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**ASSET ENCUMBRANCE AND BANK  
RISK: FIRST EVIDENCE FROM PUBLIC  
DISCLOSURES IN EUROPE**

Albert Banal-Estanol, Enrique Benito and Dmitry  
Khametshin

**FINANCIAL ECONOMICS**



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*Albert Banal-Estanol, Enrique Benito and Dmitry Khametshin*

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Centre for Economic Policy Research  
33 Great Sutton Street, London EC1V 0DX, UK  
Tel: +44 (0)20 7183 8801  
[www.cepr.org](http://www.cepr.org)

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## Abstract

Asset encumbrance refers to the existence of bank balance sheet assets being subject to arrangements that restrict the bank's ability to freely transfer or realise them. Asset encumbrance has recently become a much discussed subject and policymakers have been actively addressing what some consider to be excessive levels of asset encumbrance. Despite its importance, the phenomenon of asset encumbrance remains poorly understood. We build a novel dataset of asset encumbrance metrics based on information provided in the banks' public disclosures for the very first time throughout 2015. We provide descriptive evidence of asset encumbrance levels by country, credit quality, and business model using different encumbrance metrics. Our empirical results point to the existence of an association between CDS premia and asset encumbrance that is negative, not positive. That is, on average encumbrance is perceived to be beneficial. Still, certain bank-level variables play a mediating role in this relationship. For banks that have high exposures to the central bank, high leverage ratio, and/or are located in southern Europe, asset encumbrance is less beneficial and could even be detrimental in absolute terms.

JEL Classification: G01, G21, G28

Keywords: Asset encumbrance, Collateral, bank risk, credit default swaps

Albert Banal-Estanol - [albert.banalestanol@upf.edu](mailto:albert.banalestanol@upf.edu)  
*Universitat Pompeu Fabra and Barcelona GSE*

Enrique Benito - [enrique.benito@sbs.ox.ac.uk](mailto:enrique.benito@sbs.ox.ac.uk)  
*Saïd Business School; City, University of London*

Dmitry Khametshin - [dmitry.khametshin@upf.edu](mailto:dmitry.khametshin@upf.edu)  
*Universitat Pompeu Fabra*

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# **Asset encumbrance and bank risk: First evidence from public disclosures in Europe**

Albert Banal-Estanol†

Enrique Benito‡

Dmitry Kametshin§

July 2017

## **ABSTRACT**

Asset encumbrance refers to the existence of bank balance sheet assets being subject to arrangements that restrict the bank's ability to freely transfer or realise them. Asset encumbrance has recently become a much discussed subject and policymakers have been actively addressing what some consider to be excessive levels of asset encumbrance. Despite its importance, the phenomenon of asset encumbrance remains poorly understood. We build a novel dataset of asset encumbrance metrics based on information provided in the banks' public disclosures for the very first time throughout 2015. We provide descriptive evidence of asset encumbrance levels by country, credit quality, and business model using different encumbrance metrics. Our empirical results point to the existence of an association between CDS premia and asset encumbrance that is negative, not positive. That is, on average encumbrance is perceived to be beneficial. Still, certain bank-level variables play a mediating role in this relationship. For banks that have high exposures to the central bank, high leverage ratio, and/or are located in southern Europe, asset encumbrance is less beneficial and could even be detrimental in absolute terms.

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† Universitat Pompeu Fabra and Barcelona GSE. E-mail: albert.banalestanol@upf.edu

‡ Saïd Business School, University of Oxford and City, University of London. E-mail: enrique.benito@sbs.ox.ac.uk

§ Universitat Pompeu Fabra. E-mail: dmitry.khametshin@upf.edu

## 1. INTRODUCTION

As of June 2011, Dexia, a Franco-Belgian bank, reported a strong Tier 1 Capital Ratio of 11.4%.<sup>1</sup> Out of the 91 institutions analysed in the European Banking Authority (EBA) stress tests, Dexia came joint 12th, with a forecast Core Tier 1 capital ratio of 10.4% under the adverse stress scenario.<sup>2</sup> From a liquidity standpoint, the bank had built up a buffer of €88bn in liquid securities, had decreased short-term funding needs by €47bn and its short-term ratings had been reaffirmed as investment grade by the main credit rating agencies. But just three months later, in October 2011, Dexia was partly nationalised by the Belgian and French governments. Several commentators highlighted the high levels of “encumbered” assets as the key factor precipitating its move into government arms.<sup>3,4</sup>

Asset encumbrance refers to the existence of financial bank balance sheet assets being subject to arrangements that restrict the bank’s ability to freely transfer or realise them. Bank assets become encumbered when these are used as collateral to raise funding, for example in repurchase agreements (repos) or in other collateralised transactions such as asset-backed securitisations, covered bonds, or derivatives.<sup>5</sup> In the particular case of Dexia, more than €66bn of its €88bn buffer securities were encumbered through different secured funding arrangements, particularly with the European Central Bank (ECB), and were therefore unavailable for obtaining emergency funding.

Policymakers are acting decisively in order to address what some consider to be excessive levels of asset encumbrance. Some jurisdictions have introduced limits on the level of encumbrance (Australia, New Zealand) or ceilings on the amount of secured funding or covered bonds (Canada, US), while others have incorporated encumbrance levels in deposit insurance premiums (Canada). Several authors have proposed linking capital requirements to the banks’ asset encumbrance levels or establishing further limits to asset encumbrance as a back-stop (Helberg and Lindset, 2014; IMF, 2013; Juks, 2012). As part of the Basel III regulatory package, the Net Stable Funding Ratio (NSFR), an additional minimum liquidity requirement of the LCR will be introduced in 2018. The NSFR heavily penalises asset encumbrance by requiring substantial amounts of stable funding to finance encumbered assets. In Europe, regulatory reporting and disclosure requirements have been introduced and all institutions are required to incorporate asset encumbrance within their risk management frameworks. The Dutch National Bank has even committed to *‘keeping encumbrance to a minimum’* (De Nederlandsche Bank, 2016).

Despite the importance of asset encumbrance, the phenomenon remains poorly understood. There is not even a consensus as to how asset encumbrance should be measured, and there is limited knowledge of how asset encumbrance varies across countries or bank business models. Surprisingly, the relationship between bank risk and asset encumbrance remains unexplored empirically. As highlighted by an incipient theoretical literature and policy papers, higher asset encumbrance could

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<sup>1</sup> See Dexia 2Q & 1H 2011 Results and Business Highlights Presentation, 4 August 2011.

<sup>2</sup> The Core Tier 1 ratio represents the ratio of very high quality capital (shareholders’ capital and reserves) to risk-weighted assets (RWA). The Tier 1 capital ratio includes, in addition to Core Tier 1 capital, other perpetual capital resources such as subordinated debt instruments with conversion features and is also expressed as a fraction of RWA.

<sup>3</sup> See e.g. Financial Times, ‘Bank collateral drying up in rush for security’, October 2011.

<sup>4</sup> More recently, in June 2017, Banco Popular was put into resolution by the European Single Supervisory Mechanism (SSM) and was acquired by Banco Santander for a symbolic amount of €1. Yet, as of year-end 2016, the Spanish bank Banco Popular reported a Tier 1 capital ratio of 12.3% and had passed the EBA stress tests undertaken in 2016 with a solid margin. However, nearly 40% of its total balance sheet assets were encumbered as of December 2016.

<sup>5</sup> Collateralisation is a common method of mitigating counterparty credit risk in derivative markets through the provisioning of margin.

result in a reduction of the assets that become available to unsecured creditors under insolvency, an effect coined as “structural subordination” (Bank of England, 2012; CGFS, 2013; Houben and Slingenberg, 2013; IMF, 2013; Juks, 2012; Le Leslé, 2012). This may be priced in by unsecured creditors, potentially increasing overall funding costs. On the other hand, increasing the proportion of secured funding, which carries lower rollover risks and is generally cheaper than equivalent unsecured funding, could translate into an increased capacity of debt repayment and a lower probability of default.

This paper tries to shed some light on these issues in three steps. First, we define asset encumbrance, describe how assets become encumbered and review the sources of asset encumbrance. Second, we provide descriptive evidence of asset encumbrance levels by country, bank credit quality, size and business model using different encumbrance metrics. To do so, we build a novel dataset using information provided in the asset encumbrance disclosures published for the first time throughout 2015 by European banks, following a set of harmonised definitions provided by the EBA (2014). Finally, we investigate the association between bank risk and the levels of asset encumbrance empirically. In line with recent studies, we estimate the relationship between bank balance sheet ratios, based on capital adequacy, liquidity, asset quality and earnings potential (CAMEL) indicators, typically used in supervisory rating systems to classify a bank’s overall condition, and implied five-year CDS spreads. We then consider the extent to which asset encumbrance contributes to the explanatory power of such models. Our analysis provides, to the best of our knowledge, the first empirical investigation of the relationship between encumbrance and bank risk.

Our findings show that banks with higher encumbrance levels present lower CDS spreads across all three metrics of asset encumbrance considered – i.e. bank risk seems to be negatively associated with asset encumbrance. In addition, and consistently with the demise of Dexia, we find that ratios measuring asset encumbrance or asset quality provide more valuable information on bank risk than capital and liquidity ratios. This result is consistent with recent literature pointing to limited reliance by markets on capital and liquidity ratios to account for overall bank risk (Ötoker-Robe and Podpiera, 2010; Chiaramonte and Casu, 2013; Hasan et al., 2015; Kanagaretnam et al., 2016).

We find that CAMEL and other bank-level variables play a mediating role in the relationship between asset encumbrance and bank risk. For banks with a high reliance on central bank funding and high levels of liquid assets, such as Dexia, or with a high leverage ratio and high levels of impaired loans, such as Banco Popular, or for banks located in Southern Europe (GIIPS), asset encumbrance is less beneficial and could even be detrimental in absolute terms.<sup>6</sup> Banks with high levels of loan loss provisions and Nordic banks, on the contrary, could further benefit from increasing their levels of asset encumbrance. Banks in Nordic countries rely to a large extent on covered bonds, which are perceived as a very safe investment and source of funding. These findings imply that regulators need to be cautious when assessing asset encumbrance levels and leaping to across-the-board conclusions about its effects.

The remainder of the paper is structured as follows. Section 2 defines asset encumbrance and explains its sources. Section 3 explores the benefits and risks of asset encumbrance from the perspective of both secured and unsecured creditors. Section 4 presents the methodology used and the data. Section 5 presents the results. Section 6 concludes.

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<sup>6</sup> In the demise of Banco Popular (see footnote 4), the bank had high levels of asset encumbrance and of impaired loans. As of December 2016, almost 15% of Popular’s loan portfolio was non-performing compared to a European average of 5.1% (EBA 2017). Its Basel III Leverage Ratio was also high (5.31% compared to a weighted average for European banks of 5.2% as per EBA, 2017).

## 2. ASSET ENCUMBRANCE: DEFINITION AND SOURCES

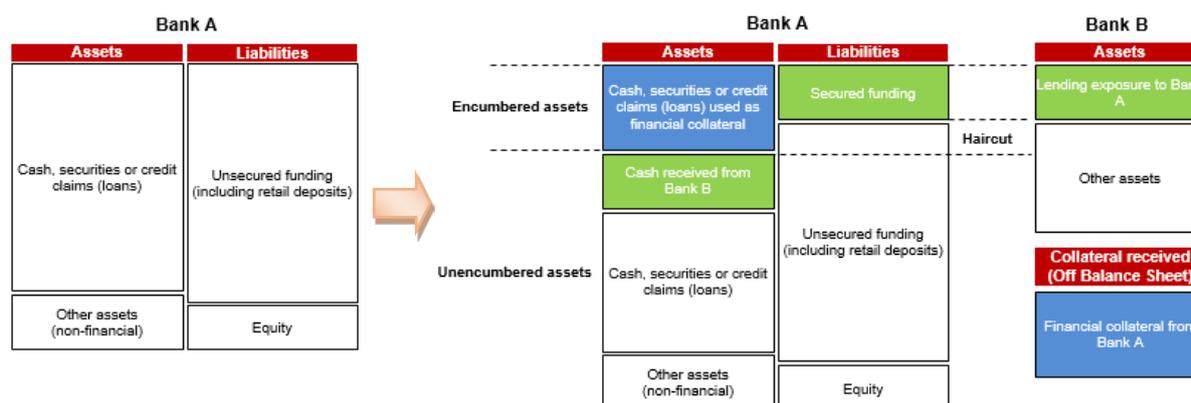
In this section we define asset encumbrance and describe how assets become encumbered. We also review the most common sources of asset encumbrance (i.e. the liabilities or obligations that give rise to encumbered assets).

### 2.1. Defining asset encumbrance

European regulations define encumbered assets as “*assets pledged or subject to any form of arrangement to secure, collateralize or credit enhance any transaction from which it cannot be freely withdrawn*”.<sup>7</sup> Assets that are not encumbered are referred to as ‘unencumbered’. The Basel Committee on Banking Supervision (BCBS) defines unencumbered assets as those assets which are “*free of legal, regulatory, contractual or other restrictions on the ability of the bank to liquidate, sell, transfer, or assign the asset*”.<sup>8</sup>

To clarify the definition of encumbrance, let us consider a bank (Bank A) whose assets include loans and a portfolio of securities (government or corporate bonds, equities, etc.), financed via equity capital, retail deposits and unsecured wholesale funding, as shown on the left-hand side of figure 1. Bank A could obtain additional funding from a counterparty, let us say Bank B, by entering into a secured financing transaction, as shown on the right-hand side of figure 1.

**Figure 1. Bank A encumbers assets by obtaining secured funding from Bank B**



Under such an arrangement Bank A provides collateral to Bank B in order to mitigate the risk of failing to keep up with interest repayments or repaying the borrowings. In exchange, Bank A benefits from cheaper funding when compared to an equivalent unsecured transaction.<sup>9</sup> The arrangement imposes restrictions on Bank A in its ability to sell, transfer or dispose of the collateral provided during the term of the transaction. Bank A would consider such assets encumbered.

Figure 1 represents the securities provided as collateral as recorded or *recognised* in Bank A’s balance sheet rather than being *transferred* to Bank B’s balance sheet. Collateral obtained by Bank B is therefore represented in an off-balance sheet (OBS) rather than an on-balance sheet, and is known as ‘OBS collateral’ or simply ‘collateral received’. The assumption that the collateral remains recognised from Bank A’s balance sheet is a necessary condition for being considered an

<sup>7</sup> See European Commission (2015).

<sup>8</sup> See BCBS (2012).

<sup>9</sup> In addition, the arrangement may provide for savings in regulatory capital requirements to Bank B as well as lower regulatory liquidity requirements to Bank A and Bank B.

encumbered asset of Bank A. If the assets used as collateral were derecognised by Bank A then they would be recognised by Bank B and they would not be encumbered for Bank A.

In practice, the recognition or derecognition of collateral provided depends on the contractual terms of the transaction as well as its accounting treatment. Derecognition cannot occur unless the securities are 'transferred' to the counterparty. This can be achieved by using 'title transfer' arrangements, whereby full ownership of the collateral is passed on to the counterparty during the term of the transaction.<sup>10</sup> Collateral can also be provided under 'security interest' arrangements, which do not transfer ownership but concede rights to the counterparty to obtain full ownership of the collateral under some pre-determined event, such as failure to repay.<sup>11</sup> The use of one technique over the other depends on market practice. Collateral provided in secured financing transactions such as repurchase agreements (i.e. repo), is typically provided by way of title transfer whereas collateral used as a margin for OTC derivatives can be provided using both methods.<sup>12</sup>

The transfer of title over collateral, however, is not a sufficient condition for derecognition to occur, with the actual outcome depending on the applicable accounting treatment. Under International Financial Reporting Standards (IFRS), IAS 39 applies a set of tests to assess whether (i) the risks and rewards and (ii) control over the asset have been transferred.<sup>13</sup> If the risks and rewards have not been transferred, or in other words, if the collateral provided continues to be exposed to the risks of ownership of the assets such as loss in market value and/or the benefits that they generate such as dividends, then the collateral would remain recognised on its balance even if a transfer of assets has occurred. But even if the risks and rewards had been transferred, further 'control' tests are undertaken to understand which entity controls the asset. If the collateral provider could direct how the benefits of that asset are realised, then the collateral would not be derecognised either.

As illustrated in figure 1, the value of securities that Bank A posted as collateral is higher than the value of the borrowings. This practice is known as overcollateralisation and is intended to mitigate the risk of the collateral falling in value during the term of the transaction. It is usually undertaken by means of a 'haircut' or 'margin ratio'.<sup>14</sup> Collateral agreements often require a frequent (sometimes daily) marked-to-market valuation of the collateral and requests to top up the value of collateral, known as collateral calls, may be triggered if its market value falls below certain pre-determined threshold amounts.

Even in the case in which the collateral received is not reflected in its balance sheet, Bank B could re-use some or all of the collateral received from Bank A to obtain financing from a third party (let us say, Bank C). As illustrated in figure 2, this re-use of collateral by Bank B would result in the encumbrance of OBS collateral. As such, encumbrance can affect both on-balance sheet assets as well as OBS collateral. The practice of providing collateral that has been previously received is known

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<sup>10</sup> Under title transfer, Bank B would have to return the collateral (or equivalent securities) to Bank A when the original transaction matures.

<sup>11</sup> Security interest arrangements are also known as collateral 'pledges'.

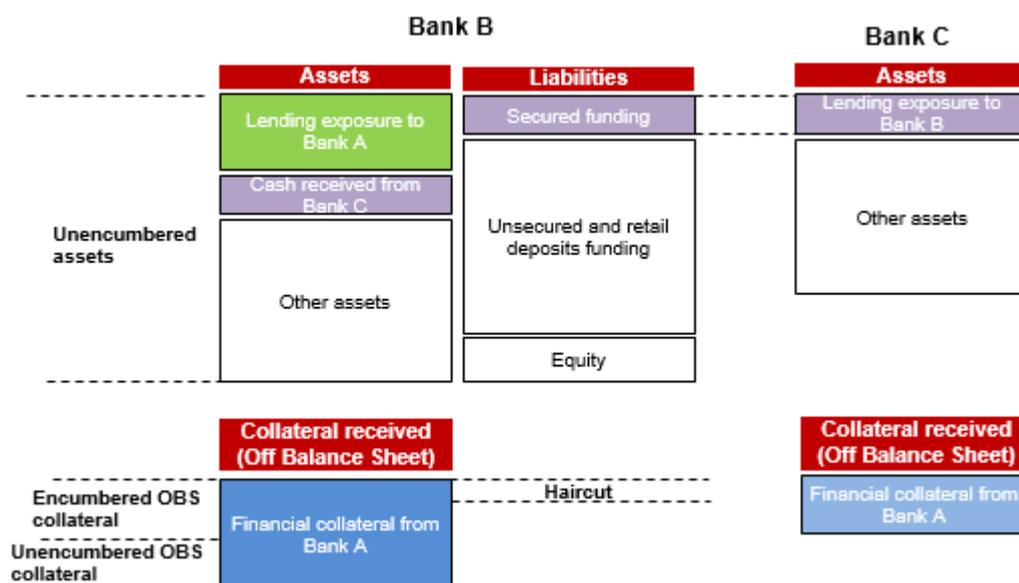
<sup>12</sup> Under English Law the collateral for OTC derivatives is typically provided by way of title transfer, whereas under New York Law collateral is typically provided under security interest.

<sup>13</sup> The treatment under US GAAP (ASC 860) differs from IFRS since the focus is on whether the transferor has surrendered control over a financial asset.

<sup>14</sup> The agreed haircut or margin ratio determines the percentage by which the market value of a security is reduced for the purpose of calculating the amount of collateral being provided.

as collateral re-use or re-hypothecation. It is common practice and may result in long ‘collateral chains’.<sup>15</sup>

**Figure 2. Collateral received and re-used**



## 2.2. Sources of asset encumbrance

The liabilities or obligations that give rise to encumbered assets are known as ‘sources of asset encumbrance’ or ‘matching liabilities’. The typical bank will have encumbered assets from several sources but the simplest institutions may rely only on a single source or may present no encumbered assets at all. We now discuss some of the most common sources of asset encumbrance.<sup>16</sup>

### 2.2.1. Secured financing transactions

Secured financing transactions encompass myriad transactions involving the temporary provision of securities to borrow cash or other securities. Common types include repurchase agreements (repos), buy/sell backs or securities borrowing and lending. Collateral in repo is provided under a title transfer but it remains recognised in the balance sheet of the collateral provider’s (i.e. the repo seller) since the risks and rewards of the collateral are retained.<sup>17</sup> Thus, repo collateral is

<sup>15</sup> The terms re-hypothecation and re-use are often used interchangeably and we will do so here. In practice there are legal distinctions between them that may be relevant in a different context. Recent studies have analysed the concept of re-hypothecation and ‘collateral velocity’. Analytical work includes Adrian and Shin (2010) and Singh (2010). More recent work has focussed on liquidity mismatches and the role of collateral in intermediation chains. Brunnermeier et al. (2014) introduced the Liquidity Mismatch Index (LMI) which compares the market liquidity of assets and the funding liquidity of liabilities, thus capturing the length of collateral intermediation chains.

<sup>16</sup> In addition to the sources covered in section 2.2, transactions that may result in encumbered assets include collateral swaps, also known as collateral upgrade transactions, where collateral of a different quality is exchanged. Collateralised guarantees rely on securities to secure an existing or future liability. Other arrangements, such as factoring—which include the transfer of trade receivables to an institution—may result in similar encumbrance to securitisations.

<sup>17</sup> If this was not the case, banks could artificially reduce its overall leverage by derecognising collateral in repurchase agreements. This treatment was exploited by Lehman Brothers’ under the well-known ‘Repo 105’

encumbered for the collateral provider. Encumbered assets in repo are predominantly government bonds, followed by corporate bonds and covered bonds. Asset-backed securities and equities are also used as collateral. Most of the funding provided by central banks is transacted through repo. Like Dexia, many European banks were, and some still are, heavily reliant on repo financing from the ECB.

### **2.2.2. Asset-backed securities (ABS) and mortgage-backed securities (MBS)**

Another potential source of asset encumbrance is securitisations. These entail ABS and MBS bonds or notes being issued and receivables, which may include retail or commercial mortgages in MBS, or credit card debt or other loans in ABS, being used as collateral.

A traditional 'two-step' securitisation involves the initial transfer of the receivables of the originating bank to a Special Purpose Vehicle (SPV) and the sale of the ABS or MBS to investors. The overall securitisation structure is intended to make sure that there is a true sale of receivables to the SPV and that the SPS is 'bankruptcy remote'. Accounting standards however, may require that the SPV is consolidated into the 'sponsoring' bank's balance sheet, including all of its assets and liabilities, even the receivables.<sup>18</sup> If the underlying receivables were consolidated, this would result in the recognition of such receivables on the sponsor's balance sheet. However, tests to assess whether the assets meet the criteria for accounting derecognition, as discussed earlier, shall still be undertaken. If derecognition criteria are not met the receivables would be encumbered. This is often the case since it is common for the sponsoring bank to keep an active role in the securitisation, for example, by servicing the assets or providing support by retaining certain tranches to absorb first losses and potential risks in relation to timings in the collection of the receivables.

ABS or MBS can be used as collateral to raise funding with counterparties and central banks. Thus, a common practice across some banks, especially during the Eurozone crisis, is the retention of their self-issued ABS or MBS rather than its sale to investors.<sup>19</sup> If notes are retained, they would not be encumbered. But if the notes are used to raise fresh funding, for example, from the central bank via repo, the receivables would become encumbered as it occurs in securities' financing transactions.

Figure 3 (left-hand side) illustrates how securitised receivables can be encumbered (highlighted in green) by collateralising ABSs that are either (i) sold to investors or (ii) used as repo collateral to obtain funding from another counterparty.

### **2.2.3. Covered bonds**

Covered bonds are similar to MBS but the mortgages used as collateral always remain recognised on the consolidated balance sheet of the issuing entity and thus always generate encumbrance. The issuer and the investors have dual recourse to the collateral. This feature, together with the existence of overcollateralisation requirements and the dynamic replenishment of non-performing loans in the collateral pool imply that these instruments are perceived as being very safe. There is indeed no known default on covered bonds since their inception.

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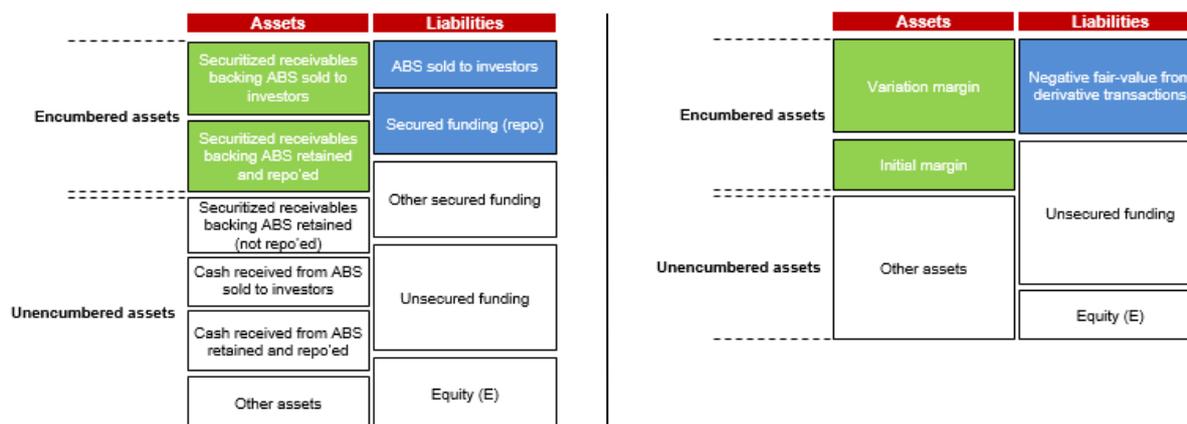
scheme, characterised by the New York Attorney General Andrew Cuomo as a 'massive accounting fraud' and leading to a review by the accounting standard setters of the accounting treatment of repo transactions.

<sup>18</sup> The consolidation models under IFRS and GAAP are relatively similar and are based on the criteria of entity control over the SPV.

<sup>19</sup> The acceptance of securitised notes as collateral in the ECB facilities led to an important increase in retention levels during the Eurozone crisis, with overall retention as a proportion of total gross issuance increasing from 26% in the first half of 2007 to 42% in the first half of 2012 (IMF, 2013).

The use of covered bonds as collateral has significantly increased in recent times. For many banks in peripheral European countries (GIIPS) funding collateralised by retained covered bonds became the main source of long-term funding during the Eurozone sovereign crisis, as their access to unsecured markets was partially or fully closed (van Rixtel and Gasperini, 2013).

**Figure 3. Encumbered and unencumbered assets from securitisation (LHS) and derivative transactions (RHS)**



#### 2.2.4. Derivatives

Derivatives also generate encumbrance, as collateralisation has become a key method of mitigating counterparty credit risk in derivative markets, both on over-the-counter (OTC) and exchange-traded (ETD) derivatives. Collateralisation occurs because of the provisioning of the margin, in two different forms. A variation margin is posted during the course of the transaction to cover adverse changes in value (i.e. a negative mark-to-market value). Initial margin (also known as an independent amount) is posted at the beginning of a transaction to cover potential future adverse changes in the value of the contract, and is recalculated on a regular basis.

The margin provided is subject to restrictions and therefore constitutes encumbered assets. This is illustrated in figure 3 (right-hand side).<sup>20</sup> The margin can be provided in the form of cash or securities and it is common to provide re-hypothecation rights to the counterparty. According to the latest ISDA Margin Survey, for non-cleared OTC derivatives cash represents 76.6% of the collateral provided, followed by government bonds (13.4%) and other securities (10.1%), including US municipal bonds, government agency/government-sponsored enterprises (GSEs), and equities (ISDA, 2015).

### 3. ASSET ENCUMBRANCE: RISKS AND BENEFITS

The potential negative impact of asset encumbrance on unsecured creditors has been the focus of much discussion recently. As highlighted by an incipient theoretical literature, higher asset encumbrance would result in a reduction of the assets that become available to unsecured creditors under insolvency, an effect coined as “structural subordination” (Bank of England, 2012; CGFS, 2013;

<sup>20</sup> The figure assumes that the variation margin is not offset against the derivative liability (i.e. the negative fair value from the derivative) therefore becoming encumbered. Some contracts allow for such an offsetting of the variation margin. The outstanding exposure between the counterparties is settled and the terms of the derivative contracts are reset so that the fair value is zero, leading to no encumbered assets due to an exchange of the variation margin.

Houben and Slingenberg, 2013; IMF, 2013; Juks, 2012; Le Leslé, 2012). The same seniority that secured creditors enjoy means that as more secured debt is issued, balance sheet shocks are asymmetrically concentrated on unsecured creditors, exacerbating the possibility of a run of unsecured creditors (Ahnert et al., 2016; Matta and Perotti, 2015). The resulting shifting of risks depends on the magnitude of the haircuts being applied since the required overcollateralisation reduces the amount of collateral available for unsecured funding (Eisenbach et al., 2014).

If unsecured creditors reflect the risk of structural subordination into required returns, this could result in higher overall funding costs to institutions. As stated by Dr Joachim Nigél, a former member of the executive board of the Deutsche Bundesbank in a speech at the 2013 European Supervisor Education Conference on the future of European financial supervision: “Higher asset encumbrance has an impact on unsecured bank creditors. The more bank assets are used for secured funding, the less remain to secure investors in unsecured instruments in the case of insolvency. They will price in a risk premium for this form of bank funding.”

In addition, a higher amount of encumbered assets may reduce a bank’s headroom to obtain funding under a stressed market environment. This could in turn trigger investor concerns about the bank’s viability, as shown in Dexia’s demise. During economic downturns, falling collateral values and higher haircuts result in higher overcollateralisation levels, requiring more assets to be pledged to raise a given level of funding and increasing asset encumbrance (Bank of England, 2012). This latter effect would in turn magnify the impact of asset encumbrance on unsecured creditors via structural subordination. There is evidence that during the Eurozone crisis, not only the funding costs of banks increased significantly alongside the increases in asset encumbrance, but larger over-collateralisation levels also shrank the pools of unencumbered assets, further reducing banks’ ability to raise secured and unsecured funding (CGFS, 2011; CGFS, 2013; ECB, 2012).<sup>21</sup>

As it is shown in the data, higher asset encumbrance may also bring in benefits for unsecured creditors. Clearly, secured creditors benefit from the safety that collateral provides. This is reflected in lower funding costs than equivalent unsecured funding. Secured funding also carries a lower rollover risk. There is indeed evidence that repo funding was rolled-over during the financial crisis, up to the eve of default (Gorton and Metrick, 2012; Krishnamurthy et al., 2014). As a result, higher collateralisation could lead to a lower probability of default and increased capacity of debt repayment, which would also benefit unsecured creditors.

In addition, higher collateralisation could provide a reduction in the cost of settling creditors’ conflicts in case of resolution or bankruptcy (Hardy, 2014). Claimants holding collateral do not have to enter the contest for residual assets and, despite increasing levels of structural subordination, the remaining claimants have less to fight over, thus reducing bankruptcy costs. This would also benefit unsecured creditors.

In sum, asset encumbrance carries risks of subordinating unsecured creditors, increasing funding costs and reducing a bank’s headroom to obtain funding under stressed conditions. However, it may also bring benefits to both secured and unsecured creditors, which could lead to a decreased probability of default and decreased overall funding costs.

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<sup>21</sup> Recent literature has also analysed the system-wide implications of increased asset encumbrance levels and the potential for increased susceptibility to procyclical swings in the underlying value of the collateral assets (Gai et al., 2013; Haldane 2012; Krishnamurti, 2010; Perotti, 2010). More generally, the amplification role of haircut shocks in generating procyclicality has been broadly considered in the literature (see e.g. Adrian and Shin, 2010; Brunnermeier and Pedersen, 2009; Geanakoplos, 2010; Gorton and Metrick, 2012).

## 4. DATA AND METHODOLOGY

Our analysis has two parts. First, we provide a descriptive analysis of asset encumbrance levels by country, bank credit quality, size and business model. We then assess the extent to which bank CDS premia are associated with asset encumbrance through a series of multivariate regressions.

### 4.1. Measuring asset encumbrance

There is currently no consensus as to how asset encumbrance shall be measured and different measures have been proposed. We focus on the three key ratios being used by policymakers. The computation of each ratio is illustrated in figure 4.

The ‘asset encumbrance ratios’ (AERs) capture the amount of encumbered assets as a proportion of total assets. There are two variations:

- The ratio of *encumbered assets to total assets*, which captures the overall proportion of balance sheet assets that have been encumbered. This ratio has been used by the Bank of England and the European Systemic Risk Board (ESRB) to undertake analysis of the UK and European banking sectors respectively (BoE, 2012; ESRB, 2013). We denote it as AER1.
- The ratio of *encumbered assets and other collateral received and re-used to total assets and total collateral received*, which captures the overall proportion of encumbered balance sheet assets as well as off-balance sheet collateral. This ratio is used by the EBA to undertake their risk assessment of the European banking system and to apply more comprehensive regulatory reporting requirements (EBA, 2016). We denote this ratio as AER2.

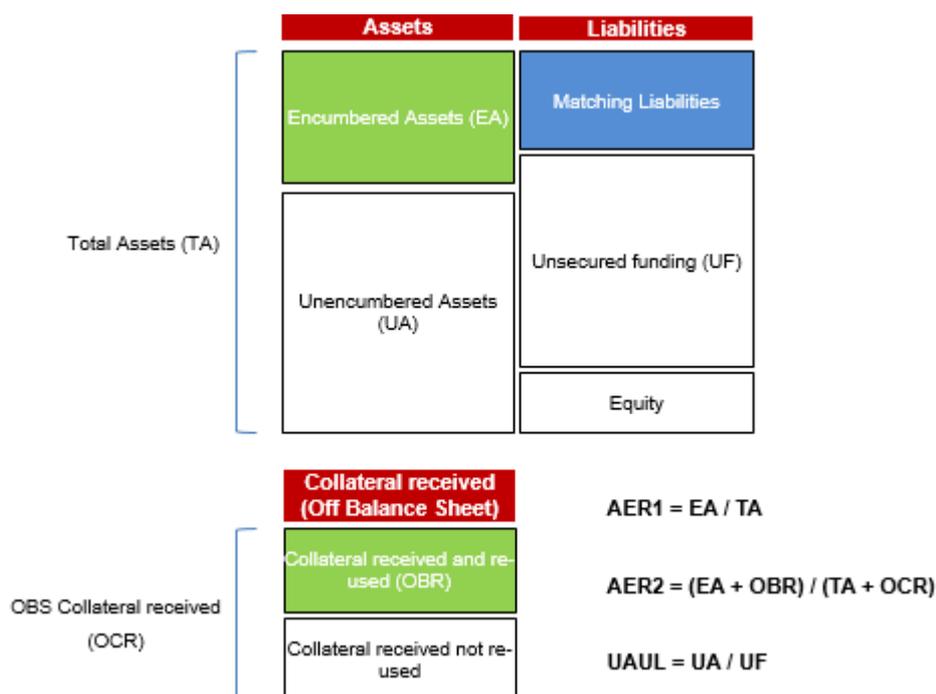
The third ratio focusses instead on unencumbered assets:

- The ratio of *unencumbered assets to unsecured liabilities* (UAUL), which captures the proportion of assets which are not subject to collateral agreements as a proportion of unsecured creditor’s claims and provides an indication of the amount of structural subordination of unsecured creditors. According to a report from the Bank of International Settlements’ Committee on the Global Financial System (CGFS, 2013), the UAUL ratio is the most appropriate measure of asset encumbrance.

As opposed to AER1 and AER2, UAUL is a measure of how many assets are available to unsecured creditors under insolvency, and should therefore capture the structural subordination of unsecured creditors more directly than AER1 and AER2. Since UAUL is measured relative to unsecured funding, this ratio would be unable to capture low levels of unencumbered assets relative to the total assets of banks that rely heavily on capital or secured funding. As opposed to AER2, AER1 and UAUL do not capture encumbrance arising from off-balance sheet activities.

Computing asset encumbrance measures at the bank level is not straightforward since accounting data provides limited information to infer the amount of banks’ encumbered assets, unencumbered assets and matching liabilities. Accounting statements are accompanied by disclosures which try to shed light on the amount of assets that are collateralising transactions but, as noted by the EBA: “existing disclosures in International Financial Reporting Standards (IFRS) may convey certain situations of encumbrance but fail to provide a comprehensive view on the phenomenon” (EBA, 2014). For this reason, the EBA introduced new guidelines in 2014 proposing the requirement to disclose asset encumbrance reporting templates. EBA guidelines do not constitute a regulatory requirement and, although most did, not all of the European institutions disclosed such information.

**Figure 4. Asset encumbrance metrics**



We extract data from the risk disclosures of banks, including information on encumbered assets, unencumbered assets, off-balance sheet collateral received and available for encumbrance, OBS collateral received and re-used and matching liabilities as of year-end 2014. We complement the disclosure data with data on total assets and equity extracted from Bankscope to compute the asset encumbrance ratios, AER1 and AER2 considered for each institution. For UAUL, we use a slightly modified version which we denote as AUAUL (Adjusted UAUL), calculated as  $AUAUL_i = (Max(UAUL) - UAUL_i) / (Max(UAUL) - Min(UAUL))$  where  $UAUL_i$  is bank's  $i$  ratio of unencumbered assets to unsecured liabilities. This adjustment facilitates comparisons with AER1 and AER2 by ensuring that higher encumbrance is associated with a higher AUAUL and that its values fall between 0 and 1.

#### 4.2. Other variables

Our main dependent variable in the multivariate regressions is a measure of bank risk represented by banks' CDS spreads as of year-end 2015. CDS spreads are widely considered to be a good indicator of bank risk and can be a proxy for bank unsecured funding costs (see e.g. Babihuga and Spaltro, 2014; Bank of England, 2014).

We use implied rather than market-based spreads because only the largest global institutions are involved in CDS issuance. For most banks, Fitch Solutions determines the implied spreads on a daily basis using a proprietary model that includes, as inputs, banks' financial fundamental information, distance-to-default information derived from the equity market, and other market variables. In line with the existing literature, we focus on five-year senior spreads since these contracts account for 85% of the market and are highly liquid. Data is provided by Fitch Solutions and extracted from Bankscope.

Explanatory variables include, in addition to the asset encumbrance measures, CAMEL and control variables. We follow Chiaramonte and Casu (2013) to select the following CAMEL variables:

#### Capital Adequacy:

- The *Tier 1 capital ratio*, which represents the ratio of high-quality capital (shareholders' capital, reserves and other perpetual capital resources such as subordinated debt), divided by risk-weighted assets (RWA).
- The *leverage ratio*, which is calculated as the fraction of common equity to total assets and reflects the level of indebtedness of a firm.

#### Liquidity:

- The *net loans to deposits and short-term funding ratio*, which is a measure of structural liquidity. A lower value of the ratio means the bank relies to a greater extent on more stable deposit funding, as opposed to wholesale funding, to finance its loan book.
- The *liquid assets to total assets ratio*, which measures the amount of liquid assets that the bank holds and that could be converted into cash to withstand a liquidity stress event.

#### Quality of assets:

- The *ratio of loan-loss reserve to gross loans*, which measures the quality of the loan portfolio by indicating the proportion of reserves for losses relative to the banks' loan portfolio.
- The *ratio of unreserved impaired loans to equity*, which is another indicator of the quality of the loan portfolio but expressed relative to common equity. It is also known as the 'capital impairment ratio'.

#### Earnings potential:

- The *return on equity ratio (ROE)*, which measures the bank's income-producing ability as reflected by its net income relative to the bank's common equity.
- The *return on assets ratio (ROA)*, which is an indicator of the return on a firm's investments and is calculated by dividing the bank's net income over its total assets.

Control variables include bank size (measured by the natural logarithm of total assets), central bank exposure to total assets and off-balance sheet exposure to total assets. We include dummy variables to differentiate the business model of the institution using three categories: 'Commercial banks and Bank holding companies (BHC)', 'cooperative and savings banks' and 'other banks'. We also include a dummy variable to identify which banks are investment grade. We use implied ratings in order to avoid compromising the sample size, in a similar fashion to CDS spreads.<sup>22</sup>

Country-specific dummies are included in all models to help to control for factors affecting CDS premia at the country level, including regulatory particularities. To account for the potential correlation of the errors among the banks belonging to the same business category in a given country, we apply country-business model clustering in all our regression models.

Our final data sample includes institutions with total assets above €1bn for which CDS spreads, asset encumbrance, CAMEL and control variables are available, resulting in 367 banks.

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<sup>22</sup> Implied ratings are provided by Fitch Solutions and derived from proprietary fundamental data. These provide a forward-looking assessment of the stand-alone financial strength of a bank and are categorised according to a 10-point rating scale from A to F where A denotes the maximum creditworthiness, with four interim scores (A/B, B/C, C/D and D/E).

### 4.3. Model specifications

To construct our model specifications, we follow recent studies which estimate the relationship between CAMEL indicators and CDS spreads (see e.g. Chiaramonte and Casu, 2013), and consider the extent to which asset encumbrance contributes to the explanatory power of these models.

Our baseline model specification is as follows:

$$CDS_i = \alpha + \beta_1 AE_i + \beta_2 CAMEL_i + \beta_3 Control_i + Z_i + \varepsilon_i$$

where CDS is the natural log of the CDS spread for bank *i* at year-end 2015; AE is the asset encumbrance measure for bank *i* at year-end 2014; CAMEL represents the set of eight CAMEL variables for bank *i* at year-end 2014; CONTROL represents the control variables for bank *i* at year-end 2014; and Z corresponds to country dummies.

We also look at the relationship between encumbrance and CDS spreads for different types of banks, by interacting the asset encumbrance ratios with the CAMEL indicators and some of the control variables, using the following model:

$$CDS_i = \alpha + \beta_1 AE_i + \beta_2 CAMEL_i + \beta_3 Control_i + \beta_4 AE_i * CAMEL_i + \beta_5 AE_i * Control_i + Z_i + \varepsilon_i$$

## 5. RESULTS

In this section we present the results of our analysis. We first provide a descriptive analysis of asset encumbrance followed by the regression results.

### 5.1. Descriptive analysis and summary statistics

Table 1 presents the summary statistics of the variables of study. The mean values of AER1, AER2 and AUAUL are 0.13, 0.14 and 0.60 respectively. Note that there is a wide disparity across banks in our sample. AER1 and AER2 present standard deviations of 0.11 and 0.12 respectively. Although the standard deviation of AUAUL is lower (0.08), the mean and the original standard deviation of UAUL are 1.06 and 0.15.

**Table 1. Summary statistics of asset encumbrance metrics**

	Mean	Median	Std.	Min.	Max.
<b>AER1</b>	0.13	0.09	0.11	0.00	0.68
<b>AER2</b>	0.14	0.10	0.12	0.00	0.70
<b>AUAUL</b>	0.60	0.59	0.08	0.00	1.00

The number of observations for all variables is 367.

Table 2 presents the correlation matrix of encumbrance ratios. AER1 and AER2 present a high correlation of 0.974 which is expected given their similar construction with the only difference being the inclusion of off-balance sheet collateral in AER2. The correlation coefficients of AUAUL with AER1 and AER2 are 0.388 and 0.363 respectively.

**Table 2. Correlation matrix of asset encumbrance metrics**

	AER1	AER2	AUAUL
<b>AER1</b>	1		
<b>AER2</b>	0.974***	1	
<b>AUAUL</b>	0.388***	0.363***	1

\*\*\*: Significant at 1% level.

Given the above results, we hereafter focus on AER1 and AUAUL. Figure 5 presents the histograms for both ratios. Whereas AER1 shows high skewness towards the lower values (between 0 and 0.2), the AUAUL distribution is much more symmetric.

**Figure 5. Histograms of AER1 and AUAUL**

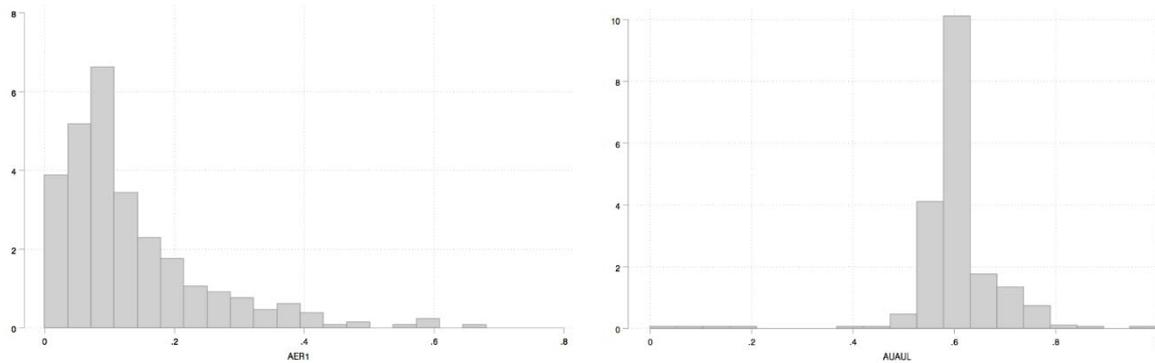


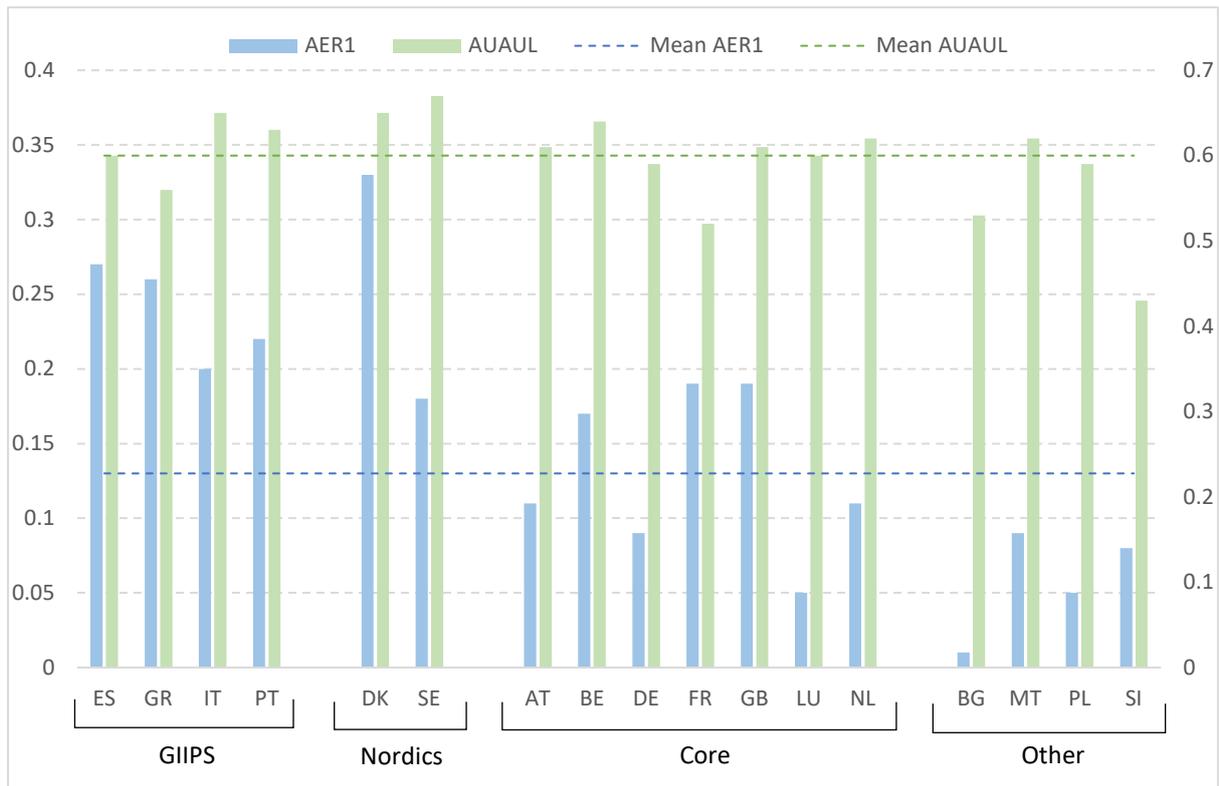
Figure 6 shows the mean ratio levels of AER1 (blue, left scale) and AUAUL (green, right scale) for those countries with more than one observation. The countries are shown in four groups corresponding to GIIPS, Nordic countries, core countries including Austria, Belgium, Germany, France, UK, Luxembourg and the Netherlands, and other European countries such as the Eastern European countries and Malta. Results show a wide disparity in mean encumbrance levels across countries. All the GIIPS countries present higher mean encumbrance ratios than the sample average, as do Nordic countries such as Denmark and Sweden. Denmark, in particular, presents the highest mean ratio of all countries in the sample. Nordic countries have a long tradition of covered bond issuance, which may help explain these results. Of the remaining countries, Belgium, France and the UK present higher mean encumbrance levels than the overall sample average. Belgium, Malta, Netherlands and the UK present higher mean values of AUAUL than the sample mean. Luxembourg and some of the countries classified as ‘other’ such as Bulgaria, Poland and Malta present the lowest values of AER1 but also the largest differences between AUAUL and AER1.

Figure 7 shows the mean levels of the two asset encumbrance ratios across rating categories. Banks within the most extreme categories, A/B and E/F, present the lowest mean AER1 and AER2 ratios of all categories. For AUAUL, it is banks in categories D/E and E/F that present the lowest mean values.

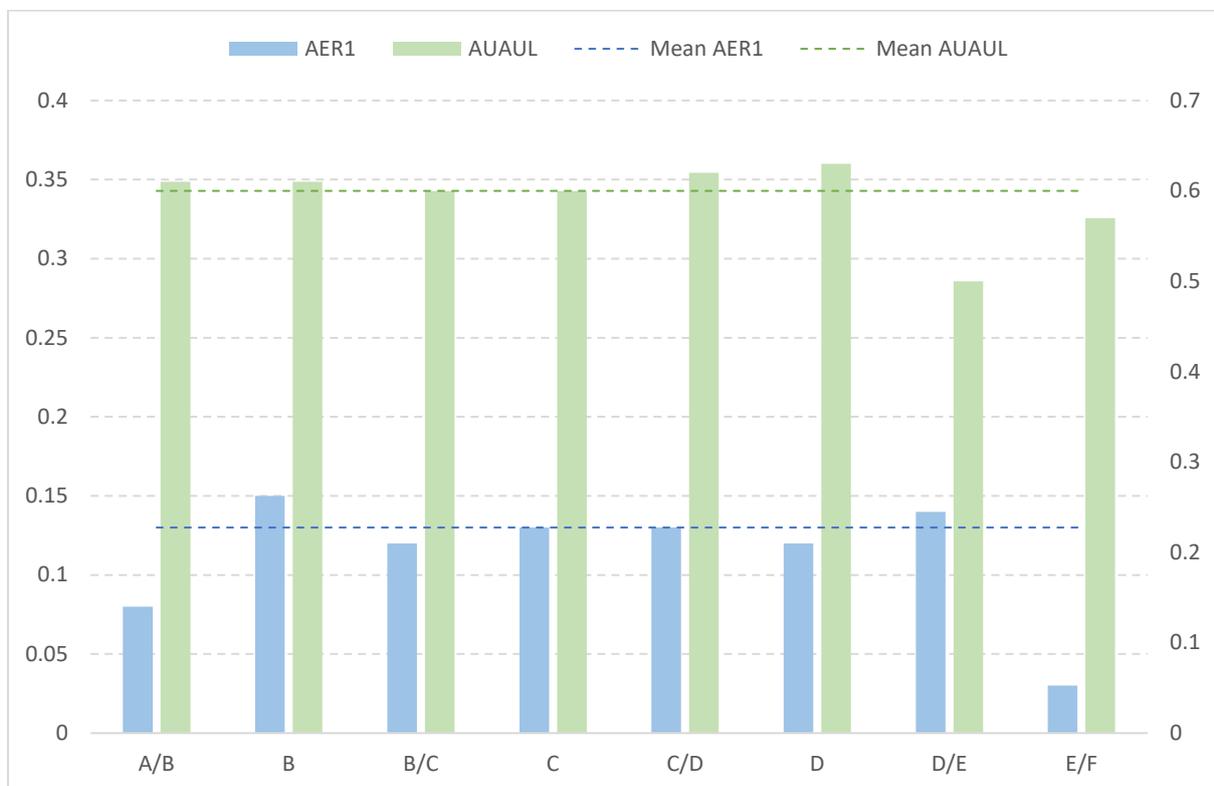
As shown in figure 8, mean encumbrance levels tend to increase with bank size, measured in terms of total assets, across all ratios. Since securitisations involve substantial costs, mostly of a fixed nature, these should be particularly costly to issue for smaller banks (Affinito and Tagliaferri, 2010; Carbó-Valverde et al., 2012; Panetta and Pozzolo, 2010).

Figure 9 shows the mean ratio levels by type of institution. We distinguish between ‘commercial banks and bank holding companies (BHC)’, ‘cooperative banks’, savings banks’ and ‘other banks’, including mortgage banks and pure investment banks. Savings banks show the lowest levels for both AER1 and AUAUL. Institutions classified as ‘other’ show relatively high values of AER1 but not AUAUL. Cooperative banks show the highest average level of asset encumbrance when measured by AUAUL.

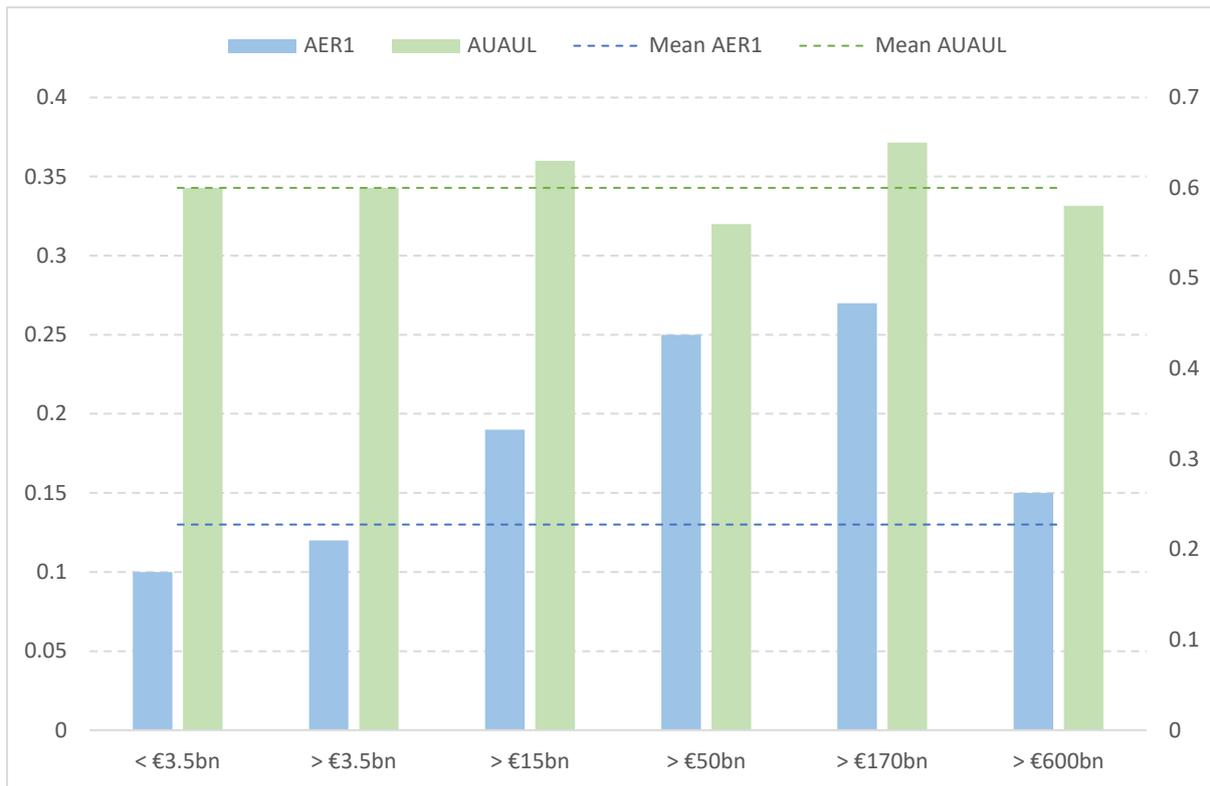
**Figure 6. Mean AER1 (left scale) and AUAUL (right scale) by country**



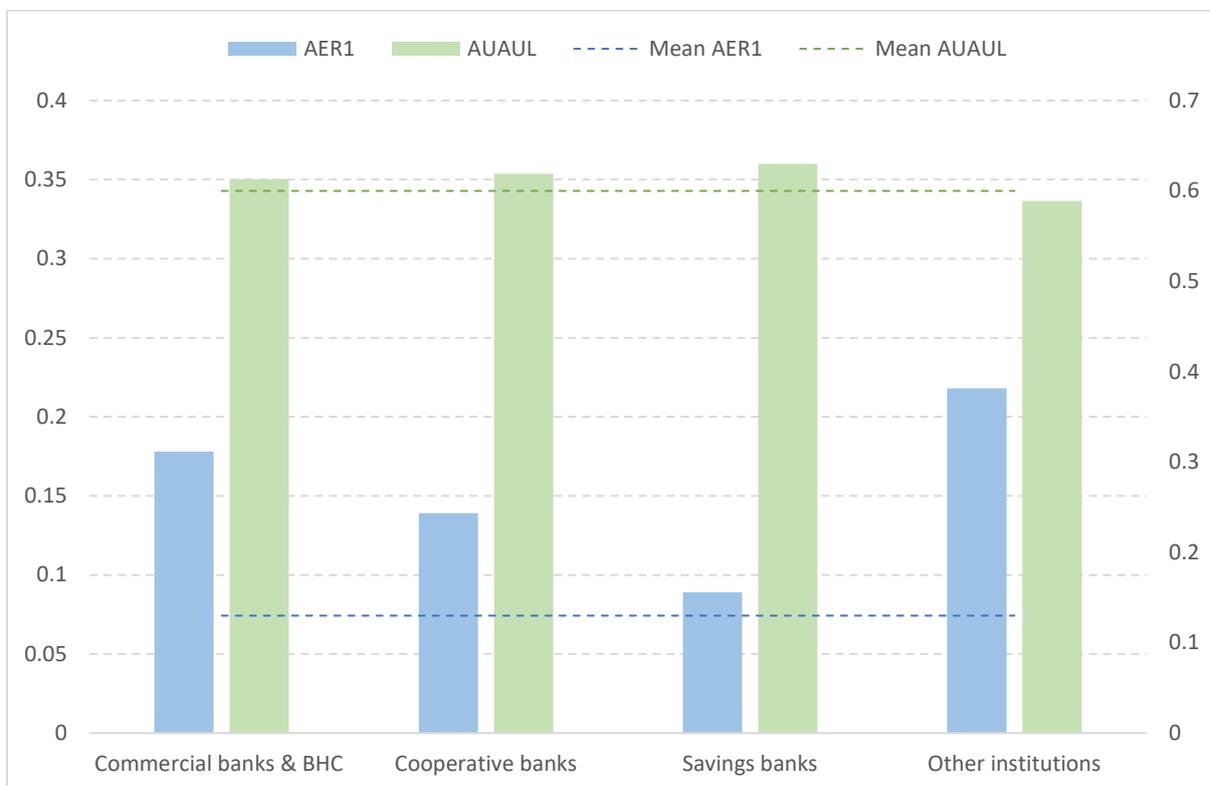
**Figure 7. Mean AER1 (left scale) and AUAUL (right scale) by implied credit rating category**



**Figure 8. Mean AER1 (left scale) and AUAUL (right scale) by size**



**Figure 9. Mean AER1 (left scale) and AUAUL (right scale) by business type**



## 5.2 Regression analysis

Our regression analysis consists of a series of multivariate regressions run with the natural logarithm of a CDS spread as the dependent variable. Our first set of regressions (baseline results) includes asset encumbrance ratios, CAMEL variables, bank-specific controls and country dummies as explanatory variables. In our second set of regressions (mediating effects) we also include interactions of asset encumbrance with CAMEL and control variables.

Table 3 presents the summary statistics of the variables of study. The average value of the CDS spread variable is 5.14, corresponding to 171 basis points. The median value is 5.17, corresponding to 176 basis points. In terms of bank CAMELS indicators, we find that, on average, a sample bank has a tier 1 ratio of 0.15, a leverage ratio of 0.08, net loans to deposits and a short-term funding ratio of 0.77, a liquid assets to total assets ratio of 0.18. The average ratio of the loan-loss reserve to gross loans is 0.04, and the ratio of unreserved impaired loans to equity is 0.33. The average ROA and ROE are nearly 0. From all the control variables, central bank exposure presents the lowest standard deviation of 0.01.

**Table 3. Summary statistics, variables of study**

	Mean	Median	Std.	Min.	Max.
<b>Dependent variable</b>					
CDS Spread	5.14	5.17	0.33	4.56	6.56
<b>Asset Encumbrance</b>					
AER1	0.13	0.09	0.11	0.00	0.68
AER2	0.14	0.10	0.12	0.00	0.70
AUAUL	0.60	0.59	0.08	0.00	1.00
<b>CAMEL variables</b>					
Tier 1 ratio	0.15	0.14	0.04	0.05	0.35
Leverage ratio (Equity / TA)	0.08	0.08	0.02	0.01	0.18
Net loans to deposits and ST funding	0.77	0.75	0.24	0.05	2.05
Liquid assets / TA	0.18	0.11	0.23	0.01	2.98
Loan loss reserve / gross loans	0.04	0.02	0.04	0.00	0.27
Unreserved impaired loans / equity	0.33	0.14	0.49	0.00	4.63
ROA	0.00	0.00	0.01	-0.04	0.03
ROE	0.01	0.02	0.10	-1.08	0.32
<b>Control variables</b>					
Central bank exposure / TA	0.01	0.01	0.01	0.00	0.12
Off-balance sheet exposure / TA	0.08	0.06	0.10	0.00	1.66
Investment grade	0.66	1.00	0.47	0.00	1.00
BHC and commercial banks	0.19	0.00	0.39	0.00	1.00
Saving and cooperative banks	0.75	1.00	0.43	0.00	1.00
Size	6.75	6.41	0.84	6.00	9.32
GIIPS	0.28	0.00	0.45	0.00	1.00
Nordics	0.02	0.00	0.15	0.00	1.00

This table reports the summary statistics of the variables used in regressions. The number of observations for all variables is 367. 'CDS Spread' refers to the logarithm of the CDS Spread (in basis points). 'TA' refers to total assets. 'Size' refers to the logarithm of total assets (in thousand Euros).

### 5.2.1. Baseline results

Table 4 reports the results of the baseline regressions. We control for fixed country effects in all regressions and continuous variables are demeaned for ease of interpretation. Model 1 includes

CAMEL variables, bank-specific controls and country dummies as explanatory variables but excludes asset encumbrance.

**Table 4. Baseline results**

	Dependent variable: 5-year implied CDS spreads			
	(1)	(2)	(3)	(4)
<b>Asset Encumbrance</b>				
AER1		-0.177*** (0.06)		
AER2			-0.131* (0.07)	
AUAUL				-0.267*** (0.10)
<b>CAMEL variables</b>				
Capital: Tier 1 Capital Ratio	1.013 (0.94)	1.058 (0.93)	1.046 (0.92)	1.103 (0.92)
Capital: Leverage Ratio (Equity / TA)	-0.907 (1.50)	-1.164 (1.42)	-1.102 (1.40)	-1.195 (1.52)
Liquidity: Net Loans / Deposits and Short-Term Funding	-0.057 (0.04)	-0.049 (0.04)	-0.053 (0.04)	-0.055 (0.04)
Liquidity: Liquid Assets / TA	-0.104 (0.07)	-0.105 (0.07)	-0.103 (0.07)	-0.108* (0.06)
Asset quality: Loan Loss Reserve / Gross Loans	2.025*** (0.65)	1.927*** (0.61)	1.959*** (0.64)	2.085*** (0.62)
Asset quality: Unreserved Impaired Loans / Equity	-0.066* (0.03)	-0.060* (0.03)	-0.062* (0.03)	-0.063* (0.03)
Profitability: ROA (Net Income / TA)	-16.454*** (4.77)	-16.398*** (4.92)	-16.369*** (4.91)	-17.019*** (4.78)
Profitability: ROE (Net Income / Equity)	0.513*** (0.17)	0.538*** (0.18)	0.528*** (0.18)	0.555*** (0.17)
<b>Control variables</b>				
Central Bank Exposure / TA	1.240** (0.50)	1.150** (0.56)	1.171** (0.55)	1.190** (0.53)
Off-Balance Sheet Exposures / TA	0.056 (0.08)	0.077 (0.09)	0.073 (0.09)	0.072 (0.08)
Investment grade	-0.467*** (0.02)	-0.466*** (0.02)	-0.466*** (0.02)	-0.464*** (0.02)
BHC and commercial banks	0.050 (0.06)	0.035 (0.05)	0.039 (0.05)	0.050 (0.05)
Saving and cooperative banks	0.006 (0.05)	-0.007 (0.05)	-0.002 (0.05)	0.002 (0.05)
Size	-0.152*** (0.02)	-0.149*** (0.02)	-0.149*** (0.02)	-0.157*** (0.02)
Country FE	YES	YES	YES	YES
Observations	367	367	367	367
R-squared	0.79	0.79	0.79	0.79

All regressions are estimated using OLS. A constant is included, but its coefficient is left unreported. Country-specific dummies are included in all models and country-business model clustering is applied in all models. \*\*\*: Significant at 1% level; \*\*: Significant at 5% level; \*: Significant at 10% level.

Models 2-4 include the three asset encumbrance measures as explanatory variables. A negative and significant association between banks' implied CDS spreads and asset encumbrance emerges across all models. Thus, our initial evidence suggests a net positive perception of unsecured creditors

towards asset encumbrance. As suggested in the theoretical discussion, higher collateralisation could lead to a lower probability of default and an increased capacity of debt repayment. Higher collateralisation could also reduce bankruptcy costs and increase value (Hardy, 2014).

While the coefficients for AER1 and AUAUL are highly significant, AER2 is significant only at the 10% level. An increase in AER2 is also associated with a lower decrease in CDS spreads when compared to AER1 and AUAUL. In contrast to AER1, AER2 reflects the encumbrance of OBS collateral. This finding could point to a more negative perception of on encumbrance of off-balance sheet collateral compared to on-balance assets. High levels of encumbered OBS collateral are characteristic of investment banks which engage in matched book trading, the activity of carrying large volumes of repos and reverse repos, effectively re-using collateral received to finance repo liabilities.

In contrast to asset encumbrance ratios, the coefficients for capital and liquidity ratios turn out to be insignificant in all models. Variables such as asset encumbrance or asset quality seem to provide more valuable information on bank risk than capital and liquidity ratios. These results are consistent with recent literature pointing to a limited market reliance on capital and liquidity ratios to account for overall bank risk. Ötoker-Robe and Podpiera (2010) find no significance in capital and liquidity ratios over the period 2004–2008 using a sample of 29 European Large Complex Financial Institutions (LCFI). Chiaramonte and Casu (2013), using a sample of 57 mostly European banks, find no statistical significance for Tier 1 and leverage and a limited statistical significance of liquidity ratios. Hasan et al. (2015) also find no statistically significant relation with the Tier 1 capital or liquidity ratios using a sample of 161 global banks in 23 countries. Kanagaretnam et al. (2016) find in a sample of 27 U.S. Bank Holding Companies (BHC) that the capital ratio is not significantly related to CDS spreads.

The coefficients for the ratio of loan-loss reserve to gross loans ratio are all positive and highly significant. The higher this ratio, the lower the quality of the loan portfolio; and therefore an increase in loan loss reserves should lead to an increase in CDS spreads. This result is consistent with Hasan et al. (2015) who also find a positive relationship between CDS spreads and the loan loss provision ratio.

The coefficients for the ratio of unreserved impaired loans to equity are all negative and significant on a 10% level. Banks with a higher value of this ratio exhibit higher impairments that have not been provisioned. Thus, this result implies that investors are not excessively concerned with such impairments. Chiaramonte and Casu (2013) also obtain this inverse relationship.

We observe opposing signs on the effects of ROA and ROE. The coefficients on ROA are all negative and highly significant. A negative sign for ROA could point to investors perceiving banks with a lower level of operating income relative to a level of investment as riskier. The coefficients for ROE are positive and highly significant, pointing to increased perceived default risk in institutions with higher profitability relative to their capital base. This result is somewhat surprising. Given the subdued profitability in traditional lending businesses in Europe, this finding could point to concerns by markets with banks that engage in highly profitable activities such as trade finance, invoice discounting or securities lending, with a comparatively low capital base.

The coefficient on the ratio of central bank exposure to total assets turns out to be positive and significant, implying that reliance on central bank funding is positively associated with bank risk. Not surprisingly, credit quality is also strongly associated with lower CDS spreads. Negative and highly significant coefficients are obtained across all models. The coefficient for size turns out to be

negative, pointing out to a size advantage. The ratio of off-balance sheet items to total assets and business model variables are not statistically significant.

### 5.2.2. Mediating effects

Our second set of regressions explores the relationship between CDS spreads and key variables, including the interactions of asset encumbrance metrics with CAMEL, control variables, GIIPs and Nordic countries dummies. The results are presented in table 5. All models include the individual (non-interacted) CAMEL and control variables but for clarity these are not shown since the coefficients are very much in line with those presented in table 4.

We first discuss models 1 and 2 together as they yield very similar results. The stand-alone coefficients of asset encumbrance ratios (AER1 and AER2) are negative and significant. Several coefficients of the interacted CAMEL and control variables are significant, pointing to the existence of mediating effects in the relationship between asset encumbrance and CDS spreads. We first discuss the results for the interactions with control variables followed by CAMEL variables.

The coefficients for the interaction of asset encumbrance with the GIIPS and Nordic country dummies are significant but present opposite signs. GIIPS and Nordic countries present, on average, the highest levels of asset encumbrance in our sample. For GIIPS, the positive sign of the interaction term may reflect the negative perceptions of investors towards banks with high asset encumbrance levels in these countries. The coefficient, however, is not large enough to offset the negative relationship between asset encumbrance and the bank risk arising from the main effect. For Nordic countries, the negative coefficient would reflect a positive perception towards asset encumbrance arising from the issuance of covered bonds, considered very safe investments.

A positive and significant coefficient is obtained for the interaction with the ratio of central bank exposure to total assets. High asset encumbrance levels in banks with high amounts of central bank funding, as in Dexia's case, are negatively perceived by investors. The positive effect of the interaction term, for banks with high levels of central bank exposure (the maximum of which is 0.12 in our sample), offsets the negative effect of the stand-alone asset encumbrance coefficient, thus making higher levels of encumbered assets detrimental in absolute terms. The overall effect in AER1 would be  $-10+10.914*0.12=-0.869$  whereas for AER2 it would be  $-10+8.9*0.12=-8.932$ .

A negative and significant coefficient is found for the interaction with the ratio of loan loss reserves to gross loans. Although higher loan loss reserves may point to a lower quality of the loan portfolio, excess reserves may signal a lower probability of incurring unexpected losses in the future and may therefore be perceived positively by markets. A positive and significant coefficient, however, is found for the interaction with the unreserved impaired loans to equity ratio. This could point to concerns by investors in banks with large amounts of encumbered assets that lack the reserves to deal with future loan defaults. This finding is in line with the demise of Banco Popular, which presented high levels of asset encumbrance and simultaneously impaired loans.

**Table 5. Results, models with interactions**

	Dependent variable: 5-year implied CDS spreads		
	(1)	(2)	(3)
<b>Asset Encumbrance (AE)</b>			
AER1	-0.712*** (0.19)		
AER2		-0.605*** (0.21)	
AUAUL			-0.552 (0.48)
<b>CAMEL variables (interactions)</b>			
AE * Tier 1 capital ratio	-5.500 (4.97)	-5.182 (4.83)	3.596 (2.95)
AE * Leverage Ratio	15.409** (6.03)	15.180** (6.42)	2.751 (4.81)
AE * Net loans / deposits and ST Funding	0.522*** (0.16)	0.554*** (0.17)	0.172 (0.34)
AE * Liquid assets / TA	0.845** (0.38)	0.978** (0.41)	-0.358 (0.51)
AE * Loan Loss Reserves / Gross Loans	-12.749*** (3.66)	-11.524*** (3.49)	-8.465*** (3.15)
AE * Unreserved impaired loans / equity	0.650** (0.29)	0.595** (0.30)	0.553 (0.57)
AE * ROA	15.780 (29.44)	28.157 (36.22)	-52.962 (67.71)
AE * ROE	-0.430 (1.41)	-1.059 (1.83)	2.658 (4.32)
<b>Control variables (interactions)</b>			
AE * Central Bank Exposure / TA	10.914** (4.16)	8.900* (4.65)	9.887 (10.08)
AE * Off-Balance Sheet Exposures / TA	-0.012 (0.82)	-0.119 (0.81)	3.054 (2.15)
AE * Investment grade	0.348* (0.20)	0.351* (0.20)	0.317 (0.19)
AE * BHC and commercial banks	0.048 (0.19)	0.146 (0.23)	0.404 (0.46)
AE * Saving and cooperative banks	0.234 (0.18)	0.262 (0.19)	0.539 (0.32)
AE * Size	0.125 (0.16)	0.073 (0.16)	-0.061 (0.29)
AE * GIIPS	0.671*** (0.17)	0.466** (0.22)	0.068 (0.41)
AE * Nordics	-0.466** (0.21)	-0.712** (0.27)	-1.236*** (0.41)
CAMEL and control variables	YES	YES	YES
Country FE	YES	YES	YES
Observations	367	367	367
R-squared	0.81	0.81	0.80

All regressions are estimated using OLS. A constant is included, but its coefficient is left unreported. Country-specific dummies are included in all models and country-business model clustering is applied in all models. \*\*\*: Significant at a 1% level; \*\*: Significant at a 5% level; \*: Significant at a 10% level.

The coefficients for the interactions of asset encumbrance with the Tier 1 capital and leverage ratios have conflictive signs, negative and positive, although the former turns out to be not significant. The leverage ratio is a non-risk-based measure of capital adequacy. A high value of the leverage ratio accompanied by larger amounts of encumbered assets could point to increasing risk in the loan portfolio which in turn would point to higher overall bank risk.<sup>23</sup> Similarly to central bank exposure, the positive effect of the interaction term offsets the negative effect of the stand-alone asset encumbrance coefficient, thus making higher levels of encumbered assets detrimental in absolute terms. In this case, the overall effects in AER1 and AER2 are  $-10+15.409*0.18=-7.226$  and  $10+15.18*0.18=-7.26$  respectively.

The coefficients of the interacted liquidity variables are both positive and significant. A high number of net loans to deposit ratios points to a higher reliance on wholesale funding, which would make high levels of encumbered assets particularly detrimental. A positive sign is also found for the interaction with the liquid assets to total assets ratio. If investors are unable to identify the specific assets that are being encumbered, high levels of liquid assets accompanied by higher levels of encumbered assets could point to those liquid assets being encumbered, as in Dexia's case. The interactions of profitability variables (ROE and ROA) with asset encumbrance ratios are not significant.

Model 3 presents the results for AUAUL. While the stand-alone coefficient of AUAUL ratio turns out to be not significant, the coefficients corresponding to the interaction with the loan loss reserves to gross loans ratio and the Nordics dummy are both significant and of a negative sign. Consistent with the results of models 1 and 2, banks with high levels of asset encumbrance and with high levels of loan loss provisions, or based in Nordic countries, could benefit from increasing their levels of asset encumbrance. The effects of the remaining interacted variables are less significant but almost all, including central bank exposure and GIIPS, conserve the same sign found for models 1 and 2.

## 6. CONCLUSION

Asset encumbrance has been a much discussed subject in recent literature and policymakers have been actively addressing what some regulators consider to be excessive levels of asset encumbrance. Still, the question of whether asset encumbrance is as perverse as it is portrayed arises. The risks of asset encumbrance because of the structural subordination of unsecured creditors, or because of the reduction of a bank's capacity to obtain funding, may end up being a concern for a subset of banks only. Other banks, on the other hand, could be signalling their overall 'health' by, and thus benefit from, increasing asset encumbrance levels (issuing covered bonds to private investors, for instance).

Our descriptive analysis shows a wide disparity in mean encumbrance levels across countries with southern European (GIIPS) and Nordic countries presenting higher mean encumbrance ratios than the sample average. Banks within the most and least creditworthy-rating categories present the lowest mean AER1 and AER2 ratios. For AUAUL, however, it is only banks in the least creditworthy categories that present the lowest mean values. Mean encumbrance levels tend to increase with bank size, measured in terms of total assets, across all ratios which could be explained by the substantial costs of securitisation issuance for smaller banks. By type of institution, saving banks

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<sup>23</sup> As noted in footnote 6, Banco Popular had a relative high value of the Basel III leverage ratio (5.31%) compared to a weighted average for European banks of 5.2% as of year-end 2016.

show the lowest levels for both AER1 and AUAUL whereas cooperative banks show the highest average level of asset encumbrance when measured by AUAUL.

Our empirical analysis provides, to the best of our knowledge, the first investigation of the relationship between asset encumbrance and bank risk. We show that asset encumbrance is, on average, negatively associated with bank risk across different asset encumbrance measures. We also find that ratios measuring asset encumbrance or asset quality provide more valuable information on bank risk than capital and liquidity ratios, which is consistent with the recent literature pointing to a limited reliance by markets on capital and liquidity ratios to account for overall bank risk.

We also show that certain bank-level variables play a mediating role in the relationship between asset encumbrance and bank risk: for banks that have a high exposure to the central bank, high levels of unreserved impaired loans, high leverage ratio and/or located in southern Europe, larger amounts of encumbered assets and encumbered OBS collateral are less beneficial and could even be detrimental in absolute terms. Banks with high levels of loan loss provisions and/or based in Nordic countries, in contrast, benefit from increased levels of asset encumbrance. Banks in Nordic countries rely to a large extent on covered bonds, which are perceived as a very safe investment and source of funding. These results suggest that regulators need to be cautious before leaping to all-encompassing conclusions when assessing the effects of asset encumbrance levels.

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