Covered Bonds, Asset Encumbrance and Bank Risk: Evidence from the European Banking Industry

Emilia Garcia-Appendini
University of St. Gallen, School of Finance, St. Gallen, Switzerland

Stefano Gatti
Bocconi University, Department of Finance, Milan, Italy

Giacomo Nocera*
Audencia Business School, Nantes, France

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Abstract

We use cross-country data on a sample of 106 listed banks from 23 European countries over the 2004-2013 period to evaluate the effects of asset encumbrance linked to covered bond issuance on senior creditors' and banks' risk. We distinguish between the bank's overall default risk (measured through its distance-to-default), senior creditors' credit risk (proxied by the Senior CDS average spread), and the bank's portfolio risk (measured by the bank asset risk). We report three main results. First, asset encumbrance increases bank overall default risk. Second, it produces structural subordination as it contributes to increase senior creditors' credit risk. Third, asset encumbrance has no real effect on the portfolio risk.

JEL Classification: G21, G32.

Keywords: Covered Bonds, Asset Encumbrance, Risk.

* Corresponding author. Address: Audencia Business School, 8 route de la Jonelière, 44312 Nantes Cedex 3, France; tel. +33 240 378 101; fax 33 240 373 437.
E-mail addresses: emilia.garcia@unisg.ch (E. Garcia-Appendini), stefano.gatti@unibocconi.it (S. Gatti), and gnocera@audencia.com (G. Nocera).
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1. Introduction

The 2007-09 global financial crisis has acted as a catalyst for major adjustments in banks' funding models, especially in Europe (van Rixtel and Gasperini, 2013). Ever since, European banks have started relying more and more on secured sources of financing, in particular covered bond, whose attractiveness, especially when wholesale funding markets were severely stressed, was clearly remarked by Jean-Claude Trichet as follows: "Given that the financial crisis clearly exposed the dire consequences of the imprudent evaluation of credit risk, the usefulness of more conservative asset classes such as covered bonds, which have proved to be safe assets over a long time, is obvious."[1]

What makes covered bonds special is that, differently from traditional long-term debt securities issued banks, they are secured by dedicated collateral. As a matter of fact, they constitute a sort of "secured senior debt" with dual recourse, by offering to the covered bondholders (*i*) a priority claim on the issuer and (*ii*) a claim on an underlying pool of specific high-quality assets of the issuer (called "cover pool" assets, and constituted mostly by first-rank mortgage loans or high-quality public debt).[2] The cover pool assets have three main characteristics. First, they are deemed to remain on the issuer's balance sheet. Second, they are ring-fenced or encumbered to give covered bondholders greater protection in case of the issuer's default. Finally, they tend to be dynamic, in the sense that the issuer has the ongoing obligation to replenish weak quality assets with good quality ones of equivalent value throughout the life of covered bonds to maintain the requisite collateralization. The collateral value is typically required to be higher than the nominal value of the outstanding covered bonds[3] of an issuer in order to obtain a certain level of "over-collateralization". Voluntary over-collateralization tends to be chosen above legal/regulatory minimum levels, when these requirements exist, as a result of market choices or prerequisites to obtain a given external credit rating grade for the covered bond (Packer et al., 2007).

While the over-collateralization is in place to protect covered bond investors, thus reducing their risk exposure and the cost of such funding instruments, it constitutes a form of *asset encumbrance* (or pledging or earmarking assets) especially in the case of those issuers that do not adopt a specialized credit institution model in which the lending activity is entirely or almost entirely financed via the issuance of covered bonds.

Higher asset encumbrance levels translate into higher levels of subordination of unsecured creditors, a process called "structural subordination", and affect adversely the residual claims of unsecured creditors, raising their loss given default (LGD).

Houben and Slingenberg (2013) identify three reasons for this. First, over-collateralization increases asset encumbrance relative to obtained funds, thereby lowering the amount of assets to satisfy residual claims in the

[1] From a keynote address by Jean-Claude Trichet at the University of Munich on 13 July 2009.
[2] In case of default, if the collateral is insufficient, the covered bondholders have a claim on the issuer's other assets, equivalent in seniority to other creditors.
[3] Or, which is the same thing, the loan-to-value ratio is typically required to be lower than 100%. According to the Capital Requirements Directive (CRD), the loan-to-value ratio for mortgage loans may not exceed between 80% (if residential) and 60% (if residential).

event of default. Second, issuers generally use better quality assets to back covered bonds, thus eroding the average quality of the assets backing claims of unsecured creditors. Third, the dynamic nature of the cover pool forces the covered bond issuer to replace non-performing assets with performing ones of equivalent value over the life of the bond. By implication, the assets available to meet claims of other creditors can decline quickly, particularly in periods of weaker economic activity with a general decline in the quality of bank balance sheet assets.

Additionally, it is indeed during stressed market conditions that the risk premium for holding unsecured bank debt is likely to rise and banks can have stronger incentives to raise more secured funding, leading to a further increase in the level of asset encumbrance. As pointed out by Bank for International Settlements (2013), rising asset encumbrance levels, in turn, tend to amplify banks' reliance on secured funding markets, due to limited levels of disclosure on asset encumbrance and over-collateralization. Since this makes the estimation of the LGD more difficult, the access to unsecured funding markets can become more difficult, thus generating a vicious circle where the willingness of unsecured creditors to provide funding decreases more and more and the secured senior debt becomes the only type of funding reasonable. Beyond a certain threshold level of asset encumbrance and in absence of other risk mitigants, issuers might find it increasingly difficult to access unsecured funding markets.[4]

Such two-way interaction between secured and unsecured funding markets is well described by Ahnerty et al. (2016) who develop a model of bank funding and asset encumbrance in which covered bonds assume center stage. Covered bond issuance influences the incidence of runs by unsecured creditors and, in turn, conditions in the unsecured funding market influence the choice of asset encumbrance and covered bonds by banks. They highlight two effects of asset encumbrance and covered bond issuance. The first is a *risk concentration effect*: as more covered bonds are issued, credit risk is asymmetrically concentrated onto unsecured creditors, resulting in greater fragility. The second is a *bank funding effect*: greater issuance of covered bonds finances more profitable investment, which increases the expected equity value and reduces the potential for a run. The optimal choice of encumbrance balances these opposing effects.

Houben and Slingenberg (2013) highlight the fact that the increasing level of asset encumbrance tilts risk not only towards unsecured debt holders but also towards retail depositors, especially in jurisdictions where they enjoy the same seniority (i.e., rank *pari passu*), and – ultimately – towards deposit insurers. Interestingly, since the pricing of deposit insurance schemes is usually insensitive to LGD, banks with a large retail deposit base may find it attractive, from a cost perspective, to issue secured rather than unsecured debt, thereby shifting risks to depositors and the deposit guarantee scheme. To the extent that insured depositors (especially if the deposit

[4] See Houben and Slingenberg (2013).

insurance system is sufficiently credible) have less incentive to monitor banks than bond holders,[5] increasing levels of asset encumbrance might also weaken the market discipline mechanisms on bank risk-taking.[6]

Summing up, the higher the level of asset encumbrance and the greater the structural subordination for senior unsecured debt holders and, by that, the lower their recovery values in the case of default of the issuing bank (Erhardt et al., 2016 and Houben et al., 2013). On the other hand, being secured funding cheaper than unsecured funding, a higher amount of secured funding might decrease the overall costs of funding of the bank. Structural subordination induced by asset encumbrance has another possible effect: it might affect a bank's decision regarding the risk profile of its asset. On one side, a higher level of asset encumbrance could bring the bank to decrease its asset risk to relieve the senior unsecured creditors, who would impose some market discipline on banks; on the other side, it could induce the banks to relieve the unsecured creditors by increasing the equity capital through an investment in more lucrative (but riskier) assets, consistently with the bank funding effect *à la* Ahnerty et al. (2016).

We address these issues by investigating the following research questions: Is there a causal relationship between a bank's covered bond exposure (i.e., its covered bond-based asset encumbrance) level and its risk exposure? Is such effect related only to a change in the capital structure or is it also the consequence of a change in the asset risk? In order to address these questions, we test whether three different market based measures of the bank risk exposure are sensitive to the level of the covered bond-based asset encumbrance. In particular, we distinguish among the bank's general default risk, the senior unsecured creditors' credit risk, and the bank's asset or portfolio risk. We conduct our tests on a sample of listed European banks over the 2004-2013 period.

Our empirical results indicate that (*i*) covered bond exposure increases the bank's general default risk; (*ii*) such effect is mainly driven by an increase of the senior unsecured creditors' credit risk; whereas (*iii*) the bank's asset risk is not directly affected by the asset encumbrance level.

Our paper contributes to the academic literature on the asset encumbrance and covered bonds, which, despite the systemic importance of the phenomenon, is quite scarce. Most existing research has been conducted by fixed-income departments of major European banks, international covered bond associations,[7] or international organizations.[8] The existing academic literature on covered bonds is both empirical and theoretical.

As the empirical literature is concerned, Carbo-Valverde et al. (2011) examine to which extent covered bonds are substitutes for mortgage-backed securities; Packer et al. (2007) evaluate the relation between covered bond spreads and issuer credit quality, Prokopczuk and Vonhoff (2012) and Prokopczuk et al. (2013) study the impact of market liquidity and asset quality on covered bond pricing;[9] Helberg and Lindset (2016) use the yield

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[5] See Morgan and Stiroh (2000) and Martinez Peria and Schmukler (2001).
[6] Such argument is also put forward by Duffie and Skeel (2012) in the case of the repo collateral.
[7] Like the European Covered Bond Council.
[8] Like the Bank for International Settlements, the European Central Bank, or the European Banking Authority.
[9] Using a wide sample of European covered bonds, Packer et al. (2007) do not find any significant relationship between the spreads and issuers' credit quality. Prokopczuk et al. (2013) examine the yield spread between covered bonds and governments bonds in Germany and show that not only liquidity, but also issuer-specific effects, especially the quality of the cover pool (in particular whether they are covered public-sector or mortgage loans), are relevant factors of these spreads. In particular, the yield spread differences among covered bonds are mainly driven by their relative liquidity. Studying the

on unsecured senior bonds and secured covered bonds of the same issuer to analyze the risk reduction due to the collateral. Finally, Erhardt et al. (2016) evaluate the impact of asset encumbrance on the bank's weighted average cost of funding and find a positive relation.

On the theoretical side, we build mainly on the studies such as Ahnert et al. (2016) and Gai et al. (2013). Ahnert et al. (2016) study how a bank's usage of covered bonds affects a trade-off between profitability (due to the cheap source of funding for banks offered by covered bonds) and fragility (due to the risks that these instruments asymmetrically shift onto unsecured creditors). They find that, on the one hand, as covered bonds are a stable funding instrument, they reduce bank default risk. On the other hand, the structural subordination induced by the asset encumbrance associated with the use of covered bonds dilutes the claims of unsecured creditors, thereby raises their incentives to withdraw early and increases default risk. Gai et al. (2013) investigate how the insolvency and illiquidity risks of a bank are influenced by the way it finances its business activities. To this end, they use a simple model of secured and unsecured bank funding to analyze the impact of increased asset encumbrance on liquidity risk, solvency risk and changes in collateral value and they find that unsecured creditors are harmed by the prospect of falling collateral values and expectations that the bank's asset encumbrance might increase.

Our study makes three main contributions to the existing literature. First, it looks at different effects of asset encumbrance on bank risk profile, proving that the risk concentration effect *à la* Ahnert et al. (2016) dominates the bank funding effect and that the covered bond exposure does not affect the asset risk. Second, it quantifies these effects, showing that if asset encumbrance affects a bank risk dimension, such effect is economically significant. Third, we focus our attention on all the listed European banks over a ten years period during which the covered bonds have become gradually more important and two crisis episodes, the global banking crisis of 2007-2008 and the Euro sovereign debt crisis of 2010-2012, have occurred.

Our focus on the European banks is justified by the fact that the current covered bond market is essentially a European market: 94% of the covered bonds outstanding in 2012 were issued by European firms (Le Leslé, 2012). The value of such market in 2014 was of around 2.5 trillion Euros (European Covered Bond Council, 2016). The issuance volume of European covered bonds in 2014 accounted for 33% of the overall Euro bonds issued by financial institution and 17% of all private sector Euro bonds.[10] Even if differences in countries' financial systems still represent important driving forces of asset encumbrance across countries (Juks, 2012), in the European Union covered bonds are defined by the Capital Requirements Directive (CRD), which limits the range of accepted collateral to debts of highly rated public entities, residential, commercial and ship mortgage loans, and bank debt or mortgage-backed securities (MBSs).

European covered bond market, Prokopczuk and Vonhoff (2012) examine the yield spread between covered bonds and interest rate swaps and show that country-specific differences exist and developments in the real estate market explain a major fraction of these spreads during the financial crisis.

[10] Source: Dealogic.

The paper is organized as follows. Section 2 presents the methodology of the empirical analysis. Section 3 describes the data sources and summarizes sample characteristics. Section 4 presents the empirical results. Section 5 concludes.

2. Research methodology

As mentioned, the main goal of this study is to evaluate the impact of the asset encumbrance originated from outstanding covered bonds on bank risk. Below we explain how we measure “covered bond-based asset encumbrance” and bank risk and we illustrate our research strategy.

2.1.Measuring covered bond-based asset encumbrance

Our research relies on a measure of the total amount of covered bonds outstanding at the bank level at the end of each year. However, such a measure is difficult to retrieve, as public information on covered bonds is poor. For most banks, financial statements disclose whether there was an issuance of covered bonds during the last accounting year, but do not give any information about outstanding amounts. Data are available at the country level, but are not disclosed at the individual bank level.[11]

Given these issues, we retrieve our measure of total covered bonds outstanding from Dealogic DCM. The Dealogic DCM database contains information at the individual bond issuance level and lists, for each issuance (included the covered bond ones), the amount, the issue date, the maturity date, the name of the issuer and its parent company, and further additional details. Given that we observe banks at the parent company level, to compute the amount of total outstanding covered bonds of bank i at time t, we must identify all the covered bond issuances whose issuer parent at time t is bank i and with maturity date $m > t$. Unfortunately, the parent company that Dealogic DCM attaches to a bond issuance is the current one (or, to be more precise, the one at time of the data downloading).

As an example of the amount of work needed to compute the bank’s total outstanding covered bonds, consider the case of HypoVereinsbank (HVB), a German listed bank. The bank, originally independent, was bought by UniCredit, an Italian listed bank, in 2005. Since then, HVB’s parent company is UniCredit. As Dealogic DCM refers the current ownership relationship, all bonds issued by HVB (even those occurred before 2005, when HBV a stand-alone independent entity) are assigned to UniCredit as parent company. In order to circumvent this problem and to assign a bond issuance to the issuer parent i at any point of time t, we trace the ownership history and events of all the covered bond European issuers available in Dealogic DCM on the base of the information collected from company websites, Wikipedia and other sources. The exact dates of relevant

[11] See Helberg and Lindset (2014).

ownership events were retrieved from Dealogic M&A and Zephyr. Once we assign each covered bond issuance to its parent company at any point of time *t*, we aggregate them by parent company *i* according to the following rule: a covered bond issuance is considered as outstanding at time *t* for bank *i* if *t* is between the deal pricing date and the maturity date. Hence, the bank *i*'s total outstanding covered bonds at time *t*, $CB_{i,t}$, is simply the sum of all the outstanding covered bond issuances that at time *t* have bank *i* as issuer parent. In case a bank is sold, its outstanding covered bonds are assigned to the new parent. Finally, we normalize the total outstanding covered bonds for the bank size dividing $CB_{i,t}$ by its total assets, thus obtaining our the $CB\_RATIO_{i,t}$ variable.

It is worth noting that covered bonds are not the sole responsible financial instruments for a bank's asset encumbrance. Repos and security borrowing and derivative claims lead to asset encumbrance as well. However, measuring the relevance of the overall asset encumbrance for a bank is far from easy, as its disclosure is, in general, poor and varies considerably across banks and different sources of asset encumbrance. As Juks (2012) points out, asset encumbrance originated from covered bonds is probably the best documented form of encumbrance, even if there are no uniform disclosure standards for covered bonds as well. Asset encumbrance from repos and derivatives has limited or no disclosure at all. This circumstance motivates the choice to focus our analysis on the effects of asset encumbrance originated by the covered bonds only. Moreover, as we base our research strategy on the market perception of the impact of asset encumbrance on bank risk exposure, we believe that our analysis, centered on the only easy-to-detect component of asset encumbrance, is consistent with its assessment by the market.

2.2. Measuring bank risk

2.2.1 The different risk dimensions

The main goal of this study is to analyze whether covered bond-based asset encumbrance has an impact on the bank risk profile. There exist different ways of referring to bank risk, as well as different ways to measure it (see Iannotta et al, 2013). We refer to three different dimensions of the bank risk profile: the bank's risk of default, the risk to senior unsecured creditors, and the riskiness of the bank's assets.

Our first measure of risk refers to the bank's general default risk, i.e., the probability that any of the bank's creditors suffers losses as a consequence of a delay in interest or principal payment, debt restructuring, or bankruptcy. A default of the bank will affect creditors differently depending on the seniority ranking or the priority of claims of the different categories of bank creditors. Senior secured creditors, such as holders of covered bonds, are secured against bank's assets and are ranked ahead of other secured creditors. Senior unsecured bonds come second, followed by subordinated creditors. Therefore, credit risk increases as we move from senior secured creditors to subordinated creditors. Given that one of the most relevant consequences of asset encumbrance is its structural subordination, i.e., its tendency to shift (default) risk to senior unsecured creditors, we find valuable to look at the default risk for such category of creditors, and see if and to which extent it is affected by asset encumbrance. Finally, looking at the default risk, referred either to the firm as a whole, or to senior creditors, would provide some useful insights on the consequences of asset encumbrance, but it could fail to explain the mechanisms behind such effects. In fact, a change in default risk could be due not only to a change in the bank liability structure, which is always triggered by debt issuance, but also to a change in the risk of the asset side. To check if this is the case we also look at a measure of asset or portfolio risk and see if it is influenced by asset encumbrance.

Consistent with this line of reasoning, we use three different measures of risk.

2.2.2 Bank's general default risk

There are different ways to measure the general bank default risk. The first and most common is based on the use of accounting ratios which are easy to compute and have the advantage of being generally available for all banks. As noted by Iannotta et al. (2013), besides the problem of the reliability of accounting values, analyzing risk using accounting ratios rises an endogeneity issue. These problems are only partially addressed with default risk measures such as the Z score, based on a bank's leverage and the mean and volatility of its return on assets. Market-based measures are generally more effective in representing a bank's risk because they reflect the capital markets' perception of risk and are more comprehensive than accounting-based measures as they account not only for the bank's economic and financial conditions but also its management quality, organization, governance, and so on. Therefore, we measure the bank ***i***-th's general default risk at year-end t with its distance to default, $DTD_{i,}$. This measure is generated from the theoretical underpinnings of the Black-Scholes-Merton structural model of default probabilities using both accounting and market data. Our firm-level default data comes from the Risk Management Institute (RMI) at National University of Singapore. RMI data are computed according to a modified version of the popular KMV estimation approach based on the Merton (1974) credit risk model. The modifications accounts for the high-leverage feature of banks and insurance companies in the transformed data MLE framework of Duan (1994) thus avoiding some of the distortions to credit analysis of such types of firms.[12]

2.2.3 Senior creditors' risk

We assess senior creditors' risk with the $SPREAD12_{i,t}$ variable, i.e., bank ***i***-th's average daily prices of 5-years[13] senior debt CDS contract denominated in euros with a "modified-modified" (MM) restructuring clause[14] observed in year t. CDS quotes are retrieved from MarkIt Group Ltd, which collects indicative CDS premia from a broad range of dealers and aggregates them into a composite value, thus ensuring reasonably continuous and accurate time series. Even if the quote aggregation performed by MarkIt alleviates the problem, in order to

[12] For a detailed description of RMI's firm-specific distance-to-default calculation method, see http://rmicri.org/data/document. For further conceptual background on this approach, see Duan et al. (2012).
[13] 5 years is the maturity of most liquid CDSs.
[14] The majority of European default swaps are transacted according to the "modified-modified" restructuring clause.

mitigate the impact on of missing and stale spreads we follow Schneider et al. (2010) and require that the overall percentage of missing or stale spreads must not exceed 15% per each bank-year and that the length of the longest series of consecutive missing/stale spreads must be 10 days or less.

2.2.3 Bank's asset risk

The previous two market-based measures refer to the bank's default risk, and account for bank capital strength. In order to isolate the component of default risk due to portfolio risk, we follow Vallascas and Hagendorff (2013) and use the $ASSET\_VOL_{i,t}$ variable, which indicates bank *i*-th's asset volatility at year-end *t*. We estimate *ASSET_VOL* using the market value of equity to solve the asset value and its volatility through a KMV-like approach.[15] We adopt this measure to capture the risk of a change in the value of a bank's assets, as in Vallascas and Hagendorff (2013).

2.3.The empirical framework

To determine whether the amount of covered bonds outstanding affects the bank risk exposure, we first estimate variants of the following regression, inspired by Flannery and Giacomini (2015), where bank characteristics are measured at *t*-1 to mitigate endogeneity concerns:

$$Risk_{i,t} = \alpha + \beta\ CB\_RATIO_{i,t\text{-}1} + \gamma\ X_{i,t\text{-}1} + \varphi\ GDP_{i,t} + \delta\ Year_t + \varepsilon_{i,t} \qquad (1)$$

The dependent variable, $Risk_{i,t}$, is measured in terms of either Distance-to-Default, $DTD_{i,t}$, the average (over the last 12 months) 5-year CDS Spread, $SPREAD12_{i,t}$, or the bank's asset volatility $ASSET\_VOL_{i,t}$. The three risk measures have different interpretation: an increase in *DTD* denotes a decrease in the bank risk exposure, whereas the same event will be mirrored – from the senior creditors' point of view – by a decrease in *Spread*12; and an increase in *ASSET_VOL* corresponds to an increase in the bank's portfolio risk. The key independent variable, $CB\_RATIO_{i,t\text{-}1}$ is the weight of covered bonds outstanding (relative to total assets) in year *t*-1.

$X_{i,t\text{-}1}$ is a vector of bank control variables that may affect the firm's credit risk. The bank characteristics that we control for are: $SIZE_{i,t\text{-}1}$, measured as the log of total assets); $ASSET\_QUAL_{i,t\text{-}1}$, the bank asset quality, inversely proxied by the ratio of loan loss provisions to gross loans; the bank profitability, measured through $ROA_{i,t\text{-}1}$; and (in the specifications where risk is measured as *SPREAD*12) $CAPITAL_{i,t\text{-}1}$, the bank capitalization, defined as the ratio of equity to total Assets. We also control for the annual gross domestic product (*GDP*) growth rate of the country where bank *i* is located.[16] Detailed definitions of all these variables and their sources

[15] See Keenan and Sobehart (1999) and Sobehart et al. (2000).
[16] The *GDP* variable should account for the impact of the economic cycle on the bank performances, while the country dummy variables should capture any difference in the institutional framework, the degree of competition, the accounting standards, etc., among the European countries.

are provided in the Appendix. To account for time-specific effects, we include a vector of time dummy variables, $Year_t$. In all the specifications, we include country fixed-effect to capture any time invariant country specific conditions. Alternatively, we include bank fixed effects to control for all time-invariant, unobserved bank characteristics that may affect risk and the amount of covered bonds outstanding. The standard errors are robust to heteroscedasticity and are clustered at the bank level.

In a second empirical approach, inspired by Gopalan et al. (2014), we estimate variants of the following first-difference panel regression model:

$$\Delta Risk_{i,t} = \alpha + \beta\, \Delta CB\_RATIO_{i,t\text{-}1} + \gamma\, \Delta X_{i,t} + \varphi\, \Delta GDP_{i,t} + \delta\, Year_t + \varepsilon_{i,t} \quad (2)$$

Here the dependent variable, $\Delta Risk_{i,t}$, represents the change in bank i's credit risk during year t. The key independent variable, $\Delta CBRatio_{i,t\text{-}1} \equiv CBRatio_{i,t\text{-}1} - CBRatio_{i,t\text{-}2}$ denotes the change in the weight of covered bonds outstanding (relative to total assets) in year t-1 relative to year t-2. Thus, a positive value of $\Delta CBRatio_{i,t\text{-}1}$ implies that bank i's relative covered bond outstanding risk has increased in year t-1.

We control in this regression for changes during year t ($\Delta X_{i,t} \equiv X_{i,t} - X_{i,t\text{-}1}$) in the same bank characteristics as in the regression model of Equation (1) that may produce a change in the firm's credit risk. Controls include the change in the growth rate of *GDP*, year fixed effects and either bank or country fixed effects. The standard errors are robust to heteroscedasticity and are clustered at the bank level.

3. Data sources and sample characteristics

Our sample consists of all the commercial banks[17] whose shares were listed on a regulated market during the 2004-2013 period and headquartered in any of the 23 European countries[18] that experienced at least one covered bond issuance during the same period. 71 out of the 106 banks in the sample were covered bonds issuers during the sample period.

Banks are observed at the parent company or bank holding level in order to avoid any potential bias in the risk measures given by the fact that a parent entity can act as guarantor on subsidiaries' liabilities. Also, as observed by Camba-Mendez et al. (2014), focusing on the parent holdings, rather than individual subsidiaries is also justified by the fact that it would be difficult to attribute to a certain subsidiary firm the debt issued by the holding, as it is common for European banks to use special purpose entities to issue debt. Finally, as banks are usually listed at the holding level, focusing at the parent level allows us evaluate bank risk exposure using

[17] We define commercial banks a company classified in the Banks industry group of the Bloomberg Industry Classification Systems with a Deposit/Total Assets ratio above 20% and a Loans/Total Assets ratio above 10%.

[18] Austria (AS), Belgium (BE), Cyprus (CC), Denmark (DE), Finland (FI), France (FR), United Kingdom (UK), Germany (GE), Greece (GR), Hungary (HU), Iceland (IC), Ireland (IR), Italy (IT), Luxemburg (LX), The Netherlands (NE), Norway (NO), Poland (PD), Portugal (PO), Russia (RU), Spain (SP), Slovenia (SV), Sweden (SW), Switzerland (SZ).

marked-based indicators that are unavailable at a lower level. The sample is an unbalanced one. A bank enters the sample when it is listed and it exits when it is delisted or it is acquired by (or merged with) another bank.[19] Table 1 reports the number of banks from each country and for each sample year. Even if German, Polish, Austrian, Italian and French banks are the most numerous in Europe,[20] the most represented countries in our sample are Italy, Spain, followed by Greece and Austria. The difference is due to the fact that our sample includes listed banks only whose distribution differs from the overall distribution of European banks (indeed Italian and Spanish banks are the most numerous (7 each) within the STOXX Europe 600 Banks Index, which comprises 44 banks and account for 5 each (just behind the UK which account for 6 banks) in the MSCI Europe Banks Index, which includes 34 banks.

Insert Table 1 approximately here

Our sample includes covered bond user and non-user banks. We define a bank *i* as a covered bond user at time *t* if the bank *i*'s total outstanding covered bonds at time *t*, $CB_{i,t}$, is positive. Table 2 reports the percentage of covered bond users in our sample classified by year and country. Overall more than half (55%) of the banks in our sample are covered bond users. The percentage has increased constantly over the sample period from 36% (in 2004) to 74% (in 2013). For some countries (Iceland, Luxembourg, Poland, and Slovenia) no covered bond user appears in our sample, even if unlisted banks in these countries have issued covered bonds in the sample period. For some other counties (Belgium, Finland, France, Hungary, and Switzerland) all the banks in our sample are covered bond users.

Insert Table 2 approximately here

4. Empirical results

4.1.Descriptive and bivariate analysis

Table 3 presents the mean of our key explicative variable, *CB_RATIO*. For all the banks in our sample, the amount of covered bonds outstanding account on average for about 3.7% of the total assets. This percentage has increased over the sample period and is varies considerably across countries, being Finland, Germany, Spain,

[19] Consider, again, the example, of HypoVereinsbank (HVB) and UniCredit. HVB was bought in 2005 by UniCredit. Consequently, both UniCredit and HVB appear in the sample in 2004, but since 2005 only UniCredit is included. Similarly, on December 2006 two Italian listed banks, Sanpaolo IMI and Banca Intesa, merged to form the current Intesa Sanpaolo. Consequently both banks are included in the sample in 2004 and 2005, but since 2006 only Intesa Sanpaolo appears in the sample.

[20] Source: European Banking Authority' aggregate statistical data (http://www.eba.europa.eu/supervisory-convergence/supervisory-disclosure/aggregate-statistical-data).

and Hungary the countries with the higher weight of covered bonds outstanding over the total banking assets. This is not surprisingly, because Germany, Spain, and Nordics are the countries with the first legislations in this area and have recently adopted some transformations (especially regarding transparency) to enhance the credibility and the quality of this debt instrument.

Insert Table 3 approximately here

The use of covered bonds is reported in Table 4 in the intensive margin, i.e., for the sample of covered bond users. The figures indicate that the average covered bond user had covered bonds outstanding for about 6.6% of its total assets. Such percentage is highest in Finland, Germany and Spain (higher than 10%) and has remained relatively stable, on average, over the sample period.

Insert Table 4 approximately here

Table 5 reports sample descriptive statistics for the three indicators of bank risk, *DTD*, *SPREAD*12, and *ASSET_VOL*, and the control variables Total Assets[21], *ASSET_QUAL*, *ROA*, and *CAPITAL*. The variables are defined in Appendix. All the statistics are provided for the entire sample and are also broken up into ten subsamples corresponding to the ten years of our sample period to value trends and differences over time. In fact, apart from capitalization, which does not change too much over our sample period due to the regulatory constraints, the risk variables, the measures of profitability and asset quality show quite clearly the impact of the two crisis episodes, the global banking crisis of 2007-2008 followed by the Euro sovereign debt crisis of 2010-2012.

Insert Table 5 approximately here

In Table 6 we perform *t*-tests for equality of means of risk exposure and other variables between banks that use and banks that do not use covered bonds. Again, we use our entire sample and the ten 2004-2013 year subsamples.

We document that covered bond users are riskier than non-users both in terms of distance to default and CDS spreads; however, they but exhibit lower asset risk. Covered bond users are less profitable than non-users in terms of *ROA*. Other significant differences refer to their size and capitalization: covered bond users are relatively larger in terms of total assets, and they are less capitalized. No significant difference emerges as far as

[21] We report the mean values of *TOT_ASSETS* instead of its logarithmic transformation (*SIZE*) used in the regressions.

the loan quality is concerned. However, apart from size and capital, the statistically significant differences that we find over the entire sample are not always confirmed when we look at the various year subsamples. This can be due to a role of a time effect which makes the phenomenon more or less pronounced in certain years or to the sample size effect. This calls for a more formal analysis to explore whether the risk – asset encumbrance relationship survive after controlling for the other bank characteristics, time and country specificities and other endogeneity concerns.

Insert Table 6 approximately here

4.2.Multivariate regression analysis

Table 7 reports the results of multivariate regressions based on Equation (1) above. We regress the three risk measure estimates, the bank's distance-to-default (in columns 1 and 2), its average CDS spread (in columns 3-6), and its asset volatility (in columns 7-10), of each bank at time *t* on lagged values of its asset encumbrance measure and control variables. Control variables include the bank's size, its asset quality, its profitability, the GDP rate of growth, and – for some specifications of the regressions of CDS spread and asset volatility– we also include a variable capturing the bank's leverage.[22] In each regression specification, we include time dummies and either country (odd columns) or bank (even columns) fixed effects. We find that the coefficient of the *CB_RATIO* variable is negative and statistically significant in the regressions of *DTD* and it is positive and statistically significant in all the regressions of *SPREAD*12. These results document an unfavorable impact of the asset encumbrance on both the bank's general default risk and the senior creditors' risk. In particular we find that an increase of one standard deviation in the covered bond outstanding ratio (6.01%) causes a decrease of up to 0.165 standard deviations of the distance-to-default – which corresponds to a 23% decrease relative to the average distance-to-default (1.21) – and an increase up to 0.157 standard deviations of the average CDS spread in the following year – which corresponds, once more, to a 23% increase relative to the average CDS spread (201.76). This result endorses the findings in Erhardt et al. (2016).

Conversely, the absence of any statistical significance of the coefficient of *CB_RATIO* in the regressions on *ASSET_VOL* reveals the neutrality of asset encumbrance for the bank's portfolio risk. Risk is negatively related to profitability (*ROA*), as expected. Finally, the sign and the statistical significance of the coefficients of the *GDP* variable in the various regression specifications suggests that stronger GDP growth reduces risk according to either *DTD* and *SPREAD*12 but it increases the bank's asset risk. One reason for this last outcome could be that as the economic environment rallies banks may increase lending and switch to riskier investments (e.g., corporate and retail).

[22] We do not include the leverage variable in the regression of distance –to-default, as the leverage variable enters the *DTD* formula.

Insert Table 7 approximately here

In Table 8 we report the estimation results of the regression model as in Equation (2). Control variables include the change in *ROA*, in some specifications, and the change in *CAPITAL*, in some of the specifications of the regressions of *SPREAD*12 and *ASSET_VOL*. For each regression specification we include time dummies and either country (columns 1-2, 5-6, and 9-12) or bank (columns 3-4, 7-8, and 13-16) fixed effects.

Results for (the change in) the *CB_RATIO* variable and most of the control variables are consistent with those of Table 7. In particular, our results document that a one standard increase in Δ*CB_RATIO*(*t*-1) (2.718) is associated with a decrease of 0.141 in *DTD*, which represents a 13% decrease relative to the mean of *DTD* (1.065) and with an increase of 23.32 in *SPREAD*12, which represents a 10% decrease relative to the mean *SPREAD*12 (221). Since this is a first-difference specification, the result implies that, all else equal, banks with greater asset encumbrance, as measured by the ratio of covered bonds outstanding to total assets, exhibit higher default risk exposure.

Insert Table 8 approximately here

To summarize, we find that asset encumbrance led by the issuance of covered bonds does not affect the bank's asset risk, but it changes the shape of the bank's liability structure in such a way that both the bank's general default risk and the specific senior creditors' risk rise.

It is worth noting that regressions reported in Tables 7 and 8 are estimated over different samples, because the number of observations available for the three dependent variables is different. Nonetheless, to make sure that our results are not driven by the sample differences, we re-run the estimations in Tables 7 and 8 on a subsample of bank/year observations for which all the three dependent variables are available. Results, not reported, do not change in any material way.

5. Conclusions

This study investigates whether and to which extent asset encumbrance affects bank risk profile. We find that that asset encumbrance induced by the bank's total covered bonds outstanding leads to structural subordination of unsecured claimants: their claims become riskier as asset encumbrance increases. The effect is economically significant, as a one standard deviation increase in the covered bond outstanding ratio (6.01%) causes a drop in the distance-to-default which corresponds to the 23% of its average value.

Asset encumbrance deteriorates also the bank's overall default risk, as documented by the effect of bank's total covered bonds outstanding on the bank's average senior CDS spread: a one standard deviation increase in the covered bond outstanding ratio causes an increase in the CDS corresponding to the 23% of its average value. These results suggest that the risk concentration effect prevails over the bank funding effect as defined by Ahnert et al. (2016). The prevalence of the risk concentration effect is also consistent with our third result that is the asset encumbrance irrelevance for the bank's asset risk.

It is worth saying that our results are based on an asset encumbrance measure which is partial by definition, as it takes into account only one source of asset encumbrance: the covered bonds outstanding. Also, in absence of an objective and reliable asset encumbrance information, our measure is far from being easy-to-observe. Our evidence that even a partial asset encumbrance measure has material effects, underpins the recommendation of the Financial Stability Board (2013) that banks should provide detailed asset encumbrance information in their annual accounts. Improved disclosure on asset encumbrance could help investors to price debt correctly and enable banks to maintain an appropriate balance between secured and unsecured debt, making sure that such price valuations and decisions are taken according to a truthful representation of the asset encumbrance level rather than be mainly driven by the uncertainty around it.

Appendix

Variable definitions
Subscripts *i* and *t* refer to a particular firm and fiscal year, respectively. Subscript *c* refers to a country.

Variable	*Definition*	*Source*
$CB\_RATIO_{i,t}$	the ratio of the Total Outstanding Covered Bonds to Total Assets	DCM Analytics and Bankscope
$DTD_{i,t}$	the distance to default	NUS RMI
$SPREAD12_{i,t}$	the average daily price – over the entire observed year – of the 5-years senior debt CDS contract	Markit
$ASSET\_VOL_{i,t}$	the estimated market-based asset volatility	Bloomberg and Bankscope
$SIZE_{i,t}$	the natural logarithm of Total Assets	Bankscope
$ASSET\_QUAL_{i,t}$	the asset quality, i.e., the ratio of Loan Loss Provisions to Gross Loans	Bankscope
$ROA_{i,t}$	the ratio of Net return to Total Assets	Bankscope
$CAPITAL_{i,t}$	the capitalization, i.e., the ratio of Equity to Total Assets	Bankscope
$GDP_{c,t}$	the growth rate of the GDP	World Bank

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Tables

Table 1. Number of banks in the sample per country and year.

This table reports the number of observations in the sample, classified by year and country.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	*Total*
Austria	5	5	6	6	6	5	5	5	5	5	*53*
Belgium	2	2	2	2	2	2	2	2	2	2	*20*
Cyprus	1	1	2	2	2	2	2	2	2	2	*18*
Denmark	6	6	6	5	5	5	4	5	5	4	*51*
Finland	1	1	1	1	0	0	0	0	0	0	*4*
France	3	3	3	3	3	3	3	4	4	4	*33*
UK	8	8	8	8	6	6	5	5	5	5	*64*
Germany	7	5	5	4	4	4	3	3	3	2	*40*
Greece	7	7	7	7	7	7	7	5	5	5	*64*
Hungary	1	1	1	1	1	1	1	1	1	1	*10*
Iceland	1	1	1	1	0	0	0	0	0	0	*4*
Ireland	4	4	4	3	3	3	2	3	2	2	*30*
Italy	20	19	16	15	15	14	14	14	14	14	*155*
Luxembourg	1	1	0	0	0	0	0	0	0	0	*2*
Netherlands	2	2	2	1	1	1	1	1	1	1	*13*
Norway	1	1	1	1	1	1	1	1	1	1	*10*
Poland	1	1	1	2	2	2	2	2	2	2	*17*
Portugal	3	4	4	4	4	4	4	3	4	4	*38*
Russia	1	1	1	1	1	1	1	1	1	1	*10*
Spain	11	11	11	12	11	10	9	10	7	8	*100*
Slovenia	1	1	1	1	1	1	0	0	0	0	*6*
Sweden	4	4	4	4	4	4	4	4	4	4	*40*
Switzerland	2	2	2	2	2	2	2	2	2	2	*20*
Total	*93*	*91*	*89*	*86*	*81*	*78*	*72*	*73*	*70*	*69*	*802*

Table 2. Covered bond users in the sample.

This table reports the percentage of the banks in each country of the sample with covered bonds outstanding classified by year.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	*Total*
Austria	20%	20%	17%	33%	33%	40%	40%	20%	20%	20%	*26%*
Belgium	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	*100%*
Cyprus	0%	0%	0%	0%	0%	0%	0%	50%	50%	50%	*17%*
Denmark	0%	0%	17%	20%	20%	20%	25%	20%	20%	25%	*16%*
Finland	100%	100%	100%	100%	-	-	-	-	-	-	*100%*
France	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	*100%*
UK	38%	38%	38%	50%	83%	83%	80%	80%	80%	80%	*61%*
Germany	57%	60%	60%	50%	75%	75%	67%	67%	67%	100%	*65%*
Greece	0%	0%	0%	0%	29%	29%	29%	60%	60%	60%	*23%*
Hungary	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	*100%*
Iceland	0%	0%	0%	0%	-	-	-	-	-	-	*0%*
Ireland	50%	50%	75%	100%	100%	100%	100%	100%	100%	100%	*83%*
Italy	5%	11%	13%	13%	27%	36%	57%	71%	71%	71%	*35%*
Luxembourg	0%	0%	-	-	-	-	-	-	-	-	*0%*
Netherlands	100%	100%	50%	0%	100%	100%	100%	100%	100%	100%	*85%*
Norway	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%	*70%*
Poland	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	*0%*
Portugal	33%	25%	25%	50%	75%	75%	75%	100%	100%	100%	*66%*
Russia	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%	*30%*
Spain	73%	82%	82%	92%	100%	100%	100%	90%	100%	100%	*91%*
Slovenia	0%	0%	0%	0%	0%	0%	-	-	-	-	*0%*
Sweden	75%	50%	100%	100%	100%	100%	100%	100%	100%	100%	*93%*
Switzerland	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	*100%*
Total	*36%*	*37%*	*41%*	*48%*	*59%*	*62%*	*65%*	*72%*	*72%*	*74%*	*55%*

Table 3. Average covered bond outstanding ratio.

This table reports the mean of *CB_RATIO* (i.e., the ratio of the Total Outstanding Covered Bonds to Total Assets) for the banks in each country of the sample classified by year. All values are expressed in percentages (%).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	*Total*
Austria	0.040	0.100	0.100	0.250	0.250	0.410	0.550	0.700	0.720	0.660	*0.368*
Belgium	8.290	6.390	6.120	6.660	7.210	7.790	7.810	3.470	3.850	4.830	*6.242*
Cyprus	0	0	0	0	0	0	0	2.270	2.740	2.800	*0.868*
Denmark	0	0	0.090	0.090	0.290	0.540	0.690	0.700	0.950	1.240	*0.414*
Finland	18.950	24.960	28.040	26.020	-	-	-	-	-	-	*24.491*
France	0.180	0.210	0.290	0.540	0.690	1.130	1.400	3.330	3.620	3.600	*1.681*
UK	0.730	0.660	2.140	3.250	8.550	6.390	2.030	1.930	2.000	2.020	*2.870*
Germany	13.410	19.820	16.290	13.740	11.840	9.830	4.010	3.680	3.180	4.040	*11.419*
Greece	0	0	0	0	0.720	0.850	3.100	5.680	5.620	3.240	*1.647*
Hungary	7.980	7.820	9.140	7.850	11.410	13.160	10.820	8.760	7.920	6.610	*9.148*
Iceland	0	0	0	0	-	-	-	-	-	-	*0*
Ireland	9.720	9.490	11.820	3.920	4.450	5.350	6.140	5.610	6.060	5.420	*7.245*
Italy	0	0.260	0.250	0.190	0.440	0.980	1.500	3.050	4.020	4.260	*1.366*
Luxembourg	0	0	-	-	-	-	-	-	-	-	*0*
Netherlands	1.430	1.110	0.340	0	0.290	0.620	1.040	1.510	2.110	2.410	*1.057*
Norway	0	0	0	2.290	4.740	7.970	10.640	11.860	12.250	14.370	*6.412*
Poland	0	0	0	0	0	0	0	0	0	0	*0.000*
Portugal	0.170	0.110	0.130	0.820	3.020	4.010	5.580	8.140	5.730	4.970	*3.220*
Russia	0	0	0	0	0	0	0	0.02	0.01	0.01	*0.004*
Spain	4.260	5.870	7.460	8.160	10.360	11.240	12.570	14.520	15.040	14.790	*9.997*
Slovenia	0	0	0	0	0	0	-	-	-	-	*0*
Sweden	3.930	2.580	2.220	2.050	2.970	3.560	3.930	4.720	5.480	5.840	*3.729*
Switzerland	1.520	1.250	0.820	0.540	0.320	0.200	0.140	0.110	0.120	0.120	*0.514*
Total	*2.558*	*2.799*	*3.069*	*2.775*	*3.680*	*4.062*	*4.074*	*5.057*	*4.870*	*4.685*	3.691

Table 4. Average covered bond outstanding ratio of covered bond users.

This table reports the mean of *CB_RATIO* (i.e., the ratio of the Total Outstanding Covered Bonds to Total Assets) for the covered bond users in each country of the sample classified by year. All values are expressed in percentages (%).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	*Total*
Austria	0.189	0.484	0.607	0.738	0.757	1.030	1.384	3.496	3.623	3.299	*1.394*
Belgium	8.285	6.390	6.116	6.664	7.210	7.788	7.814	3.470	3.848	4.830	*6.242*
Cyprus	0	0	0	0	0	0	0	4.536	5.478	5.603	*5.206*
Denmark	0	0	0.544	0.446	1.441	2.711	2.759	3.513	4.757	4.961	*2.642*
Finland	0	0	0	0	0	18.947	24.956	28.039	26.023	0	*24.491*
France	0.181	0.212	0.289	0.539	0.694	1.125	1.403	3.327	3.617	3.596	*1.681*
UK	1.943	1.771	5.693	6.497	10.257	7.664	2.540	2.407	2.501	2.523	*4.710*
Germany	23.471	33.027	27.150	27.484	15.784	13.112	6.019	5.513	4.772	4.037	*17.567*
Greece	0	0	0	0	2.514	2.980	10.852	9.468	9.374	5.393	*7.026*
Hungary	7.979	7.820	9.140	7.855	11.409	13.160	10.824	8.765	7.924	6.607	*9.148*
Iceland	0	0	0	0	0	0	0	0	0	0	*0*
Ireland	19.439	18.979	15.761	3.920	4.454	5.353	6.142	5.608	6.056	5.416	*8.694*
Italy	0.005	2.461	2.009	1.432	1.645	2.753	2.623	4.272	5.622	5.970	*3.922*
Luxembourg	0	0	0	0	0	0	0	0	0	0	*0*
Netherlands	1.428	1.113	0.670	0	0.290	0.622	1.044	1.506	2.113	2.410	*1.249*
Norway	0	0	0	2.290	4.737	7.970	10.643	11.858	12.245	14.373	*9.159*
Poland	0	0	0	0	0	0	0	0	0	0	*0*
Portugal	0.501	0.458	0.516	1.641	4.029	5.341	7.438	8.136	5.729	4.967	*4.895*
Russia	0	0	0	0	0	0	0	0.021	0.008	0.008	*0.012*
Spain	5.851	7.173	9.117	8.905	10.364	11.240	12.570	16.131	15.040	14.786	*10.985*
Slovenia	0	0	0	0	0	0	0	0	0	0	*0*
Sweden	5.241	5.165	2.222	2.055	2.968	3.561	3.932	4.721	5.478	5.838	*4.031*
Switzerland	1.521	1.253	0.824	0.539	0.317	0.201	0.139	0.113	0.117	0.120	*0.514*
Total	*7.055*	*7.548*	*7.417*	*5.828*	*6.210*	*6.550*	*6.280*	*7.024*	*6.744*	*6.306*	6.653

Table 5. Sample Descriptive Statistics.

This table reports mean, standard deviation (in parenthesis), and number of observations (in brackets) of risk and accounting variables. *DTD* is the bank's the distance to default; *SPREAD12* is the average daily price – over the entire observed year – of the bank's 5-years senior debt CDS contract; *ASSET_VOL* is the bank's estimated market-based asset volatility; *CAPITAL* is the ratio of the bank's Equity to its Total Assets; *ROA* the bank's Return on Assets; *ASSET_QUAL* is the ratio of the bank's Loan Loss Provisions to its Gross Loans. Total Assets are measured in billion Euros.

	Entire sample	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
DTD	1.306	1.897	2.286	1.994	1.478	0.359	0.818	0.962	0.672	0.764	1.439
	(1.752)	(1.748)	(1.921)	(1.644)	(1.323)	(1.281)	(1.451)	(1.413)	(1.914)	(1.58)	(1.996)
	[744]	[87]	[84]	[79]	[76]	[75]	[73]	[69]	[68]	[67]	[66]
SPREAD12	179.879	18.252	15.087	12.954	30.856	131.469	195.663	227.271	466.234	488.253	301.283
	(293.662)	(7.394)	(6.51)	(8.57)	(16.501)	(90.756)	(138.185)	(194.082)	(470.508)	(495.878)	(270.878)
	[483]	[53]	[53]	[51]	[51]	[47]	[45]	[46]	[47]	[45]	[45]
ASSET_VOL	0.020	0.018	0.018	0.024	0.028	0.019	0.025	0.015	0.015	0.015	0.025
	(0.025)	(0.017)	(0.016)	(0.018)	(0.045)	(0.016)	(0.022)	(0.012)	(0.027)	(0.016)	(0.0356)
	[728]	[71]	[72]	[70]	[78]	[78]	[76]	[73]	[72]	[70]	[68]
Total Assets	318	190	246	280	320	347	326	361	390	396	371
	(490)	(281)	(372)	(429)	(525)	(583)	(499)	(539)	(571)	(554)	(500)
	[802]	[91]	[89]	[87]	[84]	[81]	[79]	[74]	[75]	[72]	[70]
ASSET_QUAL	0.010	0.005	0.004	0.004	0.004	0.008	0.019	0.011	0.014	0.018	0.018
	(0.019)	(0.004)	(0.005)	(0.003)	(0.004)	(0.004)	(0.045)	(0.009)	(0.017)	(0.019)	(0.025)
	[798]	[87]	[89]	[87]	[84]	[81]	[79]	[74]	[75]	[72]	[70]
ROA	0.361	0.735	0.860	0.972	1.072	0.481	0.093	0.312	-0.672	-0.438	-0.215
	(1.458)	(0.572)	(0.637)	(0.57)	(1.138)	(0.794)	(1.416)	(0.912)	(2.447)	(1.681)	(2.159)
	[800]	[89]	[89]	[87]	[84]	[81]	[79]	[74]	[75]	[72]	[70]
CAPITAL	0.061	0.065	0.059	0.060	0.063	0.056	0.064	0.064	0.055	0.055	0.067
	(0.034)	(0.065)	(0.025)	(0.025)	(0.034)	(0.026)	(0.024)	(0.024)	(0.029)	(0.03)	(0.024)
	[802]	[91]	[89]	[87]	[84]	[81]	[79]	[74]	[75]	[72]	[70]

Table 6. Bivariate Comparison of Risk Measures and Control Variables.

This table reports mean values of risk measures and control variables of Non-Covered Bond User Banks and Covered Bond User Banks, for the entire sample and each of the sample years. The value in parenthesis is the *t*-statistic for testing the equality of variable means. *DTD* is the bank's the distance to default; *SPREAD12* is the average daily price – over the entire observed year – of the bank's 5-years senior debt CDS contract; *ASSET_VOL* is the bank's estimated market-based asset volatility; *CAPITAL* is the ratio of the bank's Equity to its Total Assets; *ROA* the bank's Return on Assets; *ASSET_QUAL* is the ratio of the bank's Loan Loss Provisions to its Gross Loans. Total Assets are measured in billion Euros.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, for a *t*-test for the equality of variable means.

	Entire sample		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013	
	Non-CB user banks	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*	*Non-CB user banks*	*CB user banks*
	(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)		(*t* statistic)	
DTD	1.832	0.900	2.127	1.500	2.480	1.970	2.196	1.737	1.731	1.224	0.816	0.070	1.306	0.532	1.901	0.491	1.564	0.300	1.081	0.637	1.807	1.31
	(7.455)***		(1.626)		(1.185)		(1.198)		(1.692)*		(2.543)**		(2.264)**		(4.399)***		(2.584)**		(1.037)		(0.882)	
SPREAD12	102.513	212.418	19.598	16.494	16.699	13.138	16.13	10.131	34.085	28.405	141.104	128.865	266.328	182.646	337.08	207.561	496.663	462.611	589.264	475.626	346.416	296.879
	(-3.807)***		(1.534)		(2.041)**		(2.640)**		(1.223)		(0.374)		(1.492)		(1.657)		(0.151)		(0.478)		(0.345)	
ASSET_VOL	0.0239	0.0172	0.020	0.013	0.021	0.012	0.029	0.017	0.036	0.018	0.022	0.017	0.028	0.022	0.190	0.120	0.011	0.015	0.016	0.014	0.024	0.025
	(3.549)***		(1.672)*		(2.137)**		(3.049)***		(1.821)*		(1.551)		(1.035)		(2.132)**		(-0.603)		(0.494)		(-0.144)	
Total Assets	97.5	494	94.8	357	125	452	159	451	164	492	49.1	552	49.8	496	48.2	531	42.5	525	43.5	531	47.3	483
	(-12.436)***		(-4.772)***		(-4.399)***		(-3.298)***		(-2.993)***		(-4.184)***		(-4.258)***		(-4.047)***		(-3.526)***		(-3.617)***		(-3.422)***	
ASSET_QUAL	0.009	0.010	0.006	0.004	0.005	0.003	0.004	0.003	0.0037	0.0034	0.0077	0.0076	0.015	0.021	0.012	0.009	0.0145	0.0136	0.023	0.015	0.029	0.013
	(-0.675)		(2.063)**		(2.188)**		(2.291)**		(0.398)		(0.078)		(-0.598)		(1.116)		(0.214)		(1.564)		(2.432)**	
ROA	0.583	0.183	0.739	0.728	0.893	0.802	1.040	0.876	1.285	0.838	0.672	0.350	0.288	-0.027	0.441	0.241	-0.532	-0.726	-0.524	-0.405	-0.810	-0.008
	(3.884)***		(0.086)		(0.648)		(1.330)		(1.824)*		(1.824)*		(0.962)		(0.899)		(0.306)		(-0.267)		(-1.366)	
CAPITAL	0.069	0.053	0.072	0.051	0.063	0.051	0.065	0.050	0.073	0.052	0.069	0.047	0.075	0.056	0.074	0.057	0.063	0.052	0.062	0.052	0.079	0.063
	(6.854)***		(1.547)		(2.327)**		(2.799)***		(2.978)***		(4.048)***		(3.718)***		(3.131)***		(1.565)		(1.254)		(2.599)**	

Table 7. Effect of Covered Bonds Outstanding on Bank Risk (Regressions on lagged values).

This table reports the coefficient estimates and robust standard errors clustered at the bank level (in parentheses) of a test for the impact of the outstanding covered bonds on bank risk. The dependent variables are: (*i*) *DTD*, i.e., the bank's the distance to default (columns 1-2); (*ii*) *SPREAD12*, i.e., the average daily price – over the entire observed year – of the bank's 5-years senior debt CDS contract (columns 3-6); and (*iii*) *ASSET_VOL*, i.e., the bank's estimated market-based asset volatility. The explanatory variables are: the ratio of the bank's Total Outstanding Covered Bonds to its Total Assets (*CB_RATIO*); the natural logarithm of the bank's Total Assets (*SIZE*); the ratio of the bank's Equity to its Total Assets (*CAPITAL*); the ratio of the bank's Loan Loss Provisions to its Gross Loans (*ASSET_QUAL*) the bank's Return on Assets (ROA); the growth rate of the GDP of the country where the bank is domiciled (*GDP*). Bank balance sheet and income variables and bank risk variables are winsorized at the 1% and 99% levels. All the explanatory variables are measured at *t*-1 to mitigate endogeneity concerns. All the specifications also include year dummies.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	DTD(*t*)		*SPREAD*12(*t*)				*ASSET_VOL*(*t*)			
CB_RATIO(*t*-1)	-0.036***	-0.046**	2.883*	7.805**	2.946*	7.779**	-0.000	0.000	-0.000	0.000
	(0.013)	(0.023)	(1.644)	(3.612)	(1.689)	(3.712)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE(*t*-1)	-0.130*	-0.865**	-28.558***	-23.189	-28.144***	-23.232	-0.001*	-0.017***	-0.001	-0.018***
	(0.073)	(0.421)	(5.828)	(37.406)	(5.911)	(37.404)	(0.001)	(0.004)	(0.001)	(0.004)
CAPITAL(*t*-1)	-	-	-	-	180.074	-66.183	-	-	0.120	-0.010
					(492.215)	(948.540)			(0.104)	(0.113)
ASSET_QUAL(*t*-1)	4.091	2.939	2,158.254	-18.185	2,074.423	-10.325	0.281	0.293	0.254	0.294
	(9.449)	(10.549)	(1,606.221)	(1,811.854)	(1,562.528)	(1,794.406)	(0.208)	(0.217)	(0.187)	(0.212)
ROA(*t*-1)	0.445***	0.358***	-120.109***	-127.205***	-123.022***	-126.456***	-0.003*	-0.004*	-0.005*	-0.004
	(0.100)	(0.113)	(12.611)	(17.017)	(15.134)	(19.938)	(0.002)	(0.002)	(0.003)	(0.003)
GDP(*t*)	0.109***	0.100***	-58.592***	-57.520***	-58.614***	-57.511***	0.002***	0.001***	0.002***	0.001***
	(0.032)	(0.035)	(9.662)	(10.170)	(9.631)	(10.217)	(0.000)	(0.000)	(0.000)	(0.001)
Constant	4.342***	16.284**	786.027***	688.115	772.810***	690.782	0.036**	0.317***	0.018	0.322***
	(1.512)	(6.995)	(117.838)	(674.638)	(121.436)	(673.326)	(0.016)	(0.065)	(0.017)	(0.064)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Bank fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
No. of obs.	642	642	426	426	426	426	649	649	649	649
No. of banks	94	94	63	63	63	63	97	97	97	97
R^2	0.472	0.663	0.854	0.875	0.854	0.875	0.490	0.668	0.508	0.668

Table 8. Effect of Covered Bonds Outstanding on Bank Risk (First-difference regressions).

This table reports the coefficient estimates and robust standard errors clustered at the bank level (in parentheses) of a test for the impact of the outstanding covered bonds on change in bank risk. The dependent variables are: (*i*) Δ*DTD*, i.e., the change in the bank's distance to default (columns 1-2); (*ii*) Δ*SPREAD12*, i.e., the change in the average daily price – over the entire observed year – of the bank's 5-years senior debt CDS contract (columns 3-6); and (*iii*) Δ*ASSET_VOL*, i.e., the change in the bank's estimated market-based asset volatility. The explanatory variables are: the change, measured at t-1, in the ratio of the bank's Total Outstanding Covered Bonds to its Total Assets (Δ*CB_RATIO*); the change in the natural logarithm of the bank's Total Assets Δ(*SIZE*); the change in the ratio of the bank's Equity to its Total Assets (Δ*CAPITAL*); the change in the ratio of the bank's Loan Loss Provisions to its Gross Loans (Δ*ASSET_QUAL*); the change in the bank's Retun on Assets (Δ*ROA*); the growth rate of the GDP of the country where the bank is domiciled (*GDP*). Bank balance sheet and income variables and bank risk variables are winsorized at the 1% and 99% levels. All the specifications also include year dummies.
***, **, * indicate statistical significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Δ*DTD*(*t*)				Δ*SPREAD*12(*t*)				Δ*ASSET_VOL*(*t*)							
Δ*CB_RATIO*(*t*-1)	-0.040***	-0.040**	-0.052**	-0.051**	7.507**	7.388**	8.582*	8.439*	-0.000	-0.000	0.000	0.000	-0.000	0.000	0.000	0.000
	(0.015)	(0.016)	(0.022)	(0.023)	(3.663)	(3.611)	(5.189)	(5.044)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ*SIZE*(*t*)	-0.722	-0.747	-0.521	-0.550	-264.762***	-256.601***	-287.670***	-279.083***	-0.008	-0.011*	-0.004	-0.006*	-0.008	-0.012	-0.006	-0.008*
	(0.460)	(0.486)	(0.522)	(0.560)	(65.975)	(65.134)	(89.296)	(89.148)	(0.007)	(0.006)	(0.003)	(0.003)	(0.009)	(0.008)	(0.005)	(0.005)
ΔASSET_QUAL(*t*)	-17.623***	-14.974*	-15.767**	-14.154	3,733.041***	2,671.610**	3,701.758***	2,576.294*	-0.127	0.253	0.066	0.191	-0.100	0.251	0.074	0.199
	(5.696)	(7.940)	(6.749)	(8.701)	(1,261.822)	(1,352.516)	(1,338.433)	(1,443.610)	(0.181)	(0.155)	(0.170)	(0.158)	(0.204)	(0.178)	(0.189)	(0.178)
Δ*ROA*(*t*)	-	0.048	-	0.032	-	-25.889	-	-27.653	-	0.007***	-	0.003**	-	0.007***	-	0.003**
		(0.072)		(0.078)		(16.692)		(17.794)		(0.001)		(0.001)		(0.001)		(0.001)
Δ*CAPITAL*(*t*)	-	-	-		-3,031.682**	-2,025.900	-3,053.363**	-1,974.488	-	-	0.525***	0.439***	-	-	0.503***	0.415***
					(1,388.120)	(1,267.403)	(1,526.201)	(1,415.659)			(0.072)	(0.077)			(0.081)	(0.086)
CB_RATIO(*t*-1)	0.004	0.004	0.025	0.024	-0.392	-0.290	-1.701	-1.647	0.000	0.000	-0.000	-0.000	0.000	0.000	-0.000	-0.000
	(0.007)	(0.007)	(0.022)	(0.022)	(1.078)	(1.023)	(3.195)	(2.980)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP(*t*)	-0.027	-0.028	-0.025	-0.026	-10.603***	-11.167***	-10.108***	-10.649**	-0.001	-0.001**	-0.001***	-0.001***	-0.001	-0.001	-0.001***	-0.001***
	(0.032)	(0.032)	(0.034)	(0.033)	(3.572)	(3.894)	(3.886)	(4.219)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Constant	-0.131	-0.128	-0.140	-0.127	46.172**	48.502**	75.184***	76.930***	0.010***	0.010***	0.012***	0.012***	-0.006**	-0.004*	-0.001	-0.001
	(0.428)	(0.429)	(0.248)	(0.252)	(20.596)	(21.911)	(17.566)	(18.079)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	No	No
Bank fixed effects	No	No	Yes	Yes	No	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes
No. of obs.	544	544	544	544	360	360	360	360	548	548	548	548	548	548	548	548
No. of banks	88	88	88	88	57	57	57	57	91	91	91	91	91	91	91	91
R^2	0.233	0.234	0.291	0.291	0.610	0.619	0.622	0.631	0.213	0.335	0.430	0.445	0.366	0.472	0.547	0.562