 | −0.0639* | −0.0088 |
| | | (0.004) | (0.007) | (0.001) | (0.038) | (0.008) |
| Observations | 2624 | 2624 | 2624 | | | |
| Controls | Yes | Yes | Yes | | | |
| Country & Year FE | Yes | Yes | Yes | | | |

**Panel C: Instrumental Variable Regressions based on Indirect Proxies of Public Spending and Additional Controls**

| | **IV-1 stage** | **IV-2 stage** | | **Marginal Effects: 2 stage** | | |
|---|---|---|---|---|---|---|
| | (1) Public Debt/ GDP | (2) Participation Equation | (3) Quantity Equation | (4) Prob. of Issuing | (5) Exp. Amount Issued | (6) Average Marginal |
| Effects | | | | | | |
| Public Debt/GDP | | −0.0188 | **−0.0080** ** | −0.0041 | **−0.0382** ** | −0.0272 |
| | | (0.049) | **(0.004)** | (0.010) | **(0.019)** | (0.052) |
| Election | **1.0069*** ** | | | | | |
| | **(0.154)** | | | | | |
| Life Expectancy | **1.5562*** ** | | | | | |
| | **(0.422)** | | | | | |
| Domestic Credit Growth | −0.2337*** | −0.0083 | −0.0029 | −0.0018 | −0.0139 | −0.0114 |
| | (0.019) | (0.012) | (0.002) | (0.003) | (0.010) | (0.013) |
| Labor force | −7.7331*** | −0.0581 | 0.0165 | −0.0127 | 0.0794 | −0.0498 |
| | (0.877) | (0.442) | (0.141) | (0.093) | (0.709) | (0.482) |
| Residuals | | 0.0276 | −0.0174* | 0.0060 | −0.0835* | 0.0157 |
| | | (0.050) | (0.009) | (0.010) | (0.048) | (0.052) |
| Observations | 2254 | 2254 | 2254 | | | |
| Controls | Yes | Yes | Yes | | | |

(*continued on next page*)

**Table 6** (*continued*)

| **Panel A: Instrumental Variable Regressions based on Indirect Proxies of Public Spending** | | | | | | |
|---|---|---|---|---|---|---|
| | **IV-1 stage** | **IV-2 stage** | | **Marginal Effects: 2 stage** | | |
| | (1) Public Debt/ GDP | (2) Participation Equation | (3) Quantity Equation | (4) Prob. of Issuing | (5) Exp. Amount Issued | (6) Average Marginal Effects |
| Country & Year FE | Yes | Yes | Yes | | | |
| **Panel D: Instrumental Variable Regressions based on Instruments for Non-Discretionary Public Debt** | | | | | | |
| | **IV-1 stage** | **IV-2 stage** | | **Marginal Effects: 2 stage** | | |
| | (1) Public Debt/ GDP | (2) Participation Equation | (3) Quantity Equation | (4) Prob. of Issuing | (5) Exp. Amount Issued | (6) Average Marginal |
| Effects | | | | | | |
| Public Debt/GDP | | −0.0186 | **−0.0072*** ** | −0.0041 | **−0.0336** ** | −0.0258 |
| | | (0.028) | **(0.002)** | (0.006) | **(0.014)** | (0.029) |
| Natural Disaster Costs | **0.5108*** ** | | | | | |
| | **(0.052)** | | | | | |
| Military Expenses | **0.0026*** | | | | | |
| | **(0.002)** | | | | | |
| Residuals | | 0.0283 | −0.0158** | 0.0062 | −0.0738* | 0.0178 |
| | | (0.028) | (0.008) | (0.006) | (0.041) | (0.030) |
| Observations | 2533 | 2533 | 2533 | | | |
| Controls | Yes | Yes | Yes | | | |
| Country & Year FE | Yes | Yes | Yes | | | |

countries are more likely to default on the international public debt (Ağca and Celasun, 2012). In the presence of a crowding out (sovereign risk) effect, therefore, our findings should be stronger for banks operating in countries with a larger domestic (international) public debt component.

We estimate a model where we include as explanatory variables the ratio between domestic public debt and GDP and international public Debt and GDP.[13] We conduct the analysis by initially using each of the public debt components separately in our baseline model (Panels A and B of Table 7) and then by including both components simultaneously (Panel C). We consistently find that only Domestic Public Debt/GDP enters the quantity equation with a negative and highly significant coefficient. Hence, our result is driven by the component of public debt that should reflect a crowding out effect and not by the public debt component that is expected to be more sensitive to sovereign risk.

The contractual features of bonds can also provide indications on whether the crowding out effect is driving our results. In this respect, our sample also includes subordinated bonds that have much more complex contractual features than senior bonds and expose investors to higher risks of losing their capital. As a result, while senior bonds can be perceived as the closest substitutes to government bonds in the presence of a crowding out channel, a sovereign risk effect would make subordinated debts especially costly for banks, thus lowering their issuance by the banking industry. In the case of a crowding out effect, investors should perceive senior bank, and not subordinated bonds as the most plausible alternative to government bonds.

To account for differences in the contractual features of bonds in our sample we repeat the analysis separately for senior and subordinated debts. The results, reported in Panels D and E of Table 7 show the negative impact of Public Debt/GDP on bond quantity only in the sample of senior bonds (Panel D), whereas there is no effect in the sample of subordinated bonds (Panel E).

Overall, all the results discussed in this section lead to the conclusion that the sovereign risk channel is unlikely to be the main driver of our findings.

### *3.3.2. Additional tests to rule out a political channel*

Another potential explanation of our results is related to the presence of political factors that influence the holdings of sovereign bonds by banks (Becker and Ivashina, 2018; Ongena et al., 2019). Domestic banks might be induced to absorb an increase in government debt in exchange for more favorable funding conditions from the central bank. This should then result in banks having less need to raise bonds when the ratio between public debt and national GDP increases. Along these lines, Becker and Ivashina (2018) show that domestic sovereign bond holdings by European banks are influenced by political factors being larger in banks with state ownership and politically affiliated board members. Furthermore, sovereign bond holdings by European banks have been shown to have a home bias (Gennaioli et al., 2018; Horvath et al., 2015).

A first implication of the argument above is that the negative relationships between bank bond issuance and public debt/GDP should be stronger when the political influence on the banking sector is more pronounced. In this section we begin by measuring the

[13] Domestic Public Debt/GDP is "outstanding domestic public debt securities to GDP" (code: GFDD.DM.04; source: World Bank). International Public Debt/GDP is the international public debt securities to GDP (%) retrieved from the External Debt Statistics (source: International Monetary Fund and World Bank).

political influence on the banking sector in three ways based on: a) bank ownership structure; b) sovereign bond holdings; and c) board political connections.

To quantify the political influence on banks via the ownership structure we employ two settings. First, we employ country level data from the Fraser Institute (available at https://www.fraserinstitute.org/economic freedom/dataset?geozone=world&page=dataset&min-year=2&max-year=0&filter=0) to identify banking systems characterized by a stronger government presence in terms of ownership. We construct a variable High State Ownership – Country Level that is a dummy equal to 1 if the rating providing information on bank deposits held in privately owned banks (with a low rating indicating a low level of deposits in privately owned banks) is lower or equal to 5 and zero otherwise.[14] We next interact this variable with Public Debt/GDP. In a second setting, we differentiate banks with high state ownership (namely, banks with at least 20% of shares being owned by the state as in Panizza, 2021) from the other banks in our sample using a dummy variable based on ownership data from Thomson Eikon. We add this dummy and its interaction with Public Debt/GDP to our baseline equations. Against the political perspective, the marginal effects reported in the first two Panels of Table 8 show that banks with a larger state ownership are less likely to be penalized in terms of bond issuance when Public Debt/GDP increases.

In Panel C, we build on the evidence documented in Becker and Ivashina (2018) and measure indirectly the sovereign influence of banks via the relevance of sovereign debt in their asset portfolio. We follow De Bruyckere et al. (2013) and employ data from Bankscope. We identify the total amount of government bonds (although not necessarily issued by the national government) in a bank's balance sheet that we divide by total assets. Gennaioli et al. (2018) show this is a good proxy of a bank's holding of domestic sovereign bonds. Nevertheless, to reduce measurement errors we employ a broad categorization between banks that are more likely to be exposed to domestic government debt and the rest of the sample. This is achieved by constructing a dummy variable equal to one for banks where this indicator is in the last quartile of the sample distribution. We next re-estimate the baseline specification adding this dummy and its interaction term with the public debt to GDP ratio. Again, we find results against the political perspective: in the quantity equation the marginal effect is less negative for banks with higher levels of sovereign bond holdings compared to the rest of the sample. This finding and the previous test based on state ownership, therefore, are more consistent with the view that banks are more exposed to the crowding out effect when they are likely to absorb less of the supply of government debt (that is then available to other investors).

In Panel D, we quantify the political influence on banks by constructing a dummy (**Politically Connected)** based on the index proposed by Braun and Raddatz (2010). This index is based on the fraction of banks with Bankscope data on board of directors that had a former politician on their boards. We assign a value of one to banks located in countries with an index higher or equal to 4 and zero otherwise.[15] Again we do not find that our results are more pronounced in countries with more politically connected bank boards.

A second and final testable implication arising from the political perspective is linked to a country's default risk. Essentially, especially in times of sovereign distress, the political pressure on the banking sector to absorb government debt should increase. Indeed, the home bias in European bank sovereign bond holdings is more pronounced in countries with higher sovereign risk (Horvath et al., 2015). Furthermore, Ongena et al. (2019) show that domestic banks were more likely than foreign banks to increase their domestic sovereign holdings during the sovereign debt crisis when the government was in need of rolling over a large amount of debt closed to maturing. This was the consequence of a "moral suasion effect" on banks from the government.

The above evidence implies that under the political interpretation of our findings, the impact of the Public Debt/GDP ratio on bond issuance should become more pronounced in countries that are more likely to default on their debt. To assess the validity of this argument we identify countries with a low sovereign rating with a dummy variable that is equal to 1 if the rating from S&P is below the upper investment grade and zero otherwise and interact this dummy with the Public Debt/GDP ratio in the two equations. The results, reported in Table A5 of the Online Appendix, go against the political explanation and show a weaker influence of Public Debt/GDP on bank bond issuance when sovereign risk is higher. We achieve a similar conclusion when we replace the credit rating with a country risk proxy based on the government spread computed as the difference between domestic government bonds and US government bonds with a maturity of 10 years.

### *3.4. Which banks are more affected by the crowding out effect?*

Our analysis indicates that the crowding out effect influences banking firms and this is a necessary condition for the regulatory requirements of sovereign bond holdings to potentially affect the funding structure of banks. However, in the next sections we show that not all banks are equally exposed to the crowding out effect and as a result there could be heterogenous consequences on banks associated with an increase in the supply of government debt for private investors.

#### *3.4.1. The importance of bank business models*

A bank's business model can influence the exposure of banks to the crowding out effect. In particular, a first source of heterogeneity can emerge from the degree of internationalization of the banking business. More internationally active banks should be less likely to be exposed to the crowding out effect. In fact, these banks should have more opportunities to sell their bonds to international investors

[14] The original rating ranges between 10 for countries with shares between 95% and 100% of privately held deposits, and 0 for countries with private deposits at 10% or below.

[15] We choose as a cutoff the value 4 based on the sample of countries under consideration ranging between 1 to 8, which is more limited that the one considered in Braun and Raddatz (2010), including countries with much wider values.

**Table 7**
Additional tests to rule out the sovereign risk channel
This Table reports the results of the double hurdle model on bank activity in the bond market after distinguishing the domestic and international components of public debt. The participation equation models the yearly probability that a bank issues bonds, while the quantity equation models the quantity issued once a bank has decided to participate in the market. **Domestic Public Debt/GDP** is the ratio between domestic public securities outstanding and national GDP. **International Public Debt/GDP** is the ratio between international public securities outstanding and national GDP. Standard errors, robust to heteroscedasticity and clustered at the bank level, are reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

| | | | Marginal Effects | | |
|---|---|---|---|---|---|
| | Participation Equation (1) | Quantity Equation (2) | Prob. of Issuing (3) | Exp. Amount Issued \| $Y>0$ (4) | Average Marginal Effects (5) |
| **Panel A: Domestic Public Debt** | | | | | |
| Domestic Public Debt/GDP | 0.0122 | **−0.0090*** ** | 0.00266 | **−0.0510** ** | 0.00632 |
| | (0.009) | **(0.003)** | (0.00186) | **(0.0217)** | (0.00990) |
| Observations | 2313 | 2313 | 2313 | 2313 | 2313 |
| Country & Bank controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel B: International Public Debt** | | | | | |
| International Public Debt/GDP | 0.0019 | −0.0099 | 0.000410 | −0.0559 | −0.00610 |
| | (0.007) | (0.008) | (0.00147) | (0.0465) | (0.00955) |
| Observations | 2313 | 2313 | 2313 | 2313 | 2313 |
| Country & Bank controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel C: Domestic and International Public Debt** | | | | | |
| Domestic Public Debt/GDP | 0.0124 | **−0.0099** ** | 0.00271 | **−0.0557** ** | 0.00581 |
| | (0.009) | **(0.004)** | (0.00188) | **(0.0266)** | (0.0106) |
| International Public Debt/GDP | −0.0009 | 0.0029 | −0.000191 | 0.0160 | 0.00136 |
| | (0.007) | (0.011) | (0.00147) | (0.0584) | (0.0116) |
| Observations | 2313 | 2313 | 2313 | 2313 | 2313 |
| Country & Bank controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel D: Senior Bonds** | | | | | |
| Public Debt/GDP | 0.0083 | **−0.0198** ** | 0.0018 | **−0.1089** ** | −0.0059 |
| | (0.007) | **(0.008)** | (0.002) | **(0.052)** | (0.011) |
| Observations | 2651 | 2651 | 2651 | 2651 | 2651 |
| Country & Bank controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |
| **Panel E: Subordinated Bonds** | | | | | |
| Public Debt/GDP | −0.0019 | −0.0046 | −0.0002 | −0.0035 | −0.0005 |
| | (0.008) | (0.006) | (0.001) | (0.005) | (0.001) |
| Observations | 2651 | 2651 | 2651 | 2651 | 2651 |
| Country & Bank controls | Yes | Yes | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes | Yes | Yes |

that we have documented are less important for the crowding out effect.

Furthermore, banks adopting less traditional business models (that is, showing a higher non-interest income share and less lending), should benefit more from economies of scale and scope in their issuance activities and as such may be less affected by the pressure coming from the supply of government bonds. Additionally, these banks may be less likely to offer 'vanilla' securities that are subject to greater competition from government bonds and might be operating across different business lines, thus increasing their cross-selling capabilities with private investors.

To validate the conjectures above, we include in the participation and quantity equations a dummy that takes the value of one if the ratio between bank foreign assets (taken from Worldscope) and total assets is above the 75th percentile of the yearly sample distribution and zero otherwise and its interaction with Public Debt/GDP. We create similar dummy variables using the ratio between non-interest income over operating income and between total loans and total assets to describe the bank business model.

In Table 9 (Panels A to C), in line with our predictions, the reported marginal effects show that the impact of Public Debt/GDP in the quantity equation is weaker for banks that are more internationally active or characterized by a less conventional business model.

**Table 8**
Sovereign influence on banks
This Table reports the marginal effects of the double hurdle model on bank activity in the bond market by the degree of interlinks with sovereign. The participation equation models the probability that a bank issues bonds in a given year, while the quantity equation models the quantity issued once a bank has decided to participate in the market. We use three measures of bank interlinks. The first (**High State Ownership – Country Level**) is a dummy equal to 1 if the ownership index taken from the Fraser Institute (available at https://www.fraserinstitute.org/economic-freedom/dataset?geozone=world&page=dataset&min-year=2&max-year=0&filter=0) is lower or equal to 5 and zero otherwise. The second variable (**High State Ownership – Bank Level**) is a dummy variable that is equal to 1 if at least 20% of bank shares are state owned and zero otherwise. The third variable (**High Sovereign Bond Holding**) is a dummy equal to 1 if a bank has a sovereign bond holding above the 75th percentile of the sample distribution in a given year and zero otherwise. The fourth variable **Politically Connected** is a dummy equal to 1 if the index from Braun and Raddatz (2010) fraction of banks with Bankscope data on board of directors that had a former politician on their boards is higher or equal to 4 and zero otherwise. All models include the set of controls reported in Table 2 and time and country dummies. Standard errors, robust to heteroscedasticity and clustered at the bank level, are reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

| | **Marginal Effects** | | |
|---|---|---|---|
| | Prob. of Issuing | Exp. Amount issued \| $Y>0$ | Average Marginal Effects |
| **Panel A: State Ownership – Country Level** | | | |
| 1. High State Ownership – Country Level = 0 | 0.0015 | **−0.1273**** | −0.0094 |
| | (0.001) | **(0.052)** | (0.010) |
| 2. High State Ownership – Country Level = 1 | 0.0014 | **−0.0463***** | −0.0048 |
| | (0.001) | **(0.017)** | (0.006) |
| 1–2 = 0 (p-value) | 0.3712 | **0.0300**** | 0.3364 |
| Observations | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |
| **Panel B: State Ownership – Bank Level** | | | |
| 1. High State Ownership – Bank Level = 0 | 0.0007 | **−0.0414**** | −0.0040 |
| | (0.001) | **(0.020)** | (0.006) |
| 2. High State Ownership – Bank Level = 1 | 0.0009 | **−0.0215**** | −0.0073 |
| | (0.001) | **(0.010)** | (0.007) |
| 1–2 = 0 (p-value) | 0.4872 | **0.0740*** | 0.2702 |
| Observations | 1662 | 1662 | 1662 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |
| **Panel C: Sovereign Bond Holding** | | | |
| 1. High Sovereign Bond Holding = 0 | 0.0000 | **−0.0263**** | −0.0053 |
| | (0.002) | **(0.009)** | (0.014) |
| 2. High Sovereign Bond Holding = 1 | 0.0000 | **−0.0149**** | −0.0053 |
| | (0.002) | **(0.007)** | (0.013) |
| 1–2 = 0 (p-value) | 0.9826 | **0.0833*** | 0.9851 |
| Observations | 1616 | 1616 | 1616 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |
| **Panel D: Politically Connected** | | | |
| 1. Politically connected = 0 | 0.0006 | **−0.0752*** | −0.0125 |
| | (0.001) | **(0.041)** | (0.009) |
| 2. Politically connected = 1 | 0.0006 | **−0.0942*** | −0.0073 |
| | (0.001) | **(0.052)** | (0.007) |
| 1–2 = 0 (p-value) | 0.4686 | 0.5950 | 0.3077 |
| Observations | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |

### *3.4.2. The impact of bank size*

Studies on non-financial firms show that the crowding out effect is more pronounced for large companies (Graham et al., 2014). However, the general perspective that motivates the crowding out effect is the increase in funding costs produced by a larger supply of government debt that discourages firms from increasing the quantity of bonds they issue. In the banking industry, there are several reasons why this cost transmission mechanism should be less important for large banks.

First, large banks are more likely to operate internationally and across different business lines and are generally active in underwriting corporate bond issuance. Their expertise in terms of pricing, marketing and placement of securities in the primary market, can then lead to significant advantages over smaller banks in designing the terms of new issuances, timing the market conditions and

understanding investor appetite (for details on underwriting activity see Papaioannou and Karagozoglu, 2017).

Furthermore, ceteris paribus, large banks have lower funding costs than other banks because of the subsidy they receive from the presence of implicit bailout guarantees (Admati et al., 2018; Baron, 2020) and can benefit from additional cost efficiencies via significant economies of scale (Hughes and Mester, 2013). Notably, ceteris paribus, the reduced funding cost for large corporations is not observed outside the financial industry (Acharya et al., 2016). Therefore, the expected increase in funding costs due to the competitive pressure from government bonds should be more penalizing for small banks that already pay relatively higher funding costs as compared to the largest banks and are less cost efficient.

Additionally, Fernandez de Guevara et al. (2005) document that large European banks benefit more from market power than small European banks and this gives greater flexibility in setting the prices of their products (Drechsler et al., 2017; Li et al., 2019).

**Table 9**

Heterogeneity by bank characteristics

This Table reports the results of the double hurdle model on bank activity in the bond market for different bank business models. The participation equation models the yearly probability that a bank issues bonds, while the quantity equation models the quantity issued once a bank has decided to participate in the market. **Public Debt/GDP** is the ratio between public debt outstanding and national GDP. **International Active Banks** is a dummy equal to 1 if the ratio of foreign assets and total assets is above the top **75th** percentile in a given year, zero otherwise. **Non-Interest Income Share** is a dummy equal to 1 if the ratio between Non-Interest Income and total operating income is above the 75th percentile of the sample distribution. **Lending Oriented** is a dummy equal to 1 if the variable Loans is above the 75th percentile of the sample distribution. **Large bank** is a dummy variable equal to one if a bank has total assets above the 75th percentile of the sample distribution. All models include the set of controls reported in Table 2 and time and country dummies. Standard errors, robust to heteroscedasticity and clustered at the bank level, are reported in parentheses and are significant as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

| | **Marginal Effects** | | |
|---|---|---|---|
| | Prob. of Issuing | Exp. Amount issued \| $Y>0$ | Average Marginal Effects |
| | (1) | (2) | (3) |
| **Panel A: International Active versus Non-International Active Banks** | | | |
| 1. International Active Banks =0 | 0.0015 | **−0.0796**** | −0.0052 |
| | (0.002) | **(0.041)** | (0.011) |
| 2. International Active Banks =1 | 0.0019 | **−0.0297*** | −0.0046 |
| | (0.002) | **(0.017)** | (0.008) |
| 1–2 = 0 (p-value) | 0.3392 | **0.0558*** | 0.8686 |
| Observations | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |
| **Panel B: Low Non-Interest Income Share versus High Non-Interest Income Share** | | | |
| 1. Non-Interest Income Share =0 | 0.0016 | **−0.0906*** | −0.0055 |
| | (0.001) | **(0.046)** | (0.011) |
| 2. Non-Interest Income Share =1 | 0.0018 | **−0.0444*** | −0.0026 |
| | (0.002) | **(0.023)** | (0.008) |
| 1–2 = 0 (p-value) | 0.2910 | **0.0572*** | 0.4093 |
| Observations | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |
| **Panel C: Lending Oriented versus Non-Lending Oriented Banks** | | | |
| 1. Lending Oriented=0 | 0.0018 | **−0.0517*** | −0.0021 |
| | (0.002) | **(0.031)** | (0.009) |
| 2. Lending Oriented =1 | 0.0018 | **−0.1253*** | −0.0042 |
| | (0.002) | **(0.072)** | (0.018) |
| 1–2 = 0 (p-value) | 0.8942 | **0.0946*** | 0.8170 |
| Observations | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |
| **Panel D: Small versus Large Banks** | | | |
| 1. Large bank=0 | 0.0006 | **−0.1053*** | −0.0107 |
| | (0.001) | **(0.055)** | (0.012) |
| 2. Large bank=1 | 0.0009 | **−0.0180**** | −0.0094 |
| | (0.002) | **(0.009)** | (0.009) |
| 1–2 = 0 (p-value) | 0.6468 | **0.0644*** | 0.7457 |
| Observations | 2651 | 2651 | 2651 |
| Country & Bank Controls | Yes | Yes | Yes |
| Country & Year FE | Yes | Yes | Yes |

Accordingly, large banks might take advantage of their market power to transfer (at least part of) the increase in funding costs from raising bonds to depositors. This latter transfer mechanism within the liability side is unlikely to be observed for non-banks given the significantly much lower presence of debt in their capital structure and the lack of any form of debt that can be seen as comparable to deposits. From all these arguments, it follows that large banks should be less penalized in operating in the bond market than smaller banks in the presence of more competition from government bonds

To test for the role of bank size, we estimate the baseline specification reported in Table 3 with an interaction term between a dummy (**Large Banks**) that takes a value of one for banks in the last quartile of the sample distribution (that are plausibly under the umbrella of the implicit bailout guarantee) and the public debt to GDP ratio.

We report the marginal effects from this analysis in Panel D of Table 9 computed for small (dummy equal to zero) and large (dummy equal to one) banks. Large banks are significantly less penalized, in terms of the quantity of bonds raised per unit of bank assets, by the presence of a larger public debt in the national economy. All in all, in the case of banks, the effects of Public Debt/GDP on private debt by organization size is the opposite of what is documented for non-financial firms.

## 4. Conclusions

European banks located in countries with larger public debt raise less funds in the bond market. A series of tests indicate our finding reflects a crowding out effect that reduces the possibilities of banks raising funds in the bond market, because of the competition coming from the supply of government bonds, and not a sovereign risk channel or political influence. The crowding out effect results in banks having a lower leverage (higher equity ratio). We further document that not all banks are equally exposed to the crowding out effect. Specifically, banks that are more prone to the crowding out effect tend to be less internationally active, have a more traditional business model and are smaller.

Ultimately, our analysis implies that regulatory interventions that have the potential to reduce the demand for government bonds by the banking industry, might significantly affect a bank's funding policy and generate heterogeneous effects across banks. In short, several of the proposed regulatory changes are likely to impact on banks' funding choices, with consequences for bank leverage and debt composition. The potential deleveraging of banks can be beneficial for bank stability and, hence, should be positively perceived by regulators. This deleveraging might potentially lower bank size with a consequent decline in too-big-to-fail concerns by regulators.

Finally, a note of caution is warranted. We have placed emphasis on the stability benefits deriving from lower bank leverage. However, there might less obvious additional implications. Some scholars, for instance, suggest that higher capital may push banks to make more efficient portfolio choices and strengthen borrower monitoring (Holmstrom and Tirole, 1997), with positive effects in terms of the amount of lending, liquidity creation and bank values (Mehran and Thakor, 2011). Others argue instead that more capital may directly or indirectly reduce liquidity creation and transaction services, thus resulting in negative effects on banks (Diamond and Rajan, 2001).

## Credit statement

**Michela Rancan:** Methodology Design, Data Curation; Writing - Reviewing and Editing. **Jessica Cariboni**: Writing – Structuring, Reviewing and Editing.

**Kevin Keasey**: Project Supervision; Writing- Structuring, Reviewing and Editing; **Francesco Vallascas**: Methodology Design, Writing- Original draft preparation, Reviewing and Editing.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jempfin.2023.101417.

## References

Abiad, A., Detragiache, E., Tressel, T., 2010. A new database of financial reforms, IMF staff papers. Palgrave Macmillan 57 (2), 281–302.
Acemoglu, D., Johnson, S., 2007. Disease and development: the effect of life expectancy on economic growth. J. Polit. Econ. 115, 925–985.
Acharya,V.V., Anginer, D., and Warbuton, R.J., 2016. The end of market discipline? Investor expectations and implicit government guarantees. Working Paper.
Acharya, V.V., Drechsler, I., Schnabl, P., 2014. A pyrrhic victory? Bank bailouts and sovereign credit risk. J. Finance 69, 2689–2739.
Acharya, V.V., Eisert, T., Eufinger, C., Hirsch, C., 2018. Real effects of the sovereign debt crisis in Europe: evidence from syndicated loans. Rev. Financial Studies 31, 2855–2896.
Admati, A.R., DeMarzo, P.M., Hellwig, M.F., Pfleiderer, P., 2018. The leverage ratchet effect. J. Finance 73, 145–198.
Ağca, Ş., Celasun, O., 2012. Sovereign debt and corporate borrowing costs in emerging markets. J Int Econ 88, 198–208.
Albertazzi, U., Ropele, T., Sene, G., Signoretti, F.M., 2014. The impact of the sovereign debt crisis on the activity of Italian banks. J. Bank. Finance 46, 387–402.
Alesina, A., and Passalaqua, A., 2015. The political economy of government Debt. NBER Working Paper No. 21821.
Allen, F., Carletti, E., Marquez, R., 2011. Credit market competition and capital regulation. Rev. Financial Studies 24, 983–1018.
Altavilla, C., Canova, F., Ciccarelli, F., 2020. Mending the broken link: heterogeneous bank lending rates and monetary policy pass-through. J Monet Econ 110C, 81–98.
Babecký, J., Havránek, T., Matějů, J., Rusnák, M., Šmídková, K., Vašíček, B., 2014. Banking, debt, and currency crises in developed countries: stylized facts and early warning indicators. J. Financ. Stabil. 15, 1–17.
Badoer, D.C., James, M.C., 2016. The determinants of long-term corporate debt issuances. J. Finance 71, 457–492.

Baron, M., 2020. Countercyclical bank equity issuance. Rev. Financial Studies 33, 4186–4230.
Supervision, Basel Committee on Banking, 2017. The Regulatory Treatment of Sovereign Exposures. Discussion Paper, December.
Becker, Bo, Ivashina, V., 2018. Financial repression in the European sovereign debt crisis. Rev. Financial Studies 22, 83–115.
Bedendo, M., Colla, C., 2015. Sovereign and corporate credit risk: evidence from the eurozone. J. Corp. Finance 33, 34–52.
Behn, M., Haselmann, R., Wachtel, P., 2016. Procyclical capital regulation and lending. J. Finance 71, 919–956.
Berger, A.N., DeYoung, R., Flannery, M.J., Lee, D., Oztekin, O., 2008. How do large banking organizations manage their capital ratios? J. Financial Serv. Res. 34, 123–149.
Blundell, R., Meghir, C., 1987. Bivariate alternatives to the tobit model. J. Econom. 34, 179–200.
Borisova, G., Megginson, W.L., 2011. Does government ownership affect the cost of debt? Evidence from privatization. Rev. Financial Studies 24, 2693–2737.
Braun, M., Raddatz, C., 2010. Banking on politics: when former high-ranking politicians become bank directors. World Bank Econ. Forum 24, 234–279.
Brunnermeier, M.K., Garicano, L., Lane, P.L., Pagano, M., Reis, R., Santos, T., Thesmar, S., Van Nieuwerburgh, S., Vayanos, D., 2016. The sovereign-bank diabolic loop and ESBies. Am. Econ. Rev. 106, 508–512.
Camba-Mendez, G., Carbo-Valverde, S., and Rodriguez-Palenzuela, D., 2014. Financial reputation, market interventions and debt issuance by banks: a truncated two-part model approach. Working Paper.
Correa, R., Lee, K.H., Sapriza, H., Suarez, G.A., 2014. Sovereign credit risk, banks' government support, and bank stock returns around the world. J. Money, Credit Banking 46, 93–121.
Covitz, D.M., Harrison, P., 2004. Do banks time bond issuance to trigger disclosure, due diligence, and investor scrutiny? J. Financial Intermed. 13, 299–323.
Cragg, J.G., 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. Econometrica 39, 829–844.
Craig B., Giuzio, M. and Paterlini, S., 2020. The Effect of Possible EU diversification requirements on the risk of banks' sovereign bond portfolios, ECB Working Paper Series No 2384.
De Bruyckere, V., Gerhardt, M., Schepens, G., Vander Vennet, R., 2013. Bank/Sovereign risk spillovers in the european debt crisis. J. Banking Finance 37, 4793–4809.
Demirci, I., Huang, J., Sialm, C., 2019. Government debt and corporate leverage: international evidence. J financ econ 133, 337–356.
Diamond, D., Rajan, R., 2001. Liquidity risk, liquidity creation, and financial fragility. J. Polit. Econ. 109, 278–327.
Dinger, V., Vallascas, F., 2016. Do banks issue equity when they are poorly capitalized? J. Financ. Quantit. Anal. 51, 1575–1609.
Drechsler, I., Savov, A., Schnabl, P., 2017. The deposits channel of monetary policy. Q. J. Econ. 132, 1819–1876.
Drukker, D.M., 2017. Two-part models are robust to endogenous selection. Econ. Lett. 152, 71–72.
Efthyvoulou, G., 2012. Political budget cycles in the european union and the impact of political pressures. Public Choice 153, 295–327.
Erel, I., Julio, B., Kim, W., Weisbach, M.S., 2012. Macroeconomic conditions and capital raising. Rev. Financial Studies 25, 341–376.
Fernandez de Guevara, J., Maudos, J., Perez, F., 2005. Market power in European banking sectors. J. Financial Services Res. 27, 109–137.
Fiordelisi, F., Girardone, C., Minnucci, F., Ornella, R., 2020. On the nexus between Sovereign risk and banking crises. J. Corp. Finance 65, 101717.
Flannery, M.J., Sorescu, S.M., 1996. Evidence of bank market discipline in subordinated debenture yields: 1983-1991. J. Finance 51, 1347–1377.
Gennaioli, N., Martin, A., Rossi, S., 2014. Sovereign default, domestic banks, and financial institutions. J. Finance 69, 819–866.
Gennaioli, N., Martin, A., Rossi, S., 2018. Banks, government bonds, and default: what do the data say? J. Monet. Econ. 98, 98–113.
Golinelli, R., Momigliano, S., 2006. Real-time determinants of fiscal policies in the euro area. J. Policy Model. 28, 943–964.
González, A.L.R., 2016. The drivers of European banks' EU dollar debt issuance: opportunistic funding in times of crisis? Banco de España Working Paper.
Graham, J.R., Leary, M.T., and Roberts, M.R., 2014. How does government borrowing affect corporate financing and investment? Working Paper.
Greenwood, R., Hanson, S.G., Stein, J.C., 2010. A gap-filling theory of corporate debt maturity choice. J. Finance 65, 993–1028.
Gropp, R., Heider, F., 2010. The Determinants of bank capital structure. Rev. Financ. 14, 587–622.
Hale, G., Obstfeld, M., 2016. The euro and the geography of international debt flows. J. Eur. Econ. Assoc. 14, 115–144.
Heckman, J.J., 1979. Sample selection bias as a specification error. Econometrica 47, 153–161.
Holmstrom, B., Tirole, J., 1997. Financial intermediation, loanable funds and the real sector. Q. J. Econ. 112, 663–691.
Horvath, B.L., Huizinga H., and Ioannidou, V., 2015. Determinants and valuation effects of the home bias in european banks' sovereign debt portfolios. Working Paper.
Huang, Y., Panizza, U., and Varghese, R., 2018. Does public debt crowd out corporate investment? International Evidence. CEPR Discussion paper No. 12931.
Hughes, J.P., Mester, L., 2013. Who said large banks don't experience scale economies? Evidence from a risk-return-driven cost function. J. Financ. Intermed. 22, 559–585.
Iannotta, G., 2006. Testing for opaqueness in the european banking industry: evidence from bond credit ratings. J. Financial Services Res. 30, 287–309.
Jones, A.M., 1989. A double-hurdle model of cigarette consumption. J. Appl. Econ. 4, 23–39.
Juncker, J.C., Tusk, D., Dijsselblom, J., Draghi, M., and Schulz, M., 2015. Completing Europe's economic and monetary union. Five Presidents' Report.
Kamiguchi, A., Tamai, T., 2019. Public investment, public debt, and population aging under the golden rule of public finance. J. Macroecon. 60, 110–122.
Kaminsky, G.L., Reinhart, C.M., 1999. The twin crises: the causes of banking and balance-of-payments problems. Am. Econ. Rev. 89, 473–500.
Laeven, L., Valencia, F., 2013. Systemic banking crises database. IMF Econ. Rev. 61, 225–270.
Lenarčič, A., Mevis, D., and Siklós, D., 2016. Tackling sovereign risk in European banks, European Stability Mechanism Discussion Paper.
Lepetit, L., Nys, E., Rous, P., Tarazi, A., 2008. Bank income structure and risk: an empirical analysis of European banks. J. Bank. Finance 32, 1452–1467.
Li, L., Louskina, E., and Strahan, P.E., 2019. Deposit Market Power, Funding Stability and Long-term Credit, NBER, 1050.
Mediobanca, 2011. Interventi dei Governi Nazionali a Favore delle Banche e degli Istituti Finanziari in Europa e Negli Stati Uniti dal Settembre 2007 al Giugno 2012. [Government Interventions in Favor of Banks and Financial Institutions in Europe and in the US from September 2007 to June 2012].
Mehran, H., Thakor, A., 2011. Bank Capital and Value in the Cross-section. Rev. Financial Studies 24, 1019–1067.
Melis A., and Weissenberg, K., 2019. EU Banks' Journey Towards an Enhanced Capital Framework, EBA Staff Paper Series.
Moffatt, P.G., 2005. Hurdle models of loan default. J. Oper. Res. Soc. 56, 1063–1071.
Omori, S., 2022. Introducing the revised and updated financial reform database. J. Financ. Regulat. 8, 230–240.
Ongena, S., Popov, A., Van Horen, N., 2019. The invisible hand of the government: moral suasion during the european sovereign debt crisis. Am. Econ. J. 11, 346–379.
Pan, H., Wang, C., 2012. Government debt in the euro area-evidence from dynamic factor analysis. Econ. Lett. 115, 272–275.
Panizza, U., Presbitero, A., 2014. Public debt and economic growth: is there a causal effect? J. Macroecon. 41, 21–41.
Panizza, U., 2021. State owned commercial banks, CEPR discussion paper 16259.
Papaioannou, G.J., Karagozoglu, A.K., 2017. Underwriting Services and the New Issues Market. Academic Press.
Papke, L.E., Wooldridge, J.M., 2008. Panel data methods for fractional response variables with an application to test pass rates. J Econom 145, 121–133.
Popov, A., Van Horen, N., 2015. Exporting sovereign stress: evidence from syndicated bank lending during the euro area sovereign debt crisis. Rev Financ 19, 1825–1866.
Reinhart, C.M., Rogoff, K.S., 2013. Banking crises: an equal opportunity menace. J. Bank. Finance 37, 4557–4573.
Saka, O., 2020. Domestic banks as lightning rods? Home bias and information during the Eurozone crisis. J. Money, Credit Bank. 52, 273–305.
Schepens, G., 2016. Taxes and Bank Capital Structure. J. Financ. Econ. 120, 585–600.
Sironi, A., 2003. Testing for market discipline in the european banking industry: evidence from subordinated debt issues. J. Money, Credit Bank. 25, 443–472.
Thakor, A.V., 2014. Bank capital and financial stability: an economic trade-off or a Faustian bargain? Ann. Rev. Financ. Econ. 6, 185–223.
Tobin, J., 1958. Estimation of relationships for limited dependent variables. Econometrica 26, 24–36.
van Rixtel, A., González, L.R., and Yang, J., 2015. The determinants of long-term debt issuance by european banks: evidence of two crises, BIS Working Papers.
Williams, G., Alsakka, R., Ap Gwilym, O., 2013. The impact of sovereign rating actions on bank ratings in emerging markets. J. Bank. Finance 37, 563–577.
Wooldridge, J., 2010. Econometric Analysis of Cross Section and Panel Data, 2nd edition. The MIT Press, Cambridge, MA.
Yared, P., 2019. Rising government debt: causes and solutions for a decades-old trend. J. Econ. Perspect. 33, 115–140.