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Bank funding strategy after the bail-in announcement

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ABSTRACT

Euro area countries have recently moved to a new centralized bail-in framework by removing implicit public guarantees. Our paper analyzes banks' funding strategies after the bail-in proposal. We show that Euro area banks relied more on cheaper and better protected sources of funding, such as deposits, and reduced 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). A similar asymmetric information situation exists between banks and households, and this has been traditionally been mitigated by the government with regulatory and supervisory tools, setting deposit insurance schemes, and ultimately, a public implicit guarantee for large banks. During the global financial crisis, implicit public guarantees became in certain cases explicit - governments bailing out many large banks using taxpayers' money - for example, the Monte dei Paschi di Siena (the world's oldest bank) in Italy in 2012, Hypo Group Alpe Adria in Austria in 2013, and various Greek banks in 2014 (Alpha Bank, National Bank of Greece, and Piraeus Bank). From this

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perspective, Europe is an interesting case study since the government has provided enormous financial support to banks. Between 2008 and 2014, European Union governments approved state aid to banking systems, amounting to 45.8% of gross domestic product (GDP). It comprised 1.49 trillion in capitalization and asset relief programs and 4.3 trillion in guarantees and liquidity measures. Most state-authorized aids were in the form of guarantees, some 3.9 trillion in total (most of which were granted at the peak of the financial crisis during 2008). The many bailout policies implemented by the European governments, to face the subprime financial crises, 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 have an orderly crisis management (based on effective tools and using private sector resources), Euro area countries announced the development of a new resolution regime at the end of 2012, moving from a bailout resolution policy at the country level to bail-in regime at the centralized European level. Specifically, the new regulation provides a predefined hierarchy of "who" is in charge of rescuing a bank close to default by explicitly stating which liabilities will be written off or converted into equity.[2] 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. The market prices of outstanding banks' issued securities 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 have run event studies focusing on stock returns and credit default swap spreads around the announcement of the various steps of its launch (Schafer et al., 2016; Pancotto et al., 2019). The second effect concerns the issuance of new securities: after the bail-in regulation, banks must 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 behavior of banks and investors in case an external shock increases the risk levels of bank liability (without a specific bad event related to a bank).

The removal of implicit public guarantees is exogenous shock that increased investors' expected return on banks' liabilities (without changing banks' risk-taking) and spread variations depend on liability legal protection and the bank's risk. Our study aims to understand banks' funding[3] 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 Euro area banks during the period 2011–2015, we show that after the bail-in proposal, Euro area banks increased fund collections from sources with greater creditor protection (which are also cheaper), such as customer deposits, and reduced fund collections from sources with weaker creditor protection (which are also more expensive), such as bonds, relative to US banks (unaffected by a change in bank resolution procedures).

Our identification strategy relies on difference-in-differences (DID) approach, which allows us to compare banks affected (treated) and unaffected (untreated) by the introduction of the new resolution regime. We used various strategies to identify banks in the treatment and control groups. First, we compare Euro area banks (affected by the introduction of the new resolution regime) and US banks (that did not experience a similar regulatory change over the same period). To restore the randomization condition, banks in the control and treated groups are selected using a propensity score matching (PSM) approach. We developed an alternative robust identification by focusing only on Euro area banks. Although the new resolution treats all banks in the Euro area, the underpinning idea is that it only potentially affects sound banks, whereas it has a real effects for risky banks. To these aims, we define the treatment and control groups in two different ways. First, we posit that the banks' investors can screen banks' soundness and thus we compare banks with a loan portfolio of poor quality (treated) with those with a high quality (control). Second, we consider the case that banks' investors may be unable to screen banks' soundness but realize the adverse consequences of the new resolution regime only when one or more bail-in cases occur in their country. Thus, we compare banks in Euro area countries that experienced bail-in cases (treated) with those in countries that did not (control).

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 (May 2014) or legal application (January 2016). Various papers (Fiordelisi et al., 2017; Schafer et al., 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.

We contribute to past papers in three ways. First, our paper is the first to analyze changes in banks' funding strategies 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 the case of bank default, declined, while the portion of instruments less exposed to be bailed in increased. Our results suggest that 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 asset compositions (Bouwman et al., 2017; Gropp et al., 2018; Berger et al., 2016; Fiordelisi et al., 2017). Moreover, we show that the European reform of resolution procedures was credible since banks rebalanced 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, therby causing banks to hold unproductive reserves (Diamond and Dybvig, 1983).

[2] 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.

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

The remainder of this paper is organized as follows: in Section 2, we describe the European reform of resolution procedures; subsequently, we review past papers and develop our research hypotheses in Section 3, we provide our data and variables in Section 4, and present the main identification strategy in Section 5; in Section 6, we present our results and robustness checks; in Section 7 we discuss the results of the alternative identification strategy supporting the main findings; finally, in Section 8, we conclude the paper.

2. The new bail-in framework in Europe

After the global financial and the sovereign debt crises, 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 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's 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),[4] which was initially proposed in June 2012[5] and finally approved in May 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 at the European level to make decisions about the resolution of financial institutions. When a bank fails to meet its 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 must 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 the 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 to cover losses, subordinated debts and senior unsecured debts[6] will be called upon to cover losses. We define subordinated debt and senior unsecured debt as bank liabilities less legally protected under the bail-in rule; hence, they 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 the case of a bank resolution. If these instruments (equity and bonds) are insufficient to cover losses, customer deposits exceeding 100,000 euros may be called upon to cover the remaining losses. Specifically, the deposit insurance fully guarantees customer deposits are fully guaranteed up to 100,000 euros, while the exceeding amount remains 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 under the bail-in rule; hence, they are 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.

The BRRD also prescribed a new requirement, labeled as the minimum requirement for own funds and eligible liabilities (MREL) effective from January 1st, 2017, to ensure that the investors' money is enough to recover the bank losses. Specifically, the MREL requires that banks must hold a sufficiently large number of securities that are eligible ("bailinable") to cover losses in case of the 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 might limit the change in the liability mix.

During the period analyzed in this paper (2011–2015), 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' asset levels and mix or the equity levels. Furthermore, these reforms have different implementation timings.

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

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

[6] Some countries found ambiguity for the class senior unsecured debt; the BRRD classified a big bucket of different types of debts, 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 are worse off) decided to adopt the directive into their national legislation with a further sub-classification of the category "senior unsecured debt" (Pigrum et al., 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.

3. 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 et al., 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 et al., 2020b), and senior debts (Francis et al., 2019).

The second stream of literature deals with the effects of the bailout and bail-in regulations. Focusing on the optimal resolution policy, Berger et al. (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. Regarding financial contagion, Bernard et al. (2017) showed that a credible bail-in framework must to take banks' networks into account since they play a key role in amplifying the shock. In the literature on deposits, Brown et al. (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 et al. (2014) analyzed the evolution of deposits during the financial crisis. Their study shows that, at the peak of the global financial crisis, depositors were well informed about deposit insurance and raised their deposits, but in the aftermath of the crisis, deposits declined to lower, precrisis levels. Bossu et al. (2012) provided an extensive analysis of debt restructuring of financial institutions moving from a bailout policy to bail-in, placing evidence on the Too-Big-To-Fail (TBTF) problem; in general, Dudley and Yin (2018) analyzed the debt structure, and tested the effects of financial distress on bank refinancing. On bank stability, Ignatowski and Korte (2014) showed that the banks more affected by US Orderly Liquidation Authority (OLA) decrease their overall risk-taking and create lower risk loans; conversely, Imai (2006) showed that the substantial reduction in deposit insurance in Japan in 2002 increased the deposits' interest-rate sensitivity and enhances market discipline in Japan.

Our study 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 a bail-in framework) is exogenous and mandatory for all Euro area countries, and its public announcement, in 2012, was clear (e.g., the creditors' protection hierarchy was publicly declared). The new resolution regime (bail-in instead of bailout) implied the removal of implicit guarantees, and by lowering implicit public guarantees, investors ask for greater return on their investments; consequently, banks' funding costs increased, as Giuliana (2019), Cutura (2018), and Crespi and Mascia (2018) proved.

We develop a set of research hypotheses to capture the banks' reactions to the new resolution framework. First, we posit that following the increase in banks' cost of funding (Giuliana, 2019), banks change their liability composition by reducing more expensive funding sources (because they are less protected by the bail-in rule), such as senior and subordinated bonds (we refer to them as"other interest-bearing liabilities" thereafter), and by increasing in cheaper sources of funding (with greater creditor protection), such as customer deposits. Hence:

H1. *Banks rely more on customer deposits and less on other interest-bearing liabilities after the bail-in announcement.*

The first hypothesis is strictly related to the increase in the cost of funding documented by Giuliana (2019), Cutura (2018), and Crespi and Mascia (2018). Other interest-bearing liabilities are more expensive because they are at the top of the bail-in hierarchy (after equity instruments) and are less legally protected, thus making them riskier. In 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 euros benefit from the deposit insurance.

Furthermore, we tested the relationship between bank risk and the bail-in introduction. Imai (2006) proves the relationship between the removal of implicit guarantee and risk, a reduction in explicit guarantee increased the deposits' interest-rate sensitivity and enhanced market discipline. This allows us to look for a difference in the reaction to the bail-in announcement by Euro area banks according to their level of risk (proxied by credit quality) perceived by the investors; we expect that riskier banks would rely more on customer deposits and less on other interest-bearing liabilities relative to financially sound banks. This implies:

H2a. *The shift from expensive toward cheaper liabilities is stronger for risky banks (since the risk premium required by investors for these banks is higher) than for financially sound banks.*

However, the investors might be unable to differentiate among banks according to their level of risk as Flannery and Sorescu (1996) documented. Hence, we may not find any differences between risky and financially sound banks:

H2b. *There is no difference in the shift from expensive toward cheaper liabilities among banks with different levels of risk.*

We also test the TBTF issue; during the sovereign debt crises many Euro area banks were resolved using taxpayer money (e.g., bailout) because they were judged as TBTF. These decisions by national governments hamper the sovereign debt (also referred to as sovereign debt nexus[7]). Academia believes that the bail-in tool cannot be concretely applied to such banks, hence, we posit:

[7] Fiordelisi et al. (2020a)

H3a. *Investors will not ask for greater yields on bank instruments issued by large banks.*

If the TBTF view remains an issue, the large Euro area banks should not have changed their liability mix.
Alternatively:

H3b. *Investors will ask for greater yields on bank instruments issued by large banks.*

The 3b originates from the Too Big To Save view (Demirguc-Kunt and Huizinga, 2013), which refers to the cases where the bank size becomes sufficiently large to define the bank as"Too Big To Save". Investors may believe that governments cannot further bailout any large banks due to the low fiscal capacity after the sovereign debt crises in the Euro area. Certainly, the policymakers aim to rule out both the issues (TBTF and Too Big To Save); we expect that the results of our analysis do not support either H3a or H3b.

Confounding effects due to the year of the announcement of the new resolution tool (e.g., 2012), the sovereign debt crises during the pre-treatment period, and the prescription by the BRRD of the MREL have been tested in Section 6.3.

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 bonds and GDP growth rates were from the OECD database; and (c) 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 the Appendix (Table B.I).

We include in our dataset commercial banks by imposing the condition of having at least 10% of deposits on total assets. Our data cover the period 2011–2015 (two years before the year of the announcement and three years from the announcement) and include Euro area countries (treated group) and the US (control group). To examine differences among banks in the treated and control groups, we performed a PSM analysis[8] (PSM implementation available in the Appendix, Fig. A.I). The final sample is composed of 5106 year-observations.

As dependent variables, we use various liability measures such as 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 used the senior unsecured debt, subordinated debt, and bank deposits ratios. We controlled for various micro and macroeconomic 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), GDP growth rate, Treasury-Bill rate (intended as the rate on the 10-year treasury bonds), and the stage of the implementation of Basel regulation (Basel stage). The summary statistics according to the treatment are provided in Table 1, showing the differences in the main variables for this analysis among the Euro area (Panel A) and US (Panel B) banks. In our sample, Euro area banks are riskier than US banks (the mean NPL ratio is 6.8% and 1.7% for Euro Area and US banks, respectively) and this is consistent with the financial sovereigns and NPL crises in the Euro area during the period covered by our sample. Moreover, we observe that in the mean, Euro area banks rely more on riskier liabilities (i.e., other interest-bearing liabilities and senior unsecured and subordinated debts) than on customer deposits relative to US banks; this trend leaves enough space for a change in the liability structure of Euro area banks. Table 2 shows the treated group composition by country; Italy, France, Germany and Spain represent around 80% of the sample; furthermore, all Euro area banks (except for Finland) raise funds more via customer deposits than via other interest-bearing liabilities.

5. Identification strategy

Our identification strategy relies on a DID approach to compare banks affected (treated) and unaffected (untreated) by the introduction of the new resolution regime around its launch. We used various strategies to identify banks in the treatment and control groups. First, we compare the Euro area and US banks that did not experience a similar regulatory change over the same period (control group). Second, we select the treatment and control groups within Euro area banks.

5.1. Main identification

We use a DID estimate framework to investigate whether Euro area banks (treated units) adjusted their liability composition differently from US banks (control units) around the launch of the new resolution regime. We argue that US banks can be used as a control group for various reasons. Although US banks underwent their own set of changes in regulation during the postcrisis period (for instance, the Volcker rule was enacted in 2010 and then later amended in 2020), 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 Euro area countries are comparable in the pretreatment period - Demirguc-Kunt and Huizinga (2013) calculated the "real" deposit insurance (the nominal amount insured by the government over national GDP) and

[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).

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

Table 1
Summary statistics.

A: Treated group (Euro area)

Variables	Mean	Median	St. Dev	Min	Max	Observations
Bank deposit ratio	0.174	0.133	0.149	0.000	0.779	1982
Basel stage	3.023	3.330	0.463	2.210	3.400	1982
Customer Deposits ratio	0.521	0.524	0.168	0.102	0.940	1982
Equity ratio	0.084	0.079	0.045	0.000	0.581	1982
GDP growth rate	0.024	0.020	0.026	−0.081	0.347	1982
NPL ratio	0.068	0.046	0.070	0.000	0.869	1982
Other interest liabilities ratio	0.221	0.187	0.176	0.003	0.798	1982
Senior unsecured debt ratio	0.121	0.095	0.113	0.000	0.575	1519
Subordinated debt ratio	0.154	0.108	0.141	0.005	0.765	1031
T-bill rate	2.994	2.536	2.122	0.496	22.497	1982
Total assets (million)	76.291	7.734	234.708	0.160	2164.103	1982
Post	0.652	1.000	0.476	0.000	1.000	1982
Treated	1.000	1.000	0.000	0.000	1.000	1982
Treated × Post	0.652	0.000	0.476	0.000	1.000	1982
Treated × Post × Risk	0.041	0.020	0.060	0.000	0.761	1982
Treated × Post × Size	5.950	7.606	4.604	0.000	14.547	1982

B: Control group (US)

Variables	Mean	Median	St. Dev	Min	Max	Observations
Bank deposit ratio	0.004	0.000	0.014	0.000	0.199	3124
Basel stage	2.671	2.500	0.395	2.170	3.330	3124
Customer Deposits ratio	0.784	0.805	0.100	0.135	0.940	3124
Equity ratio	0.107	0.101	0.043	0.000	0.550	3124
GDP growth rate	0.032	0.032	0.003	0.029	0.036	3124
NPL ratio	0.017	0.011	0.021	0.000	0.349	3124
Other interest liabilities ratio	0.102	0.082	0.089	0.001	0.782	3124
Senior Unsecured debt ratio	0.041	0.021	0.055	0.000	0.375	1316
Subordinated debt ratio	0.072	0.052	0.071	0.000	0.633	995
T-bill rate	2.324	2.351	0.336	1.803	2.786	3124
Total assets (million)	30.127	1.430	166.821	0.022	2160.035	3124
Post	0.604	1.000	0.489	0.000	1.000	3124
Treated	0.000	0.000	0.000	0.000	0.000	3124
Treated × Post	0.000	0.000	0.000	0.000	0.000	3124
Treated × Post × Risk	0.000	0.000	0.000	0.000	0.000	3124
Treated × Post × Size	0.000	0.000	0.000	0.000	0.000	3124

This table reports the sample's summary statistics of all the variables used in the paper. Panel A displays the summary statistics for banks in the treated group (Euro area banks). Panel B shows the summary statistics for banks in the control group (US banks). Banks in the treated and control groups have been selected using a PSM. Source of data: Fitch Connect, OECD, and BCBS data.

Table 2
Euro area countries composition.

Country	Customer Deposits ratio (mean)	Other interest liabilities ratio (mean)	Observations
Austria	45.20%	30.70%	60
Belgium	55.70%	33.80%	40
Finland	27.70%	54.80%	19
France	50.30%	13.90%	528
Germany	60.40%	15.70%	299
Greece	52.90%	12.40%	19
Ireland	50.20%	27.50%	24
Italy	47.70%	30.20%	636
Latvia	53.00%	3.00%	15
Lithuania	62.60%	3.00%	15
Netherlands	54.70%	31.30%	65
Portugal	57.10%	20.40%	52
Slovakia	74.00%	11.10%	25
Slovenia	58.00%	15.60%	51
Spain	56.70%	23.20%	134

The table reports the means of the main dependent variables: the percentage of deposits ratio (column 1), other interest-bearing liabilities ratio (column 2), and the number of observations by country in the treated group (column 3). Source of data: Fitch Connect.

found that the US lies within the range of Euro area countries.[10]

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 et al., 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 mainly held on a national basis (usually, customers deposit their money in a bank in their own country) as well as other liabilities. The "home bias" existence is proved - the securities are mainly held 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 the 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. This is also supported by the very small number of Google worldwide searches of the words"bail-in" and"BRRD" (Fig. A.II in the Appendix) before the selected treatment period[11] signaling that the new resolution regime announcement was not further anticipated by depositors and investors and confirms the soundness of our choice to use 2013 as the treatment year.

To face differences between Euro area and US banks, we ran a PSM analysis aiming to restore the randomization condition. Specifically, we ran the one neighbor matching according to both the bank asset size and percentage of gross loans on total assets in 2011. As shown in the Appendix, the plot of the kernel density before and after the matching provides us with strong support for the common support assumption. The propensity score implemented has balanced the number of observations among the treated and control groups.

We estimate the impact of the new bail-in resolution framework by running the following DID model:

$$\begin{aligned} y_{i,t} = \; & \beta_1 Treated \times Post + \beta_2 TotalAssets_{t-1} + \beta_3 NPLratio_{t-1} + \beta_4 Equityratio_{t-1} + \\ & \beta_5 GDPgrowthrate_{t-1} + \beta_6 T - billrate_{t-1} + \beta_7 Baselstage + \\ & \theta_i + \lambda_t + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where $y_{i,\,t}$ is the liability ratio[12] for each *i*-th bank at time *t*. We ran the model (1) twice - once for customer deposits and once for the other interest-bearing liabilities[13] ratios. We add a set of variables (lagged by 1 year) to control for potential differences between EU and US banks (such as the equity ratio, NPL ratio, and asset size) and restore the randomization condition. We also include the GDP growth and interest rates on the 10-year Treasury bond to account for real and financial conditions in the analyzed countries. Basel 3 Accord changed banking regulation in 2010 and 2011, hence we include a variable in the model to capture the adoption stage of these rules in each country.[14] We augment our model with bank- and year-fixed effects (θ_i, and λ_t, respectively). These fixed effects capture unobserved factors that are invariant at the firm, country, and time level and may play an important role in driving depositors' and investors' reactions (as, for instance, cultural differences[15]). All variables are described in Table B.I, and the relative *t*-test conducted for checking the significance of independent variables included in the model is provided in the Appendix (Table B.III).

Our coefficient of interest is β_1 for the dummy variable *Treated* × *Post*, which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks before 2013 and in the control group after 2013. β_1 provides us with 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.

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. Banks and investors did not expect this announcement, and it was immediately clear that the new framework was mandatory for all Euro area banks, with no way to avoid the new regulation. We provide evidence to support the second assumption. We test this by looking at differences formally, year by year, between the Euro area banks (treated) and US banks (control groups) before the announcement, focusing on our dependent variables (Table B.II growth rates, parallel trend test). In the pretreatment 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 B.II shows also these

[10] In 2013, for instance, Euro area countries had a range of "real" deposit insurance between 282 and 861. In the US, the same ratio had a value of 471.

[11] The countries (in order of number of research during the period 2010–2018) are: Cyprus, Italy, Switzerland, Austria, Greece, Portugal, Belgium, Hong Kong, Canada, United Kingdom, Romania, Germany, Sweden, The Netherlands, France, Australia, Poland, Belarus, United States of America, Spain, Russia, United Arab Emirates, Ukraine, and India.

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

[13] Total liabilities minus total deposits

[14] Data collected from the Basel Committee on Banking Supervision Monitoring Reports (from the 1st to the 15th one) published in October every year.

[15] Various papers show that national culture differences impact depositors' and investors' decisions. Damtsa et al. (2021) find that the effect of hierarchy and individualism cultures on deposits is stronger in domestic banks, where culture is more homogeneous compared to global banks. Zheng et al. (2012) also find that firms located in countries with high uncertainty avoidance, high collectivism, high power distance, and high masculinity (proxies of culture) tend to use more short-term debt. As a robustness check, we run an additional test by controlling for national cultural differences, using Hofstede's six culture dimensions weighted by bank size. These additional results (available on request) strongly confirm the main findings of the paper. We would like to thank the referee for pointing out the role played by national cultural differences.

growth rates for the period after the treatment, showing that the differences in the means of US and EU banks became statistically significant from 2013 onwards. This preliminary evidence shows that the policy event in 2013 has changed the liability mix of the EU banks and allows us to implement DID regression to analyze changes in the liability mix caused by the bail-in introduction.

5.2. Alternative identification

We develop alternative identification focusing on Euro area banks to check whether our main results are sensitive to the selection of the control group based on the US. The underpinning idea of our alternative identification is that although the new resolution mechanism formally treats all banks in Europe, it produces real effects only for risky banks, and not for sound banks (only"potentially" treated by the bail-in resolution regime). Hence, our empirical approach relies on replicating the DID model in Eq. (1)) by changing the selection criteria for banks in the treatment and control groups.

We concretely implement this alternative identification in two ways. First, we posit that investors can screen bank riskiness. Therefore, we compare banks with a loan portfolio of poor quality (*Treated* = 1)[16] with those with a high-quality portfolio (*Treated* = 0).[17] The main idea is that investors (depositors and bondholders) require a risk premium on unprotected banks' liabilities in the case of"risky" banks (not any more protected by public guarantees), but do not for healthy banks (where the bail-in is not considered a real option). Therefore, only risky banks have a greater incentive to change their funding strategies after the introduction of the bail-in regulation.

Second, we consider the case that investors may be unable to screen banks' riskiness but realize the new resolution regime consequences only when they see these when one or more bail-in cases occur in their country; thus, we compare banks in Euro area countries that experienced bail-in cases (including those cases that happened before the formal effect of the tool by law)[18] with those in countries that did not. The control group includes banks from the remaining Euro area countries.[19]

We also considered the possibility of using banks from European countries not belonging to the Euro area counterfactual. Unfortunately, this is impossible for various reasons. Most of these countries[20] voluntarily adopted the European BRRD framework. The remaining countries[21] did not voluntarily adopt the Euro area framework but their banking market is too different (with respect to size, complexity, and the number of banks) from the Euro area one. Finally, Switzerland adopted a national own-resolution framework based on a bail-in as well that was introduced at the same time as the BRRD.

6. Main results

In this section, we analyze whether Euro area banks changed their external funding sources mix after the bail-in announcement by reducing the more expensive (where creditors have less legal protection) liabilities and increasing the cheapest ones (where creditors have greater legal protection). We ran our baseline DID model in Eq. (1) by comparing banks in the Euro area and the US. Our coefficient of interest is β_1 for the variable (*Treated* × *Post*), which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks before 2013 and 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 3, we report our results using the following two variables as response variables: customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. We show that all coefficient estimates for the treatment variable (*Treated* × *Post*) are statistically significant at the 1% confidence level: the coefficient is positive for the customer deposits ratio (the cheapest source of funding) and negative for the other interest-bearing liabilities ratio (the more expensive source of funding). The change in the sign follows the level of seniority and their position in the bail-in hierarchy. The magnitude of the coefficient estimates is meaningful. We show that the treatment (e.g., bail-in announcement) produced a decline in the other interest-bearing liabilities ratio (−2.40%) of Euro area banks relative to US banks, while Euro area banks relied more on customer deposits compared to US banks, column 1 of Table 3 shows an increase in customer deposits ratio by 2.80%.

Next, we ran a followup 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 4, the treatment coefficient is statistically significant and negative for both (columns 1 and 2). Specifically, the treatment coefficient of subordinated debt ratio is more statistically significant and larger than the ones of the senior unsecured debt ratio. Economically, this result means that banks declined mostly the subordinated bonds (more expensive relative to the senior bonds). This result confirms that the driver of our findings is the bail-in introduction rather than the whole revision made by the BRRD.

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

[16] Banks in the Euro area in the third and fourth quartiles of the NPL ratio distribution.
[17] Banks in the Euro area in the first and second quartiles of the NPL ratio distribution.
[18] The treated group is composed of banks in Austria, The Netherlands, Portugal, and Spain: these countries have experienced at least one bank bail-in case during the period analyzed.
[19] We omit countries (e.g., Italy and Greece) where there have been both bail-in and bailout cases
[20] Bulgaria, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom. See ISDA (2016).
[21] Iceland, Liechtenstein and Norway.

Table 3
Bank funding mix after the launch of the bail-in framework.

	(1) y=	(2) y=
	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.028***	−0.024***
	(0.004)	(0.005)
Total assets$_{t-1}$	−0.034***	0.023***
	(0.007)	(0.008)
NPL ratio$_{t-1}$	0.193***	−0.207***
	(0.064)	(0.074)
Equity ratio$_{t-1}$	−0.207**	0.056
	(0.089)	(0.048)
GDP growth rate$_{t-1}$	−0.059	0.038
	(0.082)	(0.108)
T-bill rate$_{t-1}$	−0.006***	0.001
	(0.001)	(0.001)
Basel stage	−0.017***	0.015***
	(0.004)	(0.004)
FE: Year	Yes	Yes
FE: Firm	Yes	Yes
Observations	5106	5106
R2	0.976	0.962

The table reports the results of the DID model reported in Eq. (1). The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. The main variable of interest is the interaction variable (*Treated* × *Post*), which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). Banks in the treatment and control groups have been obtained using a PSM. We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

Table 4
Senior debts and other funding sources after the launch of the bail-in framework.

	(1) y=	(2) y=	(3) y=
Dependent variable	Senior unsecured debt ratio	Subordinated debt ratio	Bank Deposits ratio
Treated × Post	−0.010*	−0.026***	−0.017***
	(0.005	(0.008	(0.006
Total assets$_{t-1}$	−0.008	0.038**	0.020***
	(0.012)	(0.019)	(0.006)
NPL ratio$_{t-1}$	−0.296***	0.035	0.052
	(0.090)	(0.143)	(0.090)
Equity ratio$_{t-1}$	0.011	0.045	−0.147***
	(0.086)	(0.112)	(0.056)
GDP growth rate$_{t-1}$	0.066	−0.333**	0.002
	(0.090)	(0.158)	(0.107)
T-bill rate$_{t-1}$	0.002	0.005***	0.006
	(0.002)	(0.002)	(0.002)
Basel stage	0.010**	−0.001	0.014***
	(0.005)	(0.006)	(0.004)
FE: firm	Yes	Yes	Yes
FE: year	Yes	Yes	Yes
Observations	1785	1189	4046
R2	0.933	0.959	0.975

The table reports the DID model results reported in Eq. (1). The dependent variables are senior unsecured debt ratio (column 1), subordinated debt (column 2), and bank deposit (column 3) ratios. The main variable of interest is the interaction variable (*Treated* × *Post*), which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US). Banks in the treatment and control groups have been obtained using PSM. We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

(Art. 5(a) 2014/49/EU directive). As shown in column 3 of Table 4, the bank deposits ratio declined to 1.70% (statistically significant at the 1% level) in the Euro area countries with respect to the US after the bail-in announcement. Due to the deposit insurance non application for the bank deposits, the sign of the treatment coefficient is opposite to that one of the customer deposits (Table 3). The results shown in Tables 3 and 4 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 relative to US banks.

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 underpinning idea is that the investors' expected returns increase more for riskier issuers, ceteris paribus, and consequently, riskier banks mostly finance their assets using deposits and fewer interest-bearing liabilities. The model arising from this piece of analysis is the following:

$$\begin{aligned} y_{i,t} = \quad & \beta_1 Treated \times Post + \beta_2 NPLratioQuartiles_{t-1} + \\ & + \beta_3 (NPLratioQuartiles_{t-1} \times Treated \times Post) + \beta_4 TotalAssets_{t-1} + \\ & + \beta_5 Equityratio_{t-1} + \beta_6 GDPgrowthrate_{t-1} + \beta_7 T - billrate_{t-1} + \\ & + \beta_8 Baselstage + \theta_i + \lambda_t + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where the dependent variables are the same as those in the baseline DID model in Eq. (1). The control variables remain the same as in Eq. (1) except for the risk control variable; we interacted the dummy of the treatment (*Treated* × *Post*) with the bank risk level proxied by the quartiles of NPL ratio ($NPLratioQuartiles_{t-1}$ × *Treated* × *Post*). All variables are described in Table B.I..

As shown in column 1 of Table 5, coefficient estimates for the treatment variable (*Treated* × *Post*) are not statistically significant for the two bank liabilities ratios, but the interaction of the treatment variable with the variable capturing bank risk ($NPLratioQuartiles_{t-1}$ × *Treated* × *Post*), is statistically significant at the 10% and 1% confidence levels for *customer deposits* and *other interest liabilities* ratios (Column 1 and 2), respectively.

This suggests that the change in bank liability mix, compared to the US control sample, caused by the new bail-in framework is different for riskier and financially sound banks. Our results support the hypothesis that riskier banks declined liabilities with lower legal protection more than financially sound banks; hence we claim that there is a difference in the shift from expensive toward cheaper liabilities among banks with different levels of risk (H2a) compared to US banks.

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:

$$\begin{aligned} y_{i,t} = \quad & \beta_1 (Treated \times Post) + \beta_2 TotalAssets_{t-1} + \beta_3 (TotalAssets_{t-1} \times Treated \times Post) + \\ & + \beta_4 NPLratio_{t-1} + \beta_5 Equityratio_{t-1} + \beta_6 GDPgrowthrate_{t-1} + \beta_7 T - billrate_{t-1} + \\ & + \beta_8 Baselstage + \theta_i + \lambda_t + \varepsilon_{i,t} \end{aligned} \tag{3}$$

Table 5
DID with the interaction of the treatment with risk.

	(1) y=	(2) y=
Dependent variable	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.008	0.018
	(0.014)	(0.012)
NPL ratio quartiles$_{t-1}$	−0.000	−0.003**
	(0.002)	(0.002)
NPL ratio quartiles$_{t-1}$ × Treated × Post	0.007*	−0.013**
	(0.004)	(0.003)
Total assets$_{t-1}$	−0.037***	0.025***
	(0.007)	(0.008)
Equity ratio$_{t-1}$	−0.232***	0.081*
	(0.087)	(0.048)
GDP growth rate$_{t-1}$	−0.046	0.017
	(0.081)	(0.108)
T-bill rate$_{t-1}$	−0.006***	0.001
	(0.001)	(0.001)
Basel stage	−0.020***	0.016***
	(0.004)	(0.004)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	5106	5106
R2	0.976	0.962

The table reports the results of the DID model reported in Eq. (2). The dependent variables are the customer deposits ratio (column 1) and other interest-bearing liabilities ratio (column 2). The main variable of interest is the interaction variable (NPL ratio quartiles ×*Treated* × *Post*): we interact the treatment variable (*Treated* × *Post*), which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US), with the risk proxied by the the quartiles of the NPL ratio (1-year lag). Banks in the treatment and control groups have been obtained using a PSM. We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

where dependent and control variables are the same as those in the baseline DID model in Eq. (1), except for the interaction with the bank size ($TotalAssets_{t-1} \times Treated \times Post$). All variables are described in Table B.I.

Once we take bank size into account, the coefficient estimates for the treatment variable (*Treated* × *Post*) are not statistically significant at the 10% confidence level or less (Table 6). 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 (*TotalAssets* × *Treated* × *Post*) are not statistically significant for either of the two liabilities ratios. Our results provide useful insights into the credibility of the bail-in framework and do not support the TBTF view (H3a), which is one of the main critical issues highlighted by the literature; additionally, our results do not support the hypothesis H3b (Too Big To Save issue). Hence, we can claim that banks' investors ask for greater yields after the bail-in announcement for all Euro area banks despite their size relative to US banks.

6.3. Robustness checks

To check the robustness of our findings, we run various robustness analyses. First, we drop the 2012 observations from our sample: the BRRD was publicly announced in June 2012, and hence, 2012 may be a confounding year because the Euro area banks are not treated in the first half but suddenly become treated in the second half of the year. Second, we assess the bail-in effect in core and peripheral Euro area countries since the sovereign debt crises greatly affected the latter. Finally, we account for the effect due to the MREL introduction.

6.3.1. The role of 2012

We ran the baseline model again (Eq. (1)), but omitted all 2012 observations. The BRRD proposal was in June 2012, and consequently, Euro area 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 7, our results are strongly consistent with the results of the baseline model (Table 3). All coefficient estimates for the treatment variable (*Treated* × *Post*) are statistically significant at the 1% confidence level, for both dependent variables, and their magnitude (3.3% for customer deposits ratio and − 1.9% for other interest-bearing liabilities ratio) fully confirms our hypothesis (H1) that Euro area banks reduced riskier (and more expensive) securities with respect to legally protected instruments relative to US banks.

6.3.2. 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 treated group between countries where the crisis was more severe (labeled as "peripheral countries" including Greece, Ireland, Italy, Portugal, and Spain) and less severe (labeled as "core countries" including the remaining Euro area countries). Tables 8 and 9 report the results. In Table 8, we restrict the sample to using only the

Table 6
DID with the interaction of the treatment with size.

	(1) y=	(2) y=
Dependent variable	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.016	−0.020
	(0.014)	(0.014)
Total $assets_{t-1}$	−0.033***	0.022***
	(0.007)	(0.008)
Total $assets_{t-1}$ × Treated × Post	0.001	−0.001
	(0.001)	(0.002)
NPL $ratio_{t-1}$	0.196***	−0.208***
	(0.064)	(0.074)
Equity $ratio_{t-1}$	−0.206**	0.055
	(0.089)	(0.048)
GDP growth $rate_{t-1}$	−0.067	0.041
	(0.082)	(0.106)
T-bill $rate_{t-1}$	−0.006***	0.001
	(0.001)	(0.001)
Basel stage	−0.017***	0.015***
	(0.004)	(0.004)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	5106	5106
R2	0.976	0.962

The table reports the results of the DID model reported in Eq. (3). The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. The main variable of interest is the interaction variable (Total assets ×*Treated* × *Post*): we interact the treatment variable (*Treated* × *Post*), which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks before 2013 and for banks in the control group (the US), with the size measured by the total assets (natural logarithm). Banks in the treatment and control groups have been obtained using a PSM. We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

Table 7
Bank funding mix after the launch of the bail-in framework (excluding 2012 yearly observations).

	(1) y=	(2) y=
Dependent variable	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.033***	−0.019***
	(0.006)	(0.006)
Total assets$_{t-1}$	−0.039***	0.025***
	(0.007)	(0.009)
NPL ratio$_{t-1}$	0.153**	−0.187**
	(0.070)	(0.079)
Equity ratio$_{t-1}$	−0.258**	0.056
	(0.101)	(0.051)
GDP growth rate$_{t-1}$	−0.021	0.068
	(0.094)	(0.120)
T-bill rate$_{t-1}$	−0.007***	−0.001
	(0.002)	(0.002)
Basel stage	−0.014***	0.020***
	(0.005)	(0.005)
FE:firm	Yes	Yes
FE:year	Yes	Yes
Observations	4120	4120
R-squared	0.974	0.962

The table reports the results of the DID model reported in Eq. (1). The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. We exclude from the sample observations of 2012 to control for confounding effects because the BRRD was at the end of June 2012, hence the treated group in 2012 was partially treated. The main variable of interest is the interaction variable (*Treated* × *Post*), which equals 1 for Euro area banks between 2013 and 2015 and 0 for all banks in 2011 and for banks in the control group (the US). Banks in the treatment and control groups have been obtained using a PSM. We include the time fixed effect and bank fixed effect. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

peripheral Euro area countries vs. the US. In Table 9, our sample includes the remaining Euro area 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 liability mix. Both peripheral Euro area countries (Table 8) and core Euro area countries (Table 9) increased their reliance on customer deposits and declined the more expensive liabilities. This is consistent with the main findings and grant robustness to the results in Table 3. However, by

Table 8
Bank funding mix after bail-in in peripheral Euro area countries.

	(1) y=	(2) y=
Dependent variable	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.026***	−0.043***
	(0.006)	(0.009)
Total assets$_{t-1}$	0.026***	0.018**
	(0.007)	(0.009)
NPL ratio$_{t-1}$	0.284***	−0.115
	(0.093)	(0.086)
Equity ratio$_{t-1}$	−0.282***	0.041
	(0.101)	(0.056)
GDP growth rate$_{t-1}$	−0.037	0.043
	(0.153)	(0.220)
T-bill rate$_{t-1}$	−0.001***	0.002
	(0.001)	(0.001)
Basel stage	−0.014**	0.024***
	(0.006)	(0.007)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	3989	3989
R2	0.971	0.949

The table reports the results of the DID model reported in Eq. (1). The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. The main variable of interest is the interaction variable (*Treated* × *Post*), 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). Banks in the treatment and control groups have been obtained using a PSM. We include the time fixed and bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

Table 9
Bank funding mix in core Euro area countries.

	(1) y=	(2) y=
Dependent variable	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.031***	−0.006**
	(0.005)	(0.003)
Total assets$_{t-1}$	−0.025***	0.032***
	(0.007)	(0.007)
NPL ratio$_{t-1}$	0.116*	−0.073
	(0.068)	(0.062)
Equity ratio$_{t-1}$	−0.259***	−0.006
	(0.092)	(0.046)
GDP growth rate$_{t-1}$	−0.048	0.147***
	(0.090)	(0.055)
T-bill rate$_{t-1}$	−0.007	−0.002
	(0.005)	(0.002)
Basel stage	−0.018***	0.014***
	(0.006)	(0.004)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	4241	4241
R2	0.976	0.968

The table reports the results of the DID model reported in Eq. (1). The dependent variables are the customer deposits ratio (column 1) and other interest-bearing liabilities ratio (column 2). The main variable of interest is the interaction variable (*Treated* × *Post*), which equals 1 for banks in the Euro area 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). Banks in the treatment and control groups have been obtained using a PSM. We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

comparing the results of Tables 8 and 9, we can notice that the peripheral Euro area countries mostly declined the other interest-bearing liabilities (−4.30%) relative to the decline committed by the core Euro area countries (−0.60%). This is consistent with the severity of sovereign debt crises in peripheral Euro area countries. Overall, this confirms that our results are not related to some Euro area countries; rather, the bail-in effect on the bank funding mix was common to all Euro area countries.

Table 10
Bank funding mix after MREL effectiveness.

	(1) y=	(2) y=
Dependent variable	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.067***	−0.062***
	(0.016)	(0.014)
Total assets$_{t-1}$	−0.022***	0.013*
	(0.008)	(0.007)
NPL ratio$_{t-1}$	0.236**	−0.090
	(0.104)	(0.067)
Equity ratio$_{t-1}$	−0.433***	−0.028
	(0.127)	(0.060)
GDP growth rate$_{t-1}$	0.152**	−0.206***
	(0.061)	(0.076)
T-bill rate$_{t-1}$	−0.015***	0.011**
	(0.004)	(0.005)
Basel stage	−0.072***	0.061***
	(0.018)	(0.015)
FE: firm	Yes	Yes
FE: year	Yes	Yes
Observations	3892	3892
R2	0.975	0.970

The table reports the results of the DID model reported in Eq. (1). The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. The sample goes from 2015 to 2018 to capture the effect of the MREL introduction. The main variable of interest is the interaction variable (*Treated* × *Post*), which equals 1 for Euro area banks in 2017 and 2018 and 0 for Euro area banks before 2017 and for banks in the control group (the US). Banks in the treatment and control groups have been obtained using a PSM. We include the time and bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

6.3.3. Confounding events: The minimum requirement for own funds and eligible liabilities (MREL)

The BRRD introduced the new bail-in resolution regime and a minimum requirement of the amount of "bailinable" liabilities (labeled as minimum requirement for own funds and eligible liabilities, MREL). The MREL imposes banks to hold a minimum amount of equity and subordinated debt (meeting specific conditions) with an expiration date after January 1, 2017. The MREL requirement might limit the shift from more expensive bank liabilities relative to customer deposits (less expensive sources of funding). If banks are required to hold enough senior and subordinated unsecured bonds (bailinable securities), they could not reduce too much the amount of other interest-bearing liabilities; hence, we might expect the MREL introduction from 2017 to limit the effects found in the main analysis.

To check whether the introduction of the MREL regulation limits the change in bank liability mix (previously discussed) we ran our baseline DID model (Eq. (1)) by setting the treatment period 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. As shown in Table 10, the customer deposits ratio (column 1) increased, relative to the control sample, and other interest-bearing liabilities ratio (column 2) decreased, consistent with our main findings in Table 3. This shows that the MREL requirement did not limit the effect of the bail-in introduction on the change in banks' liability mix.

7. Alternative identification results

In this section, we present results for our alternative identification in which we restrict our analysis to Euro area banks only. The underpinning idea is that new bail-in regulation does not affect sound banks but only risky banks. First, we posit that banks' investors can screen banks' soundness, and thus we compare banks with a loan portfolio of poor quality (*Treated* = 1) with those with high quality (*Treated* = 0). As shown in Table 11, the coefficient estimates for our main variable of interest (*Treated* × *Post*) are strongly consistent with the main results in Table 3. Risky banks increased cheaper liabilities (customer deposits ratio) by 1% and decreased expensive liabilities by 2.3% relative to financially sound banks in the Euro area.

Second, we consider the case that banks' investors may be unable to screen banks' riskiness but realize adverse consequences of the new resolution regime only when one or more bail-in cases occur in their country; thus, we compare banks in countries that experienced bail-in cases (*Treated* = 1) with those in countries that did not (*Treated* = 0). As shown in Table 12, (*Treated* × *Post*) coefficient estimates are consistent with the main results in Table 3. Banks in Euro area countries that experienced a bail-in case increased the cheaper liabilities (customer deposits) and decreased more expensive liabilities (other interest-bearing liabilities) relative to the banks in Euro area countries that did not use investors' money to cover bank losses.

Overall, the results obtained focusing on Euro area banks further grant robustness to our main results that do not appear sensitive to the selection of the control group (US banks).

Table 11
First alternative identification based on the impairment loans ratio.

	(1) y=	(2) y=
	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.010**	−0.023***
	(0.004)	(0.004)
Total $assets_{t-1}$	−0.093***	0.041**
	(0.016)	(0.016)
Equity $ratio_{t-1}$	−0.088	0.068
	(0.126)	(0.121)
GDP growth $rate_{t-1}$	−0.159*	0.137
	(0.082)	(0.089)
T-bill $rate_{t-1}$	−0.007***	0.001
	(0.001)	(0.001)
Basel stage	0.017	−0.013
	(0.015)	(0.015)
FE: Year	Yes	Yes
FE: Firm	Yes	Yes
Observations	4811	4811
R2	0.964	0.965

The table reports the results of the DID model reported in Eq. (1) using a sample restricted to Euro Area banks. The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. The treated group (*Treated* = 1) includes the risky banks in the Euro area, those in with the highest levels of impairment loans ratio (third and fourth quartiles). The control group (*Treated* = 0) includes financially sound banks, those with the lowest levels of impairment loans (first and second quartiles). The *Post* variable represents time, which is equal to 1 between 2013 and 2015 and 0 before 2013. The main variable of interest is the interaction variable (*Treated* × *Post*), the interaction between *Treated* and *Post*. The other independent variables are the ones described in the model, excluding NPL ratio being the variable used to form the treated and control groups (*Treated* dummy). We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

Table 12
Second alternative identification based on the bail-in experience.

	(1) y=	(2) y=
	Customer Deposits ratio	Other interest liabilities ratio
Treated × Post	0.019**	−0.044***
	(0.010)	(0.012)
Total assets$_{t-1}$	−0.072***	0.069***
	(0.022)	(0.019)
NPL ratio$_{t-1}$	0.187**	−0.152
	(0.075)	(0.096)
Equity ratio$_{t-1}$	0.019	0.048
	(0.137)	(0.094)
GDP growth rate$_{t-1}$	−0.130	0.031
	(0.090)	(0.071)
T-bill rate$_{t-1}$	−0.004**	−0.001
	(0.002)	(0.001)
Basel stage	−0.011	0.001
	(0.015)	(0.014)
FE: Year	Yes	Yes
FE: Firm	Yes	Yes
Observations	3137	3137
R2	0.972	0.974

The table reports the results of the DID model reported in Eq. (1) using a sample restricted to Euro area banks. The dependent variables are the customer deposits (column 1) and other interest-bearing liabilities (column 2) ratios. The treated group (*Treated* = 1) includes the banks located in Spain, The Netherlands, Portugal, and Austria because they experienced at least one case of bail-in application following a bankruptcy. The control group (*Treated* = 0) includes the banks located in the remaining Euro area countries, except for Greek and Italian banks (out of the sample) because they experienced bank resolutions via both bail-in and bailout. The *Post* variable represents the time of the treatment, which is equal to 1 between 2013 and 2015 and 0 before 2013. The main variable of interest is the interaction variable (*Treated* × *Post*), the interaction between *Treated* and *Post*. We include the time and the bank fixed effects. The GDP growth rate also captures country-year fixed effects. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect, OECD and BCBS data.

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 a historic event for European banking. Since 2016, no bailout could be implemented by any Euro area government 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 average, Euro area 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 role of the risk and of size of the change in the bank liabilities mix. We found that riskier Euro area banks mostly declined the more expensive sources of funding relative to financially sound Euro area banks; moreover, investigating the TBTF issue, the implemented 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 sufficiently credible despite the dimension of the banks. Our results are robust to various robustness checks and alternative identifications.

Our 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. Moreover, the decrease in the more expensive liabilities was not limited by the introduction of the MREL (prescribed by the same directive).

Appendix A. Different banking regulatory reforms in Europe and the US

During the period analyzed in this paper (2011–2015), there have been other 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 or 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 essentially affects 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 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. Moreover, we argue that the announcement of LCR was in 2010, three years before the bail-in announcement; moreover, as shown in Table B.II, 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 promptly implemented the rules. 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 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 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 Euro area 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 the case of a troubled bank is different between the Euro area (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 mainly composed mainly of banks under this threshold (93% of US banks).

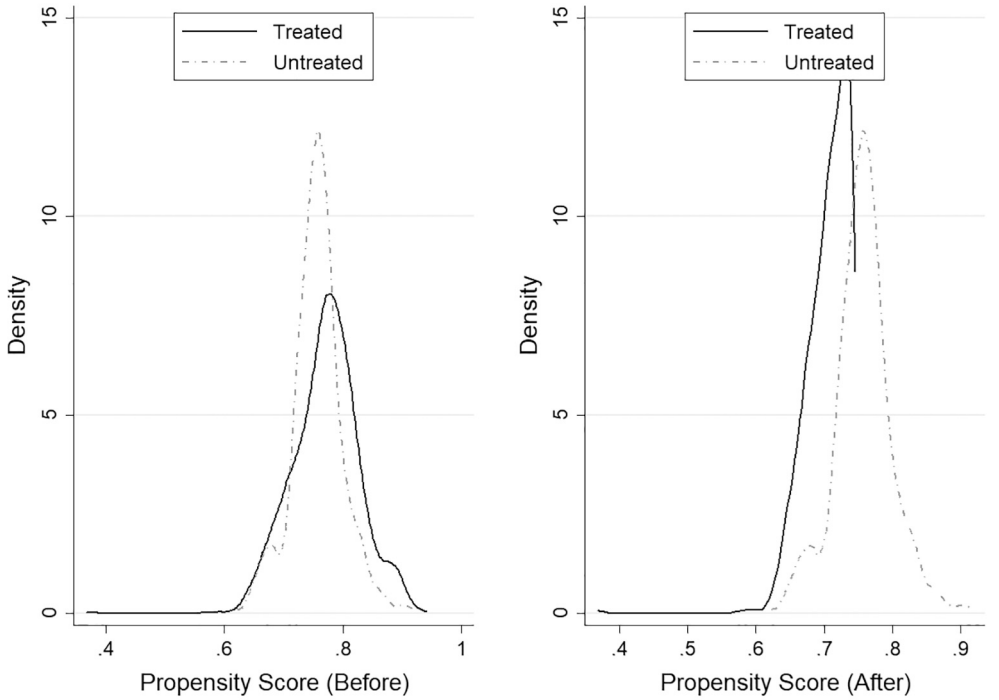

Fig. A.I. Propensity score matching.
The chart plots the kernel density and propensity score of the sample before and after implementing the matching. In the right panel (after matching), the treated curve stops because, in the beginning, the sample has 5000 treated banks and 1150 controls; the matching 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. Source: authors' production using Fitch Connect data.

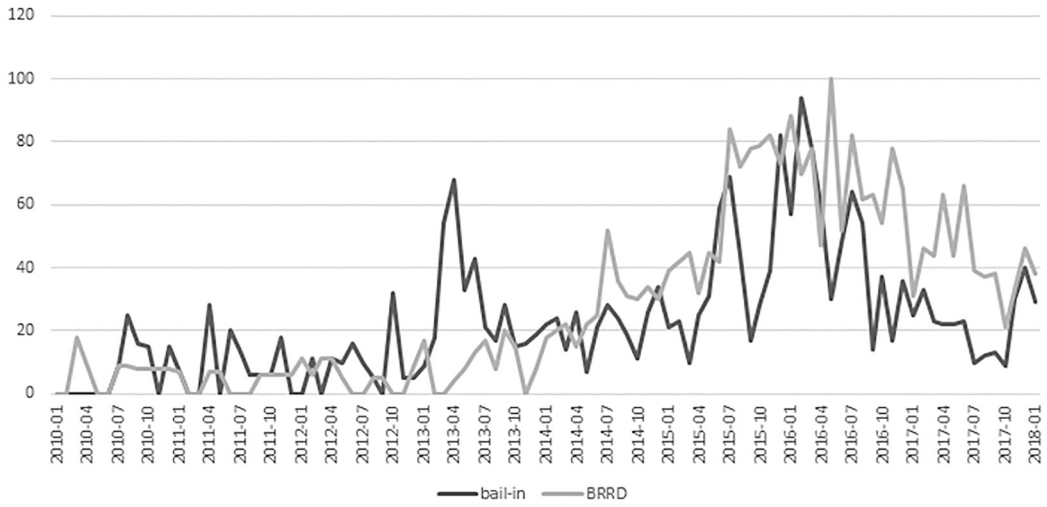

Fig. A.II. Google researches.
The chart shows the number of the research via Google on the words"bail-in" and"BRRD" from 2010 to 2018. The vertical axis represents the number of research relative to the highest point in the chart. The countries included in the analysis, reported here in order of number of research as mean during the period reported, are: Cyprus, Italy, Switzerland, Austria, Greece, Portugal, Belgium, Hong Kong, Canada, United Kingdom, Romania, Germany, Sweden, The Netherlands, France, Australia, Poland, Belarus, United States of America, Spain, Russia, United Arab Emirates, Ukraine, and India.The bail-in research reaches its first peak in April 2013. This chart confirms that the treatment year used in the analysis (e.g., 2013) is compliant and avoids further anticipation behavior. Source: Google trends.

Appendix B. Additional tables

Table B.I
Variable definitions.

Variable	Acronym	Definition and calculation method
Bank deposit ratio*	Bank Deposits Ratio	Bank deposits over total assets.
Basel Stage Implementation^{+}	Basel Stage	A categorical variable capturing the stage of the Basel capital standard implementation ranging between 1 (the draft was not yet published) and 4 (rule in force).
Customer Deposits Ratio*	Customer Deposits ratio	Customer deposits over total assets.
Equity ratio*	Equity ratio	Total equity over total assets.
GDP growth rate	GDP growth rate	GDP growth rate.
NPL Ratio*	NPL Ratio	Impairment loans over total assets
NPL Ratio Quartiles	NPL Ratio Quartiles	The quartiles of the NPL Ratio
Other interest-bearing liabilities*	Other interest liabilities ratio	(Total liabilities less total deposits) over total assets.
Return on Equity*	ROE	Return on equity is calculated as operating income over total assets.
Senior unsecured debt ratio*	Senior unsecured debt ratio	Senior unsecured debt over total assets
Subordinated debt ratio *	Subordinated debt ratio	(Total liabilities less total deposits, and senior unsecured debt) over total assets.
Treatment period	Post	A dummy taking the value of 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 units	Treated	A dummy taking the value of 1 for all banks in the Euro area and 0 otherwise

This table reports the variables' definitions and calculations. Growth rates are calculated as follows: $(x_t - x_{t-1})/x_{t-1}$. Source of data: (*) Bank Focus; ($^{+}$) Basel Committee on Banking Supervision, Monitoring Report,1st-15th editions; OECD database.

Table B.II
Testing the parallel trends assumption: Dependent variables

A: Customer deposits growth rate			
Year	Mean controls	Mean treated	Difference controls vs. treated
2010	0.022	0.020	0.002
2011	0.009	0.000	0.009
2012	0.019	0.025	−0.006
2013	0.004	0.043	−0.040***
2014	−0.004	0.013	−0.017***
2015	0.003	0.032	−0.029***
B: Other interest liabilities growth rate			
2010	0.091	0.028	0.063
2011	0.066	0.116	−0.050
2012	0.063	−0.012	0.074
2013	0.06	−0.066	0.126***
2014	−0.057	−0.026	−0.030
2015	0.132	−0.059	0.191***

The table compares the mean values of customer deposits (Panel A) and other interest-bearing liabilities ratio growth rates (Panel B) annually. We report the means and the differences of treated banks (Euro area) and controls (the US); 2010, 2011, and 2012 refer to the differences before the announcement (parallel trend); 2013, 2014, and 2015 refer to the period post-treatment period. Banks in the treatment and control groups have been obtained using a PSM. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect.

Table B.III
Testing the significance of independent variables

Variable	Mean controls	Mean treated	Difference controls vs. treated
Total assets (ln)	7.585	9.203	−1.617***
NPL ratio	0.022	0.067	−0.044***
Equity ratio	0.103	0.082	0.021***
GDP growth rate	0.032	0.021	0.011***
T-bill rate	2.293	4.612	−2.318***
Basel stage	2.501	3.141	−0.640***

The table compares the mean values of independent variables used in model 1. The t student test reports the means and the difference of treated banks (Euro area) and controls (the US) in the pre-treatment period (e.g., before 2013). Banks in the

treatment and control groups have been obtained using a PSM. ***, **, and * indicate the significance at the 1%, 5%, and 10% levels, respectively. Source of data: Fitch Connect and OECD.

References

Allen, F., Santomero, A.M., 1997. The theory of financial intermediation. J. Bank. Financ. 21, 1461–1485.
Berger, A.N., Roman, R.A., Sedunov, J., 2016. Do bank bailouts reduce or increase systemic risk? the effects of tarp on financial system stability. In: Federal Reserve Bank of Kansas City Working Paper, 16.
Bernard, B., Capponi, A., Stiglitz, J.E., 2017. Bail-Ins and Bail-Outs: Incentives, Connectivity, and Systemic Stability. NBER Working Paper.
Bhattacharya, S., Thakor, A., 1993. Contemporary banking theory. J. Financ. Intermed. 3, 2–50.
Boehmer, E., Jones, C., Zhang, X., 2020. Potential pilot problems: treatment spillovers in financial regulatory problems. J. Financ. Econ. 135, 68–87.
Bossu, W., Dobler, M.M.C., Jassuad, N., Moore, M., Rutledge, V.S., Zhou, J., 2012. From bail-out to bail-in: mandatory debt restructuring of systemic financial institutions. IMF Staff Discussion Note. IMF.
Bouwman, C.H.S., Hu, S.S., Johnson, S.A., 2017. Differential bank behaviors around the dodd frank act size thresholds. J. Financ. Intermed. 34, 47–57.
Brown, M., Evangelou, I., Stix, H., 2017. Banking Crises, Bail-Ins and Money Holdings. Central Bank of Cyprus Working Paper.
Calomiris, C.W., Kahn, C.M., 1991. The role of demandable debt in structuring optimal banking arrangements. Am. Econ. Rev. 81, 497–513.
Crespi, G., Mascia, D.V., 2018. Bank funding strategies: The use of bonds and the bail-in effect. Palgrave Macmillan Studies.
Cutura, J.A., 2018. Debt holder monitoring and implicit guarantees: Did the brrd improve market discipline?. In: SAFE Working Paper Series, 232.
Damtsa, S.M., Milidonis, A., Stathopoulos, K., 2021. National culture and bank deposits. Rev. Corp. Fin. 1, 181–221.
Demirguc-Kunt, A., Huizinga, H., 2013. Are banks too big to fail or too big to save? international evidence from equity prices and cds spreads. J. Bank. Financ. 37, 875–894.
Diamond, D.W., 1984. Financial intermediation and delegated monitoring. Rev. Econ. Study 51, 393–414.
Diamond, D.W., Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity. J. Polit. Econ. 91, 401–409.
Dudley, E., Yin, Q.E., 2018. Financial distress, refinancing, and debt structure. J. Bank. Financ. 94, 185–207.
European Union, 2014. Directive 2014/49/eu of the European Parliament and of the Council of 16 April 2014 on Deposit Guarantee Schemes, Technical report.
Fiordelisi, F., Ricci, O., Stentella Lopes, F.S., 2017. The unintended consequences of the launch of the single supervisory mechanism in Europe. J. Financ. Quant. Anal. 52, 2809–2836.
Fiordelisi, F., Minnucci, F., Previati, D., Ricci, O., 2020a. Bail-in regulation and stock market reaction. Econ. Lett. 186, 108801.
Fiordelisi, F., Ricci, O., Pennacchi, G., 2020b. Are contingent convertibles going-concern capital? J. Financ. Intermed. 43, 100822.
Flannery, M.J., Sorescu, S.M., 1996. Evidence of bank market discipline in subordinated debenture yields: 1983-1991. J. Financ. 51, 1347–1377.
Francis, B., Hasan, I., Liu, L., Wanh, H., 2019. Senior debt and market discipline: Evidence from bank-to-bank loans. J. Bank. Financ. 98, 170–182.
Giuliana, R., 2019. Impact of Bail-In on Banks' Bond Yields and Market Discipline. Working paper available at SSRN.
Goedde-Menke, M., Langer, T., Pfingsten, A., 2014. Impact of the financial crisis on bank run risk-danger of the days after. J. Bank. Financ. 40, 522–533.
Goyal, V.K., 2005. Market discipline of bank risk: Evidence from subordinated debt contracts. J. Financ. Intermed. 14, 318–350.
Granja, J., Leuz, C., 2017. The Death of a Regulator: Strict Supervision, Bank Lending and Business Activity. NBER Working Papers.
Gropp, R., Mosk, T., Ongena, S., Wix, C., 2018. Banks response to higher capital requirements: Evidence from a quasi-natural experiment. Rev. Financ. Stud. 32, 266–299.
Ignatowski, M., Korte, J., 2014. Wishful thinking or effective threat? tightening bank resolution regimes and bank risk-taking. J. Fin. Stability Paper 15, 264–281.
Imai, M., 2006. Market discipline and deposit insurance reform in japan. J. Bank. Financ. 30, 3433–3452.
ISDA, 2016. Isda brrd implementation monitor, (5th edition). available at: https://www.isda.org/a/ygide/icm-24590303-v6-isda-brrd-implementation-monitor-5th-edition.pdf. (Technical report).
Kim, D., Santomero, A.M., 1988. Risk in banking and capital regulation. Am. Econ. Rev. 80, 1183–1200.
Pancotto, L., Gwilym, O., Williams, J., 2019. The european bank recovery and resolution directive: A market assessment. J. Financ. Stab. 44.
Pigrum, C., Reininger, T., Stern, C., 2016. Bail-in: who invests in noncovered debt securities issued by euro area banks? Fin. Stab. Rep. 32, 101–119.
Rajan, A., Winton, R., 1995. Covenants and collateral as incentives to monitor. J. Financ. 50, 1113–1146.
Schafer, A., Schnabel, I., di Mauro, B.W., 2016. Bail-in Expectations for European Banks: Actions Speak Louder than Words. ESRB Working Paper Series.
Stiglitz, J.E., Weiss, A., 1981. Credit rationing in markets with imperfect information. Am. Econ. Rev. 71, 393–410.
Thakor, A.V., 1996. Capital requirements, monetary policy, and aggregate bank lending: Theory and empirical evidence. J. Financ. 51, 279–324.
Wette, H.C., 1983. Collateral in credit rationing in markets with imperfect information: Note. Am. Econ. Rev. 73, 442–445.
Zeldow, B., Hatfield, L.A., 2019. Confounding and regression adjustment in difference-in-differences studies. Diff. Diff. Stud. 56 (5), 932–941.
Zheng, X., Guedhami, O., Ghoul, S., Kwok, C.C.Y., 2012. National culture and corporate debt maturity. J. Bank. Financ. 36, 468–488.