Bank Liquidity Management through the Issuance of Bonds in the Aftermath of the Global Financial Crisis

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Abstract

Next to deposits, European banks have historically largely used bank obligations such as covered bonds. Their US counterparties, on the contrary, heavily rely on securitization to fund mortgages. We assess how banks' liquidity and funding position during and after the Global Financial Crisis (GFC) affects the decision to issue (private label) mortgage backed securities (MBS), covered bonds (CB) or senior unsecured bonds (SUB). Since the decisions to issue either instrument are not necessarily independent from each other, we estimate conditional probit and tobit models in order to account for the simultaneous nature of the issuances. We see that neither instrument plays any role in liquidity management during the GFC. In the post-GFC period, banks reach out to issuing MBS when facing short-term illiquidity. Banks could issue MBS as a way to comply with Basel III liquidity regulations. In turn, a bank's decision to issue CB is not affected by bank's liquidity and liquidity management occurs instead through managing the amount of CB. The issuance of SUB is also not affected by liquidity. Overall, the paper shows that only MBS have actively been issued as a response to liquidity shortages of banks' balance sheets and shows that MBS and CB which often are seen as alternative instruments serve different purposes.

Keywords: Bank funding, covered bonds, mortgage backed securities, senior unsecured bonds, liquidity, GFC.

JEL Classifications: D92; G21; G32

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1. Introduction

Previous research shows that banks choose among a large array of business models and structure their operations and funding activities accordingly in order to achieve the desired risk-return profile (Demirgüc-Kunt and Huizinga, 2010; Le Leslé, 2012). Given the financial market deregulation during the Great Moderation starting in the mid-1980s and the financial innovations of the last three decades, depository institutions have shifted their reliance on deposits to alternative sources of funding, mostly short-term wholesale funding, but also long-term sources, such as mortgage backed securities (MBS), covered bonds (CB), senior unsecured bonds (SUB). The use of long-term finance from capital markets can help to mitigate maturity mismatch and liquidity risks of banks but may also make banks more vulnerable to the conditions on capital markets. The latter is particularly true for short-term wholesale funding. This would mean that access to funding through short-term funding during periods of turmoil can be limited as evidenced during the global financial crisis (GFC). It is thus important to understand to what extent banks decide to issue long-term instruments to manage liquidity shortages on their balance sheets in volatile and normal periods.

This paper assesses the role of different bank liquidity and funding measures on the decision to issue each of the three instruments during and after the GFC. We then draw conclusions on the extent to which banks view those securities as a means of managing their liquidity needs. The GFC and the partial shut-out from capital markets may have led banks to change the way they approach their funding requirements. One would expect that in particular during periods of liquidity shortage such as the GFC, banks would extensively make use of the above mentioned instruments to tackle liquidity shortages whereas during normal periods banks would issue only certain instruments to manage their balance-sheet liquidity. The issuance of which of the three instruments would result to mitigate liquidity problems is unclear.

Most of the previous research explore the drivers of issuance for MBS but ignore the other types of bonds. Panetta and Pazzolo (2010) propose a granular scheme of a total of nine cost and benefit drivers for securitization, while Pais (2009) clusters the motives very broadly into ‘financing’ and ‘comparative advantages’. The most important balance-sheet drivers for European MBS issuance appear to be funding liquidity, credit risk, profitability, and regulatory capital arbitrage (e.g. Affinito and Tagliaferri, 2010; Farruggio and Uhde, 2015; Cardone-Riportella et al., 2010; Uzun and Webb, 2007; Casu et al., 2013). However, the research so far has mainly centered on the issuance of agency MBS prior to the GFC. In terms of the CB

market, there are only a handful of studies on the issuance drivers (Affinito and Tagliaferri, 2010; Farruggio and Uhde, 2015; Martin-Oliver and Saurina, 2007).[1] However, those studies look at each instrument independently and most of them are assessing the market prior to the GFC following which important regulatory changes may have induced structure changes for bank balance-sheet liquidity management. When it comes to SUB, most studies have assessed them individually in the context of the capital structure theory and mostly for non-financial firms (e.g. Colla et al., 2013; Rauh and Sufi, 2010). Despite the above findings, there are no studies, to the best of our knowledge, which look at the SUB issuance decisions for banks along with other funding alternatives.

Looking at banks' balance sheet management during and after the GFC is important as some structural shifts on the market may have occurred. Romo-Gonzales and van Rixtel (2011) identify a trend in European banks towards the issuance of instruments with greater recourse. This has been induced by events during the GFC, when the markets for CB and SUB remained active throughout the downturn and provided much needed liquidity (van Rixtel and Gasperini, 2013). In the aftermath of the GFC, regulators have reflected liquidity and funding concerns in the Basel III Accords by introducing a number of risk measures such as the net stable funding ratio (NSFR) and the liquidity coverage ratio (LCR), which were proposed in 2010. With a redefined role of liquidity in European banking markets, a number of studies highlight that a change in banking business models has come along (Altunbas, Gambacortea, and Marques-Ibanez, 2009; Gropp and Heider, 2010; Le Leslé, 2012).

It is also important to look at the decision of the issuance of either of the above instruments as a simultaneous one in which banks are aware of all options and compare the issuance of one instrument against the others. This is related to a number of corporate finance theories. Recent literature has highlighted the importance of assessing conflicts of interest among debt holders of different debt instruments and how those affect debt capital choices for firms (Calla et al., 2013; Rauh and Sufi, 2010). The rationale behind the choice of funding instruments in capital structure theories such as the pecking-order theory[2] (Rajan and Zingales, 1995), agency theory (Brennan and Schwartz, 1988), and trade-off theory. Based on the pecking order theory, for example, we would expect that the difference in credit risk can affect the

[1] In addition, Carbo-Valverde et al. (2017) and Demirgüc-Kunt and Huizinga (2010) study the effects of CB issuance on bank balance sheets and performance.

[2] The pecking order theory of corporate structure suggests that once firms are short of internal funds, they would prefer to use debt first before they use equity. The reason is that debt is not as information sensitive as equity and hence the value of debt will not be affected by the mangers' inside information.

choice of which instrument to issue.[3]

In this paper we address above identified gap by investigating how liquidity shortages on banks' balance sheets and their funding position affect the decisions of European banks to issue MBS, CB and SUB. We use Thomson Reuters Platinum CDS data on bond issuances and Bankscope data on bank balance sheets to assess the joint decision of issuing either security under the option of issuing the other two in response to changes in the ratio of liquid assets to deposits and short-term funding, the ratio of net loans to deposits and short-term funding and the ratio of deposits to assets. We estimate conditional and simultaneous probit and tobit models to account for the joint decision to issue none, either, or multiple mortgage funding instruments, rather than the sole independent decision to issue MBS. The sample contains 315 European banks which have issued at least one of the three instruments between 2007 and 2014.

We find that neither instrument plays any significant role in liquidity management during the GFC. In the post-GFC period, banks reach out to issuing MBS when facing short-term liquidity shortages. Banks could issue MBS as a way to comply with Basel III liquidity regulations. In turn, a bank's decision to issue CB is not affected by its liquidity and liquidity management occurs instead through managing the magnitude of CB funding. The issuance of SUB is also not affected by liquidity. Overall, the paper shows that only MBS have actively been issued as a response to illiquidity of banks' balance sheets and shows that MBS and CB which often are seen as alternative instruments serve different purposes.

The remainder of this paper is organized as follows. Section two provides a brief comparison between the three types of securities. In section three, we explain how liquidity and funding can affect the issuance and discuss alternative motives of issuance for which we control in the empirical part. Section four describes our dataset and the methodology employed. The results of our analysis are presented in section five, before concluding the paper.

2. Characteristics of mortgage backed securities, covered bonds and senior unsecured bonds

While securitisation has been the predominant way to access funding for mortgage lenders in the US, the European banking system has abstained from broadly using MBS. One reason to that are the differences in the banking systems between the US and Europe and the

[3] Cvijanovic (2014) shows that real estate prices have an effect on capital structure decisions of firms and serve to mitigate information imperfections. Matias and Serrasqueiro (2017) find evidence for the pecking-order theory and the trade-off theory with the first providing stronger evidence.

way European banks get access to funding. Part of the reason for the popularity of MBS in the U.S. is the existence of agency MBS, for which the US government provides implicit guarantees. These are neither provided for private label MBS in the US, nor for MBS issued in Europe. Thus European MBS expose their investors to a larger risk. Instead, European banks often use CB to re-finance mortgage loans. CB are highly regulated and issued under a special legislative regime.[4] The key difference between CB and MBS is that investors in CB are protected by means of dual recourse – a recourse on the underlying mortgages and on the bank's assets – which makes them a very safe investment as well as a cheap way of funding for the bank. MBS investors would have recourse only to the mortgage pool but not the issuer. Furthermore, the mortgage pool of an MBS is static while that of a CB is dynamic. This means that the quality of the underlying mortgages entering into the CB pool is strictly regulated and banks are required to maintain the quality of the pool by continuously replacing bad-performing loans with good ones. Due to above characteristics and in particular to the dual recourse structure, CB are rated and priced advantageously over MBS in most cases, largely depending on tranche seniority and mortgage quality.

While CB and MBS are a form of secured borrowing, SUB are a form of unsecured borrowing and are not related to funding a particular type of assets. This means that SUB are more risky for investors and more expensive for issuers. Similar to CB, SUB also remain on the bank's balance sheet and bond holders have a claim to the bank's assets in the case of default. Given that the majority of the mortgage loans are provided by large European banks, building societies, and savings banks, they can issue SUB in addition to CB to reduce reliance on deposits. Furthermore, most countries require overcollateralization of loans in the cover pool, which means that banks using CB need additional funding.

3. **Drivers of issuance decisions**

Traditional banking theory states that the provision of long-term loans, while relying on short-term funding leads to the maximum exposure to market risk and allows for the greatest gain from maturity transformation. Banks thereby earn (high) long-term rates, while owing (low) short-term rates. Yet, with the imminent requirements of the Basel III accord with a growing focus on prudent asset-liability management (in terms of the NSFR) and the liquidity

[4] Each country has its own legislation of covered bonds. However, differences are small enough to be considered homogeneous for our purposes. See Burmeister, Grossmann, and Stöcker (2011) for an overview of the different legislative CB frameworks.

requirements (in terms of the LCR), banks have strong incentives to increase the short-term liquidity of their balance sheet, to reduce the maturity mismatch, and to diversify their funding sources.

First, we recognize that the issuance of all three instruments leads to an immediate cash inflow into the bank balance sheet via, what is called, an asset swap and a balance-sheet extension, respectively. The asset swap in an MBS issuance consists of a cash inflow and a loan outflow from the balance sheet and can therefore be considered as monetizing the mortgage's future benefits and making them available today. CB issuance, on the other hand, provides for a cash inflow by adding additional liabilities to the balance sheet, without changing the future cash flows stemming from the underlying mortgages.

The GFC was a severe occurrence for the banking industry, as the wholesale funding market became largely dysfunctional. In consequence, banks relying on this market to meet their liquidity needs became troubled. A potential solution to this issue is the issuance of long-term funding instruments, such as CB, MBS, and SUB and thereby taking advantage of the respective cash inflow. As shown by Loutskina (2011), banks are able to maintain lower levels of liquid assets, when they are able to quickly convert mortgages into liquidity through the issuance of MBS. During the GFC, this concept was required to prove its validity. We therefore expect an increased likelihood to issue either of the three products during the liquidity restrained crisis period. During the post crisis period, liquidity has become a lesser issue, since the interbank market had recovered and central banks provided nearly unlimited liquidity measures. We therefore expect the liquidity argument not to hold for the post crisis period, unless banks prepare for the LCR-requirements or manage their liquidity requirements. The larger the percentage of loans funded via short-term instruments, the larger is the profit potential, but the larger becomes the maturity mismatch. The difficulty of this strategy has become largely evident during the GFC: with banks' inability to roll over their short-term funding, they run into illiquidity.

As MBS are the only instrument, which takes loans off banks' balance sheet, we can interpret it as a way of reducing the asset maturity by reducing the amount of mortgages on the balance sheet. CB and SUB, instead, increase the liability-side maturity and hence match the maturity of the assets. We therefore expect banks with a large maturity mismatch to be more inclined to issue either of the three instruments than none and thereby to improve their stable funding base (and thereby improving their NSFR as indicated in Basel III) for the post-crisis period.

A number of studies (Pais, 2009; Agostino and Mazzuca, 2011; Affinito and Tagliaferri, 2010; and Farruggio and Uhde, 2015) put strong emphasis on the diversification effects of MBS in the liability portfolio. This could also apply for CB and SUB. Loutskina, 2011) finds that more variety of funding sources leads to a lesser dependence on depositor preferences and external funding shocks. Also, the diversification across funding sources allows issuers to exploit different characteristics of various funding channels in terms of pricing and signalling (e.g. Greenbaum and Thakor, 1987; DeMarzo and Duffie, 1999; deMarzo, 2005). Furthermore, Altunbas et al. (2009) argue that securitization increases the resilience of bank loan supply with regard to monetary policy. Larger availability of these sources of funding would mean less issuance of either instrument.

We also consider two factors, which enable the issuance of long-term funding instruments: loan credit quality and bank size. Generally speaking, long-term funding on a low-quality loan portfolio is expensive and banks are inclined to pursue alternative funding measures. Securitization was originally intended and considered as a tool to reduce banks' credit risk exposure by moving credit risk off the balance sheet and thereby outside of the financial system to those investors who can best absorb it (Cumming, 1987; Casu et al., 2013; Chiesa, 2015). Following the above logic, banks should securitise the riskiest loans in order to prevent losses on their loan portfolio and thereby become more resilient.[5] On the other hand, it is assumed that banks are disciplined by capital markets to securitize high quality loans, which means that bad loans are kept on the books as investors may not want to buy low quality loans. A number of studies (Pais, 2005; Affinito and Tagliaferri, 2010; and Bannier and Hänsel, 2010) finds that banks with a more risky mortgage portfolio are more strongly engaged in securitization. On the contrary, Farruggio and Uhde (2015), in line with DeMarzo and Duffie (1999) and Calem and Lacour-Little (2004) find banks with a low-quality mortgage portfolio to securitize less, while Martin-Oliver and Saurier (2007), Casu et al. (2013) and Battaglia and Mazzuca (2014) find no support for credit risk transfer. Empirical evidence (Jones, 2000; Adrian and Shin, 2010) on the performance of securitised loans also provides little support to credit transfer. Battaglia and Gallo (2013) find larger tail risk in case of extreme events for banks active in securitization, which suggests a tendency of high quality mortgages to be securitized. Similarly, Ambrose et al. (2005) find ex-post default rates for securitized loans to be lower than for those retained by the bank. Further, Bedendo and Brunella (2012) find that

[5] During the GFC junior tranches containing low quality loans were pooled into collateralized debt obligations (CDOs) and sliced into tranches again, whereby they obtained high credit ratings.

the motive to use securitization for credit risk transfer is only present in times of severe funding constraints and then only with the intention to generate liquidity. When it comes to CB, we do not expect credit risk to be a driver for issuance activity, as the cover pool quality has to be maintained. For SUB on the other hand, banks prefer to use unsecured borrowing when their credit risk is low and their credit rating is high (Rauh and Sufi, 2010), as the investors' credit risk in minimal. On the contrary, banks are heavily punished, in terms of refinancing rates, for a low-quality loan portfolio as the default risk increases.

Also, issuing a bond or securitising a loan typically requires a substantial effort, especially if it is for the first time. The issuance of a bond requires a prospectus and of a CB additionally cover pool management and external supervision. Securitising involves similar requirements in that bylaws for the SPVs have to be drawn and servicing for the loans has to be implemented. Further, to reach a marketable volume for institutional investors, loans in an amount of several hundred million have to be funded at one point in time. This largely favors large banks to issue the each of the three products.

4. **Empirical methodology**

4.1. Data

Our sample consists of annual balance sheet data of European[6] banks from Bureau van Dijk's Bankscope between 2007 and 2014. We split the data into two samples – the GFC period and the post-GFC of fiscal years 2007 to 2009, and a post-GFC period from 2010 to 2014. This data is complemented by emission data of MBS, CB and SUB from Thomson Reuters' SDC Platinum database. Figure 1 shows that the highest issuance of CB is in 2008 and the highest issuance of MBS is in 2007. A peak volume of EUR 2.9 billion in total has been reported in 2008, followed by a drop of approximately 50% in 2009, and further to as low as EUR 100 million by 2013. SUB issuance volumes remain rather stable throughout this period.

[Insert Figure 1 here]

With regards to the issuances, we have a total of 3,987 CB issues, 557 MBS issues, with a total of 2,234 tranches, and 17,665 SUB issues. Subsequently, we match each issuance to the respective banking entity. We thereby limit our analysis to banks that have issued either of the three long-term funding instruments under consideration - which therefore have access to

[6] The founding members of the Eurozone (i.e. Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain), as well as Cyprus, Denmark, Great Britain, Greece, Iceland, Norway, Sweden, and Switzerland.

capital markets - and represent functional banking entities which independently manage their balance sheets. Those entities are clustered in three categories – commercial banks, savings and cooperative banks and real estate banks.

As such, we identify 315 banking entities[7] from Europe, having issued an aggregate amount of EUR 3,881.2 billion in CB, EUR 8,511.5 billion in MBS, and EUR 5,207.8 billion in SUB for the 2007 to 2014 period. Figure 2 depicts a detailed picture of the distribution of the three instruments across countries. We can see a large variation across countries in terms of the prevalence of either instrument. While Finland's issuance is almost entirely dominated by CB, in the Netherlands we observe hardly any CB issuance but instead MBS issuance dominates. Countries with high MBS issuance are Belgium, UK, Portugal and Spain. Countries with high CB issuance are Austria, France, Germany, Norway and Sweden.

[Insert Figure 2 here]

We have two types of dependent variables. The first one is a dummy variable that consists of the decision whether to issue either instrument or not. Following related studies (e.g. Martin-Oliver and Saurina, 2007; Agostino and Mazzuca, 2011) we construct a dichotomous variable for each institution and instrument over time, which takes the value of one if a bank has issued the respective instrument during a given year and zero otherwise. The second variable is in percentage terms and is the relative volume of each instrument aggregated for a reporting year[8] and bank by dividing the face value of the cumulated issues by the previous year end's total long-term funding instruments on the respective bank's balance sheet. We censor our independent variables by the availability of CB legislation and issuance of MBS in each country.

In terms of explanatory variables, we include three variables to reflect the liquidity and funding position of a bank. Similar to previous studies (e.g. Cardone-Riportella et al., 2010; Farruggio and Uhde, 2015; Pais, 2009; Panetta and Pazzolo, 2010; Agostino and Mazzuca, 2011), we use the ratio of liquid assets to deposits and short-term funding, *LiqToDep*[9], as a

[7] These figures do not reflect merger and acquisition activities and are limited to the lifespan available as per Bankscope. Investment banks and government agencies, as per Bankscope's classification have been excluded.

[8] In cases where the fiscal year does not end in December, data for entities for which the fiscal year ends between January and June is assigned to the previous calendar year; data for entities with a fiscal year ending between July and November is assigned to the same calendar year. Accumulation of the issue volumes, however, follows fiscal years in order to reflect the proper balance sheet information available when at the time the decision to issue the funding instrument was made.

[9] See Table 1 for an overview of the definition of the explanatory variables and the shortcuts used for them in the results section.

proxy of a bank's ability to meet its short-term withdrawal requirements. This is comparable to the LCR introduced in Basel III. The higher the ratio, the better the bank's short-term liquidity position. As proxy of maturity mismatch between assets and liabilities, we use the ratio of loans to deposits, *LtD-Ratio*, as for example Cardone-Riportella et al. (2010) do. This is comparable to the inverse of the NSFR. With an increasing ratio, the maturity mismatch increases and so does the sensitivity to a withdrawal of short-term funds. The third measure, deposits and short-term funding to total assets, *DepToAss*, represents the strength of the deposit base, for which no alternative sources of funding should be used and therefore no diversification is necessary (e.g. Affinito and Tagliaferri, 2010; Loutskina, 2011). A positive coefficient would therefore suggest diversification benefits, offsetting the larger funding costs versus deposits.

[Insert Table 1 here]

As a proxy of issuance related to the mitigation of credit risk exposure of the loan portfolio, we control for the ratio of loan loss reserves to gross loans, *CredRisk* (e.g. Cardone-Riportella et al., 2010; Farruggio and Uhde, 2015; Pais, 2009; Affinito and Tagliaferri, 2010). The ratio illustrates how much of the loan portfolio is covered by current reserves. A higher ratio corresponds to a lower quality loan portfolio and higher credit risk for investors in bank's obligations.

We use the total regulatory capital ratio, *RegCap*, to control for issuance related to regulatory capital arbitrage (e.g. Affinito and Tagliaferri, 2010; Panetta and Pazzolo, 2010).[10] In comparison to core Tier 1 and Tier 2 capital, the regulatory capital requirement of 8 percent has not changed during the period under investigation, while the calculation of risk-weighted assets has been modified. A larger ratio reflects a stronger capital position.

We also use dummies for the type of financial institution – commercial banks, savings banks and real estate bank to proxy for bank business models. In addition to the type of bank, another important dimension capturing bank business models is the return on equity, *RoE*. It illustrates the returns generated from the equity by the bank, and acts as a general proxy of a

[10] The issuance of either CB or SUB would not have a direct effect on the regulatory capital ratio and we do therefore not expect any effect of varying regulatory capital ratios on the likelihood of their issuance. However, Farruggio and Uhde (2015), Bannier and Hänsel (2008), and Affinito and Tagliaferri (2010) observe that banks with a low capital base tend to securitize more. A second question rationale would be found in potential for regulatory capital arbitrage. That is, banks securitize high quality assets and keep low quality loans which are more profitable on their balance sheets. Assuming that both types of loans require the same capital base, this strategy allows the bank to become more profitable. Yet, under a Basel II framework, low quality loans are penalized in that banks are required to provide relatively more regulatory capital. Minton et al. (2004), Martin-Oliver and Saurina (2007) and Cardone-Riportella et al. (2010) however do not find that regulatory capital arbitrage is a significant driver for securitization.

bank's ability to employ its equity for its best use (e.g. Affinito and Tagliaferri, 2010; Loutskina, 2011; Cardone-Riportella, 2010; Bannier and Hänsel, 2008). The larger the ratio, the more profitably the bank employs the equity. The Cost-to-Income-Ratio, *CIR*, measures a bank's efficiency in managing its operations and therefore provides a proxy for specialization (e.g. Farruggio and Uhde, 2015; Cardone-Riportella, 2010; Bannier and Hänsel, 2008). Lastly, the ratio of interest expense to average interest-bearing liabilities, *HistCost*, illustrates the historical funding costs of a bank. The larger the ratio, the larger the historical funding costs (e.g. Agostino and Mazzuca, 2011). We measure bank size as the natural logarithm of bank's total assets, *TotAss(ln)*, which is expected to have a positive effect on all issuance types (e.g. Affinito and Tagliaferri, 2010; Panetta and Pazzolo, 2010).

In addition to bank-level variables, we use the change in the natural logarithm of GDP, $\Delta GDP(ln)$, to reflect on the differences in the state of the national economies. We also use time and country dummies to reflect sample-wide factors, such as trends in the banking industry, differences in the regulatory environment or market sentiment across time.

[Insert Table 2 here]

Table 2 provides the descriptive statistics for the bank balance-sheet variables during and after the GFC as well as across business model.[11] We can see that the average ratio of liquid assets to deposits is 30 percent during the GFC with some banks having a ratio of as high as 89 percent or as low as 3.9 percent. In the post-GFC sample the average ratio declines to 27 percent however the median value now is much lower being 17 percent which suggests a skew in the data. The 95th quintile is also much lower at 77 percent. In terms of the maturity mismatch, we can see that on average loans are 1.3 times the deposits during the GFC with some banks having 2.4 loans to deposits and others as low as 0.5 loans to deposits. In the post-GFC period, the maturity mismatch decreases to on average 1.18. The proportion of deposits to total assets in on average 58.8 percent during the GFC with a standard variation of 17 percent. The highest ratio is 86 percent and the lowest 28.8 percent. The ratio has increased in the aftermath of the financial crisis to 62 percent on average. This is to highlight that in Europe deposits still play an important role in bank funding however huge variations are observed across institutions and countries. When comparing across three types of business models – savings and co-operative banks, real estate banks and others including commercial banks, we can see that the latter for

[11] Whenever the bank-level variables show inconsistencies, we omit the respective observations. In the empirical analysis we use the dataset where only spurious observations have been removed. The results are robust to winsorizing at 1% and 2.5% level.

the largest proportion of the banks and real estate banks the smallest proportion. Savings banks are the smallest on average and commercial or other banks being the largest in terms of total assets. We see that commercial banks have much higher share of liquid assets to deposits – nearly twice as high as the other types of banks. They seem to be most active on the short-term paper market buying short-terms assets to match the maturity of their liabilities. This can be because such banks are large and have the facilities to involve in short-term borrowing. On the other hand, savings banks have the highest ratio of loans to deposits as one would expect given that the primary role of such banks has not been in collecting deposits. The banks in the other category are also the most profitable ones in terms on return on equity.

4.2. Methodology

Arguing that bank decisions to issue CB, MBS, and SUB are made jointly, we use a seemingly unrelated regression (SUR) framework, allowing for correlation of the error terms across the different issuance equations. Similar to Hopkins et al. (2013), and Anagnostopoulour and Drakos (2016), we employ the conditional mixed-process (CMP) estimator by Roodman (2011). The CMP estimator has several characteristics that make it attractive for our purpose. It allows for the estimation of censored, multi-equation and simultaneous-equation systems with continuous and non-continuous dependent variables. The procedure obtains the estimates by fitting SUR models in which we embed conditional probit and conditional tobit models.

We estimate the probability *y* of a bank *i* to issue a funding instrument *I* in the respective year *t*, with *I* = {CB, MBS, SUB} and *t* = {2007, …, 2014}:

$$\Pr\left(y_{I,i,t}=1|y_I,X',Y'\right)=y^*_{I,i,t}=\begin{cases}\alpha_0+\beta_1X'_{i,t-1}+\beta_2Y'_{i,t}+\delta_t+g_i+h_c+\epsilon_{1,i,t}\\ \alpha_0+\beta_1X'_{i,t-1}+\beta_2Y'_{i,t}+\delta_t+g_i+h_c+\epsilon_{2,i,t}\\ \alpha_0+\beta_1X'_{i,t-1}+\beta_2Y'_{i,t}+\delta_t+g_i+h_c+\epsilon_{3,i,t}\end{cases} \quad \textbf{(1)}$$

where the latent variable $y^*_{I,i,t}$, takes the value of zero if the volume of funding instrument *I*, issued by bank *i* for year *t* is nil, and one if it is greater than zero. *X* represents a vector of lagged bank characteristics and *Y* is the lagged country-level change in GDP, while δ_t represents year dummy variables and h_c represents country dummies and g_i bank business model dummies. The error-terms ε_1, ε_2, and ε_3 are clustered at the bank level *i* and are jointly normally distributed with rho_{ij} being the correlation between ε_i and ε_j.

In order to avoid endogeneity of *X*, we lag their values to their previous fiscal year's end value.

We observe low multicollinearity among the explanatory variables as the correlation matrixes in Table 3 demonstrate.[12]

[Insert Table 3 here]

Following the same reasoning, we estimate a tobit model where the dependent variable is the relative volume $z_{I,i,t}$ of each funding instrument *I* by bank *i* in year *t*, in relation to that bank *i*'s total long-term funding, as reported in the previous fiscal year *t-1*:

$$z^*_{I,i,t} = \begin{cases} \alpha_0 + \beta_1 X'_{i,t-1} + \beta_2 Y'_{i,t} + \delta_t + g_i + h_c + \epsilon_{1,i,t} \\ \alpha_0 + \beta_1 X'_{i,t-1} + \beta_2 Y'_{i,t} + \delta_t + g_i + h_c + \epsilon_{2,i,t} \\ \alpha_0 + \beta_1 X'_{i,t-1} + \beta_2 Y'_{i,t} + \delta_t + g_i + h_c + \epsilon_{3,i,t} \end{cases}, \quad \textbf{(2)}$$

where the latent variable $z^*_{I,i,t}$ is censored for $z \leq 0$ and $z > 1$, and $z^* = z$ for $0 < z \leq 1$ for CB and SUB. For MBS, the upper censoring limit is set at five[13]. All other input factors y^I, *X', Y', δ, ε1*, *ε2*, and *ε3* are the same as above.

5. **Results**

Our baseline results of the role of liquidity in the joint decision to issue either of the funding instruments are based on a conditional multi-equation probit model and are presented in Table 4, for which panel (a) refers to the decision to issue CB, panel (b) to the decision to issue MBS and panel (c) to the decision to issue SUB. We also investigate how the volumes vary across instruments depending on the liquidity position of the bank. Those results are based on a conditional multi-equation Tobit model and can be found in Table 5. For both tables, the first section represents the GFC period from 2007 to 2009 and the second section accounts for the post-GFC period between 2010 and 2014.

[Insert Table 4 here]

[Insert Table 5 here]

[12] We acknowledge the high correlation between *LtD-Ratio* and *DepToAss* but robustness checks reveal no changes in the material results upon omission of either variable.

[13] Since MBS leave the balance sheet, a bank can issue more MBS than loans on balance sheet. Five provides the best model based on information criteria, the results are robust to limits of one and two.

5.1 Issuance decisions

We are interested in the decision of banks to issue either of the funding instruments driven by liquidity and funding considerations. Table 5 presents the results of the CMP estimations during the financial crisis and therafter. The conditionality of the issuance is demonstrated by the significant correlation of the error terms as is revealed by the significance of atanhrho.[14] We find that during the crisis, the CB and the SUB issuances are significantly dependent from each other. The issuance decision of MBS, on the other hand, is not related to either CB or SUB, as embodied in the insignificant atanhrho. After the crisis, the decisions to issue CB and SUB are still significantly related to each other, as is the decision to issue CB and MBS. Consequently, determining the probability function for issuance of either instrument independently would result could lead in biased and inconsistent results.

When first looking at the decisions to issue during the crisis, we primarily note that liquidity, in terms of liquid assets to deposits, *LiqToDep*, does not seem to matter for the decision to issue either instrument. What instead explains the issuance decision during the GFC is the bank business model, not active balance-sheet management. For CB, the only drivers that are significant are return on equity, *RoE,* and bank size. Banks with high RoE are more likely to issue CB. However, we find it likely that this finding is related to the bank's business model, particularly the historical funding costs which provide a competitive advantage to banks which issue CB. Similarly, for MBS the only statistically significant measures are the bank's operational efficiency, that is its cost-to-income ratio[15] (CIR), historical funding costs and total assets. As proposed by Pais (2009), a larger value of CIR provides a clear indicator for specialization. Banks specializing in the origination of mortgages – and thereby inclined to securitize – tend to exhibit larger CIRs than those specializing in the servicing and monitoring of mortgages – and thereby inclined to issue CB. The rationale for such a separation based on CIR is that the latter banks incur interest expenses leading to a large cost factor being omitted for CIR calculation purposes. Similarly, banks that have higher historical funding costs are more likely to issue MBS in order not to increase the base on which the funding costs occur.

For SUB, the only significant measures are deposits and short-term funding, RoE and bank size. Deposits and short-term funding are a source of cheap funding and hence present a favorable alternative to the more expensive SUB. Thus, during the crisis, banks which had a

[14] Atanhrho is the inverse hyperbolic tangent of rho, where $atanhrho = \frac{0.5*\ln(1+rho)}{(1-rho)}$, and thereby remains the same interpretation.
[15] As defined by "The Fitch Universal Format on BankScope".

large base of short-term funding via deposits had a lesser need to issue particularly expensive SUB. This relationship is indicated by the significantly negative coefficient for SUB, specifying a 1% larger funding via deposits to lead to a 0.6% lower probability to issue SUB.

From above findings, we conclude that we cannot find support for the hypothesis that issuance decisions of CB, MBS and SUB would be driven by liquidity reasons during the crisis.

Moving to the post-crisis period, we observe a clear change in the results for MBS, but less so for CB and SUB. In a more normalized funding environment, we find strong support for the liquidity hypothesis for MBS. We note that the effect of liquid assets to deposits is significantly negative. Thus, the higher the share of liquid assets to deposits and short-term funding, the lower the probability to issue those instruments. MBS therefore do provide for the possibility to improve a weak liquidity position. We find the difference in issuance probability of MBS to be approximately 20% between a non-existing and full coverage of deposits with liquid assets. This finding is in line with the results of Loutskina (2011) who shows that funding through securitization serves as an alternative to cash liquidity. For CB and SUB, we observe no such effect.

Also maturity mismatch, our second measure of liquidity, is a significant driver of MBS issuance but not for CB or SUB. We observe that banks with larger maturity mismatch are more likely to opt for MBS funding given the availability of all three long-term funding instruments. This suggests banks to favor a reduction of asset maturity via issuing MBS and taking loans off the balance sheet instead of an increase of liability maturity via issuing CB or SUB. The coefficient of funding diversification (deposits to assets) remains insignificant for MBS or CB also during the post-crisis period. For SUB, the coefficient is significant instead suggesting that SUB act as a substitute to deposits rather than complementing those.

Further, after the crisis credit risk becomes marginally significant for MBS and significant for SUB meaning that the likelihood of issuing either instrument decreases with credit risk. This is not in line with findings for the US (Affinito and Tagliaferri, 2010; Pais, 2005; Bannier and Hänsel, 2010) that MBS are used to remove credit risk off banks' balance sheets. According to the efficient contracting hypothesis by Minton et al. (2004), securitization is used to reduce bank credit risk by removing bad loans and increasing the loan portfolio quality. Instead, we confirm the findings in DeMarzo and Duffie (1999), Calem, Lacour-Little (2004) and Farruggio and Uhde (2015) that a low-quality credit portfolio leads to reduced securitization activity. The reason why banks which are more risky securitize less as discussed

in Gorton and Souleles (2006) is that more risky banks would find it more difficult to convince investors that the MBS issued by those banks are of good quality. Our finding is aligned with Martin-Oliver and Saurina (2007) who do not find that high credit risk of the loan portfolio leads to more securitization in the Spanish banking industry. SUB show high sensitivity to credit risk. With a 1% increase in credit risk, the probability of issuing SUB decreases by approximately 1.9% for the post-GFC period. This result is explained by the junior position of those bonds in the capital structure, which imposes a strong dependence on default risk of bank's assets. Those bonds hence may not be issued for the purpose of credit risk management although they are negatively affected by credit risk as shown by Rauh and Sufi (2010). CB issuances on the other hand show no sensitivity to credit risk – which is in line with its default-remoteness. The fact that the quality of the loan portfolio does not have an effect on the likelihood of issuing a CB suggests that investors do not associate credit risk with a potential bank default which is due to the implicit government guarantees for CB.

For CB, the RoE has the only significant coefficient as in the crisis period. The marginal effect is, however, three times larger during the financial crisis than afterwards. This is likely to be a reflection of the lack of confidence in the banking industry, and dysfunctional CB markets, allowing particularly healthy banks to issue CB, while others are mostly shut out. After the policy interventions of the European Central Bank (ECB), the demand for CB stabilized. As during the crisis, none of the liquidity management related coefficients for CB are significant after the GFC. The finding is surprising, as earlier research on CB issuances finds support for the liquidity hypothesis. As expected, all three instruments exhibit positive sensitivity to banks' size.

5.2 Issuance volumes

The results on the conditional probit estimations suggest that MBS issuance decisions are partly driven by liquidity needs, while the decisions to issue CB are not and the decision to issue SUB only partly. The results on the decision to issue might, however, give a limited picture of the balance sheet management of the banks; if banks have set up and support issuance programmes[16] for CB and SUB, the liquidity management decisions would not be done at the level of issuance, but rather at the level of volumes or how much to issue. A similar logic holds in that it is largely beneficial for an MBS issuer to have a track-record – particularly during the crisis. In this part of our analysis, we move to the results on conditional and simultaneous tobit

[16] That is have drawn and approved issue programs under which they may issue a large amount of bonds in a number of individual issuance dates.

estimations, where our dependent variable is the annual volume of issuance of each instrument in relation to all long-term funding on its balance sheet. The results of these estimations are presented in Table 5.

We start by looking at the conditionality of the volume of issuance decisions, as measured through significance of atanhrho. Unlike for the decisions to issue, we find no conditionality between the volumes of issuance of any of the instruments during the crisis. Post GFC, however, CB and the SUB issuances are significantly dependent from each other. The issuance decision of MBS, on the other hand, is not related to either CB or SUB, as embodied in the insignificant atanhrho. This enforces our previous findings that determining the probability function for issuance of either instrument independently would result in biased and inconsistent results.

We still find no strong evidence that liquidity needs would have served as a major driver of issuances during the crisis. The coefficient of liquidity is insignificant for all three instruments. However, we find that maturity mismatch is a significant driver of issuance volumes for CB during the crisis, whereas for MBS and SUB we find no such relationship. For CB, we conclude that the management of the funding mismatch was the only concern in determining the volume of funding obtained via that instrument. The coefficient of diversification of funding channels that was significant for SUB in the probit estimations, is insignificant in all tobit estimations. This supports our argument that in the probit estimation, the significant coefficient is more a measure of the bank business model and general funding preferences than that of liquidity management decision. On the contrary, the decision of how much is issued does actually represent the active management of the balance sheet. In the conditional tobit model, banks whose issuance volume is zero for an instrument are excluded when estimating the coefficients of the respective instrument. Thus, the coefficients represent the effect of funding diversification within a sample of banks that issue SUB.

Post GFC, we find support for the liquidity management hypothesis for MBS, but not for CB and SUB. Liquidity significant affects how much MBS a bank issues. The lower the liquidity, the larger the issuance volume. For CB, the coefficient is only significant at the 10% level of confidence and indicates that CB do therefore not enable banks to quickly convert mortgages into liquidity, as is the case for MBS. For SUB, the coefficient is consistently insignificant. Furthermore, maturity mismatch is statistically significant in determining issuance volumes after the crisis for both CB and MBS.

Interestingly, credit risk only affects the issuance volume decisions of SUB. Loan loss reserves are insignificant in the crisis period, but highly significant and negative in determining issuance volumes of SUB in the post-crisis period. This enforces our findings in the probit model of the signaling motivations. On the contrary, the missing relation during the crisis suggests, the credit risk would not to have mattered for obtaining funding. We find no relationship between regulatory capital and issuance volumes. The results on the effects of bank profitability, specialization, funding costs and size are similar to those on the decision to issue effects.

6. **Robustness analysis**

6.1 Controlling for simultaneity

One of the empirical contributions of our paper is that we control for the conditionality and simultaneity of the issuance decisions of the three instruments. To illustrate and evaluate the importance of controlling for it, we repeat our analysis using pooled probit and tobit regressions. The results of these estimations are presented in Tables 6 and 7.

[Insert Table 6 here]

[Insert Table 7 here]

For the results of the probit estimation in Table 6, we see that the results remain practically unchanged. The small differences in the coefficients are because the samples used for estimating the coefficients for each instrument separately now include all banks and periods, not only those banks that have issued at least one instrument in the respective period.

For the issuance volume decisions, the changes in the results are notable. When comparing the results in Table 7 with Table 5 we note that there are changes in both the coefficients as well as their significance levels. For the pre-crisis results, the funding diversification turns highly significant for CB issuance. Further, in the crisis results the coefficient of liquidity for MBS loses statistical significance. There results confirm the earlier interpretation based on the *atanrho*s, i.e. that analyzing the issuances of instruments independently would lead to biased results.

6.2. Controlling for previous issuances

Up till now our analysis has relied on the assumption that banks issuance decisions are done simultaneously, but do not depend on the earlier issuance decisions. In the case in which starting to issue certain product is linked to notable set-up costs, this assumption might be unrealistic. In this section, we analyse, whether loosening this assumption would change our main results.

The challenge in controlling for previous issuances by e.g. indicators of earlier issuances of the same instrument is that this could lead to biased results. To avoid this challenge, we estimate a variation of Equations (1) and (2) where we include the last year's observed issuance status for the latent variable of the other two funding instruments y^J. These dummies have a value of one if the bank issued the alternative instrument in the previous year and zero otherwise.[17] The results of these estimations are presented in Table 8. Tobit results in Table 9 are derived with the relative funding volume, respectively.

[Insert Table 8 here]

[Insert Table 9 here]

For the issuance decision (Table 8), the results remain robust in crisis and post-crisis period. We see no notable changes in either the magnitude or significance of coefficients. In the GFC period, the dummy indicating earlier issuances of SUB is significant for the CB issuance decision. During the GFC, the lagged issuance dummies capture some of the correlation in the error terms, and the *atanhrho* between CB and SUB turns insignificant. For the post crisis period, although the lagged issuance dummies are significant, the *atanhrho*s remain significant as well, indicating that even after controlling for previous issuances, the error terms should be adjusted for the correlation. For the issuance volume decision (Table 9), dummies for the issuance of alternate instruments are insignificant in both periods and all results remain robust, despite the inclusion of them.

7. **Conclusion**

We analyze the joint issue decision for CB, MBS, and SUB for a sample of 315 European banks with capital market access. In employing conditional multi-equation systems, we are able to establish a clear mutual dependence between the decisions to issue CB and SUB,

[17] We also estimated a variant where the dummy variable has a value of 1 if the bank has issued the alternate instrument within the last 3 years. The results remain unchanged.

while the decision to issue MBS appears independent of the two alternative instruments under consideration. Our main interest is to explore to what extent bank liquidity and its funding position are a drivers of the issuance of either instrument during and after the GFC. We find that during the GFC, liquidity does not seem to be driving any of the issuance decisions but instead what seems to be behind the issuance are business model considerations. In the post-GFC period, only MBS issuance decisions are significantly affected by bank liquidity. MBS are used as a means to quickly provide liquidity to banks with funding illiquidity and thereby lower the requirement to hold cash. MBS also serve as the only instrument to reduce maturity mismatch suggesting that banks prefer to shorten the maturity of their asset base via MBS instead of extending the maturity of their liabilities via CB or SUB.

Our results imply that arguing that the three instruments are close substitutes when it comes to managing illiquidity is not correct. On the contrary, CB, MBS, and SUB serve different purposes from bank's point of view and it is important that banks have access to all three types of instruments.

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Appendix

Table 1: Definitions of explanatory variables

Variable	Variable formulation
Liquidity variables	
LiqToDep	Liquid assets over Deposits and short-term funding (in %)
LtD-Ratio	Net loans over Deposits and short-term funding (in %)
DepToAss	Deposits and short-term funding over Total assets (in %)
Control variables	
CredRisk	Loan loss reserves over Gross loans (in %)
RegCap	Total regulatory capital over risk weighted assets (in %)
RoE	Return over average Equity (in %)
CIR	Non-interest expenses over gross revenues (in %)
HistCost	Interest expenses over Average interest-bearing liabilities (in %)
TotAss(ln)	Natural logarithm of Total Assets (in EUR billion)

Table 2: Descriptive Statistics

A: Descriptive statistics GFC period

	N	Range	Percentile			Mean		Std. Dev.
			5th	Median	95th	Mean	SE	
$LiqToDep_{t-1}$	583	1.703	0.039	0.218	0.892	0.300	0.012	0.279
$LtD\text{-}Ratio_{t-1}$	583	7.772	0.531	1.119	2.424	1.299	0.036	0.881
$DepToAss_{t-1}$	583	0.888	0.288	0.590	0.863	0.588	0.007	0.169
$CredRisk_{t-1}$	583	0.162	0.002	0.017	0.046	0.019	0.001	0.017
$RegCap_{t-1}$	583	0.219	0.088	0.111	0.162	0.116	0.001	0.025
RoE_{t-1}	583	1.864	-0.035	0.098	0.245	0.093	0.006	0.146
CIR_{t-1}	583	1.647	0.362	0.600	0.866	0.606	0.007	0.164
$HistCost_{t-1}$	583	0.164	0.021	0.037	0.063	0.039	0.001	0.017
$TotAss(ln)_{t-1}$	583	8.236	0.658	3.230	6.417	3.430	0.073	1.752

B: Descriptive statistics post GFC period

	N	Range	Percentile			Mean		Std. Dev.
			5th	Median	95th	Mean	SE	
$LiqToDep_{t-1}$	1112	4.193	0.033	0.173	0.770	0.270	0.009	0.294
$LtD\text{-}Ratio_{t-1}$	1112	8.249	0.502	1.035	2.287	1.183	0.024	0.792
$DepToAss_{t-1}$	1112	0.941	0.312	0.633	0.883	0.623	0.005	0.173
$CredRisk_{t-1}$	1112	0.369	0.002	0.023	0.099	0.032	0.001	0.034
$RegCap_{t-1}$	1112	0.726	0.093	0.135	0.222	0.147	0.002	0.057
RoE_{t-1}	1112	2.964	-0.313	0.047	0.150	0.008	0.006	0.211
CIR_{t-1}	1112	1.933	0.343	0.617	0.912	0.628	0.006	0.211
$HistCost_{t-1}$	1112	0.129	0.008	0.021	0.048	0.023	0.000	0.014
$TotAss(ln)_{t-1}$	1112	7.828	0.766	3.388	6.501	3.441	0.051	1.716

C. Descriptive statistics by bank business model

	Savings & Coop				RE Bank				Other			
	N	p5	p50	p95	N	p5	p50	p95	N	p5	p50	p95
Crisis	172	0.042	0.143	0.696	65	0.024	0.105	0.615	346	0.077	0.272	0.945
	172	0.748	1.297	1.825	65	0.761	1.073	5.476	346	0.463	1.042	2.494
	172	0.378	0.577	0.731	65	0.147	0.660	0.913	346	0.282	0.603	0.870
	172	0.003	0.020	0.043	65	0.000	0.003	0.019	346	0.003	0.016	0.052
	172	0.086	0.110	0.160	65	0.093	0.119	0.160	346	0.088	0.111	0.162
	172	0.021	0.090	0.198	65	-0.152	0.071	0.205	346	-0.035	0.121	0.266
	172	0.493	0.605	0.793	65	0.147	0.587	0.819	346	0.340	0.599	0.882
	172	0.020	0.032	0.055	65	0.030	0.045	0.087	346	0.021	0.038	0.068
	172	-0.091	2.654	5.855	65	1.699	2.880	5.407	346	0.860	3.917	6.713
	N	p5	p50	p95	N	p5	p50	p95	N	p5	p50	p95
Post crisis Crisis	298	0.027	0.104	0.621	138	0.020	0.165	0.541	676	0.045	0.226	0.844
	298	0.561	1.151	1.729	138	0.739	1.531	4.273	676	0.410	0.971	1.984

298	0.430	0.599	0.881	138	0.182	0.428	0.900	676	0.350	0.653	0.871
298	0.003	0.028	0.084	138	0.000	0.008	0.053	676	0.003	0.026	0.115
298	0.094	0.126	0.186	138	0.091	0.153	0.381	676	0.093	0.140	0.218
298	-0.182	0.040	0.149	138	-0.228	0.044	0.184	676	-0.414	0.051	0.149
298	0.416	0.617	0.811	138	0.125	0.536	0.909	676	0.363	0.624	0.946
298	0.011	0.019	0.035	138	0.011	0.027	0.044	676	0.007	0.020	0.053
298	0.481	2.851	5.655	138	0.805	2.723	5.366	676	0.905	3.693	6.738

Table 3: Correlation Matrix

A: GFC period

	(1')	(2')	(3')	(4')	(5')	(6')	(7')	(8')	(9')
(1) $LiqToDep_{t-1}$	1.00								
(2) $LtD\text{-}Ratio_{t-1}$	0.08	1.00							
(3) $DepToAss_{t-1}$	-0.37	-0.69	1.00						
(4) $CredRisk_{t-1}$	-0.08	-0.13	0.12	1.00					
(5) $RegCap_{t-1}$	0.10	0.00	0.07	-0.13	1.00				
(6) RoE_{t-1}	0.03	-0.04	0.05	-0.10	0.07	1.00			
(7) CIR_{t-1}	0.13	-0.26	0.11	0.13	-0.04	-0.38	1.00		
(8) $HistCost_{t-1}$	-0.02	0.02	0.00	-0.18	0.08	-0.28	0.10	1.00	
(9) $TotAss(ln)_{t-1}$	0.41	-0.17	-0.11	-0.15	-0.06	0.04	0.07	0.10	1.00

B: Post-GFC period

	(1')	(2')	(3')	(4')	(5')	(6')	(7')	(8')	(9')
(1) $LiqToDep_{t-1}$	1.00								
(2) $LtD\text{-}Ratio_{t-1}$	0.10	1.00							
(3) $DepToAss_{t-1}$	-0.35	-0.66	1.00						
(4) $CredRisk_{t-1}$	-0.11	-0.17	0.17	1.00					
(5) $RegCap_{t-1}$	0.12	0.01	-0.09	-0.11	1.00				
(6) RoE_{t-1}	0.09	0.07	-0.10	-0.32	0.13	1.00			
(7) CIR_{t-1}	0.01	-0.31	0.22	0.14	0.06	-0.24	1.00		
(8) $HistCost_{t-1}$	0.06	0.10	-0.10	-0.07	-0.01	-0.01	-0.01	1.00	
(9) $TotAss(ln)_{t-1}$	0.29	-0.15	-0.18	-0.06	0.07	0.03	-0.02	0.02	1.00

Table 4: Baseline results on the decision to issue bond instruments

	CRISIS			POST CRISIS		
	Panel (a)	(b)	(c)	Panel (a)	(b)	(c)
	CB dummy	**MBS dummy**	**SUB dummy**	**CB dummy**	**MBS dimmy**	**SUB dummy**
$LiqToDep_{t-1}$	-0.040	0.042	0.012	-0.091	-0.198*	-0.000
$LtD\text{-}Ratio_{t-1}$	0.049	0.009	-0.047	0.037	0.121**	-0.047
$DepToAss_{t-1}$	0.163	-0.315	-0.560**	-0.040	0.132	-0.437**
$CredRisk_{t-1}$	0.899	0.861	-0.446	-1.164	-2.508*	-1.881**
$RegCap_{t-1}$	-0.560	-0.803	0.076	-0.330	-0.733*	-0.221
RoE_{t-1}	0.395*	0.229	0.273*	0.132*	0.032	0.031
CIR_{t-1}	0.099	0.308**	-0.072	-0.112	0.331***	0.001
$HistCost_{t-1}$	0.066	2.770**	0.932	-0.015	3.265*	-0.865
$TotAss(ln)_{t-1}$	0.123***	0.075***	0.143***	0.126***	0.067***	0.140***
$\Delta GDP(ln)_{t-1}$	yes	yes	yes	yes	yes	yes
Business Model dummies	yes	yes	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Atanhrho CB/MBS		-0.086			0.295*	
Atanhrho CB/SU		0.295*			0.577***	
Atanhrho MBS/SU		0.030			0.082	
Observations		583			1112	
Log-Likelihood		-689			-1113	
Chi^2		532			962	
AIC		1549			2410	
BIC		1920			2871	

*Notes: The table reports the results of the estimation of the determinants for a bank's probability to issue CB, MBS, and SUB, which are presented in columns a, b, and c, respectively. The dependent variable is a set of the observed dichotomous issuance dummy equal to one, if a bank has issued the respective product and zero otherwise. The coefficients are shown in average marginal effects (dy/dx) and the descriptive statistics are borrowed from the coefficient regression. While the first section presents the GFC period from 2007 to 2009, the second section considers the post GFC period from 2010 to 2014; both models are estimated using a conditional multi-equation probit model; significance levels: * 5%, ** 1%, *** 0.1%.*

Table 5: Baseline results on the issuance volumes

	CRISIS			POST CRISIS		
	Panel (a)	(b)	(c)	Panel (a)	(b)	(c)
	CB fraction	**MBS fraction**	**SUB fraction**	**CB fraction**	**MBS fraction**	**SUB fraction**
$LiqToDep_{t-1}$	-0.045	-0.187	0.004	-0.091	-1.226*	0.005
$LtD\text{-}Ratio_{t-1}$	0.066*	0.018	-0.018	0.046*	0.413**	-0.021
$DepToAss_{t-1}$	0.294	-1.718	-0.197	0.087	0.675	-0.113
$CredRisk_{t-1}$	-0.443	3.609	-0.555	-1.154	-7.347	-1.491***
$RegCap_{t-1}$	-0.329	-8.900	0.243	-0.293	-2.943	-0.018
RoE_{t-1}	0.263	3.618**	0.026	0.088*	-0.348	-0.055
CIR_{t-1}	-0.103	1.669*	-0.166	-0.083	1.881***	-0.026
$HistCost_{t-1}$	-0.121	3.201	1.305*	-0.531	8.795	-0.252
$TotAss(ln)_{t-1}$	0.118***	0.330***	0.055***	0.081***	0.210**	0.054***
$\Delta GDP(ln)_{t-1}$	yes	yes	yes	yes	yes	yes
Business Model dummies	yes	yes	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Atanhrho CB/MBS		-0.048			0.106	
Atanhrho CB/SU		0.079			0.227***	
Atanhrho MBS/SU		-0.062			-0.007	
Observations		574			1045	
Log-Likelihood		-521			-615	
Chi^2		353			1103	
AIC		1220			1425	
BIC		1607			1905	

*Notes: The table reports the results of drivers of the share of banks' bond issuance volumes of CB, MBS, and SUB to total long-term presented in columns a, b, and c, respectively. The dependent variable ranges between 0 and 1 for CB and SUB and between 0 and 5 for MBS. The GFC period is from 2007 to 2009, the post-GFC is from 2010 to 2014; both models are estimated using a conditional multi-equation tobit model; significance levels: * 5%, ** 1%, *** 0.1%.*

Table 6: Probit issuance decision controlling for simultaneity

	CRISIS			POST CRISIS		
	Panel (a)	(b)	(c)	Panel (a)	(b)	(c)
	CB dummy	**MBS dummy**	**SUB dummy**	**CB dummy**	**MBS dummy**	**SUB dummy**
$LiqToDep_{t-1}$	-0.031	0.042	0.014	-0.088	-0.157*	-0.001
$LtD\text{-}Ratio_{t-1}$	0.046	0.008	-0.045	0.038	0.094**	-0.045
$DepToAss_{t-1}$	0.188	-0.321	-0.567**	-0.033	0.110	-0.433**
$CredRisk_{t-1}$	0.769	0.900	-0.386	-1.106	-1.862*	-1.956**
$RegCap_{t-1}$	-0.607	-0.779	0.097	-0.263	-0.544*	-0.193
RoE_{t-1}	0.429*	0.232	0.272*	0.157**	0.041	0.031
CIR_{t-1}	0.102	0.312*	-0.081	-0.097	0.261***	-0.003
$HistCost_{t-1}$	-0.053	2.793*	0.913	-0.003	2.562*	-1.006
$TotAss(ln)_{t-1}$	0.120***	0.075***	0.143***	0.127***	0.052***	0.139***
$\Delta GDP(ln)_{t-1}$	yes	yes	yes	yes	yes	yes
Business Model dummies	yes	yes	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Observations	529	476	583	1095	607	1100
Log-Likelihood	-204	-219	-270	-432	-170	-546
Chi^2	135	75	175	243	147	.
AIC	464	486	600	929	388	1157
BIC	584	586	731	1094	494	1317

*Notes: The table reports the results of the estimation of the determinants for a bank's probability to issue CB, MBS, and SUB, which are presented in columns a, b, and c, respectively. The dependent variable is a set of the observed dichotomous emission dummy equal to one, if a bank has issued the respective product and zero otherwise; both models are estimated using a pooled probit model; significance levels: * 5%, ** 1%, *** 0.1%.*

Table 7: Tobit issuance volumes controlling for simultaneity

	CRISIS			POST CRISIS		
	Panel (a)	(b)	(c)	Panel (a)	(b)	(c)
	CB fraction	**MBS fraction**	**SUB fraction**	**CB fraction**	**MBS fraction**	**SUB fraction**
$LiqToDep_{t-1}$	0.061	1.112	0.057	-0.106	-1.487	0.050
$LtD\text{-}Ratio_{t-1}$	0.130*	0.122	-0.021	0.061**	0.489*	-0.038
$DepToAss_{t-1}$	0.896**	-0.145	-0.142	0.264	0.579	-0.025
$CredRisk_{t-1}$	-0.538	9.189	0.310	-1.834	-18.341*	-1.570*
$RegCap_{t-1}$	-0.988	-4.425	0.195	-0.221	-5.655	-0.118
RoE_{t-1}	0.872*	-0.119	-0.054	0.126*	-0.128	0.009
CIR_{t-1}	0.065	2.489	-0.206*	-0.108	2.249**	-0.072
$HistCost_{t-1}$	0.886	28.108*	1.099	-0.228	31.447	-0.417
$TotAss(ln)_{t-1}$	0.153***	0.364***	0.055***	0.104***	0.274*	0.052***
$\Delta GDP(ln)_{t-1}$	yes	yes	yes	yes	yes	yes
Business Model dummies	yes	yes	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Observations	520	466	574	1035	733	1045
Log-Likelihood	-198	-402	-135	-296	-261	-393
AIC	451	853	333	659	572	853
BIC	570	957	468	827	687	1016

*Notes: The table reports the results of the estimation of the determinants for a bank's emission volumes of CB, MBS, and SUB, each in relation to total long-term funding, as presented in the bank's balance sheet for t-1, which are presented in columns a, b, and c, respectively. The dependent variable is a set of the percentages in the range [0,1] for CB and SUB and [0,5] for MBS; both models are estimated using pooled tobit model; significance levels: * 5%, ** 1%, *** 0.1%..*

Table 8: Decision to issue bond instruments with lagged dependent variables

	CRISIS			POST CRISIS		
	Panel (a)	(b)	(c)	Panel (a)	(b)	(c)
	CB dummy	**MBS dummy**	**SUB dummy**	**CB dummy**	**MBS dummy**	**SUB dummy**
CB $dummy_{t-1}$		0.036	0.066		-0.000	0.098**
MBS $dummy_{t-1}$	0.009		0.052	0.010		0.043
SUB $dummy_{t-1}$	0.114**	0.015		0.118***	0.002	
$LiqToDep_{t-1}$	-0.025	0.051	0.032	-0.090	-0.200*	0.014
$LtD\text{-}Ratio_{t-1}$	0.061*	0.009	-0.046	0.042	0.121**	-0.051
$DepToAss_{t-1}$	0.281	-0.301	-0.517**	0.041	0.138	-0.420**
$CredRisk_{t-1}$	1.141	0.936	-0.440	-0.894	-2.524*	-1.696*
$RegCap_{t-1}$	-0.444	-0.767	0.180	-0.357	-0.730*	-0.153
RoE_{t-1}	0.411*	0.228	0.270*	0.137*	0.035	0.040
CIR_{t-1}	0.104	0.308*	-0.075	-0.117	0.332***	0.009
$HistCost_{t-1}$	0.215	2.698*	0.760	0.083	3.285*	-0.922
$TotAss(ln)_{t-1}$	0.106***	0.069***	0.132***	0.108***	0.067***	0.126***
$\Delta GDP(ln)_{t-1}$	yes	yes	Yes	yes	yes	yes
Business Model dummies	yes	yes	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Atanhrho CB/MBS		-0.115			0.283*	
Atanhrho CB/SU		0.203*			0.356***	
Atanhrho MBS/SU		0.009			0.047	
Observations		583			1112	
Log-Likelihood		-684			-1100	
Chi^2		616			1036	
AIC		1551			2396	
BIC		1948			2888	

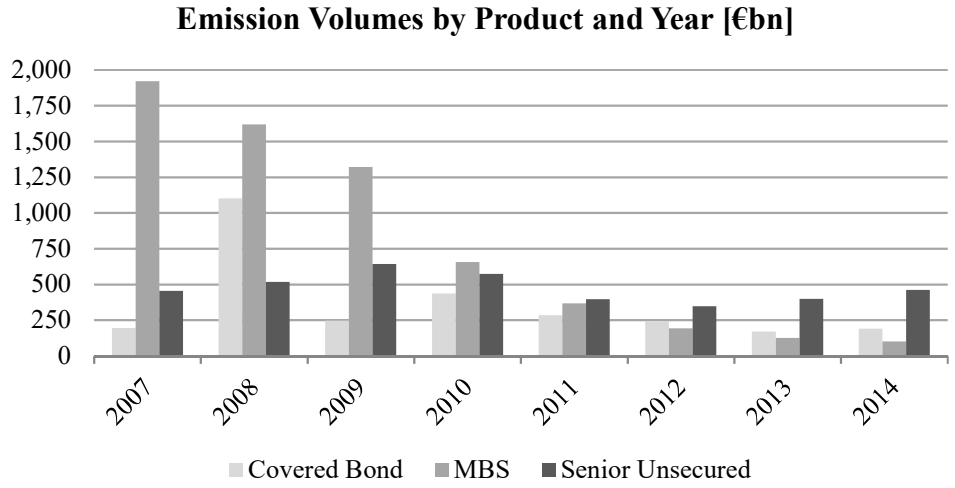
*Notes: The table reports the results of the estimation of the determinants for a bank's probability to issue CB, MBS, and SUB, which are presented in columns a, b, and c, respectively. The dependent variable is a set of the observed dichotomous emission dummy equal to one, if a bank has emitted the respective product and zero otherwise. The coefficients are shown in average marginal effects (dy/dx) and the descriptive statistics are borrowed from the coefficient regression. We include the previous year's observed emission variable for the two alternative instruments; both models are estimated using a conditional multi-equation probit model; significance levels: * 5%, ** 1%, *** 0.1%.*

Table 9: Issuance volumes with lagged dependent dummies

	CRISIS			POST CRISIS		
	Panel (a)	(b)	(c)	Panel (a)	(b)	(c)
	CB fraction	**MBS fraction**	**SUB fraction**	**CB fraction**	**MBS fraction**	**SUB fraction**
CB $dummy_{t-1}$		0.042	-0.024		-0.189	0.001
MBS $dummy_{t-1}$	0.014		-0.002	-0.022		-0.001
SUB $dummy_{t-1}$	0.013	1.127		-0.005	-0.196	
$LiqToDep_{t-1}$	-0.039	-0.178	0.003	-0.090	-1.173	0.009
$LtD\text{-}Ratio_{t-1}$	0.066*	0.045	-0.016	0.045*	0.412**	-0.021
$DepToAss_{t-1}$	0.310	-1.644	-0.182	0.093	0.810	-0.108
$CredRisk_{t-1}$	-0.416	3.954	-0.566	-1.177	-7.488	-1.496***
$RegCap_{t-1}$	-0.281	-9.263	0.236	-0.287	-2.857	-0.014
RoE_{t-1}	0.256*	3.722**	0.025	0.087*	-0.375	-0.054
CIR_{t-1}	-0.109	1.728*	-0.168	-0.081	1.886***	-0.026
$HistCost_{t-1}$	-0.177	2.568	1.246*	-0.446	8.973	-0.221
$TotAss(ln)_{t-1}$	0.118***	0.329***	0.055***	0.080***	0.211**	0.054***
$\Delta GDP(ln)_{t-1}$	yes	yes	yes	yes	yes	yes
Business Model dummies	yes	yes	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes
Atanhrho CB/MBS		-0.061			0.115	
Atanhrho CB/SU		0.080			0.225***	
Atanhrho MBS/SU		-0.080			-0.004	
Observations		572			1044	
Log-Likelihood		-517			-613	
Chi^2		375			1215	
AIC		1225			1430	
BIC		1638			1935	

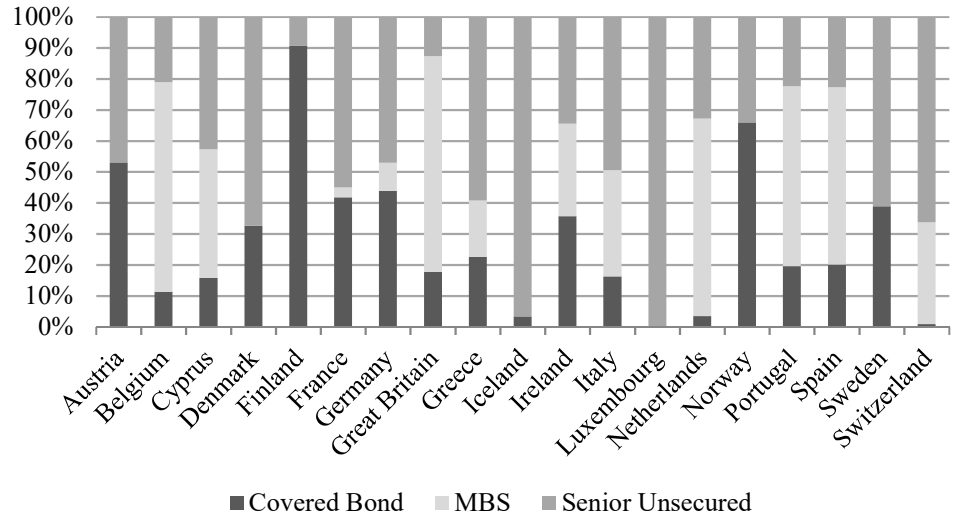
*Notes: The table reports the results of the estimation of the determinants for a bank's emission volumes of CB, MBS, and SUB, each in relation to total long-term funding, as presented in the bank's balance sheet for t-1, which are presented in columns a, b, and c, respectively. The dependent variable is a set of the percentages in the range [0,1] for CB and SUB and [0,5] for MBS. We include the previous year's observed emission variable for the two alternative products; both models are estimated using a conditional multi-equation tobit model; significance levels: * 5%, ** 1%, *** 0.1%.*

Figure 1: Volumes of the three types of bond instruments banks in the sample issue between 2007 and 2014



Source: Thomson Reuters SDC Platinum and own calculations

Figure 2: Issuance volume shares of three types of bank bonds across countries in our sample



Source: Thomson Reuters SDC Platinum and own calculations