

# **Bank Bond Holdings and Bail-in Regulatory Changes: Evidence from Euro Area Security Registers\***

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## **Abstract**

We assess the impact on bank bond holdings of regulatory changes in the requirements for bail-inable liabilities, designed to facilitate an orderly resolution process while reducing taxpayers-funded bailouts. Analyzing confidential data on securities holdings by banks, we document that the introduction of the minimum requirements for eligible liabilities (MREL) induced banks to increase their holdings of eligible bank bonds, especially if issued by other banks. The requirements for own funds and eligible liabilities (TLAC) instead raised the incentives for non-issuing banks to invest in eligible subordinated debt issued by global systemically important banks. Finally, we find evidence of increased within-country bank interconnectedness and concentration risks in the banking sector that might potentially introduce frictions in bail-in implementations.

JEL codes: G01, G21, G28.

Keywords: bank bonds, regulatory changes, bail-inable debt, MREL, TLAC

## Non-technical Summary

A key feature of the bank crisis management framework designed after the Global Financial Crisis has been the establishment of the bail-in tool, in order to facilitate an orderly resolution process, while reducing the potential need for public bailouts at the expense of taxpayers. However, to ensure the possibility to implement the bail-in, banks must have a sufficiently large amount of eligible liabilities for the bail-in.

This paper examines the effects of the regulatory changes setting the requirements for bank bail-inable liabilities in the European Union. We focus on the introduction of two regulatory changes: the Minimum Requirements on Eligible Liabilities (MREL, applicable to all EU banks) and the Total Loss Absorbency Capacity requirements (TLAC, applicable only to global systemically important institutions, G-SIIs). We analyse the impact of the introduction of these regulatory requirements on the holdings of bank bonds by credit institutions.

Our focus on banks' holdings is motivated by two reasons. First, in the euro area, banks are the largest investors in bank bonds, well above the other institutional sectors. Second, the large holdings of bank bonds by credit institutions can increase the interlinkages within the banking sector, particularly in the same country, with potential financial stability implications.

The EU framework is particularly interesting to investigate the role of regulatory incentives in shaping the investor base of bank bonds. The setting of the regulatory requirements for bank bail-inable debt for all banks implies that they all had to increase their issuances of eligible instruments – though with different timing and modalities. At the same time, the bail-inable status of these bonds favoured a reallocation of the holdings of outstanding bonds from other sectors. In addition, the unique confidential data on securities holdings for individual institutions allow us to investigate the relationships between issuer and holder banks at the security-level. We use a security register dataset for euro area banking groups – combining the Securities Holdings Statistics by Group (SHSG) and the ECB Centralised Securities Database (CSDB) – to explore at the security-level the exposures of credit institutions to bonds issued by other banks or within the same banking group.

Using a difference-in-differences approach to analyse the impact of the introduction of the requirements, we show that regulatory incentives significantly influenced the holdings of bank bail-inable bonds, leading to partly unintended effects via increased interconnectedness across banks. The specific policy design of the MREL and the built-in incentives induced banks to increase their exposures to eligible bonds issued by other banks, or within the same banking group. The introduction of TLAC raised, instead, the incentives to invest in eligible subordinated instruments issued by G-SIIs, only for other banks different from the issuer. This result reflects the effectiveness of a deduction rule, disincentivizing G-SII banks from holding eligible subordinated debt issued by GSIIIs.

We also explore the heterogeneity across issuers and holders, in terms of bank nationality and risk. We find that the setting of the MREL requirements strengthened the already existing home bias in banks' exposures to bank bail-inable bonds, particularly in stressed euro area countries. At the same time, we do not find evidence that banks increased their investments in the eligible bonds issued by riskier banks.

The results of the analysis highlight the importance of the regulatory design for the incentives shaping the investment behaviour of banks. The study provides relevant policy implications for an evaluation of the EU bank crisis management framework and for the monitoring of financial stability risks due to the interconnectedness within the banking sector.

# 1 Introduction

The bailout of a large number of banks following the global financial crisis has induced a substantial rethinking of the governing principles and rules of the crisis management framework for the banking sector across the globe. The aim of this reform process was to prevent a potential systemic crisis that could materialize in the case of a bank failure (e.g., Allen and Gale, 2000; Acemoglu et al., 2015; Bernard et al., 2022), while reducing at the same time the potential need for public bailouts at the expense of taxpayers. In the European Union (EU), one of the main steps towards this direction was the design of the bail-in tool to facilitate an orderly resolution process.<sup>1</sup> This resolution tool is aimed at ensuring that, in case of bank insolvency, the resolution of the failing institution can be implemented by writing down or converting eligible debt claims into equity claims.<sup>2</sup> In this way, losses can be absorbed and the regulatory capital ratios can be restored at levels compliant with the conditions for the authorisation of credit institutions.

To ensure the possibility to implement the bail-in for credit institutions, banks must have a sufficiently large amount of eligible liabilities to which the bail-in can be applied. This explains the basic rationale behind the introduction of the new loss-absorbency requirements for bank bail-inable liabilities. More specifically, the EU regulatory framework includes two sets of rules pursuing the same objective by defining the appropriate amount of eligible liabilities for different groups of banks: i) the Minimum Requirements on Eligible Liabilities (MREL), applicable to all EU banks, foreseen by the Bank Recovery and Resolution Directive (BRRD) and calibrated by a Commission Delegated Regulation in May 2016; and ii) the Total Loss Absorbency Capacity (TLAC) requirements, applicable to EU global systemically important institutions (G-SIIs), introduced by the Financial Stability Board (FSB) and regulated by the Basel Committee in October 2016, then transposed in the EU legislation with the review of the Capital Requirements Regulation (CRR).

This paper investigates the effects of the introduction of these two regulatory requirements on the holdings of eligible bank bonds by credit institutions. In our investigation we employ securities holdings data for individual banks in the euro area. Our focus on banks' holdings is motivated by two reasons. First, in the euro area, banks are the largest investors in bank bonds, more important than any other institutional sector. This is highlighted in recent studies conducted at the sectoral level (see Pigrum et al., 2016; Bekaert and Breckenfelder, 2019; Mink et al., 2020). These studies document that bank bonds are held disproportionately by the euro area banking system, with a strong domestic home bias in some countries; moreover, euro area banks showed some tendency to increase their exposures to domestic bank bonds after solvency shocks negatively affecting their domestic banking sectors.

Second, the large holdings of bank bonds by credit institutions increase interconnectedness as banks are also the issuers of these debt instruments (see Gaiduchevici and Zochowski, 2017; Huser et al., 2018). High interconnectedness may be a source of systemic risk in a network of credit institutions, as it may expose the system to a coordination failure even if banks are solvent (Freixas et al. 2000; Cabrales et al. 2017). When banks are interconnected via their exposures to bank bonds, if a bank is failing or likely to fail, the use of the bail-in tool may potentially trigger spill-over effects to other banks exposed to the bonds issued by the bank under resolution. This spill-over may have

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<sup>1</sup> See the EU Bank Recovery and Resolution Directive (BRRD), EU Directive 2014/59.

<sup>2</sup> Specifically, in this case, according to a hierarchy of bank liabilities, Tier 1, Tier 2 capital, as well as senior non-preferred debt instruments and potentially senior unsecured bonds are required to be written-down or converted into capital to the extent that is necessary to absorb the losses.

potential implications on financial stability. In addition, such interlinkages may raise also impediments to the feasibility of bank resolution via the bail-in.

These developments in sectoral holdings naturally raise some questions about how these holdings are distributed within the banking sector, precisely how the risk of these bail-inable instruments is allocated across the institutions in that sector, and what are the key incentives driving these holdings. In this perspective, it is important to explore whether and how regulation may shape the investor base of bank bonds, with particular focus on their holdings by individual banks.

The EU framework is particularly interesting to study the effects of the new regulatory requirements for bank bail-inable liabilities on the investor base of eligible bank bonds. The setting of these new regulatory requirements for all banks implies that all banks had to increase their eligible instruments to satisfy these requirements – though with different timing, modalities and with differences across institutions due to their systemic importance. The data used in the empirical analysis are also ideal to answer the research questions posed in the paper. We make use of unique confidential security register data for individual euro area banking groups – combining the Securities Holdings Statistics by Group (SHSG) and the ECB Centralised Securities Database (CSDB) – to explore at the security-level the exposures of credit institutions to bonds issued by other banks or within the same banking group.

Despite the importance of these regulatory changes and the possible effects on banks' investment behaviour, the literature on this topic is very scant. To the best of our knowledge, this paper is the first empirical study to evaluate how the regulatory requirements for bank bail-inable liabilities can shape the holdings of bank bonds by individual credit institutions and to investigate the incentives behind these investment decisions.

We use a difference-in-differences approach to analyse the impact of the introduction of the MREL and TLAC requirements on the holdings of eligible bank bonds by individual credit institutions. We find that, after the setting of the MREL requirements, credit institutions increased their holdings of eligible bank bonds. In particular, the probability for banks to hold MREL-eligible bonds increased by 0.75 percentage points (pp) after the introduction of MREL, implying a 20% increase in the probability of holding. This encompasses both the cases of cross-holdings, i.e., when one bank holds the debt instruments issued by another bank, and the cases of self-holdings, when the bonds are held within the same banking group. Importantly, banks increased their holdings of eligible bonds, i.e., unsecured bonds, while generally reducing their exposures to other bonds, like covered bonds; therefore, banks shifted the composition of their securities portfolios of bank bonds towards riskier instruments, subject to the bail-inable status.

This increase in the exposures of the banking sector to bail-inable bonds reflects different incentives. On one hand, the new requirements for loss-absorbency capacity changed the holding incentives, both across sectors and within the banking sector. The bail-inable status of the eligible bonds, as implying higher credit risk for investors, reduced the incentives of former traditional investors in unsecured bank bonds, like households, thereby requiring the banking sector to increase its holdings also to outstanding bonds previously issued. On the other hand, the setting of the MREL requirements required all banks to increase their issuances of MREL-eligible bonds, to fulfil the new requirements. The additional market supply of eligible bonds with these risk characteristics might have also required a stronger role of banks as investors in these debt securities.

Given the gradual phase-in of these requirements, the issuance process of these new eligible securities required some time, particularly under market developments where banks had limited incentives to issue unsecured bank bonds, particularly the subordinated ones. In the same period,

euro area banks could exploit other available and less expensive funding sources, like central bank liquidity measures, and also benefited from the increase in their deposit base fostered by central bank asset purchases. In addition, while covered bonds were included in central bank asset purchases, unsecured bank bonds were not targeted by any purchase programme. All these factors explain the generally declining trend in the outstanding amount of unsecured bank bonds, before the introduction of these requirements. Then, despite these market developments, the introduction of the requirements for bank bail-inable liabilities provided for clear incentives to invert the issuance trend particularly for the eligible bonds.

We conduct our baseline analysis comparing the two quarters before and the two quarters after the regulatory change, which is identified with the EU Commission's Delegated Regulation setting the general methodology to compute the MREL requirements, in 2016 Q2. We test the robustness of our definition for the policy change, by estimating the model for different time subsamples assuming each time a different treatment date, and we do not find evidence of potential anticipation effects. The results are also robust to other definitions of the sample of issuer banks, as they hold also when excluding the bonds issued by GSII banks, in order to exclude potential confounding effects from the TLAC introduction..

The observed results are also persistent over time and confirmed for a longer time window, when comparing the four quarters before and the four quarters after the treatment date. The results from this specification confirm an increase in the holdings of eligible bonds by other banks after the introduction of MREL. We also find a stronger tendency to an increase in the holdings of bail-inable bonds by the same banking group as the issuer bank (self-holdings). Interestingly, while banking groups reduced the holdings of their own non-eligible bonds, like covered bonds, they increased the holdings of their own eligible bonds. This could potentially reflect various factors: on one hand, the intragroup exposures of bail-inable bonds issued by subsidiaries and held by the parent may be useful for the purpose of internal MREL, i.e., to facilitate the resolution by channelling losses to the parent in a single-point-of-entry approach; on the other hand, the holdings of bail-inable bonds by the same banking group as the issuer may also address potential situations of limited demand from other market investors.<sup>3</sup>

To explore the effects of similar requirements but with different regulatory design, we also investigate the introduction of the TLAC requirements, for the unsecured subordinated instruments issued by global systemically important institutions (G-SIIs). After the TLAC introduction, banks increased their holdings of TLAC-eligible instruments, well before the entry into force of the binding requirements. However, in this case, we do observe different developments for cross-holdings and self-holdings. Banks generally increased their cross-holdings of eligible bonds issued by G-SIIs; however, G-SII banks reduced the holdings of their own TLAC-eligible instruments relative to other banks. Beyond the better access of G-SIIs to wholesale debt markets, this result reflects the incentives from the regulatory treatment of TLAC-holdings, as set in the standards of the Basel Committee on Banking Supervision (BCBS) and then in the deduction rule of the Capital Requirements Regulation. In fact, they require G-SIIs to deduct the holdings of TLAC instruments (issued by the same bank or by other G-SIIs) from the amount of their own TLAC-eligible liabilities, with the effect of strongly penalising these types of holdings.

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<sup>3</sup> The holdings of bank bonds issued by other entities of the same banking group may also fulfil the purpose to support the debt issuances of part of the banking group in case of lack of market demand. This argument is consistent with the empirical evidence that financial institutions or conglomerates direct investments to business units in financial distress. See for instance Bagattini et al. (2021) for the liquidity support to bank-affiliated mutual funds and Franzoni and Giannetti (2019) for the performance of hedge funds affiliated to financial conglomerates.

The results have relevant policy implications for the monitoring of financial stability in the banking sector and for the evaluation of the current bank crisis framework. On one hand, the presence of the banking sector in the investor base of bail-inable securities may fulfil an important skin-in-the-game function for other categories of investors and may also contribute to market discipline given the information held by banks on other institutions of the same sector. On the other hand, the concentration of bail-inable bonds within the banking sector, encouraged both by the decreasing demand from other investors for the outstanding bonds and by the need to place the new issuances of eligible bonds, might trigger linkages across banks in the event of bail-in, particularly within the same country. While the gradual phase-in approach of Resolution Authorities, particularly for medium and small banks, aims to ensure a smoother path of issuance of eligible bonds over time, the increase in the cross-holdings of bank bail-inable debt may have potential financial stability implications, also due to the shift in the composition of the securities portfolios of credit institutions towards bail-inable (and therefore riskier) instruments.

The paper proceeds as follows. Section 1.1 discusses the related literature and highlights the key contributions of this study. Section 2 describes the data and analyses the main developments in the markets for bank bail-inable bonds. The section also summarises the main regulatory changes and describes the hypotheses to be tested in the empirical analysis. Section 3 presents the estimation methodology, the identification strategy and the main empirical results. The section also provides several robustness checks. Section 4 concludes.

## **1.1 Related literature**

Our paper contributes to three main strands of literature: the intended and unintended economic effects of regulation; the incentives for correlated or strategic behaviour of banks, with the potential to amplify systemic risk; and the effects of the introduction of bail-in on market discipline and pricing.

Regulation is primarily designed to promote economic efficiency and to limit negative externalities, thereby improving social welfare (Stigler, 1971). This can be achieved in different ways, for example by shaping the conduct of economic agents, adjusting incentives, or stimulating a change in preferences. However, in addition to its intended benefits, regulation may generate also unintended consequences and distortions, also in the financial sector (Boot et al., 1999; Spatt, 2006). The debate on intended and unintended incentives of financial regulation has become more relevant in recent years, given the failures of the prudential framework existing before the global financial crisis and the significant reforms undertaken afterwards at the global and national levels (see, for example, Keppo et al., 2010; Buss et al., 2016).

For instance, some studies have explored the regulatory spillovers across the financial sector or the regulatory arbitrage incentives for credit institutions, which can be enhanced by a framework targeting the banking sector but fostering the development of non-bank financial intermediation (Coval et al., 2009; Gorton and Metrick, 2010 and 2012; Pozsar et al., 2010; Acharya et al., 2013). Some other studies have explored the failures of the pre-crisis financial regulation in adequately measuring credit risk and the incentives to reach for yield in the investment decisions of different types of financial institutions. Becker and Ivashina (2015) analyse the incentives of capital regulation for insurance companies and investigate their exposures to corporate bonds, finding evidence of a reach for yield strategy. Efung (2020) studies the role of bank capital regulation, under the Basel II framework, in shaping the incentives for banks' investments in asset-backed securities.

More recently, new evidence started to become available from the implementation of the reforms adopted after the global financial crisis, also to analyse potential unintended incentives: for instance, for the global derivatives market reform due to cross-jurisdictional arbitrage (Gandré et al., 2020); for the liquidity coverage rule due to the exposures to complex and opaque assets (Raz et al., 2022). But no other econometric study has exploited the intended and unintended effects of the requirements for bank bail-inable debt, which are a keystone of the new bank crisis management framework.

We contribute to the literature on the economic effects of regulation, by investigating the incentives of the requirements for bank bail-inable liabilities for the investment decisions of banks and the composition of their securities portfolios. This regulatory change encouraged the issuance of eligible instruments to fulfil the requirements, but it also incentivised banks to increase their cross-holdings of eligible bonds, due to the bail-inable status of these securities and the implications of this for the investor demand by other sectors. These effects are beyond the intended scope of the requirements, as they concern the distribution of bank bail-inable bonds among investors. In fact, if on one hand the stronger presence of banks as debtholders may contribute to market discipline as they may dispose of more accurate information than other investors, on the other hand these linkages may have potentially undesirable implications for financial stability. At the same time, we find that well designed regulatory incentives – as in the deduction rule for GSIIIs – may contribute to prevent the build-up of risk by shaping banks’ behaviour effectively.

Another important strand of literature refers to the incentives for banks’ correlated or strategic behaviour, which may arise from resolution policies, public guarantees or monetary policy. Acharya and Yorulmazer (2007) show that, while the ex-ante optimal policy in a crisis is to not rescue banks using public resources, the ex-post optimal policy would be to bail out them when the number of bank failures is large: they argue that this “too-many-to-fail” guarantee gives banks a stronger incentive to herd ex-ante, so to increase the likelihood of being bailed out. Farhi and Tirole (2012) analyse the strategic complementarities across banks which might render bailouts more likely and then enhance collective moral hazard: while it is not optimal for an individual bank to engage in risk-taking, it becomes so when other banks are also undertaking this behaviour.

The empirical evidence supports these theoretical arguments, for different types of policies benefiting the banking sector. Gropp et al. (2014) examine the effect of government guarantees on bank risk-taking and find that public guarantees may be associated with substantial moral hazard effects. Jasova et al. (2021) document the contribution of lender of last resort (LOLR) policies to higher bank interconnectedness. Using data on collateral pledged for central bank operations, they show that central bank policies applying lower collateral haircuts than in private repo markets incentivize banks to pledge bonds with higher gap in collateral haircut, issued by similar banks.<sup>4</sup>

The literature on financial networks and systemic risk has investigated the cascade effects of the default of a financial institution on the other exposed institutions (Elliott et al., 2014; Bougheas and Kirman, 2017). Acemoglu et al. (2015) explore the amplification potential of interconnected networks, depending on the size of the shocks. A dense network of interbank liabilities may increase the resilience of the system, when the shocks are sufficiently small, but might exacerbate the propagation of shocks, when their magnitude is large, leading to a more fragile financial system. Bernard et al. (2022) endogenize the intervention in financial crises as the outcome of the strategic interaction between regulator and banks, where the intervention can take the form of a bail-out or

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<sup>4</sup> Jasova et al. (2021) analyse the incentives induced by lender of last resort liquidity policies implemented during the euro area sovereign debt crisis.



a bail-in, and a bail-in is possible if the regulator's threat to not bail out insolvent banks is credible, particularly in sparse networks. Hüser et al. (2018) conduct a simulation exercise to study the potential effects of a bail-in decision on the network of euro area banks and provide evidence of a moderate contagion to the direct creditors, while the largest impact would take place at the systemic level, affecting smaller banks and other bondholders.

Our paper provides empirical evidence on the incentives for correlated behaviour across banks which may arise in a “too-interconnected-to-fail” setting, when resolution policies are designed to promote bail-in instead of bail-out. We investigate the effects of the requirements for bank bail-inable liabilities, using security register data on the securities holdings by banks, and we show that the setting of these requirements increased the cross-holdings of eligible bonds across institutions. We show not only that banks are generally more likely to invest in the bonds issued by banks from the same country, but also that the introduction of the requirements for bank bail-inable liabilities further strengthened this home bias, particularly in euro area countries that are more vulnerable to macroeconomic and financial shocks. This increased risk correlation across banks, with potential implications on the implementation of bail-in measures at the national level.

A third strand of literature investigates the benefits and costs of the new resolution framework, and the effects of the introduction of the bail-in reform. Some analyses developed in the design phase of the reform provide simulation-based evidence to support the effectiveness of the bail-in as a major tool to reduce the potential costs for public finance as well as to contain output losses (Breuss et al., 2015; Benczur et al., 2016). Other studies discuss the legal and economic advantages and disadvantages of bail-in regimes (Dewatripont, 2014; Avgouleas and Goodhart, 2015; Bodellini, 2018; Tröger, 2018; Martino, 2020; Maddaloni and Scardozzi, 2022). While the bail-in mechanism has benefits compared to a bailout such as better protection of taxpayers, lower levels of moral hazard, better creditor monitoring, and more transparent and fair allocation of losses, some potential limitations concern the complexity of the regime, the higher funding costs for banks, and the potential for procyclical contagion developments. Fiordelisi and Scardozzi (2022) analyse banks' funding strategies after the announcement of the bail-in, finding that banks relied more on deposits, and reduced fund collection from sources with weaker creditor protection, such as bonds. More recently, some studies have discussed the legal and economic considerations about the composition of bondholders: Ringe and Patel (2019) highlight the potential concerns for the counterparty risk due to the exposures of credit institutions; Martino (2021) analyses the optimal composition of bail-inable debtholders for different categories of potential investors, based on the trade-off between corporate governance incentives and threats for financial stability.

Empirical studies have mostly focused on the pricing of the debt securities issued by banks. For example, some papers investigate the role of the EU bail-in framework on market discipline by analysing pricing and spreads of bail-inable debt instruments. Both Crespi et al. (2019) and Cutura (2021) find that bank bonds subject to the BRRD carry a bail-in premium in their yield spread, compared to bonds not subject to the new regulatory regime. Pablos Nuevo (2020) also explores the differences between bonds issued by G-SII and non-GSII banks and finds evidence of some convergence in their bond yields after the introduction of the bail-in. Giuliana (2019) analyses the application of the bail-in to episodes of bank distress and explores whether these indications of the authorities' commitment to the bail-in were credible enough to determine a repricing of existing bonds. Other papers investigate the bail-in framework and pricing from a global point of view (Chan-Lau and Oura, 2016; Lewrick, 2019).

None of these studies presents an econometric analysis on the placement and the investor base of the bail-inable securities for individual investors. Our paper is the first empirical study using

security register data at the instrument level and for individual holder banking groups to analyse the effects of the requirements for bank bail-inable liabilities on the holding behaviour of banks, by explaining the investment decisions of individual institutions.

## 2 Bank funding and regulatory changes

### 2.1 Data

The empirical analysis combines different sources of confidential granular data at the security-level collected by the European Central Bank and the European System of Central Banks (ESCB). We obtain information on the holdings of individual securities by credit institutions from the Securities Holdings Statistics (SHS) at the level of banking groups. We retrieve information on the characteristics of the debt securities and on the identity of the issuer banks from the Centralised Securities Database (CSDB). Together, they form a unique dataset containing high quality and detailed information on debt securities as well as the linkages between issuers and holders of these securities, which enables a vast range of analyses with an unprecedented level of granularity in the euro area context (see European Central Bank, 2015).

The CSDB dataset has a monthly frequency and includes data from April 2009 onwards. The dataset provides information on the issuer identity, the security type, the issuance and the maturity date, the credit rating, the nominal amount. The SHS dataset has quarterly frequency from 2013 Q4 and contains two data modules: the SHS Sector (SHSS), providing information at the security-level on the holdings by institutional sectors; and the SHS Group (SHSG), containing information on the individual holdings by banking groups. At the ISIN-level, the SHS data collect information on the nominal amount and the market value of securities holdings, the identity of the holder. We conduct our empirical analysis using the SHS Group for individual banking groups, but we also refer to the SHS Sector for some developments in sectoral holdings relevant as stylised facts.

Security register data have been used in the analysis on the effects of monetary policy measures, like asset purchases and central bank liquidity provision programmes. Kojien et al. (2017) and Albertazzi et al. (2021) investigate the portfolio rebalancing of the Asset Purchase Programme (APP) in the euro area, using security register data at the sectoral level. Bubeck et al. (2020) study the investment behaviour of banks in securities after the introduction of the negative interest rate policy. Peydró et al. (2021) study the bank lending and the risk-taking channels of unconventional monetary policy by exploiting the Italian credit and security registers for individual credit institutions.

Different from these studies, the present paper does not focus on the effects of monetary policy but instead mobilizes the unique security register data – for individual institutions – to analyse the effects of prudential regulation changes on the holdings of debt securities directly affected by these reforms. We focus on the introduction of the requirements for bank bail-inable debt, so we study the effects of this on the holdings of bank debt instruments.

For the main purpose of this paper, we merge the SHSG and the CSDB using the International Securities Identification Number (ISIN) as the matching element. As a result, issuer banks are linked to the banks holding their bonds through a unique security identifier: a given bond may be held not only by different sectors, but also by different institutions within the banking sector. To

complement the database by filling in some gaps in the classification of some securities and to identify whether they are eligible for TLAC and MREL requirements, we further merge this dataset with DCM Analytics (Dealogic).

For the period between 2013-Q4 and 2018-Q2, the SHSG dataset covers the 26 largest euro area banking groups.<sup>5</sup> Overall, our panel comprises quarterly data covering two quarters before and two quarters after the date of treatment we are interested in. The main treatment dates of interest for this paper are the introduction of the MREL requirements in May 2016 (2016-Q2), and the setting of the Basel standards for TLAC holdings in October 2016 (2016-Q4). Therefore, the two analyses cover overall the period between 2015-Q4 and 2017-Q2, which leaves the dataset bounded to the 26 largest euro area banking groups. These 26 banking groups represent 59 percent of the total assets of the whole euro area banking sector in the period covered in this study, which assures that despite the restricted quantity of banks, the analysis covers a sizeable share of the securities portfolio of the euro area banking sector.

## 2.2 Main developments in the market of bank bonds

The developments in the market of euro area bank bonds have been shaped by macroeconomic developments, regulatory changes, and monetary policy measures. The funding structure of euro area banks has shifted from more volatile sources towards more stable types of funding, with an increase in customer deposits and a reduction in interbank borrowing. Particularly from 2015 onwards, this increase in the deposit base was fostered by the implementation of the Asset Purchase Programme (APP). The APP was targeted towards asset classes like sovereign bonds, covered bonds, asset-backed securities, and corporate bonds, but did not include unsecured bank bonds. In the same period, banks largely benefited from central bank liquidity measures, such as the 3-year Long-Term Refinancing Operations (LTROs) and the Targeted Long-Term Refinancing Operations (TLTROs), under favourable financing conditions.

These market developments, supported by non-standard monetary policy measures, reduced the incentives for banks to issue debt securities, and in particular unsecured bank bonds, even if the accommodative monetary policy indirectly contributed to some spread compression also for these securities. In fact, the increase in the deposit base fostered by asset purchases reduced the need to issue bank debt securities. In addition, the supply of central bank liquidity implied that funding sources such as Eurosystem operations were more attractive for banks than debt securities.

In this context, it is understandable that the share of outstanding debt securities in the amount of total bank liabilities observed some declining trend, though with some differences over time. It was stable around 21% from 2010 to 2013, when banks could take advantage of several measures of public guarantees on banks' liabilities to issue government guaranteed bonds.<sup>6</sup> Then this share gradually declined to 16% during the following years until 2017, as the newly issued bonds were lower than the bonds reaching maturity, due to the limited incentives for new issuances.

[Insert Figure 1]

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<sup>5</sup> Notice that from 2018-Q3 onwards, the coverage expands to all significant banking groups under the ECB supervision, with a total of 117 banks in the year 2020. However, the regulatory changes we are interested in take place in the first part of the data sample.

<sup>6</sup> During these years, banks used government guaranteed bonds also as collateral for central bank refinancing operations. See for instance: Carpinelli and Crosignani (2021); Jasova et al. (2021).

This declining trend stopped in 2017, when new incentives for the issuance of unsecured bank bonds – particularly subordinated – intervened thanks to the prudential regulation reforms introducing the requirements for bank bail-inable liabilities, and despite other disincentivising factors still present in the market. First, G-SII banks had to fulfil the TLAC requirements, binding since 2019, with the issuance of subordinated debt. Then, also non-G-SII banks gradually increased their issuances of debt securities, mainly subordinated, while benefiting from a more gradual timeline thanks to a longer phase-in period for MREL requirements. Figure 2 displays the developments in the issuance of subordinated debt instruments: the increasing trend in issuances shows a rise in the slope from the second half of 2016, following the setting of these requirements.<sup>7</sup>

[Insert Figure 2]

The increase in the issuance of bail-inable instruments, particularly those subordinated, can be observed also in comparison with the issuances of other bank debt instruments. Figure 3 shows the composition of the debt issuances by euro area banks, by quarter and by type of instrument. Starting from 2017, a large part of the new issuances was focused on subordinated instruments, including Additional Tier 1 and Tier 2 instruments, senior non-preferred notes or other senior bonds classified as equivalent for bail-in purposes.

[Insert Figure 3]

Beyond the new issuances, also the developments in the investor base of the outstanding bank bonds provide some relevant facts for the empirical analysis. The investor base of unsecured bonds issued by euro area banks highlights two main features at the sectoral level, as observed in the securities holdings data from 2014 onwards: the major role of the banking sector as investor, well above the other institutional sectors and persistently over time; the significant decline in the exposures of households, possibly related to a change in the perception of credit risk, due to the bail-inable status of these securities. Since the entry into force of the Bank Recovery and Resolution Directive (BRRD) in 2015, euro area households reduced their exposures to unsecured bank bonds, from 19% in 2014 Q4 to 6% in 2020 Q1, out of the total outstanding amount. The reduced involvement of retail investors triggered a reallocation of the investor base across sectors, towards euro area institutional investors, including banks. At the beginning of 2020, before the pandemic, among euro area investors, banks held 37%, insurance companies and pension funds 17%, investment funds 15%, while the private foreign sector held 15% of the outstanding unsecured bank bonds. In countries with high pre-existing shares of retail investors, this reallocation raised further pressure on the domestic banking sector to absorb these exposures.

Some relevant heterogeneity can be observed across issuer banks, depending on their size and market access. Different issuer banks face different opportunities for deepening the investor base of their bail-inable debt: for instance, G-SIIs differ significantly from all the other banks in their ability to place debt instruments.<sup>8</sup> This is important for the analysis of the different requirements, MREL and TLAC. G-SIIs, being subject to TLAC requirements since January 2019, frontloaded their issuances of subordinated instruments well before the pandemic. Most importantly, being very large institutions at global level, they could take advantage of their well-established access to debt markets, which allowed them to place their unsecured bonds – including subordinated debt – also in adverse market conditions. At the same time, all the other banks – subject to the MREL

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<sup>7</sup> See Section 3 for a detailed discussion of the timeline for the setting of these requirements.

<sup>8</sup> The euro area banks included as of 2016 in the FSB list of the Global Systemically Important Banks (G-SIBs) and classified in the EU as Global Systemically Important Institutions (G-SIIs), and then subject to the TLAC requirements, are eight: Deutsche Bank, BNP Paribas, BPCE Group, Crédit Agricole, Société Générale, Banco Santander, ING Group, and Unicredit Group.

requirements but with more limited access to capital markets – are still in the process of building their eligible liabilities. Despite the phase-in process, they may need time to establish their market presence as debt issuers and achieve favourable pricing, particularly in market conditions dominated by uncertainty, and by a strong concentration of the main investors.

These differences are reflected in the composition of the investor base for the unsecured bonds issued by G-SIIs and by all the other banks, as displayed in Figure 4. Indeed, the investor base of the unsecured bank bonds by G-SIIs is more diversified – in terms of sectors – than for all the other banks, and so less reliant on the holdings by the banking sector.

[Insert Figure 4]

For instance, at the beginning of 2020, the share of unsecured bonds held by euro area banks was equal to 21% and 39%, respectively, for the debt issued by euro area G-SIIs and non-GSIIs. This is due to the different role of other institutional investors, which are more active in the instruments issued by G-SIIs. For instance, insurance companies and pension funds held 26% and 16%, respectively, of the unsecured bonds issued by G-SIIs and non-GSIIs; while the corresponding shares held by investment funds hold were, respectively, 20% and 14% for these two categories of bonds.

The allocation of the holdings of unsecured bank bonds within the euro area banking sector is also important, to identify which institutions are exposed to these securities. Using the Securities Holdings Data at the banking group level (SHSG), we can distinguish the holdings by other banking groups (cross-holdings) and the holdings by the same banking group of the issuer (self-holdings). Within the overall holdings by the euro area banking sector, approximately 60% are held by the same banking groups of the issuers. This could reflect various factors: the intragroup exposures of bail-inable bonds for the purpose of internal MREL (i.e., to facilitate the resolution in complex banking groups), as well as potential situations of limited demand from other market investors.

## **2.3 Requirements for bank bail-inable liabilities**

In our analysis, we focus mainly on the effects of the introduction of the MREL requirements, as the EU framework presents the interesting feature that these requirements for bank bail-inable liabilities are set for all banks. We also analyse the impact of the setting of the TLAC requirements, applicable only to G-SIIs, to explore how this latter rule raises partially different incentives due to the different design of the regulatory provisions.

To properly evaluate the impact of the setting of these requirements, it is important to identify the timing of the regulatory changes in order to avoid incorporating potential anticipation effects, which would take place well before the entry into force of the requirement. This is particularly relevant for the holding decisions of bank bonds by credit institutions. They are among the most informed economic agents acting as investors in this debt market segment: since they are also issuers of these instruments, they may dispose of accurate information on the market before other investors. Thanks to this advanced knowledge, they can undertake potential adjustments in their investment behaviour before any forthcoming changes in the regulatory regime. For this reason, to define the timing of the events for our analysis, we need to consider the first announcements of these regulatory changes, which would provide sufficiently precise information on the definition and the calibration of requirements, or on the regulatory treatment of the holdings. The following discussion explains how we define the events for the analysis of the effects.

The **MREL** is a Pillar 2 requirement for EU banks, introduced by the Bank Recovery and Resolution Directive (BRRD), the same EU legislative act that has established the bail-in principle.<sup>9</sup> The MREL requirements have to be set for individual credit institutions by the Resolution Authorities, namely the Single Resolution Board (SRB) and the National Resolution Authorities (NRAs).<sup>10</sup> The liabilities eligible for MREL are: Tier 1 and Tier 2 instruments; unsecured debt instruments, including both senior and subordinated bonds, with a residual maturity of at least one year. Since equity instruments are usually more expensive than debt instruments due to the higher return required by shareholders, banks have strong incentives to build up the additional loss-absorbing capacity (i.e., in addition to the regulatory capital requirements and the voluntary capital buffers) via the issuance of debt securities. In fact, the introduction of MREL requirements has raised for banks the need to issue new unsecured debt instruments, even if banks may take advantage of a period of phase-in for the application of the requirements.<sup>11</sup>

The first binding requirements were set by the SRB during the 2017 resolution planning cycle round at consolidated level for the majority of the largest and most complex banks in the Banking Union and communicated to the banks in the first quarter of 2018. However, the methodology for computing these requirements had been already defined in a fairly detailed way in the EU Commission Delegated Regulation 2016/1450 adopted in May 2016, based on the technical standards proposed by the European Banking Authority. Based on these criteria, banks could ex-ante – with some approximation – estimate their shortfall of MREL eligible liabilities and start planning for the future the additional issuances of unsecured bonds needed to fulfil the incoming requirements. For this reason, we use the adoption of the EU Commission Delegated Regulation in May 2016 as the relevant event for the setting of the MREL requirements.

An increase in the supply of eligible bonds, particularly by banks with larger shortfall of MREL-eligible liabilities, raises the question about how this additional supply would be absorbed by market investors. In fact, the market placement of MREL-eligible bonds, especially the subordinated instruments, can be more difficult for banks under the new bail-in regime, which could significantly increase the credit risk of these debt securities and then discourage investors. In addition, as mentioned in the previous section, following the introduction of the bail-in, some traditional investors like households had significantly reduced their share of bank bond holdings, also for the outstanding amounts of unsecured bank bonds.

This may increase the probability that banks may increase their holdings of bank bail-inable bonds, both for new issuances, and for outstanding bonds. This may take place despite some potential deterrents, coming from a less favourable treatment of bail-inable debt for liquidity requirements,<sup>12</sup> or for the collateral eligibility in central bank liquidity operations.<sup>13</sup> Therefore, we intend to test the following hypothesis:

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<sup>9</sup> The Directive 2014/59 was adopted in May 2014, following a legislative process started with the proposal of the EU Commission in June 2012 and culminated in a political agreement reached by the EU Council in June 2013. Due to the timing constraints of our dataset, we cannot conduct a potential analysis on the effects of the bail-in introduction on the holding decisions of banks for the above events, as the security holding data for banking groups start in 2013 Q4, and more completely in 2014 Q1. This would exclude the possibility to analyse the effects of the bail-in introduction on the holdings of bank debt instruments by individual banking groups.

<sup>10</sup> The Pillar 2 nature of the requirement implies that, despite some guidelines set for all banks, the actual requirement is bank-specific and therefore determined by the Resolution Authority.

<sup>11</sup> EU banks were subject to an intermediate MREL target by 1 January 2022 and will be subject to a fully calibrated one by 1 January 2024.

<sup>12</sup> As captured in the treatment of unsecured bank bonds for the inclusion in HQLA (High Quality Liquid Assets)

<sup>13</sup> Unsecured senior preferred bonds can be eligible as collateral for central bank liquidity operations in the Eurosystem framework, but subordinated instruments are excluded, even after the recent measures of collateral easing.

***HYPOTHESIS 1.*** *The introduction of the MREL requirements raises the incentives for individual banks to increase their exposures to MREL-eligible bonds.*

The **TLAC** is a Pillar 1 requirement, set by the Financial Stability Board (FSB) to increase the loss-absorbency capacity of Global Systemically Important Banks (G-SIBs), in order to address the Too-Big-To-Fail issue for the largest systemic banks and set the conditions for an orderly resolution. The liabilities eligible for TLAC must be unsecured and subordinated instruments, namely: Tier 1 and Tier 2 instruments; unsecured subordinated bonds and senior non-preferred notes, with a residual maturity of at least one year. Funding cost considerations may explain the incentives for the recent sizeable issuances of senior non-preferred notes: being senior to capital instruments, they benefit from a more favourable pricing, while being still eligible for the TLAC requirements.

The principles on loss-absorbing and recapitalisation capacity of G-SIBs in resolution, set by the FSB in November 2015, have been in force since January 2019.<sup>14</sup> Therefore, the TLAC requirements have been binding for the EU banks classified as G-SIIs since then. To fulfil the requirements by that date, these banks had to frontload the issuances of new subordinated instruments in the years before the entry into force. While the G-SII banks are very large institutions with well-established access to debt capital markets, the subordinated nature of these instruments for loss-absorbing purposes may still raise some credit risk concerns particularly among non-bank or retail investors. Also for TLAC, we investigate whether the introduction of the requirements raised the incentives for banks to increase their holdings of eligible instruments. Moreover, given the specific regulatory design for TLAC requirements, it is important to explore potential differences across different banks as holders.

To identify the regulatory change, we consider the adoption of the Basel standard for the regulatory treatment of TLAC holdings, which was finalised in October 2016. This Basel standard is important to complement the FSB principles, not only for issuer banks, but also for potential holder banks, as they discipline the regulatory capital treatment for the holdings of these instruments. This standard defines a deduction rule for the TLAC instruments issued by G-SIBs. Banks must deduct holdings of TLAC instruments – not qualifying as regulatory capital – from their own Tier 2 capital. This means that the holdings of these instruments reduce the regulatory capital of the holder banks.

A corresponding deduction rule was consequently introduced in the EU legislation, for the computation of the TLAC eligible liabilities of G-SIIs, as set in the Capital Requirements Regulation (Reg. 2019/876). Following the Commission's proposal in November 2016, this Regulation was adopted in June 2019. This deduction rule applies to the unsecured subordinated liabilities issued by a G-SII and held either by the same group or by other G-SIIs: to compute the amount of TLAC-eligible liabilities, relevant to fulfil the requirements, G-SIIs have to deduct their holdings of TLAC instruments. This implies that, for G-SIIs, the holdings of TLAC instruments reduce the amount of their own TLAC-eligible liabilities and then increase their potential shortfall.

This deduction rule is intended to disincentivise cross-holdings and self-holdings of eligible subordinated liabilities issued by G-SIIs. In fact, if banks have sizeable exposures to bail-inable liabilities, issued by other banks or by the same banking group, this may have negative implications on the financial stability of the banking sector and may raise significant impediments for the resolvability of the issuer banks. This issue has been considered particularly for global systemic

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<sup>14</sup> Minimum TLAC requirements were set at 16% of risk-weighted assets (RWAs) and 6% of total assets since 2019; then they increased to 18% of RWAs and 6.75% of total assets from 2022.

banks, due to the risk of potential contagion in case one of these institutions may require the application of the bail-in tool.

Therefore, we focus on this regulatory change for TLAC to analyse the effects on banks' investment behaviour, and to explore the effectiveness of the deduction rule, by testing the following hypothesis:

***HYPOTHESIS 2.*** *The introduction of the TLAC requirements raises the incentives for other banks – different than the issuer – to increase their exposures to TLAC-eligible instruments, while it reduces the incentives for the issuer banks to hold their own eligible instruments.*

### 3. Empirical Analysis

The empirical analysis investigates the effects of the introduction of the requirements for bank bail-inable liabilities, as discussed in Section 2.3, on the holdings of eligible bank bonds by other banks or by the same banking group of the issuer. The setting of the MREL and TLAC requirements induced banks to increase their issuances of unsecured debt instruments, particularly subordinated, in order to raise their amount of eligible liabilities. This created an additional supply of eligible bank debt instruments to be placed among market investors. At the same time, the increased credit risk of eligible instruments – due to their bail-inable status – discouraged some categories of traditional investors, triggering some reallocation also of previously outstanding bank bonds now eligible for the bail-in. These developments may have increased the scope for cross-holdings of bank bonds across credit institutions, or for self-holdings by the same banking group of the issuer, with potential implications on bank risk and interconnectedness, and ultimately for the actual resolvability of banks.

The securities holding database for individual banking groups, as described in the previous section, allows us to investigate this question at the security-holder level, which is the largest possible degree of granularity. This analysis focuses on the investments by individual banks in specific bonds. Therefore, we know whether in quarter  $t$  bank  $b$  is exposed to the bond  $b$  issued by bank  $i$ . We conduct our analysis on the extensive margin, i.e., the decision of the bank  $b$  whether to invest in the bond  $b$ . We then define the dependent variable as a binary dummy  $Hold_{b,i,b,t}$ , which is 1 if bank  $b$  invests in bond  $b$  issued by bank  $i$  in quarter  $t$ . We develop the analysis by estimating a difference-in-differences specification: we are interested in analysing the impact of each regulatory change on the probability for a bank to hold a given eligible bond.

The treatment event is the setting of the requirements, affecting the status of the selected debt instruments: for instance, the eligibility of a debt security for the MREL (or the TLAC requirements).<sup>15</sup> For each regulatory change, we define the eligible securities ( $Eligible_{b,i}$ ) as the instruments subject to the regulatory treatment defined by the reform, while the securities not benefiting from the regulatory treatment are characterised as not eligible. Therefore, the treatment group consists of the eligible bank bonds while the control group includes the non-eligible bonds. When the sample of non-eligible securities is particularly large and heterogeneous, to construct a

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<sup>15</sup> In general, for the MREL requirements, the eligibility is defined with respect to the characteristics of the individual debt securities ( $b$ ), being an unsecured bank debt instrument with a remaining maturity of at least one year. In addition, for the TLAC requirements, the eligibility status refers also to the identity of the issuer ( $i$ ), requiring that the bank is a G-SII.



proper counterfactual for the policy evaluation, we have to restrict the control sample only to those non-eligible securities with similar characteristics to the eligible ones.<sup>16</sup>

Also, for each regulatory change, we use the timing of the event ( $Post_t$ ) as identified in Section 2.3, by considering the first announcement of each reform providing sufficiently precise information: both to the issuer banks, to set the requirements and plan the debt issuances needed to comply; and to the holder banks, to know the regulatory treatment applicable to the potential holdings.

In the simplest specification, we estimate the following difference-in-differences equation where the dummy  $Eligible_{b,i}$  is equal to one if the bond  $b$  issued by bank  $i$  is an eligible instrument subject to the regulatory treatment we are interested in.  $Post_t$  is a dummy equal to one if the quarter  $t$  is one of the two quarters after the treatment, and equal to 0 if it is one of the two quarters before.<sup>17</sup>

$$(1) \quad Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$$

The parameter  $\alpha_{i,t}$  indicates issuer-quarter fixed effects, while  $\alpha_{h,t}$  denotes holder-quarter fixed effects.

The analysis of the holdings of bank bonds by banks, as for any other type of investor, requires us to disentangle the investment decisions (demand side of the bond market) and the issuance behaviour (supply side). In fact, the developments in the holdings of securities by a given institution may be driven both by the investment decisions of holder banks, and by the issuance behaviour or the balance sheet conditions of issuer banks.

When analysing the effects of regulatory policies on bank bond holdings, we need to focus on the decisions of investor banks, by controlling for the time-variant developments concerning issuer banks. For instance, issuer banks may differ with respect to the size of their shortfalls of MREL or TLAC-eligible liabilities: these differences may have implications on the issuance behaviour of banks, as some institutions may need to issue more bonds than others to comply with the requirements. These bank-specific differences across issuer banks may have implications on the market capacity to absorb the new issuances by different banks.

To account for that, we use issuer-time fixed effects that would capture the changes – specific to individual issuer banks – in their liquidity need and funding strategy. In this way, we can analyse the investment behaviour of distinct banks with respect to bonds issued by the same bank, exploiting the heterogeneity across holder banks. To allow for this identification strategy, the investor base of individual bank bonds should include more than one bank, in such a way that we can compare the investment behaviour of distinct banks with respect to the bonds issued by the same bank.

To control for the characteristics of the holder banks, in more saturated specifications, we also use holder-quarter fixed effects which capture the time-variant developments in the investment strategy of individual holder banks. In this way, we analyse the investment behaviour of holder banks with respect to different bonds issued by the same bank (provided that we are already using issuer bank-quarter fixed effects). We can then explore the heterogeneity across distinct bank bonds issued by a given bank, which may be subject to different regulatory treatments. Finally, we cluster the standard errors at the level of holder bank, security type (eligible vs. non-eligible) and holding type (holding by another bank vs. by the same banking group).

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<sup>16</sup> This is discussed separately when presenting the empirical analysis for each type of regulatory change.

<sup>17</sup> We exclude the quarter of the regulatory change as, depending on the date of the event, the effects might not fully develop during the same quarter of the policy change.

When analysing the effects of regulatory changes on the holdings of bank bonds, it is important to distinguish the cases of cross-holdings (by other banks than the issuer) from the cases of self-holdings (by the same banking group as the issuer). The two cases reflect different market developments and economic motives, but both may have negative implications for the resolvability of issuer banks. The cross-holdings of bank bonds across different banks may reflect different potential considerations: some existing knowledge of the issuer bank and some previous relationship between the two banks; some strategic reasons related to the nationality of banks (see Section 3.3 for an analysis of the potential drivers of cross-holdings). Self-holdings of bank bonds may reflect different motives: intra-group holdings, particularly when bonds issued by subsidiaries are held by the parent company; potential difficulties in market access for the issuer bank (with the banking group acting as an investor of last resort); or potential incentives for the retention of issued debt securities (perhaps driven by the possibility to use them as collateral). In the perspective of bank resolution, both cross-holdings and self-holdings may raise potential concerns: cross-holdings may generate some contagion effects in case one bank is subject to bail-in; self-holdings may create serious issues to the bail-in implementation, as the same banking group of the issuer bank would face the losses of the bail-in.

To explore the differential effects of the regulatory changes on cross-holdings and self-holdings, we define also an issuer-holder dummy variable ( $SelfHold_{b,i,h}$ ), which is equal to 1 if the holder banking group is the same as the issuer bank and to 0 if the holder is different from the issuer. In some of the following regressions, we use this in a triple interaction with the treatment eligibility and the post dummy. Therefore, we estimate a diff-in-diff-in-diff regression, to explore whether the regulatory change induced different effects on the self-holdings versus the cross-holdings of bank bonds. The regression equation writes as follows:

$$(2) \quad Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SelfHold_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SelfHold_{b,i,h} + \beta_6 Eligible_{b,i} * SelfHold_{b,i,h} + \beta_7 Post_t * SelfHold_{b,i,h} + \varepsilon_{b,i,h,t}$$

### 3.1 MREL requirements and holdings of bail-inable liabilities

First, we explore the introduction of the MREL requirements for all EU banks. For the timing of the event, we exploit the definition of the methodology to compute the MREL requirements, as set in the Commission's Delegated Regulation adopted in 2016 Q2. Given this timing, the regression is estimated using the data for the holdings of the largest 26 euro area banking groups, which is the coverage available for this period.

Table 2 presents the results for the analysis on the extensive margin of the holding decision. As specified in the previous Section, the dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes long-term bank bonds, with a remaining maturity of at least 1 year, excluding structured products. The dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond.

[Insert Table 2]

In the col. 1-4, we run a difference-in-differences equation as in (1), to estimate the effects of the introduction of the MREL requirements on the holdings of MREL-eligible instruments. Since the setting of these criteria allowed issuer banks to have a first indication of their MREL shortfalls, and

then to plan their issuances of eligible instruments, we explore how holder banks changed their exposures to the eligible bonds after this announcement.

To control for possible changes in bank characteristics for both issuer and holder banks, we gradually introduce different types of fixed effects. In col. 1 we have only issuer bank fixed effects, while in col. 2 we use both issuer bank and quarter fixed effects, separately. Then, in col. 3 we introduce issuer bank-quarter fixed effects. As we are crucially interested in controlling for the time-variant developments for issuer banks, we consider the specification in col. 3 as our baseline, as the issuer bank-quarter fixed effects are essential for our identification to disentangle issuance behaviour and investment decisions. This can be further saturated with holder bank-quarter fixed effects, as in col. 4, to control also for the time-variant characteristics of holder banks. Given the extensive use of fixed effects, the regression is estimated using a linear probability model: therefore, the coefficients reported in the table indicate also the average marginal effects.

The results for the eligible dummy suggest that, on average before the change, the banks included in the sample were less likely to hold eligible bonds. The coefficient shows a lower probability to hold eligible bonds by around 4.1 pp. This may reflect several factors, including the higher credit risk of unsecured versus secured bonds. Most importantly, the coefficient for the interaction term is positive and significant: after the MREL introduction, banks increased by around 0.9 pp the probability to hold eligible bonds relative to non-eligible bonds.<sup>18</sup> This result suggests that the MREL introduction increased the incentives for banks to hold bonds eligible for MREL, possibly to substitute other investors interested in reducing their exposures to outstanding eligible bonds or to absorb new issuances of these debt instruments by EU banks.

To investigate whether this increase in banks' exposures to MREL-eligible bonds occurred via the holdings of other banks or of the same banking group, in col. 5-8 we estimate a diff-in-diff-in-diff specification using the dummy for self-holdings. Therefore, the coefficient for the double interaction  $Eligible_{i,b} * Post_t$  indicates the average treatment effect of the MREL introduction on the holdings of eligible bonds, independently from the identity of the holder bank; while the coefficient for the triple interaction  $Eligible_{i,b} * Post_t * SelfHold_{i,b,j}$  denotes the potential additional effect on the holdings of eligible bonds by the same banking group (i.e., self-holdings).

We focus on the specification in col. 7, which includes issuer bank-quarter fixed effects to control for the time-variant characteristics of issuer banks. The MREL introduction increased the probability for banks to hold MREL-eligible bonds by 0.76 pp, broadly in line with the results of col.3 for the diff-in-diff specification. The coefficient for the triple interaction is positive but not significant. This result does not provide evidence on an even stronger increase for the holdings by the same banking group, in the ex-post time horizon of two quarters. However, it is important that the increase in the probability to hold MREL-eligible bonds affected also the bonds issued by the same banking group.<sup>19</sup> Moreover, it is interesting to notice that banks were generally reducing the holdings of their own debt securities; this would suggest some potential shift in the portfolio of their own debt securities from non-eligible to eligible ones.

The results presented in Table 2 refer to the sample of long-term bonds issued by all euro area banks, without distinction across institutions of different type. Given that different types of banks

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<sup>18</sup> This result is economically sizeable if we consider that, based on the sample mean, the average probability that a bank  $b$  holds a given bond  $b$  in quarter  $t$  is equal to 4% (see summary statistics in Table 1, Panel A).

<sup>19</sup> The distinction between eligible and non-eligible bonds in terms of risk from the viewpoint of the bondholder may be less relevant when the bond is held by the same banking group as the issuer. In fact, when the bond is held by other banks, the possibility of double recourse (on the bank and on the collateral) implies a lower risk for secured bonds than for unsecured bonds. This difference fades out when the bonds are held by the same banking group of the issuer.

are subject to different requirements, we want to ensure that the results can be actually attributed to the introduction of the MREL requirements. In fact, G-SII banks are subject also to the TLAC requirements. For this purpose, we exclude from the sample the bond issuances by G-SIIs and we consider only the bonds issued by non-G-SII banks. We conduct the same analysis as in equation (1) for this subsample and report the results in Table 3.

[Insert Table 3]

We analyse the impact of the introduction of the MREL requirements on the holdings of MREL-eligible bonds issued by non-G-SII banks, first without distinction about the identity of the holder. The coefficient for the double interaction of the diff-in-diff analysis is positive and significant in all specifications. As in the previous analysis, we focus the attention on the baseline specification including issuer-quarter fixed effects, as reported in col. 3. After the introduction of the MREL requirements, banks increased the probability to hold eligible bank bonds by 0.9 pp: this confirms the results observed for the overall sample.

Then, in order to distinguish the holdings by other banks or by the same banking group, in col. 5-8 we estimate a diff-in-diff-in-diff specification using the dummy for self-holdings. The coefficient for the double interaction term is still positive and significant in all the specifications, while the coefficient for the triple interaction with self-holdings is positive but not significant. Looking at the specification with issuer-quarter fixed effects in col. 7, after the introduction of the MREL requirements, banks increased the probability to invest in MREL-eligible bonds by 0.8 pp. This confirms that the increase in the holdings of MREL-eligible bonds concerned bonds issued both by other banks and within the same banking group.

### **3.2 TLAC Requirements and holdings of bail-inable liabilities**

The other important regulatory change for bank bail-inable liabilities is the introduction of the TLAC requirements for all Global Systemically Important Banks, as decided by the FSB. While the MREL requirements have been in any case subject to a gradual phase-in process, due to the decisions of the Single Resolution Board, the TLAC requirements have been fully binding for EU G-SIIs since January 2019. So, the adjustment process for the issuance and the holdings of TLAC-eligible liabilities for EU G-SIIs may have somehow preceded the developments for the issuance and the holdings of MREL-eligible bonds for all EU banks.

To isolate the effects of the MREL introduction, in Table 3 we have focused our analysis only on the bond issuances by non-GSII banks, to exclude the potential effects of the TLAC introduction. In this section, we intend to focus specifically on the setting of the TLAC requirements, to investigate the impact of this on the holdings of the subordinated liabilities of G-SII banks, also taking into account the differences in the design of the two regulatory provisions, and the related implications on the incentives for cross-holdings and self-holdings.

For the timing of the event, we refer to the setting of the Basel standard on TLAC holdings, adopted in October 2016. This standard was implemented in the EU via the revision of the Capital Requirements Regulation, based on a proposal formulated by the EU Commission in November 2016. This is important to determine the regulatory treatment for the holdings of TLAC-eligible instruments. Therefore, we focus on this regulatory change to analyse the effects on banks' investment behaviour. Given this timing, the regression is estimated using the data for the holdings of the largest 26 euro area banks.

Table 4 presents the results for the analysis on the extensive margin of the holding decision. As we do for the estimations on MREL, we run a difference-in-differences equation as in (1), but now to estimate the effects of the setting of the TLAC requirements on the holdings of TLAC-eligible instruments. The sample includes long-term unsecured bank bonds issued by G-SIIs, with a remaining maturity of at least 1 year. The treatment is defined as the eligibility of these debt securities for TLAC liabilities. Therefore, the treatment group corresponds to the subordinated bonds issued by G-SIIs, while the control group includes the senior preferred bonds issued by G-SIIs.<sup>20</sup> The dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for TLAC, namely if it is subordinated and issued by a G-SII. It is equal to 0 if the bond is still issued by a G-SII but not eligible for TLAC.

[Insert Table 4]

In the col. 1-4, we run a difference-in-differences equation as in (1), to estimate the effects of the finalisation of the Basel standard on TLAC on the holdings of TLAC-eligible instruments. To control for possible changes in bank characteristics for both issuer and holder banks, we gradually introduce different types of fixed effects as in Table 2 and we estimate the regression using a linear probability model. For our baseline, we focus on the specification with issuer bank-quarter fixed effects (col.3).

The coefficient for the interaction term is positive and significant: after the setting of the Basel standard on TLAC, banks increased by around 1.1 pp the probability to hold TLAC-eligible instruments relative to non-eligible instruments issued by G-SIIs. This suggests that the TLAC introduction increased the incentives for banks to hold the unsecured subordinated bonds eligible for TLAC, both to replace other investors previously holding outstanding eligible bonds and to absorb the potential additional supply of these debt instruments by EU G-SII banks.

To investigate whether this increase in banks' exposures to TLAC-eligible instruments occurred via the holdings of other banks or of the same banking group, in col. 5-8 we estimate a diff-in-diff-in-diff specification using the dummy for self-holdings. As before, we focus on the specification in col. 7, including issuer bank-quarter fixed effects. The coefficient for the double interaction  $Eligible_{i,b} * Post_t$  indicates the average treatment effect of the TLAC setting on the holdings of eligible bonds. This coefficient still shows, on average, a positive effect of slightly higher magnitude (increase of 1.8 pp) on the holdings of TLAC instruments by banks.

However, the increase in the holdings of subordinated bonds issued by G-SIIs is not observed for all holder banks in the same way. As in the previous specifications for MREL, we investigate the potential role of self-holdings in the case of TLAC, but we find significantly different results, which are indeed an intended consequence of the regulatory design for TLAC. The coefficient for the triple interaction  $Eligible_{i,b} * Post_t * SelfHold_{i,b,j}$  measures the additional effect, if any, of the TLAC introduction on the holdings of these eligible bonds by the same issuer banking group (i.e., self-holdings). After the setting of the Basel standard, issuer banking groups reduced the probability to hold their own TLAC-eligible instruments by around 10 pp relative to other banks. In part, these differences between the holdings of MREL-eligible and TLAC-eligible debt could reflect the different access to wholesale debt markets of G-SIIs vs. other banks, as G-SIIs should be able to place their bond issuances more easily in the market. But, since these differences in the holding behaviour arise after the Basel standard for TLAC-holdings, we can argue that a key driver of these developments was the regulatory treatment of TLAC-holdings in the Basel standard, based on the

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<sup>20</sup> Senior non-preferred bonds are typically classified as subordinated bonds from the regulatory viewpoint.

provision of a deduction rule, as transposed into the EU legislative framework with the review of the Capital Requirements Regulation.

The deduction rule requires that G-SII banks must deduct holdings of the TLAC-eligible debt, issued either by the same banking group or by other GSII banks, from their TLAC eligible liabilities. This rule, set in the Basel standard, was then immediately included in the Commission's proposal (November 2016) for the Capital Requirements Regulation 2, which disciplines the TLAC requirements in the EU framework. While the EU regulation was adopted only in 2019, the content of the proposal remained unchanged on this matter. Importantly, this regulation applies the deduction rule to the holdings of subordinated instruments only when issued by G-SIIs and held by G-SIIs. On the other hand, it does not concern the subordinated instruments issued by G-SIIs when held by non-GSII banks, as well as all the subordinated instruments issued by non-GSII banks (independently from the holder).

### 3.3 Drivers of bank bond cross-holdings

In this section, we explore more in depth the developments in the cross-holdings and investigate the drivers of banks' investment decisions in the bail-inable bonds issued by other banks. In particular, we study these decisions with respect to two factors: the potential risk-taking coming from the exposures to the bonds issued by riskier banks and the potential home bias for the exposures to bonds issued by other banks headquartered in the same country.

We conduct this analysis for the introduction of the MREL requirements: while in Section 3.1 we have shown the increase in cross-holdings after the introduction of these requirements, here we explore whether after this regulatory change banks increased their cross-holdings particularly for the bonds issued by certain banks, due to risk-taking incentives or home bias. We focus on the introduction of MREL because all EU banks are subject to the MREL requirements, so we can consider the bonds issued by all banks in our euro area sample. On the other hand, only eight euro area banks are subject to the TLAC requirements, as they apply only to the global systemically important banks. This restricts significantly the margins of heterogeneity across issuer banks that we can exploit for the analysis on the drivers of cross-holdings, both for the country of establishment,<sup>21</sup> and for the credit ratings.<sup>22</sup>

A potential driver for the choice of the bonds (and of the issuer bank) in the cross-holdings could be related to risk-taking incentives. Banks may invest in the bonds issued by lower rated banks but with higher yields, to the extent this may contribute positively to the profitability of the holder banks (Becker and Ivashina, 2015; Bubeck et al., 2020; Efung, 2020).<sup>23</sup>

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<sup>21</sup> Overall, five euro area countries host G-SIIs: France (4), Germany (1), Italy (1), Netherlands (1) and Spain (1).

<sup>22</sup> The issuer credit ratings of the eight G-SIIs are included in a relatively narrow range, between A+ and BBB+ within the S&P Long Term Issuer Credit Rating scale, and between A1 and Baa2 within the Moody's Issuer Long-Term Rating scale.

<sup>23</sup> Search-for-yield considerations may affect the behaviour of various categories of institutional investors. Efung (2020) studies the securitization exposures of German banks and finds evidence of a reach-for-yield behaviour: banks with tight regulatory capital constraints invest more in asset-backed securities with higher yields, conditionally on rating-implied regulatory risk weights, as defined in the standardised approach of Basel II. Becker and Ivashina (2015) show that insurance companies reach for yield in choosing their investments in corporate bonds: they prefer to hold higher rated bonds, but conditional on credit ratings, their portfolios are systematically biased toward higher yield, higher CDS bonds. Moreover, Bubeck et al. (2020) investigate the potential risk-taking channel of negative monetary policy

For this reason, we compare the credit ratings of the issuer and holder banks and we define a dummy *RelRating*, which is equal to 1 if the issuer has worse rating than the holder, i.e., if the holder bank invests in the bonds issued by a bank with lower credit rating. We conduct a diff-in-diff-in-diff analysis to explore whether the increase in cross-holdings takes place via the holdings of bonds from lower-rated banks. We present the results of this regression in Table 5.

[Insert Table 5]

The results confirm that – after the introduction of the MREL requirements – banks increased the probability to hold MREL-eligible bonds issued by other banks. In the benchmark specifications with issuer-quarter fixed effects (in col. 3 and 7), the estimated effect of the MREL introduction is an increase in the probability of cross-holdings by 0.8 pp. The coefficient for the double interaction remains broadly unchanged, when we add the dummy for relative rating and the corresponding double and triple interaction terms. However, looking at the triple interaction for  $Eligible_{i,b} * Post_t * RelRating_{i,b,j}$ , we don't find evidence that this increase in bank bond cross-holdings was different in a statistically significant way for the bonds issued by banks with lower ratings. Banks increased their exposures to MREL-eligible bonds issued by other banks, but we do not observe a stronger increase in the holdings of bonds issued by riskier banks.

Another important driver of bank bond cross-holdings could be related to home bias. The home bias in banks' exposures to debt securities has been documented in the literature on securities holdings, for different types of asset classes, including sovereign bonds. The literature on the sovereign-bank nexus in the euro area (Altavilla et al., 2016; Drechsel et al., 2016; Ongena et al., 2019) has explored various potential explanations for the increase in domestic sovereign bond exposures, like the carry trade incentives or the moral suasion by national authorities. In the case of bank bonds, the potential preference for the debt securities issued by banks of the same country could be explained by better knowledge of other institutions from the same country, or by implicit support expectations based on a too-interconnected-to-fail paradigm.

Within the holdings of unsecured bank bonds by the euro area banking sector, the share held by domestic banks remained well above 70% in our sample period. This may have various implications both for market developments and for financial stability. First, this suggests some national fragmentation of bank debt markets in terms of investor base and may raise some constraints for the market capacity to absorb the new issuances of bail-inable debt, with additional challenges for banks with less established reputation as issuers. The home bias may be relevant also for the stability of the national banking sectors. If banks from the same country establish cross-holdings of bank bonds, the bail-in of one bank could cause significant losses to other banks exposed to that institution with significant contagion effects within the domestic banking sector: in these circumstances, it would be more difficult for the supervisory authority to declare the failure of a bank and for a resolution authority to resolve a bank via bail-in.

To investigate the potential role of home bias, we extend the analysis conducted in equation (1) by introducing a dummy defined at the issuer-holder level to indicate whether the holder bank is from the same country of the issuer bank. We conduct our analysis on cross-holdings and we estimate a difference-in-differences-in-differences regression, to investigate whether the increase in the cross-holdings of bail-inable bank bonds after the introduction of the MREL requirements

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rates on the securities holdings of euro area banks, finding that banks with more customer deposits invest more in securities yielding higher returns.

is consistent with a home bias hypothesis. Table 6 presents the results of this estimation for the overall sample of cross-holdings, without any distinction for the countries of issuance.

[Insert Table 6]

We focus on the results in col. 5-8, based on the diff-in-diff-in-diff estimation, and particularly on the benchmark specification in col. 7, including the issuer-quarter fixed effects. We observe that, independently from the introduction of the MREL requirements, banks tend to have a stronger preference to invest in bonds issued by other banks from the same country, with a higher probability to hold by 8 pp. Then, the coefficient for the double interaction  $Eligible_{i,b} * Post_t$  is still positive and significant, indicating an increase in the probability of cross-holdings by 0.4 pp, after the introduction of the MREL requirements. Most importantly, banks display an even larger increase in the probability to invest in eligible bonds by a further 0.9 pp if the issuer bank of these bonds is from the same country. This suggests that the setting of the MREL requirements, with the increase in the supply of bail-inable bank bonds, might have strengthened the already existing home bias in banks' exposures to eligible bank bonds.

### 3.4 Robustness

We conduct some robustness analyses for the effects of the introduction of the MREL requirements: by further exploring the drivers of the cross-holdings; by testing the robustness of the results to a different timing of the treatment event, in case of any anticipation effect; by allowing for a longer time horizon for the analysis of the ex-post effects.

In the main analysis, we have observed that the setting of the MREL requirements contributed to strengthen the already existing home bias in banks' exposures to bank bail-inable bonds. In principle, we may suppose that the argument about the better knowledge of institutions from the same country would hold for all banks, independently from the nationality of the issuer banks. However, some structural differences across euro area countries could imply that the too-interconnected-to-fail argument may be stronger for banks in countries with more fragile economic and financial conditions.

To explore the home bias hypothesis for different countries, we conduct the same exercise as in Table 6 for two groups of countries, i.e., depending on whether the bonds were issued by banks in countries that are more or less vulnerable to macroeconomic and financial shocks. For this purpose, we split the sample in two groups: the first group comprising "stressed" countries, which were subject to relatively higher sovereign stress and were more vulnerable to macroeconomic and financial shocks, i.e., Cyprus, Greece, Ireland, Italy, Portugal, Slovenia, and Spain and the second group comprising the remaining euro area countries, defined here as "non-stressed" countries.

We investigate whether, after the introduction of the MREL requirements, the increase in cross-holdings was stronger for bank bonds from some countries. We present these results in Tables A.1 and A.2 in the Appendix, showing the results respectively for the bonds issued by banks in stressed and non-stressed countries. We still focus on the baseline specifications of col. 7 (including issuer-quarter fixed effects). Independently from the introduction of the MREL requirements, the baseline results discussed in Section 3.3 still hold when the sample is separated in these two groups of countries. However, the positive coefficient for the triple interaction term  $Eligible_{i,b} * Post_t * SameCountry_{i,b,j}$  is statistically significant and considerably large in magnitude for the bank bonds from stressed countries (+3.2 pp); while it is not significant and small in magnitude for the bank



bonds from non-stressed countries. This suggests that the introduction of the MREL requirements contributed to increase the home bias in banks' cross-holdings particularly in more stressed national banking sectors. This could support a potential explanation of the home bias in cross-holdings of bank bonds in a “too-interconnected-to-fail” paradigm.

We also investigate the robustness of the assumptions on the timing for the policy introduction. For this purpose, we estimate the model for different time subsamples assuming each time a different date for the MREL regulatory change. Assessing the size and significance of the coefficient of interest before and after the selected dates gives information on potential anticipation effects (before) and the persistence of the effects (after). More specifically, the exercise aims at comparing sets of different hypothetical treatment dates to the results of the baseline model, in which the treatment date is set at 2016 Q2 for the introduction of MREL requirements, as defined in Section 3.1. This exercise allows us to assess whether the treatment is effective in alternative event dates.

Figure 5 shows the estimates for the coefficient of interest using our baseline specification, i.e., the coefficients of the interaction term  $Eligible_{i,b} * Post_t$ , for hypothetical treatment events immediately before and after our actual treatment event in 2016 Q2. We run difference-in-differences regressions for the same model as specified in equation (1) employing as hypothetical treatment events the following quarters: 2015 Q3, 2015 Q4, 2016 Q1, 2016 Q3, 2016 Q4 and 2017 Q1. The results are estimated using 95% confidence intervals. We also preserve our original estimation windows, i.e., two quarters before and two quarters after each hypothetical treatment event. This specification includes issuer bank-quarter fixed effects to control for the time-variant characteristics of issuer banks, as in our baseline specification.

[Insert Figure 5]

The results show that, for the first hypothetical treatment date in 2015 Q3, there is no statistically significant variation in the probability for banks to hold MREL-eligible bonds. In this case, the post window encompasses the quarters 2015 Q4 and 2016 Q1, suggesting an absence of anticipation effects in the quarters immediately before our treatment date. When considering hypothetical treatment dates in the following quarters, we observe a gradual increase in the coefficient of interest, until it reaches the largest effect (0.6 pp) for the regression using our actual treatment date in 2016 Q2. This effect would be expected given that the  $Post_t$  of the hypothetical treatment dates in 2015 Q4 and 2016 Q1 includes already our benchmark treatment date for the introduction of MREL, i.e., 2016 Q2. The effect remains somehow persistent until the end of exercise in 2017 Q1, although with lower coefficients.

In order to rule out that the effects observed before our treatment event are not generated by anticipation effects, we conduct the same exercise applying a narrower window, i.e., one quarter before and one quarter after each designated treatment date. The shorter horizons in the estimation windows allow us to have a more precise assessment on how the effects observed for banks are sensitive to different treatment dates around the event. As shown in Figure 6, we confirm that, when our actual treatment date (2016 Q2) is not included in the  $Post_t$  window of the hypothetical treatments preceding our actual experiment, the coefficients of interest are not significant.

[Insert Figure 6]

We do not find statistically significant effects when we use earlier potential treatment dates, respectively 2015 Q3 and Q4, so we can exclude that this effect could have taken place in the quarters before the introduction of the MREL requirements. We start observing a positive marginal

increase in the probability to hold an eligible bond when using 2016 Q1 as treatment event (0.76 pp). In fact, the  $Post_t$  of the treatment date in 2016 Q1 coincides with the quarter of the actual regulatory change, i.e., 2016 Q2. The large marginal increase observed in this quarter suggests that the effects of the event took place already at the end of the quarter when the MREL requirements were introduced: i.e., this regulatory change shaped the holding behaviour of banks immediately after the policy implementation.

Finally, we also explore whether the effects of this regulatory change are persistent also in a longer time horizon after the regulatory change. To make sure that the results are not driven by short-term developments, we re-estimate all the regressions employing an estimation window of four quarters before versus four quarters after the treatment date in 2016 Q2. The results are very similar to the ones reported in this paper. Table 7 shows the results for the analysis of the introduction of the MREL requirements, using this longer estimation window. These results are consistent with the ones reported in Table 2.

[Insert Table 7]

As in our benchmark results, we find that the setting of the requirements increased the probability that banks hold eligible bonds relative to non-eligible bonds, by around 0.9 pp in the specification of col. 3 and 4. This effect is confirmed also in the augmented specification with the self-holding dummy (col. 7 and 8), showing a similar increase in the probability to hold eligible bonds (0.76 pp). Importantly, the analysis on this longer horizon displays a stronger increase in the holdings of eligible bank bonds by the same banking group as the issuer (self-holdings). The coefficient for the triple interaction term  $Eligible_{i,b} * Post_t * SelfHold_{i,b,j}$  is positive and significant, pointing to an additional increase in the probability of self-holdings of eligible bonds by 6.8 pp. This may reflect both the need to absorb the issuances of eligible bonds not placed among market investors under limited demand, and the intragroup exposures where parent companies hold the instruments issued by the subsidiaries. These results point to a persistent effect and suggest that these regulatory changes impacted banks' securities portfolios for some time beyond the immediate effect.

## 4 Conclusions

This paper investigates the effects of the introduction of the requirements for bank bail-inable liabilities – MREL and TLAC – on the holdings of eligible bank bonds, particularly by credit institutions. This analysis is motivated by the large role of the euro area banking sector in the investor base of unsecured bank bonds, well above the other institutional sectors. In particular, this paper studies the role of regulatory incentives in affecting the investment behaviour of banks and in potentially fostering the interconnectedness of the banking sector via the holdings of bank bonds. We explore how the introduction of the MREL and TLAC requirements shaped the incentives of credit institutions to hold bank bail-inable debt.

We find that, overall, the introduction of the MREL requirements increased the probability that banks are exposed to eligible bank bonds. The increased holdings of bail-inable bonds by the banking sector reflect both the need to absorb the new supply of eligible instruments issued by banks to fulfil the requirements, and the reallocation of outstanding bonds from other investors due to the increased credit risk of these bonds now eligible for bail-in. To further investigate the determinants of these cross-holdings, we explore the incentives which might have explained the choice of one bank to hold the bonds issued by another bank. We find that that the setting of the

MREL requirements strengthened the already existing home bias in banks' exposures to eligible bank bonds. This evidence is more prominent amid stressed euro area countries. These effects are persistent over time, also when we consider a longer time horizon for the estimation; also, the results are robust to the timing definition of the regulatory change.

The importance of the regulatory design in shaping the incentives arises when comparing different requirements. The other pillar of the bail-in framework is the introduction of the TLAC requirements, which apply only to G-SIIs. We find that the introduction of TLAC increased the incentives for banks to hold the eligible subordinated bonds issued by G-SIIs. However, in contrast to the MREL introduction, issuer banks reduced the holdings of their own TLAC-eligible instruments relative to other banks. This result reflects the incentives from the regulatory treatment of TLAC-holdings. It confirms the effectiveness of the deduction rule, set by the Basel Committee and then established in the EU legislation, that disincentivizes the holdings of TLAC-eligible bonds by G-SIIs, to address the potential risks from the interconnectedness among the largest systemic banks.

Our findings have relevant policy implications for the regulatory design of the crisis management framework and for the monitoring of financial stability risks within the banking sector. On one hand, the sizeable role of the banking sector in the investor base of bank bail-inable debt is consistent with market discipline considerations. Since banks are the most informed potential investors in these debt securities, their presence in the investor base can ensure a more effective monitoring and can also reassure investors from other institutional sectors. On the other hand, the increase in the holdings of bail-inable bonds within the banking sector might trigger linkages across banks in the event of bail-in, as the default of one bank can generate losses for other banks, particularly within the same country. Moreover, the large holdings of bail-inable bonds within the banking sector may raise potential constraints to the actual resolvability of banks via the implementation of the bail-in tool.

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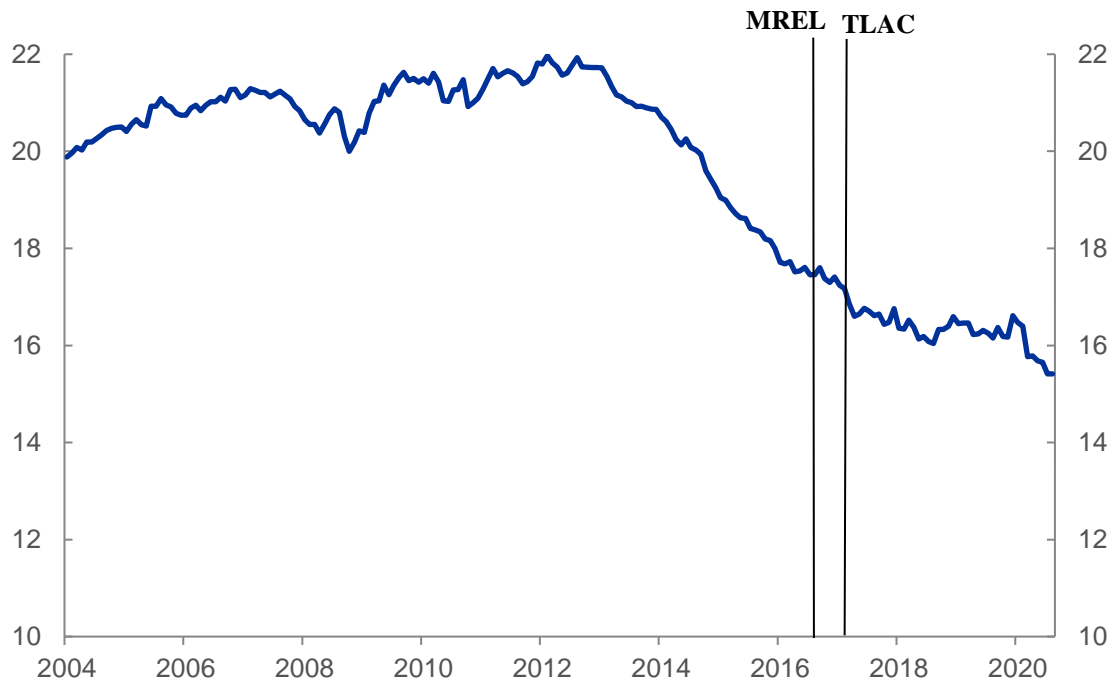
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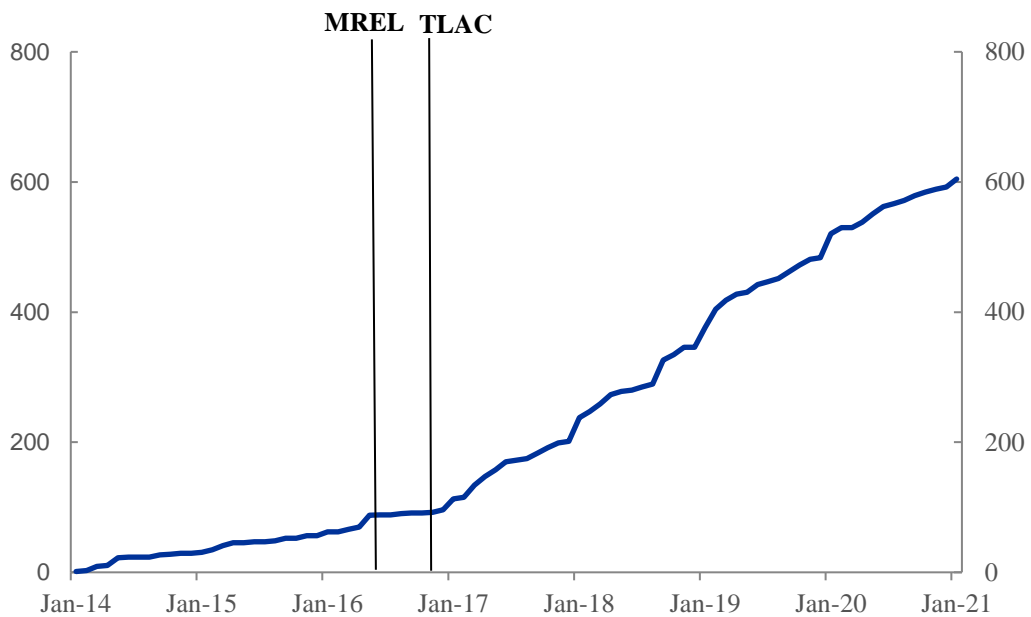
**Figure 1. Debt securities as share of main liabilities of euro area banks (percent)**



Source: ECB Statistical Data Warehouse, Authors' calculations

Note: The vertical lines indicate the timing of the regulatory changes for, respectively, the MREL requirements in May 2016, and the TLAC requirements in November 2016.

**Figure 2. Monthly issuance in volumes of subordinated bonds by euro area banks (in EUR bn)**

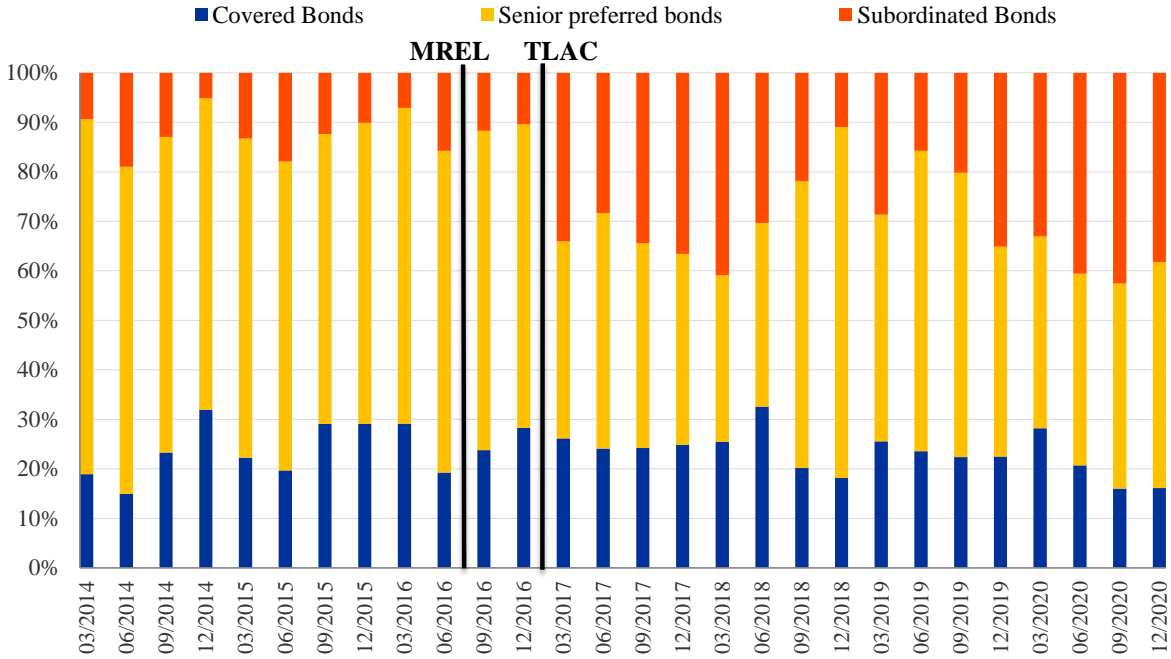


Source: Dealogic and Authors' calculations

Note: Cumulative issuances in EUR bn. The vertical lines indicate the timing of the regulatory changes for, respectively, the MREL requirements in May 2016, and the TLAC requirements in November 2016.

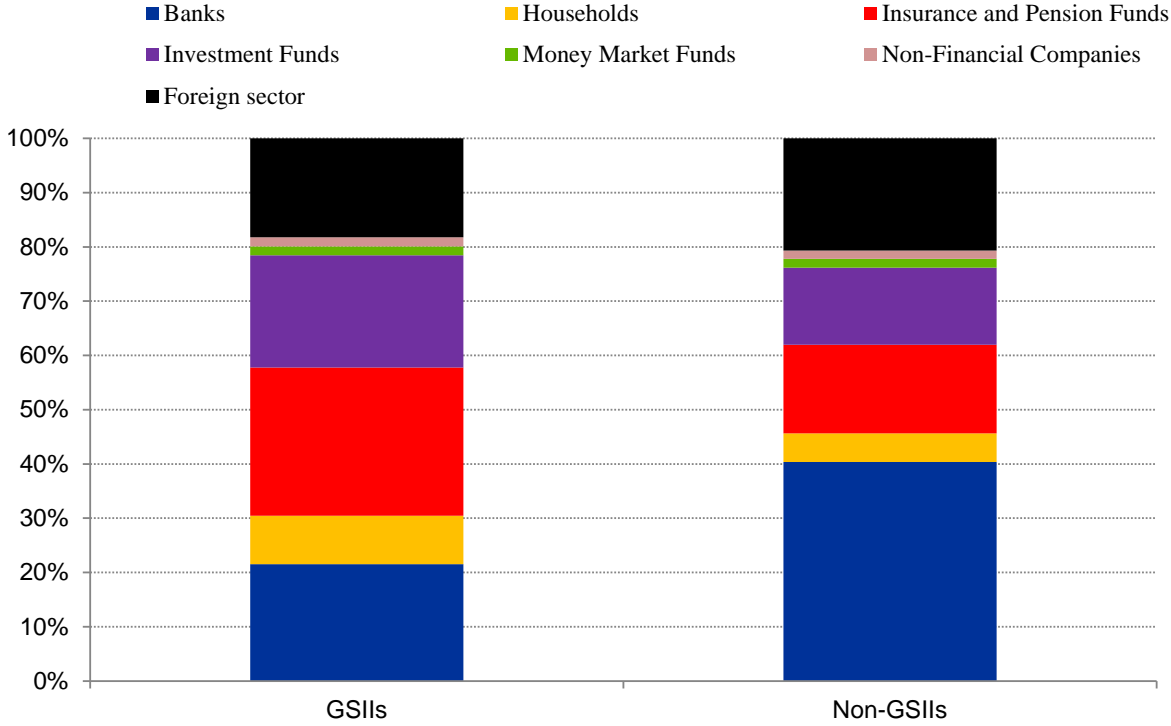


Figure 3. Share of quarterly issuances in volumes of bonds by euro area banks, by debt type



Sources: Dealogic and Authors' calculations.  
 Notes: Issuance volumes (in EUR bn) of unsecured bank bonds for euro area banks. AT1, T2 and senior non-preferred notes are subordinated bonds, and therefore are eligible for the TLAC requirement and for the subordination requirement of MREL. The vertical lines indicate the timing of the regulatory changes for, respectively, the MREL requirements as of 2016 Q2, and the TLAC requirements as of 2016 Q4.

Figure 4. Shares of the unsecured bonds issued by euro area GSII and non-GSII banks held by different institutional sectors (percent, 2020 Q1)



Source: ECB Securities Holdings Statistics at the Sector-level (SHSS) and Authors' calculations

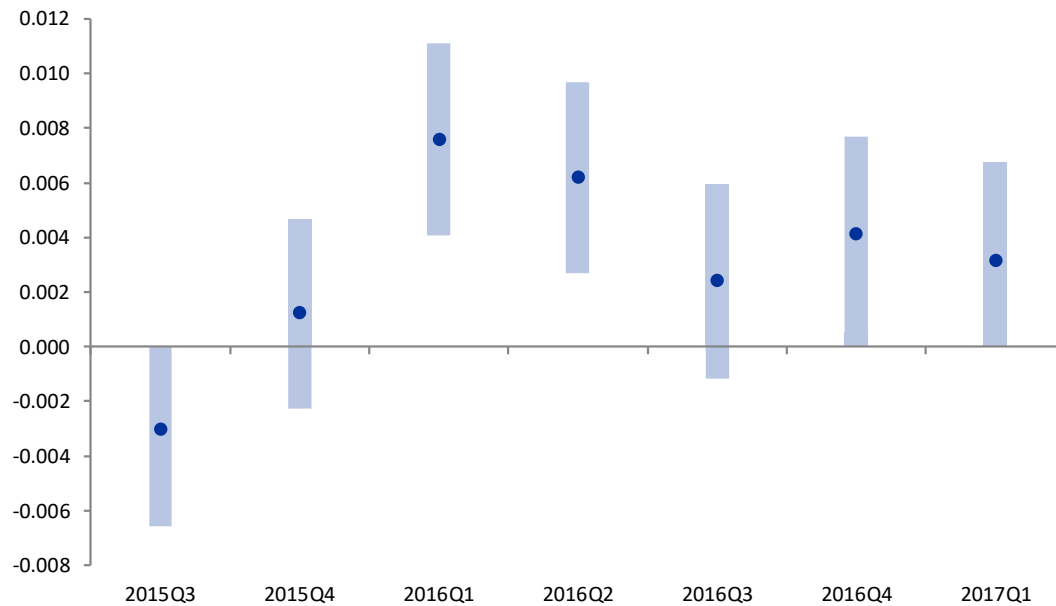
**Figure 5. Robustness on the timing of MREL introduction (1)**



Source: ECB Securities Holdings Statistics at the Banking Group level (SHSG) and Authors' calculations.

Note: The blue dots correspond to the coefficients of the double interactions (Eligible\*Post) estimated by equation (1). The shaded areas correspond to a 95% confidence interval. This specification includes issuer bank-quarter fixed effects. The estimation horizon corresponds to two quarters before and two quarters after the hypothetical treatment dates in each quarter.

**Figure 6. Robustness on the timing of MREL introduction (2)**



Source: ECB Securities Holdings Statistics at the Banking Group level (SHSG) and Authors' calculations.

Note: The blue dots correspond to the coefficients of the double interactions (Eligible\*Post) estimated by equation (1). The shaded areas correspond to a 95% confidence interval. This specification includes issuer bank-quarter fixed effects. The estimation horizon corresponds to one quarter before and one quarter after the hypothetical treatment dates in each quarter.

**Table 1. Summary statistics**

**Panel A. Analysis on MREL. Overall Sample (2015 Q4 – 2016 Q4)**

Variable	n	Mean	S.D.	Min	25 <sup>th</sup> perc	Median	75 <sup>th</sup> perc	Max
Hold	1,530,256	0.04	0.20	0	0	0	0	1
Eligible (MREL)	1,530,256	0.89	0.31	0	1	1	1	1
Post (MREL)	1,530,256	0.50	0.50	0	0	1	1	1
Self_Hold	1,530,256	0.03	0.16	0	0	0	0	1
RelRating	1,085,707	0.13	0.34	0	0	0	0	1
SameCountry	1,489,306	0.18	0.38	0	0	0	0	1

**Panel B. Analysis on MREL. Sample of Bonds by non-GSIIs (2015 Q4 – 2016 Q4)**

Variable	n	Mean	S.D.	Min	25 <sup>th</sup> perc	Median	75 <sup>th</sup> perc	Max
Hold	1,530,256	0.04	0.20	0	0	0	0	1
Eligible (MREL)	1,530,256	0.89	0.31	0	1	1	1	1
Post (MREL)	1,530,256	0.50	0.50	0	0	1	1	1
Self_Hold	1,530,256	0.03	0.16	0	0	0	0	1

**Panel C. Analysis on TLAC. Sample of Bonds by G-SIIs (2016 Q2 – 2017 Q2)**

Variable	n	Mean	S.D.	Min	25 <sup>th</sup> perc	Median	75 <sup>th</sup> perc	Max
Hold	338,104	0.03	0.18	0	0	0	0	1
Eligible (TLAC)	338,104	0.04	0.18	0	0	0	0	1
Post (MREL)	338,104	0.50	0.50	0	0	1	1	1
Self_Hold	338,104	0.02	0.15	0	0	0	0	1

**Panel D. Analysis on MREL. Overall Sample (2015 Q2 – 2017 Q2)**

Variable	n	Mean	S.D.	Min	25 <sup>th</sup> perc	Median	75 <sup>th</sup> perc	Max
Hold	3,816,176	0.03	0.18	0	0	0	0	1
Eligible (MREL)	3,816,176	0.89	0.31	0	1	1	1	1
Post (MREL)	3,816,176	0.50	0.50	0	0	1	1	1
Self_Hold	3,816,176	0.03	0.16	0	0	0	0	1

**Panel E. Analysis on MREL and Home Bias. Stressed Countries (2015 Q4 – 2016 Q4)**

Variable	n	Mean	S.D.	Min	25 <sup>th</sup> perc	Median	75 <sup>th</sup> perc	Max
Hold	233,855	0.03	0.16	0	0	0	0	1
Eligible (MREL)	233,855	0.88	0.33	0	1	1	1	1
Post (MREL)	233,855	0.50	0.50	0	0	1	1	1
SameCountry	233,855	0.10	0.30	0	0	0	0	1

**Panel F. Analysis on MREL and Home Bias. Non-Stressed Countries (2015 Q4 – 2016 Q4)**

Variable	n	Mean	S.D.	Min	25 <sup>th</sup> perc	Median	75 <sup>th</sup> perc	Max
Hold	1,255,451	0.02	0.15	0	0	0	0	1
Eligible (MREL)	1,255,451	0.89	0.31	0	1	1	1	1
Post (MREL)	1,255,451	0.50	0.50	0	0	0	1	1
SameCountry	1,255,451	0.19	0.40	0	0	0	0	1

**Table 2. Holding decisions and MREL requirements**

This table presents the results for the introduction of the MREL requirements in 2016 Q2. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  - in bond  $b$  issued by bank  $i$ . The sample includes bank bonds, excluding structured products. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $SelfHold_{b,i,h}$  is equal to 1 if the bond is held by the issuer bank. The specification used in Columns 1- 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SelfHold_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SelfHold_{b,i,h} + \beta_6 Eligible_{b,i} * SelfHold_{b,i,h} + \beta_7 Post_t * SelfHold_{b,i,h} + \varepsilon_{b,i,h,t}$ . Standard errors are clustered at the level of holder bank, security type and holding type and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0424*** (0.0136)	-0.0424*** (0.0136)	-0.0412*** (0.0136)	-0.0412*** (0.0112)	-0.0468*** (0.0109)	-0.0468*** (0.0109)	-0.0454*** (0.0108)	-0.0453*** (0.00742)
1.Post					-0.0119*** (0.00229)			
1.Eligible#1.Post	0.0111*** (0.00255)	0.0111*** (0.00255)	0.00877*** (0.00261)	0.00877*** (0.00239)	0.0105*** (0.00236)	0.0105*** (0.00236)	0.00762*** (0.00224)	0.00757*** (0.00203)
1.Self_Hold					0.632*** (0.0319)	0.632*** (0.0319)	0.633*** (0.0319)	0.622*** (0.0332)
1.Eligible#1.Self_Hold					0.0932** (0.0383)	0.0932** (0.0383)	0.0929** (0.0383)	0.0923** (0.0398)
1.Post#1.Self_Hold					-0.0988** (0.0390)	-0.0988** (0.0390)	-0.100** (0.0387)	-0.102*** (0.0380)
1.Eligible#1.Post#1.Self_Hold					0.0608 (0.0425)	0.0608 (0.0425)	0.0616 (0.0420)	0.0636 (0.0413)
Observations	1,530,256	1,530,256	1,530,256	1,530,256	1,530,256	1,530,256	1,530,256	1,530,256
R-squared	0.014	0.014	0.015	0.041	0.325	0.325	0.326	0.335
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES

**Table 3. Holding decisions and MREL requirements (for bank bonds issued by non-GSIIIs)**

This table presents the results for the introduction of the MREL requirements in 2016 Q2. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  - in bond  $b$  issued by bank  $i$ . The sample includes all bank bonds issued by non-GSIIIs. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $SelfHold_{b,i,h}$  is equal to 1 if the bond is held by the issuer bank. The specification used in Columns 1- 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SelfHold_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SelfHold_{b,i,h} + \beta_6 Eligible_{b,i} * SelfHold_{b,i,h} + \beta_7 Post_t * SelfHold_{b,i,h} + \varepsilon_{b,i,h,t}$ . Standard errors are clustered at the level of holder bank, security type and holding type and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0398*** (0.0137)	-0.0398*** (0.0137)	-0.0391*** (0.0137)	-0.0391*** (0.0111)	-0.0452*** (0.0108)	-0.0452*** (0.0108)	-0.0443*** (0.0107)	-0.0443*** (0.00701)
1.Post					-0.0118*** (0.00229)			
1.Eligible#1.Post	0.0103*** (0.00260)	0.0103*** (0.00260)	0.00895*** (0.00265)	0.00895*** (0.00242)	0.0102*** (0.00239)	0.0102*** (0.00239)	0.00832*** (0.00226)	0.00830*** (0.00204)
1.Self_Hold					0.632*** (0.0334)	0.632*** (0.0334)	0.633*** (0.0335)	0.621*** (0.0352)
1.Eligible#1.Self_Hold					0.133*** (0.0384)	0.133*** (0.0384)	0.132*** (0.0384)	0.134*** (0.0407)
1.Post#1.Self_Hold					-0.0980** (0.0409)	-0.0980** (0.0409)	-0.0998** (0.0408)	-0.102** (0.0400)
1.Eligible#1.Post#1.Self_Hold					0.0392 (0.0455)	0.0392 (0.0455)	0.0404 (0.0451)	0.0413 (0.0440)
Observations	1,239,576	1,239,576	1,239,576	1,239,576	1,239,576	1,239,576	1,239,576	1,239,576
R-squared	0.015	0.015	0.016	0.043	0.308	0.308	0.310	0.320
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES

**Table 4. Holding decisions and TLAC requirements for GSIIIs**

This table presents the results for the introduction of the TLAC requirements in 2016 Q4. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes all bank bonds issued by GSIIIs. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for TLAC, namely if it is subordinated. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $SelfHold_{b,i,h}$  is equal to 1 if the bond is held by the issuer bank. The specification used in Columns 1- 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SelfHold_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SelfHold_{b,i,h} + \beta_6 Eligible_{b,i} * SelfHold_{b,i,h} + \beta_7 Post_t * SelfHold_{b,i,h} + \varepsilon_{b,i,h,t}$ . Standard errors are clustered at the level of holder bank, security type and holding type and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	0.0235 (0.0180)	0.0235 (0.0180)	0.0223 (0.0180)	0.0223 (0.0156)	0.0333** (0.0130)	0.0333** (0.0130)	0.0320** (0.0131)	0.0319*** (0.0112)
1.Post	-0.00145** (0.000655)				-0.00144*** (0.000459)			
1.Eligible#1.Post	0.0128*** (0.00410)	0.0128*** (0.00410)	0.0153*** (0.00421)	0.0153*** (0.00401)	0.0151*** (0.00383)	0.0151*** (0.00383)	0.0178*** (0.00395)	0.0177*** (0.00392)
1.Self_Hold					0.920*** (0.00960)	0.920*** (0.00960)	0.920*** (0.00944)	0.907*** (0.00973)
1.Eligible#1.Self_Hold					-0.185*** (0.0690)	-0.185*** (0.0690)	-0.185*** (0.0687)	-0.184** (0.0708)
1.Post#1.Self_Hold					0.0526*** (0.0117)	0.0526*** (0.0117)	0.0525*** (0.0113)	0.0513*** (0.00976)
1.Eligible#1.Post#1.Self_Hold					-0.0984* (0.0541)	-0.0984* (0.0541)	-0.0994* (0.0530)	-0.0988* (0.0526)
Observations	338,104	338,104	338,104	338,104	338,104	338,104	338,104	338,104
R-squared	0.005	0.005	0.005	0.125	0.627	0.627	0.627	0.631
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES

**Table 5. Holding decisions: MREL requirements and risk taking**

This table presents the results for the introduction of the MREL requirements in 2016 Q2 and explores risk-taking in cross-holdings. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes observations for bank bonds, held by banks different than the issuer. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $RelRating_{b,i,h}$  is equal to 1 if the issuer bank is worse rated than the holder bank. The specification used in Columns 1-4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 RelRating_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * RelRating_{b,i,h} + \beta_6 Eligible_{b,i} * RelRating_{b,i,h} + \beta_7 Post_t * RelRating_{b,i,h} + \varepsilon_{i,b,j,t}$ . Standard errors are clustered at the level of holder bank, security type and relative bank rating and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0360*** (0.0132)	-0.0360*** (0.0132)	-0.0360*** (0.0133)	-0.0360*** (0.00984)	-0.0270** (0.0131)	-0.0270** (0.0131)	-0.0274** (0.0132)	-0.0250** (0.0103)
1.Post	-0.00958*** (0.00243)				-0.00858*** (0.00278)			
1.Eligible#1.Post	0.00799*** (0.00256)	0.00799*** (0.00257)	0.00797*** (0.00295)	0.00797*** (0.00267)	0.00720** (0.00289)	0.00720** (0.00290)	0.00810** (0.00320)	0.00771*** (0.00285)
1. RelRating					0.0308 (0.0435)	0.0308 (0.0435)	0.0298 (0.0437)	-0.0444 (0.0310)
1.Eligible#1. RelRating					-0.0476 (0.0427)	-0.0476 (0.0427)	-0.0460 (0.0429)	-0.0591* (0.0322)
1.Post#1. RelRating					-0.00601 (0.00486)	-0.00604 (0.00487)	-0.00405 (0.00537)	0.0107* (0.00637)
1.Eligible#1.Post#1. RelRating					0.00552 (0.00542)	0.00550 (0.00542)	0.00206 (0.00586)	0.00451 (0.00645)
Observations	1,085,707	1,085,707	1,085,707	1,085,707	1,085,707	1,085,707	1,085,707	1,085,707
R-squared	0.011	0.011	0.012	0.041	0.012	0.012	0.013	0.050
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES

**Table 6. Holding decisions: MREL requirements and home bias**

This table presents the results for the introduction of the MREL requirements in 2016 Q2 and explores home bias in cross-holdings. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes observations for bank bonds, held by banks different than the issuer. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $SameCountry_{b,i,h}$  is equal to 1 if the holder bank is from the same country of the issuer bank. The specification used in Columns 1 – 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SameCountry_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SameCountry_{b,i,h} + \beta_6 Eligible_{b,i} * SameCountry_{b,i,h} + \beta_7 Post_t * SameCountry_{b,i,h} + \varepsilon_{i,b,j,t}$ . Standard errors are clustered at the level of holder bank, security type and same country dummy and are shown in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0471*** (0.00979)	-0.0471*** (0.00979)	-0.0450*** (0.00973)	-0.0450*** (0.00717)	-0.0383*** (0.00927)	-0.0383*** (0.00927)	-0.0361*** (0.00913)	-0.0358*** (0.00683)
1.Post					-0.00964*** (0.00272)			
1.Eligible#1.Post	0.0105*** (0.00247)	0.0105*** (0.00247)	0.00634*** (0.00217)	0.00633*** (0.00195)	0.00886*** (0.00277)	0.00886*** (0.00277)	0.00448* (0.00250)	0.00446* (0.00226)
1.SameCountry					0.0794*** (0.0230)	0.0794*** (0.0230)	0.0805*** (0.0229)	0.0789*** (0.0173)
1.Eligible#1. SameCountry					-0.0430* (0.0250)	-0.0430* (0.0250)	-0.0436* (0.0249)	-0.0453** (0.0182)
1.Post#1. SameCountry					-0.0113* (0.00575)	-0.0113* (0.00575)	-0.0135*** (0.00495)	-0.0134*** (0.00472)
1.Eligible#1.Post#1. SameCountry					0.00789 (0.00593)	0.00789 (0.00593)	0.00911* (0.00509)	0.00914* (0.00474)
Observations	1,489,306	1,489,306	1,489,306	1,489,306	1,489,306	1,489,306	1,489,306	1,489,306
R-squared	0.041	0.041	0.043	0.059	0.051	0.052	0.053	0.066
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES



**Table 7. Holding decisions and MREL requirements (4-quarter estimation window)**

This table presents the results for the introduction of the MREL requirements in 2016 Q2. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes bank bonds, excluding structured products. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 4 quarters after [before] the regulatory change.  $SelfHold_{i,b,j}$  is equal to 1 if the bond is held by the issuer bank. The specification used in Columns 1- 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SelfHold_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SelfHold_{b,i,h} + \beta_6 Eligible_{b,i} * SelfHold_{b,i,h} + \beta_7 Post_t * SelfHold_{b,i,h} + \varepsilon_{b,i,h,t}$ . Standard errors are clustered at the level of holder bank, security type and holding type and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0378*** (0.0111)	-0.0378*** (0.0111)	-0.0361*** (0.0111)	-0.0361*** (0.00881)	-0.0401*** (0.00911)	-0.0401*** (0.00911)	-0.0382*** (0.00895)	-0.0382*** (0.00603)
1.Post	-0.0156*** (0.00334)				-0.0141*** (0.00332)			
1.Eligible#1.Post	0.0124*** (0.00348)	0.0124*** (0.00348)	0.00892*** (0.00326)	0.00892*** (0.00282)	0.0114*** (0.00341)	0.0114*** (0.00341)	0.00761** (0.00315)	0.00758*** (0.00270)
1.Self_Hold					0.531*** (0.0293)	0.531*** (0.0293)	0.531*** (0.0291)	0.522*** (0.0299)
1.Eligible#1.Self_Hold					0.0450 (0.0443)	0.0449 (0.0443)	0.0448 (0.0440)	0.0447 (0.0440)
1.Post#1.Self_Hold					-0.0930*** (0.0312)	-0.0931*** (0.0312)	-0.0948*** (0.0303)	-0.0951*** (0.0300)
1.Eligible#1.Post#1.Self_Hold					0.0664* (0.0387)	0.0664* (0.0387)	0.0669* (0.0374)	0.0682* (0.0370)
Observations	3,816,176	3,816,176	3,816,176	3,816,176	3,816,176	3,816,176	3,816,176	3,816,176
R-squared	0.014	0.014	0.016	0.037	0.253	0.253	0.255	0.262
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES

# **APPENDIX**

**Table A.1. Holding decisions: MREL requirements and home bias (stressed countries)**

This table presents the results for the introduction of the MREL requirements in 2016 Q2 and explores home bias in cross-holdings for bonds issued by banks in stressed countries. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes observations for all bank bonds, issued by banks in stressed countries and held by banks different than the issuer. The sample includes the following countries: Cyprus, Greece, Italy, Ireland, Portugal, Spain and Slovenia. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $SameCountry_{b,i,h}$  is equal to 1 if the holder bank is from the same country of the issuer bank. The specification used in Columns 1 – 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SameCountry_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SameCountry_{b,i,h} + \beta_6 Eligible_{b,i} * SameCountry_{b,i,h} + \beta_7 Post_t * SameCountry_{b,i,h} + \varepsilon_{i,b,j,t}$ . Standard errors are clustered at the level of holder bank, security type and same country dummy and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0536*** (0.0111)	-0.0536*** (0.0111)	-0.0529*** (0.0111)	-0.0529*** (0.00824)	-0.0500*** (0.0106)	-0.0500*** (0.0106)	-0.0493*** (0.0107)	-0.0489*** (0.00789)
1.Post	-0.0213*** (0.00389)				-0.0174*** (0.00380)			
1.Eligible#1.Post	0.0181*** (0.00399)	0.0181*** (0.00399)	0.0167*** (0.00406)	0.0167*** (0.00331)	0.0147*** (0.00391)	0.0147*** (0.00391)	0.0134*** (0.00413)	0.0136*** (0.00342)
1.SameCountry					0.102*** (0.0335)	0.102*** (0.0335)	0.102*** (0.0337)	0.100*** (0.0285)
1.Eligible#1. SameCountry					-0.0345 (0.0356)	-0.0345 (0.0356)	-0.0344 (0.0357)	-0.0384 (0.0295)
1.Post#1. SameCountry					-0.0374*** (0.0114)	-0.0374*** (0.0114)	-0.0373*** (0.0114)	-0.0362*** (0.0105)
1.Eligible#1.Post#1. SameCountry					0.0317*** (0.0117)	0.0317*** (0.0117)	0.0315*** (0.0116)	0.0304** (0.0120)
Observations	233,855	233,855	233,855	233,855	233,855	233,855	233,855	233,855
R-squared	0.035	0.035	0.038	0.058	0.051	0.051	0.054	0.065
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES

**Table A.2. Holding decisions: MREL requirements and home bias (non-stressed countries)**

This table presents the results for the introduction of the MREL requirements in 2016 Q2 and explores home bias in cross-holdings for bonds issued by banks in non-stressed countries. The dependent variable  $Hold_{b,i,h,t}$  is defined as a binary variable, which is equal to 1 if bank  $b$  invests – in quarter  $t$  – in bond  $b$  issued by bank  $i$ . The sample includes observations for all bank bonds, issued by banks in non-stressed countries and held by banks different than the issuer. The sample includes the following countries: Austria, Belgium, Germany, Finland, France, Luxembourg, Malta, Netherlands and Slovakia. The treatment dummy  $Eligible_{b,i}$  is equal to 1 if the bond  $b$  issued by bank  $i$  is eligible for MREL, namely if it is unsecured. It is equal to 0 if the bond is secured, i.e., it is a covered bond. The dummy  $Post_t$  is equal to 1 [0] in the 2 quarters after [before] the regulatory change.  $SameCountry_{b,i,h}$  is equal to 1 if the holder bank is from the same country of the issuer bank. The specification used in Columns 1 – 4 is the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 Eligible_{b,i} * Post_t + \varepsilon_{b,i,h,t}$ . The specification used in columns 5-8 is instead the following:  $Hold_{b,i,h,t} = \alpha_{i,t} + \alpha_{h,t} + \beta_1 Eligible_{b,i} + \beta_2 Post_t + \beta_3 SameCountry_{b,i,h} + \beta_4 Eligible_{b,i} * Post_t + \beta_5 Eligible_{b,i} * Post_t * SameCountry_{b,i,h} + \beta_6 Eligible_{b,i} * SameCountry_{b,i,h} + \beta_7 Post_t * SameCountry_{b,i,h} + \varepsilon_{i,b,j,t}$ . Standard errors are clustered at the level of holder bank, security type and same country dummy and are shown in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

VARIABLES	(1) Hold	(2) Hold	(3) Hold	(4) Hold	(5) Hold	(6) Hold	(7) Hold	(8) Hold
1.Eligible	-0.0457*** (0.0109)	-0.0457*** (0.0109)	-0.0433*** (0.0108)	-0.0432*** (0.00758)	-0.0355*** (0.00990)	-0.0355*** (0.00990)	-0.0330*** (0.00970)	-0.0330*** (0.00722)
1.Post					-0.00774*** (0.00283)			
1.Eligible#1.Post	0.00883*** (0.00256)	0.00883*** (0.00256)	0.00408* (0.00223)	0.00406** (0.00204)	0.00735** (0.00287)	0.00735** (0.00287)	0.00240 (0.00262)	0.00243 (0.00242)
1.SameCountry					0.0779*** (0.0250)	0.0779*** (0.0250)	0.0788*** (0.0249)	0.0738*** (0.0180)
1.Eligible#1. SameCountry					-0.0448 (0.0271)	-0.0448 (0.0271)	-0.0454* (0.0270)	-0.0455** (0.0184)
1.Post#1. SameCountry					-0.00969* (0.00572)	-0.00969* (0.00572)	-0.0115** (0.00498)	-0.0109** (0.00469)
1.Eligible#1.Post#1. SameCountry					0.00628 (0.00593)	0.00628 (0.00593)	0.00739 (0.00514)	0.00721 (0.00472)
Observations	1,255,451	1,255,451	1,255,451	1,255,451	1,255,451	1,255,451	1,255,451	1,255,451
R-squared	0.043	0.043	0.044	0.064	0.052	0.052	0.054	0.070
Issuer FE	YES	YES	NO	NO	YES	YES	NO	NO
Quarter FE	NO	YES	NO	NO	NO	YES	NO	NO
Issuer*Quarter FE	NO	NO	YES	YES	NO	NO	YES	YES
Holder*Quarter FE	NO	NO	NO	YES	NO	NO	NO	YES