Bank Funding Strategy after the Bail-In Announcement

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Abstract

At the end of 2012, eurozone countries announced the decision to develop a new Single Resolution Mechanism, moving from a bailout resolution policy at the national level to a new bail-in framework at the European level with an explicit statement of which liabilities will be written off or converted in case of resolution. Removing implicit public guarantees is an exogenous shock that increased bank creditors' expected returns (without a real change in banks' risk-taking), according to the bank riskiness (interpreted as the bank credit quality) and the creditor's legal protection (according to bail-in hierarchy). Our paper analyzes banks' funding strategies after the regulatory change announcement. We show that, after the bail-in proposal, compared to US banks, eurozone banks relied more on cheaper and better protected sources of external funding, such as deposits, while reducing the fund collection from sources with weaker creditor protection, such as bonds.

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1 Introduction

The existence of financial intermediaries is traditionally motivated by asymmetric information between firms and households (Diamond (1984); Bhattacharya and Thakor (1993); Allen and Santomero (1997)), and collateral is a key mechanism mitigating adverse selection, credit rationing, and other inefficiencies (Stiglitz and Weiss (1981); Wette (1983); Rajan and Winton (1995)). Of course, there is a similar asymmetric information situation between banks and households, and this has been traditionally mitigated by government interventions as deposit insurance, regulation, and supervision tools to ensure a prudential bank risk-taking and, ultimately, a public implicit guarantee for large banks. During the global financial crisis, implicit public guarantees became in certain cases explicit: Governments bail out many defaulting too-big-to-fail (TBTF) banks using taxpayers' money, and this was the case, for example, of Monte dei Paschi di Siena, an Italian large bank that felt in trouble during the global financial crisis. The Italian government decided that the failure of Monte dei Paschi would have hindered the financial stability; hence, it injected liquidity into the bank[1].From this perspective, Europe is an interesting case study since the government provided enormous financial support to banks[2].The subprime financial crisis started in 2007 in the United States after the collapse of Lehman Brothers became global since 2009 when also European banks felt in trouble. The health of the banking system and the many bailout policies implemented by the European governments led to a severe sovereign debt crisis. Such link between the bailouts and the sovereign debt crisis increase is referred to by academia as the sovereign debt nexus. To prevent the hamper of the sovereign debt and to have an orderly crisis management (with tools that are more effective and using private sector resources), eurozone countries announced, at the end of 2012, the development of a new

[1]We should notice that not all defaulting large banks have been bailed out (e.g., Lehman Brothers in the United States and Barings Banks in the United Kingdom).

[2]Between 2008 and 2014, European Union governments approved state aid to banking systems, amounting to 45.8 percent of GDP. It comprised 1.49 trillion of capitalization and asset relief programs and 4.3 trillion of guarantees and liquidity measures. Most state-authorized aid was in the form of guarantees, some 3.9 trillion in total (most of which was granted at the peak of the financial crisis during 2008).

resolution regime, moving from a bailout resolution policy at the country level to a bail-in regime at the centralized European level. The new regime was formally approved in 2014 and started in 2016: only when the banks' shareholders and creditors have covered losses will national resolution funds be allowed to provide banks with the resources needed to continue operating while they are being restructured and under restrictive conditions. Specifically, the new regulation provides a pre-defined hierarchy of "who" is in charge to rescue a bank close to default by explicitly stating which liabilities will be written off or converted into equity[3].

From an economic perspective, the new resolution regime implies a drop in the value of public implicit guarantees on banks' liabilities, which led, ceteris paribus, to greater risk-taking for investors. The new bail-in regime has, consequently, generated two effects on bank liabilities. On outstanding banks' issued securities, their market prices declined to the extent necessary to provide investors with yields adequate to compensate for the greater risks. Most papers have focused on market price reactions to evaluate the effect of the new bail-in regulation. A few papers run event studies focusing on stock returns and Credit Default Swap (CDS) spreads around the announcement of the various steps of its launch (Schafer and di Mauro (2016)). A handful of papers run a difference-in-difference (DID) analysis by comparing prices and yields of securities that are treated and non-treated by the new regulation (Giuliana (2019); Cutura (2018); Crespi and Mascia (2018)). The second effect concerns the issuance of new securities: after the bail-in regulation, banks have to provide investors with greater yields (higher coupons or lower issue prices) to compensate for the greater risks. Our focus is on the second effect: the bail-in introduction provides us with a quasi-natural experiment setting to study the behaviors of banks and investors in case an external shock increases the risks levels of bank liability (without a specific bad event related to a bank).

The removal of implicit public guarantees is an exogenous shock that increased investors'

[3]Namely, (1) Common Equity Tier 1; (2) Additional Tier 1 instruments; (3) Tier 2 instruments; (4) other subordinated debts; (5) senior unsecured creditors; and (6) depositors over 100,000 euro.

expected return on banks' liabilities (without changing banks' risk-taking), and spread variations depend on liability legal protection and the bank's risk. Our paper aims to understand banks' funding[4] strategies after the bail-in and whether the reaction was rational. Specifically, our paper answers the following research question: Did banks change their liability structure by increasing cheaper liabilities and declining more expensive ones? By analyzing European banks during the period 2010–2015 (including three years before and three years after the treatment), we show that, after the bail-in proposal, eurozone banks increased fund collections from sources with greater creditor protections (which are also cheaper), such as deposits, and reduced fund collections from sources with weaker creditor protections (which are also more expensive), such as bonds, in comparison to banks in countries not affected by a change in bank resolution procedures.

Our analysis is conducted using a DID approach, which allows us to compare eurozone banks interested in the new resolution regime (treated) and banks in countries that did not experience a similar regulatory change in the same period (control group). To reasonably consider the new bail-in regime as an exogenous shock, we set the treatment date in 2013 (a year after its public announcement, June 2012), rather than in the year of its formal approval (April 2014) or legal application (January 2016). Various papers (Fiordelisi, Ricci, and Lopes (2017); Schafer and di Mauro (2016)) show that banks, as rational agents directly affected by a new policy, react as soon as the new rules are publicly disclosed and do not wait for the legal starting date.

Our paper contributes to past papers in three ways. First and foremost, our paper is the first to analyze changes in banks' funding strategy to an exogenous shock of interest spreads: by exploiting the bail-in announcement in Europe, we show that the portion of instruments more exposed to bail-in in case of bank default and instruments issued by banks with a greater portion of impairment loans declined, while the portion of instruments less exposed to be bailed in or issued by banks financially sound increased. Our results suggest that

[4]From here on, by "banks' funding strategies," we mean external sources of funding (e.g., bonds and deposits).

banks prefer re-balancing their liability structure (by reducing expensive liabilities) rather than paying higher interests to maintain the same liability composition. Second, we contribute to the literature dealing with estimating the impact of regulatory and supervisory reforms since we focus on banks' liability sides, while most papers focus on banks' portfolio allocations and assets compositions (Bouwman and Johnson (2017); Gropp, Mosk, Ongena, and Wix (2018); Berger and Sedunov (2016); Fiordelisi et al. (2017)). Also, we show that the European reform of resolution procedures was credible since banks re-balanced their liability structure as soon as it was announced, before its formal approval and application. Finally, our results are very interesting for policymakers: banks' greater reliance on deposits is costly for asset–liability mismatching and bank runs, causing banks to hold unproductive reserves (Diamond and Dybvig (1983)).

The remainder of this paper is organized as follows. In Section 2, we review past papers and develop our research hypotheses. Subsequently, we describe the European reform of resolution procedures in Section 3, provide our data and variables in Section 4, and present the identification strategy in Section 5. In Section 6, we present our results. In Section 7, we provide robustness checks. Finally, in Section 8, we conclude the paper.

2 Literature and hypotheses

Our paper is related to two different literature streams: the first deals with the bank liability structure (especially deposits), and the second concerns the effect of the bail-in introduction. There is extensive literature analyzing bank liabilities, focusing on various instruments used (e.g., deposits, bonds, subordinated debts, and other types of securities) and investigating various topics, especially those assessing risk levels and pricing. Recently, various empirical papers have investigated the regulation implication related to bank liabilities and the role of deposit guarantees during the financial crisis (Goedde-Menke and Pfingsten (2014)), the role of depositors in bank runs (Diamond and Dybvig (1983); Calomiris and Kahn (1991)),

and the riskiness and regulation involved in subordinated debts (Goyal (2005)), contingent convertibles instruments (Fiordelisi and Pennacchi (2020)), and senior debts (Francis and Wanh (2019)).

The second stream of literature deals with the effects of the bailout and bail-in regulations. Focusing on the optimal resolution policy, Berger and Sedunov (2016) claimed that both bailout and bail-in resolutions outperform the case of no regulatory actions, but the optimal policy is a mix of both bail-in and bailout rules since the principle "one size fits all" does not work in this field of application. Concerning financial contagion, Bernard and Stiglitz (2017) showed that a credible bail-in framework needs to take banks' networks into account since they play a key role in amplifying the shock. In the literature of deposits, Brown and Stix (2017) analyzed depositors' reactions in the Cyprus bail-in case: depositors run to banks and reallocate their savings in money holdings. Although it is not directly related to bail-in, Goedde-Menke and Pfingsten (2014) analyzed the evolution of deposits during the financial crisis. Their paper shows that, at the peak of the global financial crisis, depositors were well informed on deposit insurance and raised their deposits, but, in the aftermath of the crisis, deposits declined to lower, pre-crisis levels. Bossu and Zhou (2012) provided an extensive analysis on debt restructuring of financial institutions moving from a bailout policy to bail-in, putting evidence on the TBTF problem; in general, the debt structure has been analyzed by Dudley and Yin (2018), who tested the effects of financial distress on bank refinancing. However, as suggested respectively by Ignatowski and Korte (2014) and Imai (2006), it is the bail-in framework increase or decline in bank stability that is unclear. By analyzing bank risk-taking after introducing the new US Orderly Liquidation Authority (OLA), Ignatowski and Korte (2014) showed that the banks more affected by OLA decreased their overall risk-taking and originated lower risk loans. Conversely, Imai (2006) showed that the substantial reduction of deposit insurance in Japan in 2002 increased the deposits' interest rate sensitivity and enhanced market discipline in Japan.

Our paper aims to show the consequences on the bank's liability structure when implicit

public guarantees are removed (or reduced). The new European resolution regulation provides an ideal case since the regulation change (from a bailout to bail-in framework) was unexpected, and its public announcement, during 2012, was clear (e.g., the creditors' protection hierarchy was publicly declared) and credible to all banking market participants. By lowering implicit public guarantees, banks' funding costs increased, as Giuliana (2019), Cutura (2018), and Crespi and Mascia (2018) proved.

We develop a set research hypothesis to capture the banks' reactions to the new resolution framework. First, we posit that banks change their liability composition by reducing less protected (and thus more expensive) funding sources, such as senior and subordinated bonds (we refer to them as "other interest-bearing liabilities") there in after, and by increasing other sources with greater creditor protections (and thus less expensive), such as deposits (H1). Other interest-bearing liabilities are more expensive because they are at the top of the bail-in hierarchy and are less legally protected, thus making them riskier. By contrast, customer deposits are less expensive because they are more legally protected under the new resolution framework: they are at the bottom of the bail-in hierarchy, and customer deposits of up to 100,000 euro benefit from the deposit insurance. Furthermore, we test the credibility of the bail-in tool: we posit that the shift from expensive toward cheaper liabilities is stronger for riskier banks (since the risk premium required by investors for these banks is higher) than for safer banks (H2a); otherwise, the bail-in tool has not been deemed credible, and consequently, we may not find any differences between risky and safe banks (H2b). We can also test whether investors implicitly have a TBTF view: investors may believe that the new bail-in framework would not be concretely applied to large banks, and consequently, they will not ask for greater yields on risk instruments issued by large banks (H3a). Alternatively, investors may also believe that governments are not able to bail out large banks (too big to save); consequently, they will ask for greater yields on risk instruments issued by large banks (H3b).

3 The New Bail-In Framework in Europe

After the global financial crisis and the sovereign debt crisis, the European Union realized problems caused by close links between public sector finances and the banking sector and decided to create a "European Banking Union" based on a full harmonization of supervisory (Pillar 1) and resolution (Pillar 2) practices.

The first pillar (labeled as "Single Supervisory Mechanism") moves from a local supervisory system (based on the "home country control" principle, i.e., banks are supervised by the National Supervisory Authority that issued the license) to a centralized system: since November 4, 2014, the largest European banks (labeled as "significant") have been directly supervised by the European Central Bank (ECB), and the remaining banks (labeled as "less significant") have remained under the direct supervision of the National Supervisory Authorities. Various papers (Fiordelisi et al. (2017); Granja and Leuz (2017)) argue that the first pillar produced its effect on the banks' assets, showing that significant banks, under the ECB direct supervision, reduced their lending activity further than did banks under the supervision of the National Supervisory Authorities during the Single Supervision Mechanism (SSM) launch. There is no evidence that Pillar 1 influenced the banks' liability composition. This is not surprising since none of the ECB's criteria for discriminating between significant and less significant banks are based on banks' liabilities.

The second pillar of the European banking union ("Single Resolution Mechanism") concerns creating a common framework for the recovery and resolution of credit institutions and investment firms in danger of failing. The new regulation is included in the "Bank Recovery and Resolution Directive" (BRRD)[5], which was proposed initially in June 2012[6] and finally approved in April 2014. Although most of the regulatory tools in the BRRD took effect in January 2015, the new bail-in regime formally started in January 2016.

The BRRD directive introduced the Single Resolution Board, as the competent authority

[5]Directive 2014/59/EU of May 15, 2014 (European Union (2014))

[6]European Commission 06/06/2012 n. 2012/0150.

at the European level, to make decisions about resolution of financial institutions. When a bank fails to meet their capital requirement, the Single Resolution Board declares the financial institution as failing or likely to fail and starts a resolution procedure: before any resolution actions, bank capital instruments have to be written down or converted into equity (in the case of contingent convertible bonds). The BRRD directive sets a creditor hierarchy of liabilities that falls within the bail-in scope. The first level of instruments, called in case of a resolution, belongs to Common Equity Tier 1, followed by Additional Tier 1 (as Contingent Convertibles) and Tier 2 instruments. If these instruments are insufficient for covering losses, subordinated debts and senior unsecured debts[7] will be called upon to cover losses. We define subordinated debts as bank liabilities less legally protected and hence are more expensive from a bank's perspective because they are bailed in before the senior bonds and deposits (the deposits are the last category of bank liability within the bail-in scope) in case of a bank resolution. If these instruments (equity and bonds) are insufficient for covering losses, customer deposits exceeding 100,000 euros may be called upon to cover remaining losses. Specifically, customer deposits are fully guaranteed up to 100,000 euros by the deposit insurance, while the exceeding amount is unprotected and may be used to cover losses. Since customer deposits are at the bottom of the bail-in hierarchy, we argue that this liability may be defined as more legally protected and hence the cheapest source of funding for a bank, especially in the last recent framework of the lower bound curve of interest rates. We argue that removing implicit public guarantees made in Pillar 2 influenced banks' liability composition: by increasing funding costs (without changing bank risk-taking) according to legal protection, banks have an incentive to shift from less protected funding sources to more protected liability instruments.

[7]Some countries found ambiguity for the class senior unsecured debt: a big bucket of different types of debts were classified by the BRRD along with the same risk under the bail-in purpose. Countries such as Germany, France, Italy, and Spain (to comply with the principle set in the directive, no creditors worse off) decide to adopt the directive into their national legislation with a further sub-classification of the category "senior unsecured debt" (Pigrum, Reininger, and Stern (2016)). The principle mentioned claims that no creditors should suffer losses greater than the ones suffered according to the national legislation of the country in which the securities exist.

The BRRD also introduced a new tool, labeled as the Minimum Requirement for own funds and Eligible Liabilities (MREL), to ensure that the investors' money is enough to recover the bank losses. Specifically, the MREL requires that banks have to hold a sufficiently large amount of securities that are eligible ("bailinable") to cover losses in case of a bail-in procedure. The MREL requirement is institution-specific; thus, it is tailored to each bank's resolution strategy. The MREL requirement does not impose a level of subordination for bank liabilities; rather, it requires that the securities eligible for its calculation have a maturity longer than 1 year and are not hedged by any guarantees or derivatives. The MREL requirement was in effect from January 2016, and eligible securities in its calculation have to expire after January 2017.

During the time period analyzed in this paper (2010–2015), there have been other various regulatory reforms in banking, in both the US and Europe, such as the launch of new Basel 3 regulatory tools (e.g., liquidity and leverage ratios) and the development of regular stress test exercises. As discussed in Appendix A, none of these reforms represent a confounding factor in our paper since none of them have a direct impact on the banks' liability mix; rather, these reforms affect either the banks' assets levels and mix or the equity levels. Furthermore, these reforms have different implementation timings.

4 Data and Variables

Data were collected from various sources: (a) accounting data were from the Fitch Connect database; (b) interest rates on 10-year treasury bond and gross domestic product (GDP) growth rates were from the OECD database; (c) supervisory tightness measures were from the Barth and Levine (2013) database; and (d) data on the progressive implementation of the Basel regulation were collected via the Basel Committee on Banking Supervision Monitoring reports (from the 1st to the 15th report). The list of variables used is provided in Table 1. We include in our dataset commercial banks by imposing the condition to have at least 10%

of deposit over total assets. Table A.I. in the Appendix reports the mean of percentage of customer deposits and other liabilities on the balance sheets by country. Our data cover the period 2010–2015 (3 years before the year of the announcement and 3 years from the announcement) and include eurozone countries (treated group) and the US (control group). To face differences among banks in the treated and control groups, we control for differences between eurozone and US banks by running a propensity score matching analysis[8] balancing the number of observations: 50% in the treated group and 50% in the control group. After a cleaning procedure, and owing to missing data, the baseline model used a total of 5102 observations year by year, as shown in Table 2.

As dependent variables, we use various liability measures such as the growth rates of the customer deposits ratio (computed as customer deposits over total assets) and other interest-bearing liabilities ratio (computed as the difference among total liabilities and customer deposits over total assets). In our follow-up analyses, we also use growth rates for senior unsecured debt ratio, subordinated debt ratio, and bank deposits ratio. We control for various micro- and macro-economic variables. Specifically, we use the equity ratio (total equity over assets), Non-Performing Loans (NPL) ratio (total impairment loans over total assets)[9], asset size (log of total assets), return on equity (ROE), GDP growth rate, and Treasury-Bill rate (intended as the rate on the 10-year treasury bonds). The summary statistics are provided in Table 3.

5 Identification Strategy

We use a DID estimate framework to investigate whether eurozone banks adjusted their liability composition differently from non-eurozone banks around the launch of the new resolution regime. The treated group (w = 1) consists of banks in the eurozone that are subject

[8]The matching implemented has one neighbor selected on size and according to the percentage of gross loans on total assets in 2011 (e.g., before the treatment). In Appendix A, we show the chart plotting the kernel density before and after the matching.

[9]We use the NPL ratio since this is well known and easily available to creditors, while other measures (e.g., risk-weighted assets density and Z-score) are usually less known by investors.

to the new bail-in regulation. The control group (w = 0) is composed of US banks. We argue that US banks can be used as a control group for various reasons. First, US banks were not influenced during our treatment period (2013–2015) by a change in resolution mechanism, other confounding reforms, or financial crises (as discussed in Appendix A). Second, explicit government guarantees in the US and eurozone countries are similar in the pre-treatment period: Demirguc-Kunt and Huizinga (2013) calculated the "real" deposit insurance (nominal amount insured by the government over national GDP) and found that US lies within the range of eurozone countries[10][11]

We know about the potential pitfalls of DID estimation (Zeldow and Hatfield (2019)), specifically about the indirect effect of the treatment on the counterfactual (Boehmer and Zhang (2020)). We argue that our treated units could not infect the controls: being subject to the bail-in regulation could not create a spillover effect on US banks. The main reason is that the customer deposits are held mainly on a national basis (usually, customers deposit their money on a bank in its own country) as well as other liabilities. The "home bias" existence is proved: the securities are held mainly in the same countries of their issuance. Pigrum et al. (2016) proved that the bailinable debt is subjected to home bias.

The treatment period is 2013–2015. The change in regulation was publicly announced for the first time in June 2012. We argue that banks, as rational agents, reacted, changing their liability mix from the 2013 balance sheets in anticipation of formal implementation of the new regulation. For most European countries outside the eurozone, the BRRD application was postponed; thus, banks in those countries may have not reacted to the BRRD announcement. Third, although there are some differences between European and US banks, we can

[10]Although US banks represent an excellent control group and we control for possible differences between banks in the treatment and control groups to restore the randomization condition, we run a robustness check focusing on banks within the euro area by comparing banks located in euro area countries experiencing at least one case of bail-in (Italy, Spain, the Netherlands, Portugal, and Austria) and those in countries not affected by bail-in cases. The main idea is that depositors in a country experiencing a bail-in case would feel treated by the introduction of the new resolution regime.

[11]Eurozone countries have a range of "real" deposit insurance between 125 and 906 (in percentage). Excluding the upper and lower outliers (Luxembourg and Latvia), our band of reference is 282–861. The US has a value of 471. These data are from 2013.

control for these differences in our DID model and restore the randomization conditions. As such, European banks in non-eurozone countries have been discarded from our sample. Therefore, we can consider the bail-in as an exogenous shock and run the following DID model:

$$\begin{aligned} y_{i,t} =& \beta_1 w * T + \beta_2 TotalAssets_{t-1} + \beta_3 NPLratio_{t-1} + \beta_4 Equityratio_{t-1} + \\ &+ \beta_5 GDPgrowth_{t-1} + \beta_6 TreasuryBillrate_{t-1} + \beta_7 ROE_{t-1} + \\ &+ \theta_i + \lambda_t + \epsilon_{i,t} \end{aligned} \tag{1}$$

where Y is a bank's liability ratio[12] annual growth rate. Specifically, we run our main model two times for the annual growth rate of each of the following variables: customer deposits ratio and other interest-bearing liabilities (total liabilities minus total deposits) ratio. We also include various micro-economic control variables (lagged by 1 year to face reverse causality problems), namely, the equity ratio, NPL ratio, and asset size, to account for differences among banks in the treated and control groups and, thus, restore the DID randomization condition. Gamma and Omega refers to bank- and year-fixed effects to account for time-invariant unobservable factors at the firm and year levels, respectively. Although we cannot account for time-variant unobservable factors at country level by adding year*country fixed effect, we include the GDP growth and the interest rate on 10-year treasury bond to account for real and financial conditions in the countries analyzed. All variables are described in Table 1.

Our coefficient of interest is $\beta 1$ for the dummy variable $\mathrm{wt_{i,t}}$, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013, and for banks in the control group after 2013. The slope p1 provides information about the causal effect of the bail-in introduction on bank behavior: a positive coefficient indicates a positive causal effect on our outcome variables, whereas a negative slope signals that introducing the bail-in had a negative causal effect on our outcome variables.

[12]The ratio is calculated as the liability considered over total assets.

Before implementing the model, we checked the necessary assumptions required by the DID estimator: the treatment must be orthogonal with respect to the outcome variables and treated and untreated banks must satisfy the parallel trend assumption.

The first assumption is satisfied since the treatment period is set immediately after the first public announcement of the new bail-in regulation. This announcement was not expected by both banks and households, and it was immediately clear that the new framework was mandatory for all eurozone banks, with no way to avoid the new regulation. We provide evidence to support the second assumptions. We test it by looking at differences formally, year by year, between the eurozone banks (treated) and US banks (control groups) prior to the announcement, focusing on our dependent variables (Table 4) (e.g., parallel trend test). In the pre-treatment period (2010–2012), there are no statistically significant differences for customer deposits ratio and other interest-bearing liabilities ratio growth rates; this supports the appropriateness of using US banks as control units for our experiment. Table 4 also reports the trend of the same variables from the treatment (2013) onwards and shows that the differences in means of US and EU banks became statistically significant. This preliminary evidence shows that the policy event in 2013 has caused a change in the liability mix of the EU banks and allows us to implement a DID regression to analyze changes in the liability mix caused by the bail-in introduction.

6 Results

In this section, we analyze whether eurozone banks changed their external funding sources mix after the bail-in announcement by reducing more expensive (where creditors have less legal protection) liabilities and increasing the cheapest ones (where creditors have greater legal protection). We run our baseline DID model in equation (1). Our coefficient of interest is $\beta 1$ for the dummy $\mathrm{wt}_{\mathrm{i,t}}$, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group. This coefficient provides

information about the causal effect of the introduction of the new bail-in framework: a positive coefficient suggests an increase in the ratio of the outcome variable, while a negative slope signals a decrease in the ratio of the outcome variable. In Table 5, we report our results using the growth rate of the following two variables as response variables: customer deposits ratio (column 1) and other interest-bearing liabilities ratio (column 2). We show that all coefficient estimates for the treatment variables (wt) are statistically significant at the 1% confidence level: the coefficient is positive for the growth rate of the customer deposits ratio (the cheapest source of funding) and negative for the growth rate of the other interest-bearing liabilities ratio (the more expensive source of funding). The change of the sign follows the level of seniority and their position in the bail-in hierarchy. The magnitude of coefficient estimates is meaningful. We show that the treatment (e.g., bail-in announcement) produced a decline in the growth rate of other interest-bearing liabilities ratio (-8.42%), while eurozone banks relied more on customer deposits, column 1 of Table 5 shows an increase in customer deposit ratio by 3.40%. The negative growth rate of other interest-bearing liabilities ratio is larger in absolute value than the growth rate of customer deposits ratio; this is consistent with the asset size drop documented in the same period by various papers (Fiordelisi et al. (2017)).

Next, we run a follow-up analysis. First, we are interested in verifying whether liability seniority matters. The bail-in hierarchy identifies who will cover bank losses, and thus, subordinated bonds become effectively riskier than senior bonds after removing implicit public guarantees. As such, we split "other interest-bearing liabilities" into "senior debts" and "subordinated debts." As shown in Table 6, the treatment coefficient is not statistically significant and negative for both (column 1 and 2). Economically, this result is somehow surprising since it seems that banks declined all bonds issued, regardless of their creditor protection (according to the seniority). Second, we are interested in the effect produced by the bail-in on bank deposits (rather than customer deposits), for two reasons: bank deposits are the most volatile funding source for a bank and, especially, they are not protected by

the Deposit Guarantee Scheme (Art. 5(a) 2014/49/EU directive). As shown in column 3 of Table 6, the growth rate of bank deposits ratio declined of 28.2% (statistically significant at the 1% level) in eurozone countries with respect to the US after the bail-in announcement. Such a great change in the growth rate is due to non-application of deposit insurance to deposits made by financial intermediaries. The results shown in Tables 5 and 6 support our hypothesis (H1) that banks decrease the most expensive sources of funding (those with lower protection) with respect to the ones with greater protection (the cheapest one) after the bail-in resolution mechanism by only comparing bonds and customer deposits; however, there is no support focusing on bonds with different risks (senior vs. subordinated bonds).

6.1 The bail-in effect on riskier banks

In this section, we test the role of bank risk in moderating the bank's reaction to the bail-in announcement: the underlying idea is that the investors' expected returns increase more for riskier issuers, *ceteris paribus*, and consequently, riskier banks finance their assets more using deposits and fewer interest-bearing liabilities.

The model arising from this piece of analysis is the following:

$$\begin{aligned} y_{i,t} =& \beta_1 w * T + \beta_2 NPLratio_{t-1} + \beta_3 NPLratio_{t-1} * w * T + \beta_4 TotalAssets_{t-1} + \\ &+ \beta_5 Equityratio_{t-1} + \beta_6 GDPgrowth_{t-1} + \beta_7 TreasuryBillrate_{t-1} + \beta_8 ROE_{t-1} + \\ &+ \theta_i + \lambda_t + \epsilon_{i,t} \end{aligned} \tag{2}$$

where dependent and control variables are the same as those in the baseline DID model in equation (1), except for the interaction with the bank risk level (NPL ratio). All variables are described in Table 1.

As shown in column 1 of Table 7, coefficient estimates for the treatment variable (wt) are statistically significant for the two growth rates of bank liabilities ratio and larger in absolute value than the ones arose from the baseline model. All eurozone banks substantially

decreased expensive external sources of funding (e.g., other interest-bearing liabilities, such as subordinated bonds) compared to control sample banks and, thus, relied more on deposits to finance their assets. Once we interact the treatment variable with the variable capturing bank risk (NPL ratio), coefficient estimates are not statistically significant at the 10% level or less for any bank liabilities. This suggests that the decline in liabilities, compared to the US control sample, caused by the new bail-in framework is the same for riskier and safer banks. Although the result may appear unusual, this is consistent with Flannery and Sorescu (1996) results: by investigating the market's ability to recognize the default risk in subordinated debentures, their paper shows that investors are unable to differentiate among risks of US banking institutions. Our results do not support the hypotheses that riskier banks declined liabilities with greater protection more than safer banks did (H2).

6.2 The bail-in effect on large banks

In this section, we investigate whether investors may believe that the new bail-in framework will not be concretely adopted for large banks, consistent with a TBTF view. In such a case, investors would not expect greater returns to larger issuers after the bail-in announcement, and *ceteris paribus*, larger banks do not have to change the funding mix.

The model arising from this piece of analysis is the following:

$$\begin{aligned} y_{i,t} =& \beta_1 w * T + \beta_2 TotalAssets_{t-1} + \beta_3 TotalAssets_{t-1} * w * T + \beta_4 NPLratio_{t-1} + \\ &+ \beta_5 Equityratio_{t-1} + \beta_6 GDPgrowth_{t-1} + \beta_7 TreasuryBillrate_{t-1} + \beta_8 ROE_{t-1} + \\ &+ \theta_i + \lambda_t + \epsilon_{i,t} \end{aligned} \tag{3}$$

where dependent and control variables are the same as those in the baseline DID model in equation (1), except for the interaction with the bank size. All variables are described in Table 1.

Once we take bank size into account, the coefficient estimates for the treatment variable (wt)

are not statistically significant at the 5% level or less (customer deposit ratio is positive and significant at the 10% level, column 1 of Table 8). Moreover, we show that the liability mix does not change according to the size of the banks. Specifically, coefficient estimates for the variable interacting with the treatment and bank size (wt * Total assets) are not statistically significant for either of the two growth rates of the liabilities ratio. Our results provide useful insights about the credibility of the bail-in framework. Our results do not support the TBTF view, which is one of the main critical issues highlighted by the literature.

7 Robustness Tests

To confirm further that the decreased liabilities growth rate is driven by the announcement of a bail-in, we run various robustness analyses. First, we change the definition of treated and control groups, focusing within Europe to increase the comparability of the two groups. Second, we take into account differences in supervision procedures and different implementation levels of Basel 3 rules. Third, we drop the 2012 observations from our sample, since the BRRD was publicly announced in June 2012, year 2012 may be a confounding year because the eurozone banks are not treated in in the first half but suddenly become treated in the second half of the year. Fourth, we assess the bail-in effect in core and periphery European countries, since the latter were greatly affected by the sovereign debt crises. Finally, we account for the effect due to the Minimum Requirement Eligible Liabilities (MREL) introduction.

7.1 An identification within euro area countries

We first develop an alternative identification by selecting banks in the treated and control groups within euro area countries. Although US banks provide us an excellent control group (being non-treated by the EU regulation and sharing a business model very similar to that of EU banks) and we controlled for possible differences to restore the randomization condition,

we now focus on banks in the eurozone. Although all banks located in the euro area are treated by the bail-in provision, we selected the treated and control groups by looking into those eurozone countries experiencing at least one case of bail-in bank creditors (including those cases that happened before the formal effectiveness of the tool by law). The main idea is that depositors in a country experiencing a bail-in case would feel treated by the introduction of the new resolution regime. As such, the treated group is composed of banks in Italy, Spain, the Netherlands, Portugal, and Austria since these countries have experienced at least one bank bail-in case. The control group includes banks in the remaining euro area countries. The empirical model is the same as in equation (1).

As shown in Table 9, the coefficient estimates for our main variable of interest is consistent with the main results in Table 5. Banks in countries that applied a full or partial bail-in mechanism increased more the cheaper liabilities (e.g., deposits) and decreased more the more expensive liabilities (the other interest-bearing liabilities) relative to the banks in eurozone countries that did not use investors' money to cover bank losses. These results grant robustness to the main model, suggesting that our main results are not sensitive to the selection of the control group (US banks).

7.2 The role of supervisory tightness and Basel 3 rules implementation

We are aware that in the aftermath of the global financial crisis, many new regulations have been introduced: Basel regulation has been reviewed by introducing new ratios and capital requirements. The innovations have been introduced at the global level; hence, the rules affected both the treated and control groups. However, we would like to provide a second robustness check, where we take into account the effectiveness of the supervision and the stage of Basel 3 rules implementation. As such, we run the baseline model (equation

(1)) including two additional control variables: the supervisory tightness[13] and the stage of Basel 3 rules implementation[14]. These variables are fixed within countries; hence, they are able to capture firm fixed effects[15]. Our results (Table 10) are strongly consistent with the baseline model results (Table 5): all coefficient estimates for the treatment variable (wt) are statistically significant at the 1% level and their magnitude (3.65% for the growth rate of customer deposits ratio and -10.30% for the growth rate of other interest-bearing liabilities ratio) confirms that the bail-in announcement changed the way of bank funding, by reducing the reliance on other more expensive sources of funding and increasing the customer deposits, controlling for the new rule introduced by Basel regulation in the aftermath of the global financial crisis. This confirms our hypothesis (H1) that eurozone banks reduced riskier (and more expensive) liabilities with respect to the safer instruments, the treatment coefficient is still highly significant even if we account for differences among the groups in terms of supervision tightness and Basel regulation implementation.

7.3 The role of 2012

We ran again the baseline model (equation (1)), but now we omit all 2012 observations. The BRRD proposal was in June 2012, and consequently, eurozone banks are not treated in the first half of the year but are treated in the second half of the year. As shown in Table 11, our results are strongly consistent to the results of the baseline model (Table 5). All coefficient estimates for the treatment variable (wt) are statistically significant at the 1% level and their magnitude (4.21% for the growth rate of customer deposits ratio and -5.31% for the growth rate of other interest-bearing liabilities ratio) fully confirms our hypothesis (H1) that banks reduced riskier (and more expensive) securities with respect to safer instruments.

[13]Data were collected from the Barth and Levine (2013) database, taking the data of the last survey available in the database (e.g., 2011).

[14]Data were collected from the Basel Committee on Banking Supervision monitoring reports (from the 1st to the 15th one) published in October every year. The model leaves out firm fixed effects due to the inclusion of supervisory tightness and Basel stage variables.

[15]The model leaves out firm fixed effects due to the inclusion of supervisory tightness and Basel stage variables.

7.4 Differences between core and peripheral European countries

Since the sovereign debt crisis was one of the main reasons for introducing the bail-in in Europe, and the crisis was more severe in some countries than in others, we repeat our analysis by splitting our sample between countries where the crisis was less severe (labeled as "core countries") and more severe (Greece, Ireland, Italy, Portugal, and Spain) (labeled as "peripheral countries"). Tables 12 and 13 report the results. In Table 12, we restrict the sample using only the peripheral countries vs. US as treated. In Table 13, our sample includes the remaining eurozone countries (labeled as "core countries") vs. US banks as well. In both cases, we show a causal effect of the bail-in announcement on the growth rate of the more expensive sources of funding (e.g., other interest-bearing liabilities). More specifically, we may compare the coefficient of the growth rate of other interest-bearing liabilities ratio when using only peripheral eurozone countries (column 2, table 12) and that when using only the core eurozone countries (column 2, table 13). Peripheral treated banks declined (with a statistical significance at the 1% level) riskier (and more expensive) liabilities more than did core treated banks. This is consistent with the severity of sovereign debt crisis in peripheral eurozone countries. Comparing the growth rate of customer deposits ratio for peripheral eurozone countries (column 1, table 12) and that for core eurozone countries (column 1, table 13), we observed that the customer deposits ratio growth rate is statistically significant only when using as treated units the banks in peripheral eurozone countries (column 1, table 12), highlighting a more pronounced behavior by banks in trouble countries to seek the cheapest source of funding. Overall, this confirms that our results are not related to some eurozone countries; rather, the bail-in effect on the bank funding mix was common to all eurozone countries.

7.5 Confounding events: Testing the Minimum Requirement for own funds and Eligible Liabilities (MREL) introduction

The new European bail-in framework (BRRD) also introduced the MREL requirement (banks have to hold enough "bailinable" liabilities) from January 2016. MREL is the minimum amount of equity and subordinated debt (meeting specific conditions) a firm must maintain to support an effective resolution so that investors and shareholders (rather than taxpayers) have the capacity to absorb losses when a bank fails.

To check whether our main findings may be driven by the introduction of the MREL regulation, we analyze whether European banks have increased subordinated debt, Tier 2, and Additional Tier 1 instruments to comply with the MREL requirement. If banks reacted to the introduction of MREL regulation, then European banks would have increased subordinated debt, Tier 2, and Additional Tier 1 instruments. As such, we run our baseline DID model (equation (1)) to test the MREL effect, setting the treatment in 2017 (since the eligible securities should have a maturity after January 1, 2017, under Art. 45 of the BRRD) and using a sample from 2015 to 2018. We show in Table 14 that the MREL stopped the effect caused by the bail-in introduction. We did not find statistical significance of the treatment coefficient for the customer deposits ratio growth rate (column 1), while we found statistical significance (but with opposite sign with respect to the one found in the baseline model, Table 5) of the other interest-bearing liabilities ratio growth rate (column 2). This means, economically, that the effect of bail-in (increase the cheaper sources of funding and decrease the more expensive one) has been limited to the time period of transition between the announcement of bail-in and the effectiveness of the MREL requirement.

8 Conclusion

The launch of a new resolution regime, moving from a bailout resolution policy at the country level to a bail-in regime at the centralized European level, was an historic event for European banking. Since 2016, no bailout could be implemented by any eurozone governments to rescue a bank declared failing or likely to fail by the competent authority. We argue that removing an implicit guarantee (e.g., bailout) by the regulation was an exogenous shock that generated a change in banks' funding strategy.

Although the effects could be observed in the medium or long run, we have evidence of an anticipated behavior of banks in changing their funding structure.

Our main finding is that banks reduce riskier sources of funding with respect to the control country. Specifically, banks prefer funding themselves using cheaper liabilities, such as customer deposits. We argue that this is an important result, especially for policymakers. Relying on customer deposits can have costly consequences in terms of asset–liability mismatches and bank runs, causing banks to hold unproductive reserves (Diamond and Dybvig (1983)).

We conclude that, on the average, eurozone banks were able to decrease their funding costs by changing their liability mix, relying more on customer deposits rather than on riskier (and more expensive) liabilities (e.g., subordinated bonds) with respect to the control group.

What we further analyzed concerns the issue of credibility, especially for banks labeled TBTF: the DID shows that there are not any differences in the reaction of larger banks with respect to smaller banks. Economically, the bail-in application is enough credible despite the dimension of the banks. Our results are robust to various additional tests.

These findings are important for policymakers because they show that investors' resolutions determine an additional risk for the securities, causing a change in banks' funding strategy: banks come back to their primary source of funding, i.e., deposits, and this may be a source of liquidity risk due to the asset-liability mismatching. Although, the decrease of the more

expensive liabilities was limited to the period before the introduction of the MREL by the same directive.

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Table 1. Variable definitions

This table reports the variables' definitions and/or the calculation method adopted. Each growth rate has been calculated as follows: $(x_t - x_{t-1})/x_{t-1}$.

Variable	Acronym	Definition and calculation method
Bank deposit ratio growth rate	Bank_Dep ratio growth	The growth rate of bank deposits ratio. The ratio is computed as Bank deposits over total assets.
Basel stage	Basel stage	Average of the stage of the Basel capital standard implementation ranging from 1 to 4: 1 (draft was not yet published) to 4 (rule in force). Source: 1st–15th Basel Committee on Banking Supervision Monitoring report (October of each year).
Customer deposit ratio growth	Cust_Dep ratio growth	Growth rate of the Customer deposit ratio. The ratio is computed as customer deposits over total assets. Customer deposits are defined as a liability more legally protected by the bail-in regulation (they benefit of the deposit insurance).
Equity ratio	Equ ratio	Total equity over total Aasets
GDP growth rate	GDP growth rate	GDP growth rate.
NPL ratio	NPL ratio	Non-performing loans ratio, calculated as impairment loans over total assets
Other interest-bearing liabilities	Oth_int_liab	Total Liabilities less total deposits. It is defined as less legally protected by the bail-in because they are subordinated to customer deposits in case of bank resolution.
Other interest-bearing liabilities ratio growth	Oth_int_liab ratio growth	Growth rate of the other interest-bearing liabilities ratio. The ratio is computed as other interest-bearing liabilities over total assets
ROE	ROE	Return on equity is calculated as operating income over total assets
Senior unsecured debt ratio growth	Senior unsecured debt ratio growth	Growth rate of the senior unsecured debt ratio. The ratio is computed as senior unsecured debt over total assets
Subordinated debt	Subordinated debt	Total Liabilities less total deposits and senior unsecured debt.
Subordinated debt ratio growth	Subordinated debt ratio growth	Growth rate of the subordinated debt ratio. The ratio is computed as subordinated debt over total assets
Supervisory tightness	Supervisory tightness	Sum of Official Supervisory Action Variables, Official Supervisory Structural Variables and Deposit Insurance Scheme Variables. The index goes from 30 (lower power of supervision) to 130.94 (greater power of supervision). Source: Barth, Caprio, and Levine (2013).
T	t	The treatment period dummy is equal to 1 from 2013 onward and 0 otherwise
Total Assets	Total Assets	The natural logarithm of total assets in millions of euro
Treasury-Bill rate	T-Bill rate	Interest rate on 10-year treasury bond.
Treatment	wt	The treatment dummy is equal to 1 for all eurozone banks from 2013 onward and 0 otherwise (w*t)
w	w	The geographic treatment dummy: 1 for eurozone and 0 for the US

Table 2. Sample size

The sample is composed of eurozone banks (treated) and controls include the US.

	2011	2012	2013	2014	2015	Total
Eurozone	337	350	368	464	458	1977
US	616	621	617	643	628	3125
Total	953	971	985	1017	1086	5102

Table 3. Summary statistics

This table reports the sample's summary statistics of all the variables used in the paper.

Variables	**Mean**	**Median**	**St. Dev**	**min**	**max**
Bank deposit ratio growth	-0.025	-0.031	0.317	-1.000	1.000
Basel stage	2.802	2.830	0.457	2.170	3.400
Cust_Dep ratio growth	0.021	0.008	0.073	-0.498	0.897
Equ ratio	0.098	0.093	0.045	0.000	0.581
GDP growth	0.029	0.032	0.017	-0.071	0.347
NPL ratio	0.035	0.017	0.045	0.000	0.869
Oth_int_liab ratio growth	-0.041	-0.048	0.241	-0.922	0.999
ROE	0.861	0.395	19.309	-0.258	1253
Senior Unsecured debt ratio growth	-0.101	-0.078	0.321	-0.997	0.992
Subordinated debt ratio growth	-0.025	-0.041	0.325	-0.994	0.998
Supervisory tightness	107.192	130.940	37.060	30.000	130.940
TreasuryBilrate	2.505	2.351	1.331	0.496	22.497
Total Assets (ln)	8.249	7.745	1.903	3.100	14.588
T	0.641	1.000	0.48	0.000	1.000
w	0.376	0.000	0.485	0.000	1.000
Treatment (wt)	0.260	0.000	0.439	0.000	1.000
Treatment*Risk	0.016	0.000	0.042	0.000	0.761
Treatment*Size	2.372	0.000	4.115	0.000	14.547

Table 4. Testing the parallel trends assumption: dependent variables
The table compares the mean values of principal dependent variables. We report the means and the difference of treated banks (eurozone) and controls (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Year	Variable	Mean Control Group	Mean Treated Group	Difference control vs. treated groups
2010	Cust_Dep ratio growth	0.022	0.020	0.002
	Oth_int_liab ratio growth	0.091	0.028	0.063
2011	Cust_Dep ratio growth	0.009	0.000	0.009
	Oth_int_liab ratio growth	0.066	0.116	-0.050
2012	Cust_Dep ratio growth	0.019	0.025	-0.006
	Oth_int_liab ratio growth	0.063	-0.012	0.074
2013	Cust_Dep ratio growth	0.004	0.043	-0.040***
	Oth_int_liab ratio growth	0.06	-0.066	0.126***
2014	Cust_Dep ratio growth	-0.004	0.013	-0.017***
	Oth_int_liab ratio growth	-0.057	-0.026	-0.030
2015	Cust_Dep ratio growth	0.003	0.032	-0.029***
	Oth_int_liab ratio growth	0.132	-0.059	0.191***

Table 5. Bank funding growth after the launch of the bail-in framework
The table reports the results of the DID model reported in equation (1). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We include the time fixed effect and the bank fixed effect. The GDP growth rate also captures country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
w^*t_t	0.034***	-0.084***
	(0.008)	(0.017)
Total $Assets_{t-1}$	0.037***	0.134***
	(0.013)	(0.040)
NPL $Ratio_{t-1}$	0.348***	-0.236
	(0.107)	(0.200)
Equ $Ratio_{t-1}$	0.363**	1.414***
	(0.139)	(0.321)
GDP $Growth_{t-1}$	-0.363*	0.962**
	(0.191)	(0.398)
$TreasuryBillrate_{t-1}$	0.002	0.011**
	(0.004)	(0.005)
ROE_{t-1}	0.000***	-0.001***
	(0.000)	(0.000)
FE: Year	Yes	Yes
FE: Firm	Yes	Yes
Observations	5,102	5,102
R2	0.339	0.287

Table 6. Senior debts and other funding sources growth after the launch of the bail-in framework

The table reports the DID model results reported in equation (1). The dependent variables are senior unsecured debt ratio growth (column 1), subordinated debt ratio growth (column 2), and bank deposit ratio growth (column 3). We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Senior unsecured debt ratio growth	(2) y= Subordinated debt ratio growth	(3) y= Bank_Dep ratio growth
w^*t_t	-0.038	-0.075	-0.282***
	(0.051	(0.047	(0.068
Total $Assets_{t-1}$	0.257***	0.059	-0.226*
	(0.089)	(0.128)	(0.118)
NPL $ratio_{t-1}$	0.368	0.963	-0.789*
	(0.588)	(0.683)	(0.455)
Equ $ratio_{t-1}$	1.073	1.463	1.534*
	(0.987)	(0.912)	(0.850)
GDP $growth_{t-1}$	-0.192	0.649	0.69
	(0.857)	(0.843)	(0.711)
$TreasuryBillrate_{t-1}$	0.019	0.017	0.01
	(0.017)	(0.016)	(0.015)
ROE_{t-1}	-0.000	-0.000	0.001***
	(0.000)	(0.000)	(0.000)
FE: firm	Yes	Yes	Yes
FE: year	Yes	Yes	Yes
Observations	1,536	1,126	1,640
R2	0.398	0.338	0.385

Table 7. DID with the interaction of the treatment with risk

The table reports the results of the DID model reported in equation (2). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). The risk is measured by the ratio of the impairment loans over total assets (1-year lag). We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
$w*t_t$	0.042***	-0.098***
	(0.008)	(0.020)
NPL $ratio_{t-1}$	0.486***	-0.478
	(0.141)	(0.295)
NPL $ratio_{t-1}*w*t_t$	-0.166	0.290
	(0.112)	(0.217)
Total $Assets_{t-1}$	0.037***	0.134***
	(0.013)	(0.040)
Equ $ratio_{t-1}$	0.374***	1.395***
	(0.139)	(0.321)
GDP $growth_{t-1}$	-0.375**	0.984
	(0.189)	(0.400)
$TreasuryBillrate_{t-1}$	0.002	-0.003
	(0.003)	(0.007)
ROE_{t-1}	-0.000**	0.000***
	(0.000)	(0.000)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	5,102	5,102
R2	0.340	0.271

Table 8. DID with the interaction of the treatment with size

The table reports the results of the DID model reported in equation (3). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We interact the treatment with the size measured by the total assets (natural logarithm). We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
w^*t_t	0.061*	-0.060
	(0.031)	(0.043)
Total $Assets_{t-1}$	0.036***	0.132***
	(0.013)	(0.041)
w^*t_t*Total $Assets_{t-1}$	-0.003	-0.003
	(0.003)	(0.003)
NPL $ratio_{t-1}$	0.340***	-0.243
	(0.109)	(0.202)
Equ $ratio_{t-1}$	0.362***	1.412***
	(0.139)	(0.321)
GDP $growth_{t-1}$	-0.351*	0.973**
	(0.195)	(0.400)
$TreasuryBillrate_{t-1}1$	0.002	-0.003
	(0.003)	(0.007)
ROE_{t-1}	-0.000	0.000
	(0.000)	(0.000)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	5,102	5,102
R2	0.340	0.271

Table 9. Bank funding growth in euro area countries

The table reports the results of the DID model reported in equation (1). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liability ratio growth (column 2). The treated group (w = 1) includes the banks located in Italy, Spain, the Netherlands, Portugal, and Austria because they experienced at least one case of bail-in application following a bankruptcy. The control group (w = 0) includes the banks located in the remaining euro area countries. We include the time fixed effect and the bank fixed effect. The GDP growth rate also captures country-year fixed effects. The t variable represents time, which is equal to 1 between 2013 and 2015 and 0 before 2013. The main variable of interest is the dummy wt_t, the interaction between w and t. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
$w*t_t$	0.080***	-0.056***
	(0.009)	(0.019)
Total $Assets_{t-1}$	0.139***	0.077*
	(0.027)	(0.043)
NPL $Ratio_{t-1}$	0.225**	-0.285
	(0.101)	(0.192)
Equ $Ratio_{t-1}$	0.628**	0.560
	(0.308)	(0.384)
GDP $Growth_{t-1}$	-0.618***	1.095***
	(0.197)	(0.375)
$TreasuryBillrate_{t-1}$	0.001	-0.007
	(0.003)	(0.007)
ROE_{t-1}	-0.001***	0.000
	(0.000)	(0.000)
FE: Year	Yes	Yes
FE: Firm	Yes	Yes
Observations	4,813	4,813
R2	0.397	0.363

Table 10. Bank funding growth after the launch of the bail-in framework (including Basel implementation stage and supervisory tightness)

The table reports the results of the DID model reported in equation (1) adding the Basel stage of implementation and supervisory tightness independent variables. The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We include only time fixed effects due to multicollinearity. The GDP growth rate also capture for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
w^*t_t	0.037***	-0.103***
	(0.007)	(0.015)
Total $Assets_{t-1}$	0.004***	0.001
	(0.001)	(0.002)
NPL $ratio_{t-1}$	0.057	-0.147
	(0.047)	(0.099)
Equ $ratio_{t-1}$	0.069***	0.041
	(0.035)	(0.088)
GDP $growth_{t-1}$	-0.000	0.199
	(0.174)	(0.331)
$TreasuryBillrate_{t-1}$	0.002	0.007*
	(0.002)	(0.004)
ROE_{t-1}	-0.000**	0.000***
	(0.012)	(0.023)
Basel $stage_t$	0.003	0.005
	(0.008)	(0.017)
Supervisory $tightness_t$	0.000	-0.000**
	(0.000)	(0.000)
FE: firm	No	No
FE: year	Yes	Yes
Observations	5,102	5,102
R2	0.067	0.030

Table 11. Bank funding growth after the launch of the bail-in framework (excluding 2012 yearly observations)

The table reports the results of the DID model reported in equation (1). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We exclude observation of 2012 because the BRRD was at the end of June 2012. We have, in this case, only 1 year prior the treatment (e.g., 2011) and 3 years after. We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
w^*t_t	0.042***	-0.053**
	(0.009)	(0.022)
Total $Assets_{t-1}$	0.028**	0.153***
	(0.014)	(0.045)
NPL $ratio_{t-1}$	0.266***	-0.247
	(0.093)	(0.225)
Equ $ratio_{t-1}$	0.380**	1.363***
	(0.148)	(0.341)
GDP $growth_{t-1}$	-0.528**	0.451
	(0.212)	(0.457)
$TreasuryBillrate_{t-1}$	0.000	-0.016**
	(0.003)	(0.007)
ROE_{t-1}	-0.000***	0.000***
	(0.000)	(0.000)
FE:firm	Yes	Yes
FE:year	Yes	Yes
Observations	4,116	4,116
R-squared	0.379	0.330

Table 12. Bank funding growth after bail-in in peripheral eurozone countries
The table reports the results of the DID model reported in equation (1). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for banks in Greece, Ireland, Italy, Portugal, and Spain between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
w^*t_t	0.065***	-0.092***
	(0.014)	(0.025)
Total $Assets_{t-1}$	0.021*	0.144***
	(0.012)	(0.047)
NPL $ratio_{t-1}$	0.142	-0.159
	(0.162)	(0.300)
Equ $ratio_{t-1}$	0.446***	1.311***
	(0.103)	(0.374)
GDP $growth_{t-1}$	-0.591*	10.789***
	(0.306)	(0.624)
$TreasuryBillrate_{t-1}$	0.001	0.001
	(0.003)	(0.007)
ROE_{t-1}	-0.000***	0.000**
	(0.000)	(0.000)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	3,988	3,988
R2	0.365	0.259

Table 13. Bank funding growth in core eurozone countries

The table reports the results of the DID model reported in equation (1). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The main variable of interest is the dummy wt_t, which equals 1 for banks in eurozone except for Greece, Ireland, Italy, Portugal, and Spain between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	(1) y= Cust_Dep ratio growth	(2) y= Oth_int_liab ratio growth
w^*t_t	0.007	-0.076***
	(0.009)	(0.021)
Total $Assets_{t-1}$	0.006	0.144***
	(0.012)	(0.045)
NPL $ratio_{t-1}$	0.213**	-0.184
	(0.099)	(0.267)
Equ $ratio_{t-1}$	0.408***	1.419***
	(0.147)	(0.351)
GDP $growth_{t-1}$	-0.197	0.539
	(0.210)	(0.494)
$TreasuryBillrate_{t-1}$	0.002	-0.007
	(0.005)	(0.014)
ROE_{t-1}	-0.000**	0.000***
	(0.000)	(0.000)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	4,237	4,237
R2	0.362	0.266

Table 14. Bank funding growth after MREL effectiveness

The table reports the results of the DID model reported in equation (1). The dependent variables are the customer deposits ratio growth (column 1) and other interest-bearing liabilities ratio growth (column 2). We include time and bank fixed effects. The GDP growth rate is also captured for country-year fixed effects. The sample goes from 2015 to 2018. The main variable of interest is the dummy wt_t, which equals 1 for eurozone banks in 2017 and 2018 and 0 for all banks between 2015 and 2017 and for banks in the control group (the US). ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively.

	(1) y=	(2) y=
Dependent variable	Cust_Dep ratio growth	Oth_int_liab ratio growth
w^*t_t	0.002	0.050**
	(0.006)	(0.019)
Total $Assets_{t-1}$	0.022	-0.045
	(0.015)	(0.052)
NPL $ratio_{t-1}$	0.051	0.229
	(0.144)	(0.405)
Equ $ratio_{t-1}$	0.318*	0.411
	(0.164)	(0.816)
GDP $growth_{t-1}$	0.067	-0.383
	(0.080)	(0.257)
$TreasuryBillrate_{t-1}$	0.049***	-0.014
	(0.013)	(0.024)
ROE_{t-1}	-0.001***	0.016***
	(0.000)	(0.004)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	3,892	3,892
R2	0.384	0.300

Appendix A Different banking regulatory reforms in Europe and the US

During the time period analyzed in this paper (2010–2017), there have been other various regulatory reforms in banking, in both the US and Europe, such as the launch of new Basel 3 regulatory tools (e.g., liquidity and leverage ratios) and the development of regular stress test exercises. Although these reforms may be a confounding factor in our identification, we discuss each of them in this Appendix and show that they do not have a direct impact on banks' external funding mix; rather, their impact is either on banks' asset levels and mix or on the equity levels. Furthermore, we show that these reforms have different implementation timings.

Focusing on the liquidity ratios, the Basel 3 framework introduced two new tools: the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). The LCR is the ratio of a bank's high-quality liquid assets (unencumbered high-quality assets with a high potential to be converted easily and quickly into cash) and its total net cash flows (difference between expected outflows and expected inflows of cash) over a 30-day stress period. Initially published by the Basel Committee in December 2010, the LCR was endorsed in January 2013. In the European Union, the LCR became a binding quantitative rule for all banks in October 2015. In the US, the Federal Reserve Board, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency issued, in October 2014, a final document imposing an LCR framework (more stringent than Basel's) to large banks. We argue that the LCR cannot be considered a confounding reform for (at least) two reasons. First, LCR affects essentially short-term asset size items. To fulfill the LCR requirement, banks usually manage the high liquid assets composition, and its impact on banks' liabilities is minor (being related to the cash outflows). Second, the timing of the LCR launch is very different, and its full implementation (2015 in the US and 2015–2018 in Europe) was later than the treatment period adopted in this paper (i.e., 2013); furthermore, both treated and control

groups in our analysis have been affected by the introduction of the LCR. Furthermore, we argue that the announcement of LCR was in 2010, 3 years before the bail-in announcement; moreover, as shown in Table 4, there is no significance in the t test implemented in 2010, 2011, and 2012. These results support the view that the LCR introduction did not affect the banks' liability structure.

The second liquidity ratio is the NSFR, which relates the bank's available stable funding to its required stable funding. The available stable funding is the portion of its capital and liability instruments that remain with the institution for more than 1 year. Each item is weighted by a factor that can be equal to 100% (funding sources fully available in more than a year), 95% (well-divided retail deposits), 90% (demand deposits and/or term deposits with residual maturities of less than 1 year provided by retail and SME customers), and 50% (secured and unsecured funding with a residual maturity of less than 1 year). Required stable funds are those required to hold given the liquidity characteristics and residual maturities of banks' assets and the contingent liquidity risk arising from their off-balance sheet exposures. Each item is weighted by a factor ranging between 100% (illiquid assets or exposures to be entirely financed by stable funding) and 0% (liquid assets not needing to be financed). Although the NFSR was launched, together with the LCR, its implementation (expected in January 2018) has been delayed in many countries (e.g., the US, the EU, Switzerland, and Japan) and less than half of the G20 members had implemented the rules in a timely manner. As for the LCR, we argue that the NFSR cannot be considered a confounding reform. The NSFR has not been introduced in Europe and the US, and the weighting factors are based on the residual maturity of liability items rather than on the seniority or subordination.

One may also potentially consider the higher capital requirements imposed by Basel 3 and various stress test exercises as confounding effects. Previous studies (Gropp et al. (2018); Kim and Santomero (1988); Thakor (1996)) showed that treated banks increase their capital ratios by reducing their risk-weighted assets (restrictions on asset composition) and by reducing lending to corporate and retail customers, but there is no evidence of changes in

the liability composition.

Finally, we also illustrate that the US bail-in framework is different from the European framework. The banking resolution framework in the US was reformed by the Dodd Frank Act, enacted in 2010 and previously announced in 2009. Consequently, we observe that the US resolution reforms happened before they did in Europe (the BRRD was announced at the end of 2012, entering into force in January 2016). This is the first reason for expecting that the US banking system, from 2013, was not treated by a bail-in regulation, and it can be used as a control group in our identification strategy. Second, there are important differences in resolving a defaulting bank. The European regulation aims at the "going concern" principle for a financial intermediary, while the defaulting bank in the US will be closed by selling its assets and its remaining liabilities to a new holding company. In the US, the Dodd Frank Act in Title II introduces the Orderly Liquidation Authority (OLA). Within the OLA, the resolution of a defaulting bank is used as part of a liquidation procedure for the holding company ("closed bank" process), while Article 43(2)(a, b) of the BRRD provides an "open bank" bail-in process. This means that the eurozone banks investors shall bear the total burden of the risk of a bank failure since the banks declared failing should use investors' money to cover the losses and restore equity. Instead, investors in defaulting US banks will become investors of a "healthy" new company and only after this movement that they could be converted into equity. Therefore, we can claim that the investors' treatment in case of a troubled bank is different between the eurozone (under the BRRD framework) and the US (under the Dodd Frank Act). Moreover, the US Federal Deposit Insurance Corporation ensures deposits up to $250,000, while in the EU, the deposit insurance is 100,000 euros. Finally, another important difference that allows us to use the US as the control group is the application of the regulation in the US just for banks with total assets over $50 billion. Our sample is composed mainly of banks under this threshold (93% of US banks).

Figure A.I. Propensity score matching

The chart plots the kernel density and the propensity score of the sample before and after implementing the matching. In the right panel (after matching), the treated curve stops because, at the beginning, the sample has 5000 treated banks and 1150 controls, the matching drops observations in the treated group since we have implemented the matching with one neighbor and the no replacement option to have a balanced sample with the same number of banks in both groups.

(a)

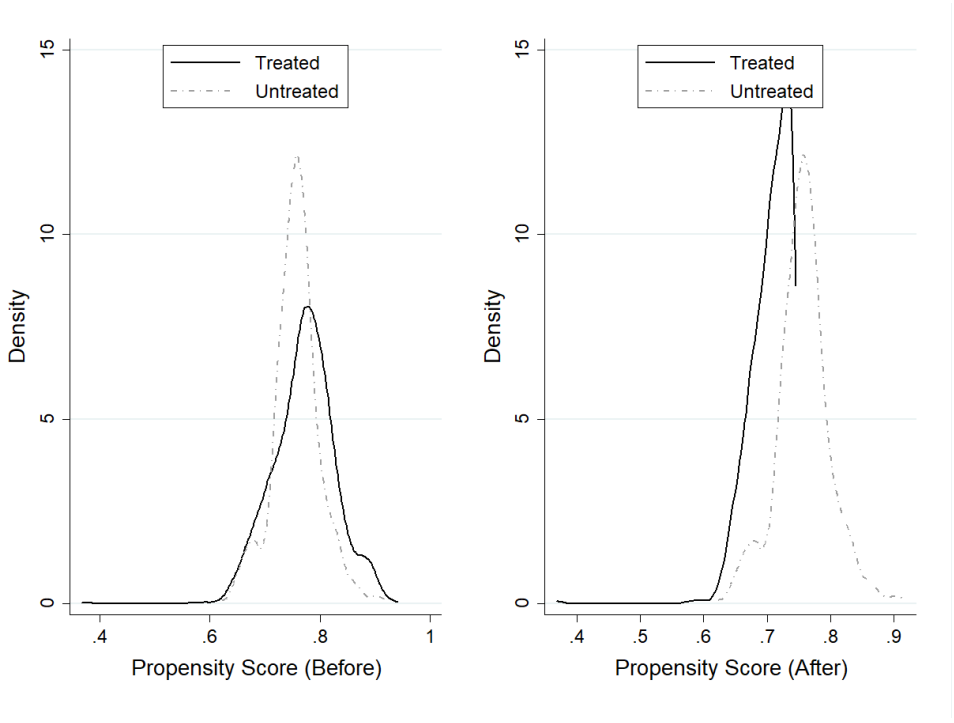

Table A.I. Percentage of deposits and other liabilities on balance sheets by country

The table reports the mean of the percentage of deposits ratio (column 1) and other interest-bearing liabilities ratio (column 2) by country.

Country	Cust_Dep ratio (mean)	Oth_int_liab ratio (mean)
Austria	45.20%	30.68%
Belgium	55.69%	33.81%
Finland	27.66%	54.75%
France	50.13%	13.92%
Germany	60.38%	15.69%
Greece	52.92%	12.37%
Ireland	50.24%	27.46%
Italy	47.68%	30.24%
Latvia	52.97%	3.04%
Lithuania	62.56%	3.02%
Netherlands	54.71%	31.27%
Portugal	57.85%	20.36%
Slovakia	73.97%	11.11%
Slovenia	58.00%	15.58%
Spain	56.73%	23.21%
United States of America	78.39%	10.15%