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Fluctuating bail-in expectations and effects on market discipline, risk-taking and cost of capital

by
Raffaele Giuliana

ESRB
European Systemic Risk Board
European System of Financial Supervision

Abstract

Through the compulsory participation of junior investors in bearing losses of their failing bank, the bail-in attempts to limit bail-outs' side-effects in terms of market discipline, too-big-to-fail, bank-sovereign nexus and risk-taking. This paper assesses the consequences of bail-in expectations along these dimensions ensuring – through a bond pricing study – that bail-in expectations are not confounded by other factors. Using hand-collected details of EU bail-in events, I study both positive and negative exogenous shocks to bail-in expectations, offering three sets of findings. First, bail-in events can reinforce (or weaken) bail-in expectations, as shown by Khwaja-Mian tests (validated by placebo analyses). Second, bail-in expectations promote market discipline, and mitigate too-big-to-fail and bank-sovereign nexus. Third, bail-in effects on bank resilience appear mixed. While it incentivises banks to reduce risk-taking (e.g., increasing risk-weighted equity by a third of Basel III requirement), it also remarkably exacerbates total funding costs through an increase in equity cost (partially off-set by a debt cost reduction).

Keywords: Bail-in, Fixed-income Claims, Expectations, Rating, Market Discipline, Risk-taking, Cost of Capital, Financial Stability
JEL codes: G21, G28, H81, C23

Introduction

During the Global Financial Crisis and the European Debt Crisis, due to the lack of a resolution policy offering a credible alternative to bail-outs or liquidations, bank fragilities were addressed with unprecedentedly expensive bail-outs.[1] Research shows that bail-out expectation can have remarkably detrimental side-effects for financial stability. It exacerbates the issues that had pushed the financial system to the brink of collapse in the first place: low of market discipline, too-big-to-fail, excessive risk-taking and bank-sovereign nexus (Acharya et al. (2016); Dam and Koetter (2012); Brunnermeier et al. (2016); Laeven and Levine (2009)). However, within the former resolution policy, the absence of bail-outs would have likely triggered financial instability, as it would have probably led to disorderly liquidations of large banks with widespread adverse consequences (Philippon and Salord (2017); Bernanke (1983); Calomiris and Mason (2003)).

To prevent an extremely harmful repeat of such "lose-lose" scenario in which both options – bail-out or liquidation – would have caused damaging side-effects for financial stability, major regulators across the globe promoted a regime shift in bank resolutions.[2] The reform entailed a move from bail-out to bail-in expectations by transferring the burden of a failing bank's resolution from *outside* stakeholders (most notably taxpayers) to its *internal* ones. The European bail-in principle - since the first EU-level proposal (i.e., EU Commission's proposal 280/2012) - consisted in the compulsory participation of junior investors (i.e., unsecured debtholders and shareholders) in bearing resolution costs of their own bank when declared as "failing or likely to fail" by resolution authorities.[3] By introducing the bail-in principle authorities

[1] Bail-outs generated large costs for taxpayers and an escalation of banks' moral hazard. ECB (2015) illustrates that, between 2008 and 2014, Euro area's governments disbursed 8% of GDP, of which only 40% has been recovered before 2015. As a result, the three largest E.U. economies - Germany, U.K. and France - approved guarantees for 16%, 30% and 15% of their GDP (EU Commission State Aid Scoreboard (2012)). Concerning the escalation of moral hazard, Acharya et al. (2016) show that bail-outs in the U.S. weakened market's incentives to monitor banks.

[2] For instance, the US Congress, the FSB and the EU Commission promoted the introduction of the bail-in principle. In 2010, the US Congress approved the "Dodd-Frank Wall Street Reform and Consumer Protection Act". In 2011, the FSB contributed with the document "Key Attributes of Effective Resolution Regimes for Financial Institutions". In 2012, the EU Commission reached political agreement on the introduction of the new resolution regime through the EU Commission's proposal 280/2012.

[3] The EBA defines the "failing or likely to fail" status in the 2015 document "Guidelines on the circumstances under which an institution shall be considered as failing or likely to fail". The competent resolution authorities should

committed ex-ante to rigorously limit bail-outs, given that the participation of junior investors must be imposed as a pre-condition for external support.[4]

This paper addresses two main questions in the European context. Did the bail-in introduction induce a repricing of banks' bonds? Are bail-in expectations effective in addressing typical side-effects of bail-out expectations?

As to the first question, I assess whether – and how – the key events in the bail-in introduction in the EU influenced bondholders' expectation that resolution authorities will opt for bail-in rather than bail-out in future bank distresses. As to the second one, it is crucial to assess the effects of bail-in expectation along dimensions related to market discipline and resilience, especially if we consider that the bail-in was introduced to limit side-effects of bail-out expectation along similar dimensions. I show that bail-in expectation addresses banks' weak market discipline and other issues. However, its effect on bank-level resilience appears mixed: while it induces banks to reduce risk-taking (e.g., increasing their equity by a third of Basel III requirement), it also remarkably amplifies funding costs.

Addressing these two main questions, this paper provides a suite of contributions to the literature. Overall, it assesses the impact of bail-in expectations on bank-level risk-taking, funding costs and other key variables ensuring - through a bond pricing study - that bail-in expectations actually reflect the legal specificity of the bail-in. Identifying bail-in expectation shocks with a bond pricing study allows me to address two main empirical challenges. First, a simple *unconditional* examination of bank-level reactions in response to bail-ins would be largely capturing the generalised banking distress correlated to bank crises. An ad-hoc remedy could be an unconditional examination of bank reactions in response to bail-in law approvals, since these events are arguably less associated to banking distress. However, this would not address the second

determine that: (i) an institution infringes, or is likely to infringe in the near future, the requirements for continuing authorisation in a way that would justify the withdrawal of its authorisation by the competent authority, including but not limited to because it has incurred or is likely to incur losses that will deplete all or a significant amount of its own funds; (ii) an institution's assets are, or there are objective elements to support a determination that its assets will be, in the near future, less than its liabilities; (iii) an institution is, or is likely to be in the near future, unable to pay its debts or other liabilities as they fall due.

[4] External support can be in the form of direct state-aids or support from resolution funds financed by governments or other banks.

challenge: legislative approvals of a resolution reform encouraging a *no-bail-out principle* - such as the bail-in - might not be a relevant event to empirically investigate because its approval might not meaningfully update expectations of economic agents. Theory and data suggest that approvals of no-bail-out policies do not decisively dissipate the uncertainties about a government's commitment to enforce the no-bail-out policy ex-post, during bank crises.[5] In line with the literature on resolution's time-inconsistency problem, severe risks of immediate financial instability disincentivises a government to enforce a no-bail-out policy ex-post even if it committed to such policy (e.g., through legislative approvals), which is ex-ante optimal. Shapiro and Skeie (2015) show that the ex-post enforcement of no-bail-out policies, albeit expensive for society, serves the crucial function of the costly signal that allows a government to build its reputation as a regulator committed not to bail-out.

To deal with these challenges, this paper calculates *conditional* bail-in expectation shocks in response to a set of bail-in events including *both applications of bail-in and legislative approvals of the reform*.[6] The study of these instances required the hand-collection of detailed information on the bail-in events occurring in the EU from 2012 to 2017. The EU provides a unique context for this analysis because of its long and non-monotonic sequence of resolution decisions demarking a gradual regime shift from bail-outs to bail-ins. Due to the non-monotonic nature of the shift, this paper can assess effects of both positive and negative bail-in expectation shocks on bank variables that are relevant for financial stability. In addition to the use of conditional expectations, the exogeneity of the shocks is warranted also by the exclusion of bailed-in banks from the sample.[7]

[5] The empirical evidence in Schäfer et al. (2016) supports the rationale for studying cases of applications of bail-in principle, rather than legislative approvals. This result is in line with the mechanisms examined by the theoretical literature on time-inconsistency problems of bank resolution policies, which includes: Bagehot (1873), Gale and Vives (2002), Acharya and Yorulmazer (2007), Diamond and Rajan (2012), Nosal and Ordonez (2016), Keister (2016) and Bianchi and Mendoza (2018).

[6] Bail-in expectations are conditional on bank-level reactions to bail-in events in the sense that the identification comes from the comparison of reactions (to bail-in) of bailinable and non-bailinable bonds issued by the same bank. This identification is inspired by Khwaja and Mian (2008).

[7] They are excluded because their investors in some cases influence governments' decisions regarding the terms of the bail-in, including the extent of public injections.

The paper is constituted by three main modules. The first one ensures that announcements classified as bail-in events actually influence bail-in expectations and that the test does not reflect confounding factors. This assessment is relevant because: (i) it is instrumental for analyses in this paper; (ii) it contributes to the debate about bail-in's credibility by showing that, although European authorities' actions were stringent enough to build significant bail-in expectations at aggregate level, certain events might warn about possible fluctuations in expectations.[8] Empirical specifications in this module are based on a key distinctive feature of the bail-in: since its inception, the EU legislation has always unambiguously excluded secured debt from the set of claims potentially exposed to bail-in (EU Commission proposal 280/2012).[9] Therefore, in line with the Merton-model of Chan-Lau and Oura (2016), the growth of bail-in expectations implies an increase in the yield differential between unsecured bonds - which are exposed to bail-in risk, and thus *bailinable* - and secured bonds - which are explicitly excluded from bail-ins, and thus *non-bailinable*. Hence, to assess if events increase bail-in expectations, I test whether they increase such yield differential, also referred to as the *within-bank bail-in yield spread* in this paper, or simply the *yield spread*. The identification of expectations is mainly based on the comparison of reactions of bailinable and non-bailinable bonds issued by the same bank. This controls for confounding factors, such as monetary or fiscal policies, or a generalised banking distress possibly correlated with the resolution of a large bank. Figure 1 represents the graphical intuition behind this test, with the yields of unsecured and secured bonds around the bail-in events.[10] Figure 1 corroborates the pre-event parallel trend assumption and shows that the yield spread increases on the day

[8] Hadjiemmanuil (2015) describes the vast legal discretion affecting bail-in decisions and identifies it as the critical determinant of the credibility problem. The theory of Walther and White (2020) points out that regulators with sufficient discretion tend to apply remarkably weak bail-ins in order to avoid revealing adverse information and triggering bank runs. Philippon and Salord (2017) consider the credibility as the primary challenge for the bail-in regime because the BRRD gives authorities the right to impose bail-ins with very large flexibility. The success of the bail-in to effectively resolve banks depends on whether bondholders and equityholders perceive it as credible (Huertas (2016)). Other elements on this debate are discussed by Enria (2015) and Ignatowski and Korte (2014).

[9] Secured debt is not the only class excluded from bail-in, but it is the one that is suited for the econometric investigation as it is endowed with standardised pricing data. The EU Commission proposal 280/2012 explains that: "There are some liabilities that would be excluded ex-ante (such as secured liabilities, covered deposits and liabilities with a residual maturity of less than one month). Exceptionally and where there is a justified necessity to ensure the critical operations of the institution and its core business lines or financial stability (Article 38) the resolution authority could exclude derivatives' liabilities."

[10] More precisely, the figure shows the average yield change with respect to the twelve days before the average bail-in event.

of the announcements (there is also a remarkable 2-days anticipation effect, which is considered the empirical tests). Hence, law approvals and specific applications of bail-in induce a widespread bond repricing at aggregate level suggesting heightened expectations.

To empirically test this causality link, I implement a cross-liabilities within-bank difference-in-differences framework, which represents a rather novel application of the identification strategy of the seminal Khwaja-Mian (or KM) approach.[11] Events indicating an increased commitment to bail-in significantly raise the yield spread, both statistically and economically. Moreover, less severe applications of the new resolution regime decrease bail-in expectations. Two types of evidence confirm the ability of the conditional responses not to be significantly driven by widespread banking distress.[12]

The second module explores whether bail-in generates the financial market effects envisaged by policymakers along three lines: an increase in market discipline (Lewrick et al. (2019); Cutura (2018); Neuberg et al. (2018)), an attenuation of "too-big-to-fail" problem (Goodhart and Avgouleas (2014); ECB Board (2013)), and a reduction in bank-sovereign nexus (Pancotto et al. (2019)). A typical measure of market discipline is the sensitivity of bank bond yields to bank default probability.[13] A triple-differencing model suggests an improvement of market discipline as bail-in events increase the yield-risk sensitivity. Concerning the "too-big-to-fail" problem, I find that the market discipline effect is more intense for banks with larger implicit-guarantee (measured also through credit ratings). In addition, bail-in events relax the link between bank yields and sovereign CDS spreads, which corroborates a reduction of the bank-sovereign nexus.

The third module tracks bank-level responses to bail-in events over a period of six months. Specifically, I compare the responses of banks with different bail-in expectation shocks, and test whether banks with the

[11] The KM approach has been previously applied in the form of cross-lender within-borrower difference-in-differences (Khwaja and Mian (2008)).

[12] First, placebo tests show that bail-in expectations do not significantly increase during days unrelated to bail-in decisions but characterised by widespread banking distress. Second, the approval of the BRRD among EU Finance Ministers caused one of the largest increases in yield spread, although banking distress is typically not problematic during EU-level legislative approvals.

[13] For instance, Acharya et al. (2016), Sironi (2003) and Flannery and Sorescu (1996).

highest shock mitigate their risk-taking and experience changes in funding costs, in line with the theory of Berger et al. (2020).[14] Results generally indicate an economically significant attenuation of risk-taking (larger capital ratios, smaller assets' risk weights, and larger retained earnings). The sequence of bail-in events increases the capital ratio by 1.1% and the weighted capital ratio by 1.7%, which is equivalent to 0.7 to 2.5 standard deviations of capital ratios. The negative impact of bail-in on assets' risk weights is also economically significant, albeit weaker, with a cumulated effect in the range of 0.1 to 1.7 standard deviations. The prudential effect of bail-in is also evident from the increase in retained earnings, which is strongly economically significant with a cumulated impact ranging from 1.1 to 3.1 standard deviations of retained earnings. Regarding bank funding costs, bail-in expectations increase Weighted Average Cost of Capital (WACC) through a rise in cost of equity that is only partially compensated by an attenuation in debt cost. The amplification of cost of equity (2.5%) and WACC (2.1%) and the mitigation of cost of debt (-0.8%) are all economically meaningful. Their magnitude ranges from 0.8 to 2.1 standard deviations.

The rest of the paper is organised as follows: Section 1 discusses the related literature; Section 2 presents the dataset and descriptive statistics; Section 3, discusses the evolution of the institutional background of the bail-in in the EU, and characterises the events; Section 4 illustrates the Khwaja-Mian approach used to assess the impact of events on bail-in expectations; Section 5 presents the analyses on market discipline, too-big-to-fail problem and bank-sovereign nexus; Section 6 presents the analyses on the impact of the bail-in expectations on bank risk-taking and funding costs.

1. Related Literature

The main contributions of the paper are related to three research areas: the first one examines the response of bank risk-taking to public support; the second area studies the response of economic variables to specific

[14] Considering that bail-in expectations are qualitatively similar to lower bail-out expectations, these predictions are also consistent with a literature showing that bail-outs create incentives to increase risk-taking, particularly when they are not optimally designed (Bagehot (1873); Gale and Vives (2002); Acharya and Yorulmazer (2007); Diamond and Rajan (2012); Nosal and Ordonez (2016); Keister (2016) and Bianchi and Mendoza (2018).

cases of bank failures; the third one investigates the response of financial markets to events such as bail-in legislative approvals or bail-out cases.

First, regarding the effects of public support on bank risk-taking, Demirgüç-Kunt and Detragiache (2002) show that public support promotes financial stability, which is consistent with Diamond and Dybvig (1983). Gropp and Vesala (2004) find that deposit insurance mitigates moral hazard among European banks. On the contrary, Gorton and Huang (2004) show that public support can generate excessive risk-taking due to the moral hazard associated to bail-out expectation. Empirical studies corroborate this prediction.[15] However, Dam and Koetter (2012) argue that empirical studies in this area are often affected by an inappropriate identification of bail-out expectation. They address this major concern by identifying a causal positive effect of bank bailout expectations on additional risk-taking through the use of exogeneous differences in political characteristics.[16]

This paper contributes to this literature by examining risk-taking responses to bail-in expectations, rather than bail-out expectations. To the best of my knowledge, this is the first empirical study focusing on the impact of bail-in expectations on bank-level risk-taking variables. Results indicate an impact that is qualitatively similar to a reduction in bail-out expectations in spite of the widespread credibility concerns on the bail-in, which might make its practical applications insignificantly different from the previous resolution regime.[17]

Moreover, risk-taking is not the only dependent variable of interest, as the paper nests analyses of several consequences into a single empirical framework, including assessments on funding costs, bond yields, market discipline and bank-sovereign nexus. This is useful not only because it allows for a coherent and broader assessment of the regulatory and financial stability implications of the bail-in, but also because it

[15] For instance, Gropp et al. (2011) use banking data from a large sample of OECD countries and find that government guarantees may increase risk-taking. Using US data, Berger et al. (2008) find that too-big-to-fail banks choose target capital levels substantially below the targets of smaller banks, which have smaller implicit guarantee.

[16] Behn and Schramm (2021) use granular data on syndicated loans and show that too-big-to-fail banks reduce risk-taking when their implicit guarantee is recognised and addressed through the designation as Global Systemically Important Banks (G-SIBs).

[17] Walther and White (2020) and Philippon and Salord (2017).

can test the validity of theories of optimal resolution policy that offer predictions regarding a wide set of economic phenomena.[18]

This paper also contributes to a second literature, which examines the economic effects caused by decisions not to bail-out or to bail-in. Bernanke (1983) and Calomiris and Mason (2003) describe the adverse shocks resulting from bank crises surrounding the period of the Great Depression.[19] Using credit register data from Portugal and exploring a wide suite of real economic variables, Beck et al. (2020) study the consequences of an instance of bail-in: the resolution of Banco Espirito Santo (BES) in 2014. In addition to hitting BES' investors, this bail-in forced other Portuguese banks to bear part of BES' resolution costs with expensive disbursements. Beck et al. (2020) use the heterogeneity in such disbursements (with a KM approach) and show that banks with larger compulsory disbursements transmitted a negative economic shock to their borrowers, compared to borrowers of banks with smaller disbursements. Thus, they focus on the effects caused by the realized disbursements mandated by a bail-in decision, rather than the consequences of bail-in *expectation*, i.e., the expectation that regulators will prefer bail-ins (over bail-outs) in future bank resolutions.

My paper contributes to this literature in two main ways. First, considering the argumentations of Dam and Koetter (2012) about the importance of an appropriate measure of bail-out *expectation shock*, I focus on the identification of bail-in expectation shocks. The identification is based on a bond pricing study comparing yield reactions to bail-in events of bailinable and non-bailinable bonds issued by the same bank.

Second, I examine the effect on bank-level variables, rather than borrower-level or aggregate variables. These estimates are useful because they allow for interpretations and discussions regarding bank balance sheets, thereby speaking directly to themes involving financial stability, prudential policies or bank economic viability. For instance, I find that bail-ins incentivise banks to increase capital by holding an

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[18] For instance, the present findings of an attenuation in risk-taking and debt cost corroborate the theory of Berger et al. (2020), which contains a large suite of predictions ranging from risk-taking to funding costs.

[19] Slovin et al. (1993) find a decline in stock valuations for firms borrowing from Continental Illinois in response to its bankruptcy. Ashcraft (2005) shows that the closure of a solvent affiliate in a US bank holding company lead to a deterioration in economic aggregates.

additional buffer of risk-weighted equity ratio (1.7%) that is larger than a third of Basel III minimum requirement (4.5%) and an additional unweighted equity ratio (1.1%) equal to a fifth of the average ratio in the sample (5.7%). On the other hand, estimates confirm the hypothesis that bail-in expectations make bank business viability significantly more problematic, as they increase banks' total funding costs by more than one standard deviation.

This paper also speaks to a third research strand, which investigates how bail-out or bail-in influence bank securities in terms of bond yields, market discipline, sovereign-bank nexus and too-big-to-fail guarantee. Several papers investigated these themes, albeit without an assessment of the bail-in framework (Völz and Wedow (2011); Cordella and Yeyati, (2003); Brunnermeier et al. (2016); Duchin and Sosyura (2014)).[20] As to the bail-in debate, event studies indicate that its introduction reduces bond and stock valuations and increase the CDS spread (Fiordelisi et al. (2020); Leone et al. (2017); Schäfer et al. (2016)). Other papers focus more on the effectiveness of the BRRD in terms of market discipline or bank-sovereign nexus, where the BRRD is the Bank Recovery and Resolution Directive, i.e., the law approved at EU level in April 2014 regulating bank bail-ins from 2016.[21] Using bond, stock, CDS and deposit data, a group of contributions suggests that the BRRD introduction was successful in increasing market discipline (Bernard et al. (2017); Lewrick et al. (2019); Cutura (2018); Boccuzzi and De Lisa (2017); Neuberg, et al. (2018)). Instead, with different approaches, others do not find evidence of BRRD's effectiveness studying events related to its legislative process. Pablos Nuevo (2019) show a generally insignificant increase in market discipline in

[20] Many studies focus on market discipline, defined as the sensitivity of subordinated bonds yields (or prices) to bank-specific risk measures. Among them, Covitz et al. (2004), Jagtiani et al. (2002), DeYoung et al. (2001), Calomiris (1999) and Flannery (1998)) show that funding costs depend on banks' risk, but this relation might be insignificant for too-big-to-fail institutions and in periods characterised by more explicit regulatory forbearance. Other papers explore whether changes in government support can modify the yield-risk sensitivity. Flannery and Sorescu (1996) show that, in the period after the bail-out of Continental Illinois (1984) and before the approval of the FDIC Improvement Act (1991), yield spreads did not reflect the risk of the issuing bank. Sironi (2003) shows that governments can alter the yield-risk relation. He illustrates that the relationship strengthens in response to restrictive fiscal or monetary policy. Focusing on the introduction of the Dodd-Frank Act, Balasubramnian and Cyree (2014) find an attenuation of the bail-out implicit guarantees for the largest US banks. However, other event studies uncovered an insignificant change in senior bonds' sensitivity to risk among the largest US banks (Gao et al. (2018), Acharya et al. (2016) and Santos (2014)). Völz and Wedow (2011) investigate market discipline in the CDS market and the potential effect on CDS spreads driven by too-big-to-fail. In a nutshell, their results indicate the presence of market discipline in the market, although CDS spreads significantly depend on bank size.

[21] In U.K., Austria and Germany the BRRD came into force in January 2015.

bank bond markets. Pancotto et al. (2019) point out that the BRRD introduction did not weaken the sensitivity of bank CDS spreads to sovereign risk, indicating that the BRRD was not effective in its objective of alleviating the bank-sovereign nexus problem.

My paper contributes to the empirical assessment of bail-in effects on financial markets in three main ways. First, while previous papers have generally focused on events related to the legislative process, this paper includes hand-collected information also on the set of bail-ins realised in Europe and finds that the bail-in mechanism increases discipline and mitigates bank-sovereign nexus.[22] These results suggest that the generally insignificant impact of BRRD found by part of previous contributions might be due to their use of events related to the bail-in's legislative process, which do not typically dissolve uncertainties about the commitment of governments to actually enforce the bail-in.[23]

Second, bail-ins are investigated also according to their severity on investors, which I classify through a detailed scrutiny of the credit rating updates of the bonds of failing banks around each event. To the best of my knowledge, this is the first paper estimating responses in terms of yields, market discipline, too-big-to-fail problem and bank-sovereign nexus by separating bail-ins according to their severity.[24] I find that flexible applications of bail-in (i.e., cases with less severe costs for unsecured bondholders) reduce the bail-in yield spread, decrease market discipline (although not robustly), and appear to favour banks with larger public support. These results are relevant for the debate about consequences of less severe bail-ins. Moreover, the results indicate that the flexible bail-ins in mid-2017 might be the key drivers of the visible decline in bail-in risk premium measured by Lewrick et al. (2020).

[22] A notable exception is Schäfer et al. (2016) who examine also the stock and CDS response to five bail-in cases in Europe.
[23] This would be in line with the literature on resolution policy's time-inconsistency problem.
[24] With different methodologies compared to this paper, Schäfer et al. (2016) and Schnabel (2020) investigate effects of less severe bail-ins on CDS spread or stock prices. Schäfer et al. (2016) show mixed responses of bank stocks and CDS to weaker bail-ins, using estimates that are not based on within-bank analyses. Schnabel (2020) provides descriptive analyses of CDS spreads around one event that had hypothetically decreased bail-in credibility: the precautionary recapitalisation of MPS. The evidence is in line with an increased bail-out expectation for senior debt of Italian banks and an insignificant impact on other European banks.

Third, in some cases this literature attempts to assess the impact of the news using methods that do not condition on bank-level reactions to events, such as traditional bond or stock event studies.[25] These methods measure the impact of a news on a security by comparing the actual returns with a counterfactual return that is largely determined by the country's aggregate financial markets (usually, the stock market index). Thus, a key identifying assumption of these methods is that a country's aggregate financial markets should not be influenced by the news under scrutiny. This is a concern in the context of bail-in assessments because news regarding bail-ins of large banks can affect a country's stock market index. These concerns are addressed in this paper through the use of cross-liabilities within-bank comparisons similar to Khwaja and Mian (2008).

Another literature uses bank balance sheets to simulate the possible impact on the securities of banks in the European financial system caused by hypothetical impairment losses or bank bail-ins. For instance, Conlon and Cotter (2014) describe the status quo of European banks' capital structure in terms of bailinable and non-bailinable bonds and show that holders of equity and subordinated bonds would have been the main losers from a crisis causing 500 billion euro in impairment losses. Halaj et al. (2016) use a multi-layered network model to quantify the potential for contagion resulting from a bail-in. Using ECB's Security Holdings Statistics data, they simulate the bail-in of a bank to identify the risk of direct contagion to the other banks that may suffer losses when their bail-inable securities are written down.

The hypotheses of this paper are related to theoretical models discussing optimal resolution interventions. The dynamic capital structure model of Berger et al. (2020) offers a wide range of predictions regarding funding costs, capital structure and risk-taking.[26] Using a model in which banks can endogenously set the level of bail-in debt, Clayton and Schaab (2019) find that, in the absence of regulatory pressure, banks do not issue an adequate level of bail-in debt. Mendicino et al. (2017) show that the optimal proportion of bail-

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[25] Notable exceptions are Lewrick et al. (2019), Cutura (2018), Neuberg, et al. (2018)

[26] Berger et al. (2020) show that the introduction of bail-in decreases cost of debt and reduces risk-taking by increasing capital levels. They also find empirical support focusing on the responses of the largest US banks (i.e., GSIBs) in the years after the Dodd-Frank act. However, estimates might be affected by the introduction, in the post-Dodd-Frank years, of several confounding reforms influencing large banks' capital structure (particularly, Basel III).

in debt is driven by two incentive problems: risk shifting (mitigated by equity) and private benefit taking (mitigated by debt). The proportion of bail-in debt resulting from their model is in line with the regulation. Walther and White (2020) speak to the credibility debate by indicating that its vast legal discretion might cause regulators to apply the bail-in principle with excessive weakness due to their concerns of bank runs. Pandolfi (2021) finds that a possible equilibrium is a policy based on full bail-in. However, this could raise cost of debt, ex ante, and might limit banks' incentives to monitor their assets. This may cause a credit market failure unless the regulator commits to an alternative resolution policy. The optimal resolution policy is either a mix of bail-in and bail-out or liquidation, depending on two main parameters: the severity of moral hazard and the cost of bail-out.[27]

The paper is also related to the literature on the pricing of contingent convertible bonds or CoCos, as they are part of bail-in debt. Several models indicate that substituting debt with CoCos diminishes the probability of default through the deleveraging occurring when the loss absorption mechanism is triggered (Jaffee et al. (2013); Pennacchi (2011); McDonald (2013)). However, other contributions show that CoCos could exacerbate moral-hazard and risk-taking thereby causing a heightened probability of default (Koziol and Lawrenz (2012); Hilscher and Raviv (2014); Berg and Kaserer (2015); Goncharenko (2017)). A related empirical literature focuses on predictions regarding triggers and implications of CoCos. Goncharenko et al. (2020) find evidence in line with the previous theoretical works by showing that riskier banks are less likely to issue CoCos and less likely to issue equity (conditional on having CoCos).[28] In a related research, Fiordelisi et al. (2020) indicate that CoCos reduce stock return variance and other measures of downside risk.

[27] Related to this literature, Farhi and Tirole (2012) identify the optimal regulatory intervention also in terms of minimum liquidity requirements and restrictions on liquid assets. Philippon and Schnabl (2013) describe the optimal regulatory intervention that reduces a debt overhang problem. Allen et al. (2018) elaborate a theory where bank runs and depositor behaviour are endogenous with respect to the amount of public guarantees.

[28] Avdjiev et al. (2017) examine the effect of CoCo issuance on bank funding cost, showing that it generates risk-reduction benefits and lower costs of debt.

2. Data

From Bloomberg, I select the bonds with non-missing information on yield-to-maturity issued by banks with non-missing information on equity, risk-weighted assets, retained earnings and 1-year default probability, and with positive secured and unsecured outstanding debt. These bonds must be active in the period between June 2012 and December 2017. I include banks headquartered in the six largest European countries in terms of GDP (i.e., Germany, UK, France, Italy, Spain, and Netherlands)[29]. This selection step leads to an initial sample of 160,723 bonds. I remove senior unsecured bonds (100,042 securities) and bonds with floating or variable coupons (13,128 securities). Senior unsecured bonds are excluded due to the highly uncertain legal treatment during the period under scrutiny and because bail-ins are expected not to significantly affect senior unsecured bonds in the countries under scrutiny, as suggested by Conlon and Cotter (2014). I also exclude putable, callable or sinkable bonds (6,563 securities), and bonds with missing issuance price or ISIN data (12,480 securities). I include only trading days and bonds with residual maturity larger than six months. The final sample consists of 8,282 bonds issued by 9 German, 9 British, 4 French, 6 Italian, 5 Spanish and 3 Dutch banks. The final sample contains a total of 2,169,806 bond-day observations analysed during the bail-in events.

Table 1 presents the key descriptive statistics for the sample. The average yield-to-maturity across all classes of bank bonds is equal to 2.5%. The portion of non-bailinable bonds in the sample is 26.4%. Due to the lack of reliable transaction and volume data, bond liquidity is proxied by its turnover (Chan et al. (2008)). It is defined as the number of days with price changes in rolling 30-days windows, and its average is equal to 28.55. The mean time-to-maturity (expressed in calendar days) is approximately 2,700. The average bank has €736 Bn in total assets, a 1-year probability of default of 0.5%, an average regulatory risk weight of 35.5%, an unweighted equity ratio equal to 5.7%, a risk-weighted equity ratio of 15.1%. Moreover, the average bank has a retention ratio of 71.6% and retained earnings to RWA equal to 4.3%. Regarding the cost of funding, the WACC is 2.8%, with an average cost of debt and equity of 1.1% and 15.3%,

[29] Smaller countries are not included because of the scarce number of banks eligible for the analyses.

respectively. The specifications examining the bank-sovereign nexus involve the use of sovereign 5-years CDS contracts. The least levels of CDS spreads are related to German, Dutch, UK and French contracts (23, 30, 32 and 52, respectively), while larger spreads and standard deviations are present among Italian and Spanish CDSs (with mean spreads of 177 and 148, respectively).

2.1 Legislative History of Bail-in and Classification of Events

I manually collect and classify the information regarding all bank resolution cases managed by the Single Resolution Board ("SRB") and – for the period before SRB's operationalisation – the list of resolution cases analysed by the World Bank document "Bank Resolution and Bail-in in the EU" (World Bank (2016)).[30] For each case, I also search for the related articles in the "News" section of the Bloomberg terminal in order to ascertain the timing of the event. The "News" section of the Bloomberg terminal contains articles from several sources, such as, Bloomberg News, Financial Times, Reuters, Wall Street Journal and reports from Credit Rating Agencies (CRAs). I consider the resolution cases from June 2012, that is from the EU Commission's proposal for a directive introducing the bail-in as it demarks the start of the institutionalisation of the bail-in principle at EU-level (EU Commission (2012); Valiante (2014)). Through Bloomberg, I verify that the event windows do not include major news regarding monetary or macroprudential policy actions (including Basel III developments). Table 2 reports a description of each of the 20 bail-in related events. For each case, I report the following information: date of the event; brief description of the event; country of the event; title of the article or document; source of the article or document.

The legislative timeline of the bail-in in the EU can be divided into three main windows: (i) *Absence of EU-level bail-in*; (ii) *Phase-in*, from June 2012; (iii) *Bank Recovery and Resolution Directive (BRRD)*, from 2016. Before June 2012, there was no EU-level legal framework mandating a bail-in of junior debtholders

[30] This document has been used also by Philippon and Salord (2017) to gather information on bail-in decisions.

of a failing bank.[31] The window between June 2012 and December 2015 (referred to as the Phase-in period), according to the document EU Commission (2013), was a necessary stage that aimed at phasing-in the banking reform before the BRRD's coming into force in 2016.[32] It starts with the proposal 280/2012 of the EU Commission (2012), as it officially opens the legislative process for the EU-level directive called BRRD, which mandates bail-ins during bank resolutions. In a nutshell, the directive defines the bail-in as the mechanisms in which a failing bank can receive external aid only after holders of equity and unsecured securities participate in bearing the resolution costs of the failing bank. This document is further clarified by the EU "Banking Communication" (EU Commission (2013)), which specifies that senior unsecured securities were not required to be bailed-in before the BRRD became the applicable law in 2016. These documents represent fundamental pillars in the European bail-in's history not only because they inaugurate the process, but also because they were used to regulate bail-ins before the BRRD became the applicable law. In fact, the documents EU Commission (2013) and EU Commission (2012) represent a fundamental basis for the pre-2016 bail-in cases in Spain[33], Cyprus[34], Slovenia[35], Portugal[36], Italy[37] and Greece[38].[39] In the third period, from 2016, the BRRD is the main applicable law regulating bail-ins. Compared to the Phase-in period, the BRRD mandates more costly bail-ins for bank investors. The BRRD allows for external aids

[31] Nevertheless, certain national laws allowed domestic authorities to impose burden sharing on smaller banks before the declaration of default. For instance, the Danish small bank Amagerbanken was resolved in 2011 under the Danish national resolution procedure. This resolution entailed losses on its creditors, with holders of senior debt and unsecured securities facing loss of 41 percent (Financial Times, 8 February 2011).

[32] See Article 13 of the Communication https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:216:0001:0015:EN:PDF

[33] See the EU Commission's Institutional Paper 019 (2016), "Evaluation of the Financial Sector Assistance Programme" regarding Spain in 2012-2014.

[34] See Scott Brown, Demetra Demetriou and Panayiotis Theodossiou (2018), "Banking Crisis in Cyprus: Causes, Consequences and Recent Developments".

[35] See the EU Commission's Press release (2013), "State aid: Commission approves rescue or restructuring aid for five Slovenian banks"

[36] See the EU Commission's Press release (2014), "State aid: Commission approves resolution aid for Portuguese Banco Espírito Santo"

[37] See the EU Commission's Press release (2015), "State aid: Commission approves resolution plans for four small Italian banks Banca Marche, Banca Etruria, Carife and Carichieti".

[38] See the EU Commission's Press release (2015), "State aid: European Commission approves state aid to Piraeus Bank".

[39] The strength of the Memorandum of Understanding 280/2012 is motivated by the wide political agreement it received as it was considered as a crucial precondition for the Outright Monetary Transactions ('OMT') programme and for the European funded public support Hadjiemmanuil (2015).

only after resolution costs are borne by all unsecured debtholder classes, including senior unsecured debt. In light of this legislative history, this paper recognizes that the applicable bail-in rule is time-varying in nature: (i) in the phase-in period (2012-2015) state aid is possible only after resolution costs are borne by stockholders and junior bondholders (hybrid and subordinated), and (ii) in the BRRD period (from 2016) state aid is possible only after costs are borne by stockholders and both junior and senior unsecured bondholders.

In addition to its time-varying nature, bail-in legislation has always granted large discretion to resolution authorities regarding the severity of bail-ins, allowing them to use their expert judgement to solve the key trade-off between moral-hazard and financial stability (Draghi (2013)[40]; Walther and White (2014); Beck (2011)).[41] This paper explores also bail-ins in which authorities used this power of imposing less severe resolutions in order to avoid excessive financial instability. Given that in such events authorities apply the bail-in rule using the degrees of flexibility offered by the legislation, this paper defines them as "flexible" bail-in events and differentiates them from the "standard" events. Specifically, flexible bail-in events are the ones that do not impose resolution costs on classes of unsecured debt that are to be bailed-in according to the main applicable bail-in rule. Given that the applicable bail-in rule is time varying, so is the definition of flexible bail-in events. Table 3 identifies flexible bail-in events based on three considerations: (i) whether resolution costs deteriorate the rating of subordinated debt and senior unsecured debt, (ii) the presence of public aid (funded by national banking systems or by public injections and guarantees), (iii) whether the applicable bail-in rule is the one related to the Phase-in period (2012-2015) or the BRRD period (from 2016). Table 3 contains a detailed classification of the 18 bail-in events that are linked to the application of

[40] ECB President Mario Draghi's Monthly Press Conference, March 7, 2013.

[41] Several aspects of the bail-in regulation offer a vast discretion to resolution authorities. For instance, three points of the BRRD forms the legal basis for such discretion. (i) Article 44 of the BRRD allows for exemptions of investors from haircuts to "achieve the continuity of critical functions" or prevent "serious disturbance to the economy of a Member State or the Union" or "destruction of value". (ii) Article 34 of the BRRD relating to precautionary recapitalization allows for an easier access to state aid "to remedy a serious disturbance in the economy of a Member State and preserve financial stability". (iii) Authorities can make bail-ins more (or less) severe by expanding (or narrowing) the definition of a failing or likely to fail financial institution. Such definition is largely based on expert judgement, especially due to the complex interpretation of "factors not directly related to the financial position of the institution".

the bail-in principle on failing banks.[42] For each case, I report the following information: date of the bail-in event; name of the main bank involved in the bail-in event (because certain bail-in events involve multiple banks, such as the Spanish cases in 2012); classification as flexible bail-in event; update of the credit rating of subordinate debt of the main bailed-in bank; update of the credit rating of senior unsecured debt of the main bailed-in bank; name of the corresponding credit rating agency used as a source of information; availability of public aid for each bail-in event; specific period in the legislative history of the bail-in.

The details regarding rating updates, availability of public aid and period of the legislative history are important not only for descriptive purposes but also because they represent the parameters of the criterion used to define flexible events in this paper. The criterion is as follows. During the Phase-in period, a bail-in is classified as flexible if: (i) public aid is granted and (ii) no significant cost[43] is imposed on subordinated debt. During the BRRD period, a bail-in is classified as flexible if: (i) public aid is granted and (ii) no significant cost is imposed on both senior unsecured and subordinated debt.

3. First Module: Impact of Bail-in Events on Bail-in Expectations

3.1 Hypotheses Development and Empirical Strategy

I investigate whether bond market reprice securities in response to applications of the bail-in principle on distressed banks and approvals of bail-in legislation. The main empirical challenge is to identify the causal impact of bail-in expectation shocks on bond pricing while controlling for the fact that the changes in bond prices depend on (i) banks active response to bail-in expectations, and (ii) the overall economic environment, which affects both investor expectations and banks' risk or behaviour. Three main aspects of the empirical

[42] Some bail-in events linked to the enforcement of the bail-in principle on failing banks are the results of legislative actions from governmental bodies. As such, they appear as not being explicitly linked to specific resolutions of failing banks. However, in some cases these legislative actions are the necessary steps to apply the EU-level bail-in principle on specific resolutions, for instance, in countries where a national bail-in law was not yet in place. For example, the Spanish Government's push for a national law introducing the bail-in (in August 2012) is a case in which a legislative step was necessary to apply on specific banks (particularly, Bankia) the bail-in principle agreed in occasion of the approval of the EU-Spanish Financial Assistance Programme.

[43] A significant cost is defined as a haircut of at least 50%, or a rating downgraded to a credit rating conversion level larger than 7 (according to Table A1), i.e., probable default or lowest quality.

methodology address these identification problems. First, I implement a difference-in-differences approach inspired by Khwaja and Mian (2008) where bailinable bonds of bank j are compared with non-bailinable bonds of bank j before and after bail-in events. This procedure (referred to as the KM regression) controls for unobserved heterogeneity in banks' risk or capital structure, and in macroeconomic or industrial factors, such as monetary or fiscal policies. Second, the exogeneity of the shocks is warranted by the fact that I study the bond repricing of banks that are not involved in the bail-in resolution. This allows for an appropriate identification of how the bail-in of a failing bank modifies expectations of a bail-in being imposed on other banks in the future. Third, by studying relatively narrow windows around the events, estimates do not incorporate endogenous adjustments in bank capital structure or risk-taking in reaction to the shock, which typically require longer periods. To deal with the 2-days anticipation effect displayed in Figure 1, I use the [-7; -3] window as the pre-event period, and the [-2; +2] window as the post-event period, where 0 is the announcement date.

In detail, by applying the KM approach I exploit the panel of matched bond-bank data and account for unobserved heterogeneity in banks' (changes in) risk and capital structure by saturating the model with bank fixed effects. As a result, my identification comes from banks that borrow through two different categories of bonds (bailinable and non-bailinable) before and after the bail-in events. This strategy isolates the impact of the bail-in shock on bond pricing by comparing the within-bank variation in the yield reaction of bonds exposed and not exposed to bail-ins. The baseline specification is defined as:

$$(1)\quad \Delta yld_{ijt} = \alpha + \alpha_j + \beta_1(bailinable_{ij}) + \alpha_1(\Delta bankyld_{ijt}) + \alpha_2(BondTurnover_{ijt}) + \alpha_3(TimeToMaturity_{ijt}) + (day_t) + \varepsilon_{ijt}$$

Bond i is issued by bank j. Each bank has both bailinable and non-bailinable bonds in the sample. In line with Khwaja and Mian (2008), for each event I collapse (i.e., time-average) the daily yields of each bond into two values: a pre-shock average and a post-shock average. The dependent variable Δyld_{ijt} is the difference between these averages for bond i. This procedure makes standard errors robust to auto-correlation (Bertrand et al. (2004)). The main independent variable, $bailinable$ takes a value of zero in the presence of “secured” or more senior bonds, and one in the presence “senior subordinated” or less senior bonds. The interpretation of a positive β_1 is that the bail-in event increases the yield spread between bailinable and non-bailinable bonds. The increase would corroborate the hypothesis of a rise in bail-in expectations. The vector of bank fixed effects, α_j, captures bank-specific determinants of bond yield growth, for instance, bank probability of default, capital structure or risk-taking. The day fixed effects, day, capture any time-varying macroeconomic condition, such as a generalised distress in the European banking sector, risk-aversion, term- and credit-premium. The variable $\Delta bankyld$ is the change in yield of all bonds issued by bank j (excluding bond i), from the pre- to the post-event period. Given that it is an event-specific variable, it controls for the impact of the changes in each bank’s risk premia in response to *each single event*, unlike bank fixed-effects.[44] In order to control for possible differences in liquidity between bailinable and non-bailinable bonds, I have included $BondTurnover$, which is the number of days – within 30-days rolling windows – in which there has been a variation in the yield. To control for discrepancies in bonds’ residual life – which affects yield dynamics – I include $TimeToMaturity$.

Hypothesis 1. In response to standard bail-in events, KM estimates are positive. This means that bailinable bonds’ yields increase, compared to non-bailinable ones.

I also implement additional tests with two main objectives: (i) assessing the effects of less severe resolutions; (ii) corroborating the ability of the KM approach in Model (1) to reflect changes in bail-in expectations, rather than confounding factors. Regarding the first objective, I test whether flexible bail-in events – which are less severe on investors, compared to standard events – decrease bail-in expectations. Given that flexible bail-in events reinforce beliefs that authorities are willing to impose less severe resolution costs (e.g., in the presence of excessive financial stability concerns), they could decrease the expectation of

[44] I also show that results are robust when this control variable is not included.

resolution costs being imposed on bailinable bonds. Thus, I test the hypothesis that flexible bail-in events produce a negative β_1.[45]

Hypothesis 2. In response to flexible bail-in events, KM estimates are negative. This means that bailinable bonds' yields decrease compared to non-bailinable ones.

Secondly, regarding the ability of the KM approach to selectively reflect bail-in expectation, a placebo analysis addresses the alternative hypothesis that the change in yield spread measured by Model (1) is capturing changes in generalised distress in the banking sector, rather than expectation regarding the bail-in mechanism. Regressions test whether the yield spread is altered by placebo events, i.e., dates characterised by sector-wide banking distress that is not due to bail-in decisions. The sector-wide banking distress is proxied by the occurrence of a severe drop in equity prices in the entire European banking system.[46] These placebo analyses test the hypothesis that placebo events produce insignificant β_1, given that they do not inform about the authorities' commitment to bail-in.

Hypothesis 3. In response to placebo events, KM estimates are insignificant. This means that bailinable bonds' yields do not change compared to non-bailinable ones.

3.2 Bail-in Expectations. Results

Table 4a presents the estimates of β_1 from Model (1) (also referred to as the KM estimates) for standard, flexible and placebo events. Columns 1 and 2 show parameters estimated from the sample of all sixteen standard bail-in events. In line with Hypothesis 1, the parameter β_1 of the variable of interest ($bailinable$) is positive, implying that investors reprice bonds according to their higher bail-in expectation in response to

[45] The hypothesis of a negative or insignificant impact requires that the bail-in events occurred before the flexible bail-in events had a significantly positive impact on expectations. This circumstance is supported by both the KM evidence in Table 4b and the market intelligence (e.g., ING's 2013 document "EU banks in transition mode"), which indicate that flexible bail-in events occurred after a series of severe bail-in events in 2012, which had built significant bail-in expectation among investors.

[46] The placebo dates are the days characterised by top price decline in the MSCI Bank Europe index, excluding the dates within a 5-days window around bail-in events (in order to exclude news related to bail-in).

events indicating a stronger commitment to bail-in distressed banks. The parameter can also be considered economically significant as it is larger than the average yield and its standard deviation (Table 1). Column 2 excludes $\Delta bankyld$ from the list of control variables. The result is equivalent, suggesting that bank fixed-effects effectively control for changes in bank risk-premia.[47]

In line with Hypothesis 2, Columns 3 and 4 show that flexible bail-in events produce negative estimates for $bailinable$, suggesting that the sign of the bail-in expectation shocks described by KM estimates mirrors the heterogeneity in the severity of bail-in events. This contributes to the discussions around bail-in's credibility and signals that certain bail-in decisions could modify bail-in credibility in the EU-wide bond markets. Column 4 excludes $\Delta bankyld$ from the list of control variables and the result is almost unaffected. The coefficients for $BondTurnover$ and $TimeToMaturity$ are similar to the ones of the standard bail-in events. Consistent with Hypothesis 3, the insignificant estimates of placebo analyses in columns from 5 to 7 corroborate the ability of the KM model to identify bail-in expectations. They indicate that the yield spread does not increase in response to days characterised by a severe sector-wide banking distress unrelated to bail-in decisions. In column 5, the top five placebo events are examined, while columns 6 and 7 subtract and add two placebo events to the sample, respectively.

Tables 4b and 4c provide a more granular depiction of responses than Table 4a in that they present KM estimates for each single bail-in event. They offer three main considerations. First, also when applied at event level, KM results generally corroborate the hypotheses about standard and flexible events. The only exceptions are represented by some insignificant cases and the negative impact of the Slovenian bail-in (in 2013). The negative estimate for this event might be linked to its rather low intensity.[48] Second, also the bail-in legislation appears to have a significant impact on bail-in expectation, with the approval of the BRRD

[47] As to the control variables, the negative coefficients for $BondTurnover$ indicate that liquid bonds increase their value in response to bail-in shocks, which is reminiscent of the "flight-to-liquidity" concept (Beber et al. (2008)). The insignificant coefficients for $TimeToMaturity$ indicate that bonds distant from maturity date do not react differently from others, potentially because such different reaction is largely absorbed by fixed effects, as the time-to-maturity does not vary remarkably within the time windows.

[48] In fact, this bail-in event does not affect the rating of senior unsecured bonds (see Table 3). However, it is still classified as a standard event due to the significant cost imposed on subordinated debt.

among EU Finance Ministers (in 2013) causing one of the largest increases in expectations. This result is different from the overall insignificant responses estimated by Shäfer et al. (2017) and confirms the ability of the conditional responses (through within-bank analyses) not to be driven by generalised banking distress, which in fact is typically unworrying during EU-level legislative approvals. Third, earlier events have larger impact in either expanding or reducing bail-in expectations, suggesting that earlier events have a more important role in updating investor beliefs. Moreover, several events appear to have built up remarkable bail-in expectations already before the BRRD's coming into force (which occurred between 2015 and 2016), inducing economic agents and banks to adapt to larger bail-in expectations before this event (as shown also in subsequent modules). This might raise doubts about the empirical validity of using BRRD's coming into force as the key date to assess the effects of bail-in.[49]

4. Second Module: Market Discipline, Too-big-to-fail and Bank-sovereign Nexus

4.1 Hypotheses Development and Empirical Strategy

The preceding module ensures that the events classified in this paper actually generate a repricing that indicates a rise in bail-in expectations. This allows for an estimation, in the current module, of the impact of bail-in on market discipline by testing whether the same bail-in events increase investors' incentives to incorporate a bank's risk while pricing its securities. The literature on market discipline typically gauges these incentives by means of the yield-risk sensitivity. Thus, I use a triple-differencing model (also referred to as the DDD model) examining market discipline's responses to events.[50] To facilitate the interpretation of the main market discipline model (i.e., triple-differencing specification in Model (4)), I gradually build-

[49] For instance, Pablos Nuevo (2019) and Pancotto et al. (2019).
[50] This model is in line with Acharya et al. (2016).

up the main specification by starting from a baseline specification (i.e., Model (2)), which describes the status quo of yield-risk sensitivity of the pooled set of European bank bonds in the sample. Model (2) is then upgraded into Model (3) by including an interaction measuring the difference in yield-risk sensitivity between bailinable and non-bailinable bonds in the entire sample from 2012 to 2017. Model (3) is then upgraded into Model (4), which addresses the main question of this module: how do bail-in events change the difference in yield-risk sensitivity between bailinable and non-bailinable bonds?

$$(2)\quad yld_{ijt} = \rho + \rho_i + \rho_1(PD_{jt-1}) + \mu_{it}$$

The measure of bank risk, PD, is Bloomberg's 1-year default probability, i.e., a daily measure of risk using a proprietary forecasting model including CDS spread, stock price volatility, net income, non-performing loans, market-to-book ratio, total assets, short-term leverage, long-term leverage and loan losses reserves.[51] Model (2) measures the yield-risk sensitivity of the pooled sample of bailinable and non-bailinable bonds, without any distinction between pre- and post-event periods. Bond fixed effects, ρ_i, control for bond-specific time-invariant factors of bond yields. A positive ρ_1 would indicate a positive yield-risk sensitivity, which corroborates the presence of significant market discipline in the European banks' bond market.

$$(3)\quad yld_{ijt} = \theta + \theta_i + \theta_1(bailinable_{ij} \times PD_{jt-1}) + \theta_2(PD_{jt-1}) + \mu_{it}$$

Model (3) upgrades Model (2) by adding the interaction between bailinable status and probability of default. θ_1 measures the difference in yield-risk sensitivity between bailinable and non-bailinable bonds, without any distinction between pre and post bail-in event. Given that bailinable bonds are subordinated while non-bailinable are secured, I expect θ_1 to be positive, indicating that bailinable bonds are more sensitive to risk compared to non-bailinable bonds.

[51] I use the natural logarithm of 1-year default probability in order to normalize the distribution.

$$(4) \quad yld_{ijt} = \gamma + \gamma_i + \beta_2(bailinable_{ij} \times post_t \times PD_{jt-1}) + \gamma_1(PD_{jt-1} \times bailinable_{ij}) + \gamma_2(PD_{jt-1} \times post_t) + \gamma_3(bailinable_{ij} \times post_t) + \gamma_4(PD_{jt-1}) + (post_t) + \mu_{it}$$

Model (4) expands Model (3) by (i) adding the main variable of interest in this module, i.e., the triple interaction $bailinable_{ij} \times post_t \times PD_{jt-1}$, and (ii) saturating the model with the appropriate interaction variables. The triple interaction measures whether the change in yield-risk sensitivity of bailinable bonds is positive, net of the change in yield-risk sensitivity of secured bond, which are not exposed to bail-in risk. This netting intends to ensure that the effect on market discipline described by β_2 is attributable to changes in expectations regarding the bail-in rule, which promotes a divergence in treatment between bailinable and non-bailinable bonds. The main hypothesis is twofold. Standard bail-in events generate a net rise in yield-risk sensitivity of bailinable bonds, compared to non-bailinable bonds. The effect of flexible bail-in events is hypothesised to be symmetrical.

Hypothesis 4. In response to standard bail-in events, triple-interaction estimates are positive. The interpretation is that the bail-in-induced market discipline is positive.

Hypothesis 5. In response to flexible bail-in events, triple-interaction estimates are negative. The interpretation is that the bail-in-induced market discipline is negative.

From a policy assessment perspective, it is also essential to investigate whether the regulation was more effective for larger institutions. As argued by Goodhart and Avgouleas (2014) and ECB board (2013), the bail-in – with its emphasis on early intervention, orderly resolution and going concern – has been designed to attenuate the too-big-to-fail phenomenon by promoting market discipline especially among the largest financial institutions, as they are supported by disproportionate explicit or implicit public guarantees.[52] In fact, the new resolution regime is supposed to allow regulators to breakup even systemically important banks by flexibly calibrating the appropriate amount of resolution costs to be imposed on different investor classes.

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[52] Using US data, Acharya et al. (2016) empirically proves that the increased expectations of public support (during the Global Financial Crisis) decrease the yield-risk sensitivity of larger financial institutions, which was already lower than smaller institutions.

In order to examine whether markets believe that the bail-in is effectively designed to increase the market discipline more for too-big-to-fail institutions, I test whether such banks experienced a larger bail-in-induced shock to their market discipline, compared to smaller banks. In detail, I compare the three main coefficients resulting from the separate estimations of Model (4) on three mutually exclusive subgroups based on total assets. I group banks into terciles of total assets at country level as this also addresses the presence of "national champions", that is banks that are considered too-big-to-fail because they are large compared to others in the same country while being relatively small compared to European competitors. If the bail-in increases market discipline more for larger banks, we should expect a larger triple-differencing estimate for banks belonging to larger terciles. In case of flexible bail-in events, we should expect a more negative triple-differencing estimate for banks belonging to larger terciles.

Hypothesis 6. Triple-interaction estimates are larger (in absolute value) for banks with the largest total assets. The interpretation is that the market-discipline induced by bail-in is larger (smaller) for banks with larger (smaller) assets.

In the context of defining banks' too-big-to-fail status, total assets are a key parameter but not the only one.[53] In line with Acharya et al. (2016), a more comprehensive alternative indicator is the difference between two types of credit ratings: (i) the standard credit rating, i.e., an estimate of a bank's ability to repay its debt taking also into account any possible source of external support; (ii) a stand-alone rating, i.e., an estimate of a bank's ability to repay excluding the effect of any external support.[54] In line with previous research (Acharya et al. (2016); Jorion et al. (2005)), I transform these types of ratings into numerical values using the rule in Appendix Table 1, where worse ratings correspond to larger numbers. Thus, the resulting numerical series of stand-alone ratings is a proxy for the intrinsic default risk, i.e., excluding any external

[53] For instance, according to the "Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments" (prepared by IMF, FSB and BIS), total assets are a "primary indicator" of Systemic Importance and Associated Risks.

[54] Among the three main Credit Rating Agencies, only Fitch and Moody's provide both rating types. Fitch calculates the "long-term issuer rating" and a stand-alone "viability rating". Moody's calculates the "issuer rating" and a stand-alone "baseline credit assessment" rating.

support. As usual, the resulting numerical series of issuer ratings proxies for the default risk (which is attenuated by the beneficial effect of external support). I calculate the *default risk borne by governmental entities* for each bank by subtracting the issuer's default risk from its intrinsic default risk. As in Acharya et al. (2016), the default risk borne by governmental entities is a proxy for the government support. I examine whether banks with larger government support experienced a larger bail-in-induced shock to their market discipline, compared to banks with smaller support.

Hypothesis 7. Triple-interaction estimates are larger (in absolute value) for banks with the largest government support. The interpretation is that the market-discipline induced by bail-in is larger (smaller) for banks with a larger (smaller) external support.

The sovereign-bank nexus received pervasive attention during the European sovereign debt crisis among regulators and researchers (e.g., De Bruyckere et al. (2013); Farhi and Tirole (2017)). Several papers argue that the BRRD was designed also with the objective of mitigating the bank-sovereign nexus (Fontana et al. (2015); Pancotto et al. (2019); Benczur et al. (2017)). To examine whether the bail-in attenuates the correlation between bank and sovereign debt, Model (5) modifies Model (4) by substituting bank PD with the sovereign CDS spread.

$$(5)\quad yld_{ijt} = \gamma + \gamma_i + \beta_3\left(bailinable_{ij} \times post_t \times SovCDS_{ct}\right) + \gamma_5\left(SovCDS_{ct} \times bailinable_{ij}\right) + \gamma_6(SovCDS_{ct} \times post_t) + \gamma_7\left(bailinable_{ij} \times post_t\right) + \gamma_8(SovCDS_{ct}) + (day_t) + \mu_{it}$$

$SovCDS_{ct}$ is day t's CDS spread on the debt issued by country c. Model (5) tests whether the occurrence of the bail-in decreases the relationship between yld and CDS for bailinable bonds, net of the change in bank-sovereign co-movement of non-bailinable bonds. The netting aims at ensuring that the effect on the bank-sovereign nexus described by β_3 is attributable to changes in expectations regarding the bail-in rule, which mandates a divergence in treatment between bailinable and non-bailinable bonds. The main hypothesis is twofold.

Hypothesis 8. In response to standard bail-in events, estimates of triple-interactions with sovereign CDS spreads are negative. The interpretation is that the bail-in reduces the bank-sovereign nexus.

Hypothesis 9. In response to standard bail-in events, estimates of triple-interactions with sovereign CDS spreads are positive. The interpretation is that the bail-in increases the bank-sovereign nexus.

4.2 Market Discipline, Too-big-to-fail and Bank-sovereign Nexus. Results

Table 5 presents the parameter estimates from the introductory specifications – Models (2) and (3) – and the triple-differencing specification – Model (4). The significantly positive coefficient for PD in column 1 indicates that yields of European banks are positively associated with banks' probability of default, which means that there is a significant yield-risk sensitivity. In column 2, the positive coefficient of $bailinable \times PD$ confirms that bailinable bonds are more sensitive to risk compared to non-bailinable bonds, which is intuitive since bailinable bonds are junior to non-bailinable bonds. Columns 3 and 4 show the parameters from Model (4), i.e., the main specification for the market discipline analysis. Column 3 investigates the standard bail-in events. In line with Hypothesis 4, the positive coefficient of the triple interaction illustrates that bail-in events raise the yield-risk sensitivity of bailinable bonds more than to secured bonds, which are not exposed to bail-in risk. Column 4 investigates the flexible bail-in events and supports Hypothesis 5. The negative coefficient indicates that flexible bail-in events deteriorate market discipline in that they decrease the yield-risk sensitivity of bailinable bonds, compared to the effect on secured bonds.

Results in Table 5 do not consider that a time-varying unobserved heterogeneity might be correlated with relevant bond time-varying characteristics, and that bank-time factors might not be fully captured by the interaction $PD \times Post$. For these reasons, I expand Model (4) with (i) day fixed effects, (ii) a vector of bank×post fixed effects specific to each single event, and even (iii) bond liquidity and time-to-maturity. Table 6 displays estimates using not only the [-7; +2] window employed in Table 5, but also a [-20; +20] one. The positive coefficients of $bailinable \times post \times PD$ in columns 1 and 2 corroborate the hypothesis that bail-in increased market discipline considering a longer response and adding a restrictive set of control variables. Columns 3 and 4 investigate the flexible bail-in events. The insignificant results suggest that the deteriorating effect of flexible bail-ins on market discipline is not robust to the inclusion of the control variables.

As to the impact of bail-in on the too-big-to-fail problem, the first three columns in Table 7 show the triple-interaction estimates for three separate terciles of banks based on size. The magnitude of the impact of relatively small banks appears to be smaller than middle-tercile's banks, which in turn is smaller than banks in the top tercile. Columns 4 and 5 show a significantly positive difference between the impacts of middle and lowest terciles. Consistent with Hypothesis 6, these results are in line with the intuition that the market discipline of the lowest-tercile banks reacts less to the bail-in, thereby suggesting that bail-in's improvement of market discipline is larger for banks that were more likely benefiting from too-big-to-fail status. Table 7 also displays the estimates of flexible bail-in events. They corroborate Hypothesis 6 suggesting a more intense response among larger banks, with a statistically negative difference between top and mid-sized banks.

Table 8 employs bank-level rating differences to extend the analyses on the too-big-to-fail issue. The lower number of observations is due to the absence of the necessary rating information. Columns from 1 to 3 indicate that the magnitude of the market discipline impact is larger for banks in the top tercile of government support compared to the ones in the middle tercile, which in turn experienced a larger impact compared to banks in the bottom tercile. Testing the differences in coefficients between terciles, columns 4 and 5 are generally in line with this pattern, which corroborates Hypothesis 7 suggesting that bail-in increases market discipline especially for banks that benefit more from public support. Table 8 also illustrates the parameters for flexible bail-in events. They support the hypothesis of a more intense response among banks with larger public support, with a statistically negative difference between banks with largest and mid support from government.

As to the sovereign-bank nexus, estimates in Table 9 test the hypotheses that standard events decrease the co-movement between bank and sovereign debt pricing, and flexible events strengthen such relationship. The significantly negative triple-interaction estimates in columns 1 and 2 indicate that standard events attenuate the bank-sovereign nexus, in line with Hypothesis 8. Overall, there is an alleviation of the nexus in both event windows, although characterised by weak statistical significance. This result differs from the generally insignificant effect found by Pancotto et al. (2019). The difference is arguably due to the fact that my paper includes not only legislative steps but also actual bail-ins, which typically have a crucial role in making new resolution regimes credible by decreasing the uncertainties around regulators willingness to impede public support for banks (Schäfer et al. (2016)). On the other hand, the insignificant estimates in columns 3 and 4 indicate that flexible events do not significantly increase the co-movement between bank and sovereign debt, which could suggest that the impact on the nexus is overall not robust.

5. Third Module: Bank-level Response of Risk-taking and Funding Costs

5.1 Hypotheses Development and Empirical Strategy

This module assesses whether bail-in expectation shocks influence bank-level variables related to risk-taking and cost of funding. To this purpose, I track bank-level responses to bail-in events and test the difference in response between (i) banks with the largest increase in bail-in expectation (labelled as top-bail-in-shock or top-shock banks, for simplicity) and (ii) banks with the least bail-in expectation shocks (labelled as least-bail-in-shock or least-shock banks, for simplicity). I test whether banks with high bail-in expectation shocks decrease their risk-taking and experience an increase in cost of equity coupled with a decrease in cost of debt. The main theoretical foundation behind such hypotheses on risk-taking and funding costs is the model by Berger et al. (2020) as it nests a wide suite of predictions within a single theory of banking capital structure. Model (6) compares responses (in terms of risk-taking and funding costs) of banks with high and low bail-in expectation shocks.

$$(6)\ \overrightarrow{y_{jt}} = \delta + \delta_j + \beta_4(TopBailinShock_j \times Post_t) + \delta_1(TopBailinShock_j) + \overrightarrow{\delta_2}(\overrightarrow{Rating}_{jt} \times Post_t) + \overrightarrow{\delta_3}(\overrightarrow{Rating}_{jt}) + \overrightarrow{\delta_4}(\overrightarrow{Country}_j \times \overrightarrow{Week}_t) + \delta_5(BondTurnover_{jt}) + \delta_6(TimeToMaturity_{jt}) + \varepsilon_{it}$$

The vector of dependent variables $\overrightarrow{y_{jt}}$ include balance-sheet measures of risk-taking (i.e., average regulatory risk weight, equity to total assets, equity to risk-weighted assets, retained earnings to risk-weighted assets and retention ratio) and market-based measures of funding cost (i.e., cost of equity, cost of debt and WACC). $TopBailinShock$ is the dummy variable separating top-bail-in-shock banks from least shocked ones. The variable is created using the bail-in expectations resulting from the estimation of the Khwaja-Mian approach of Model (1) for each bank and event.[55] The resulting Khwaja-Mian coefficients are grouped into terciles for each event. Banks in the lowest tercile are defined as least-bail-in-shock banks, while banks in the top tercile are defined as top-bail-in-shock ones. $Post$ is the dummy variable taking the value of one in the three months after bail-in events, and zero in the three months before bail-in events. This 6-months window captures bank-level responses, which are slower than the immediate market expectation adjustments calculated in previous sections. The coefficient related to $TopBailinShock \times Post$ is the main parameter in Model (6). It is interpreted as the additional risk-taking or funding cost responses to bail-in events experienced by banks with top bail-in expectation shock, compared to the response experienced by banks with least bail-in shock. Model (6) controls for bank-level averages of bonds' turnover and time-to-maturity, in addition to day, bank and country×week fixed effects.

Even if the $TopBailinShock$ already reflects a shock that is specifically linked to bail-in expectation, given that it controls for time-varying bank- and macro-factors (as suggested by previous sections), Model (6) includes a set of particularly restrictive control variables in order to further ensure that the coefficient of interest is not driven by differences in bank risk. It contains controls for banks' rating not only linearly (with

[55] These analyses explore the effects of bail-in events classified as standard, and excludes one of these events, the bail-in of Banco Popular, because it is in the close proximity of two flexible bail-in cases in mid-2017: MPS and two Venetian banks.

respect to time) in the form of rating fixed effects (i.e., $\overrightarrow{Rating}_{jt}$), but also by interacting it with the time-related dummy $Post$ (i.e., $\overrightarrow{Rating}_{jt} \times Post_t$). In this way, given that each bank's rating (i.e., an overall measure of bank risk) enters in the specification in the exact the same way as the identifier of bail-in expectation shock, Model (6) allows for a strong test of whether $TopBailinShock$ gauges the effect of bail-in expectations rather than a bank's overall risk. In addition, the fact that results are not substantially influenced by the inclusion of such restrictive controls further ensures that $TopBailinShock$ appropriately identifies bail-in effects.

Regarding the risk-taking hypothesis, several contributions point out that its mitigation represents a key aspect of the new resolution regime's objective of reducing moral hazard (ECB Board (2013); Allen et al. (2015)). Assuming that the effects of larger bail-in expectations are qualitatively similar to reductions in bail-out expectations, a more credible bail-in should attenuate risk-taking according to the literature on optimal bank resolution policy, which shows that bail-outs create incentives to increase risk-taking, particularly when they are not optimally designed.[56]

Hypothesis 10. Banks with larger bail-in expectation shock experience a decrease in risk-taking measured through a decline in average risk weights, and/or an increase in capital ratios and retained earnings.

As to the funding cost hypothesis, the model by Berger et al. (2020) examines the impact on funding costs caused by a shift from bail-out to bail-in. They find that the introduction of the bail-in regime induces an optimally behaving bank to recapitalise before the occurrence of financial distress in order to minimise the probability of a wipe-out of its stocks in case of resolution. Thus, market participants reprice bank debt considering this expected recapitalisation thereby rewarding the bank with lower cost of debt even in anticipation of actual recapitalisations. As to the cost of equity, the bail-in mandates to the wipe out of equity-holders when the capital ratio falls below a bail-in trigger. Thus, its introduction should increase the

[56] For instance, Berger at al. (2020), Bagehot (1873), Gale and Vives (2002), Acharya and Yorulmazer (2007), Diamond and Rajan (2012), Nosal and Ordonez (2016), Keister (2016) and Bianchi and Mendoza (2018).

risk-premium of bank equity compared to an ex-ante scenario in which regulation did not impose hard restrictions on bank bail-outs. The impact on the total cost of funding, WACC, is ambiguous because it depends on the magnitude of the repricing of debt and equity and their proportions in bank liabilities.

Hypothesis 11. Banks with larger bail-in expectation shock experience an increase in cost of equity and a decrease in cost of debt.

5.2 Bank-level Response of Risk-taking and Funding Costs. Results.

Estimates of Model (6) in Table 10 (columns from 1 to 5) corroborate Hypothesis 10 that higher bail-in expectations reduce risk-taking. The impact on average risk weights of the explanatory variable of interest, $TopBailinShock \times Post$, is significantly negative, while it is positive when the dependent variable is represented by capital ratios or retained earnings, with robust results across different definitions of such variables. Column 1 shows that a single average bail-in event creates a response in equity-to-assets that is 0.2% larger for banks in the top tercile of bail-in expectation shock, compared to banks in the bottom tercile. Column 2 indicates that the bail-in-induced change in equity-to-risk-weighted-assets is 0.3% larger for banks with high bail-in expectation shock, with respect to banks in the bottom tercile. Column 3 shows that the bail-in-induced change in risk-weights is 0.3% smaller for highly exposed banks. Another evidence of precautionary behaviour is demonstrated by the positive response of retained earnings. In column 4, the impact of an average bail-in event on retention ratio is 6.5% larger for banks with high bail-in expectation shock, and column 5 shows that the change in retained earnings to total assets is 1.5% larger for highly exposed banks.

Consistent with the capital structure theory of Berger et al. (2020), columns 6 to 8 corroborate Hypothesis 11 on funding costs. In response to an average bail-in event, banks with top bail-in expectation shock experience a decrease in debt cost of 0.1%, compared to banks in the third tercile. As to equity, a bail-in event increases its cost by 0.5% for banks with high exposure. Thus, in terms of impact on total cost of funding, the amplifying effect of equity cost is partially compensated by the reduction in cost of debt: an average event increases the WACC by 0.4%.

Table 10 presents the impact of a single average bail-in event using a sample containing fifteen events. An appropriate discussion about the economic significance of the estimates requires choosing the most relevant benchmarks for the variables of interest based on the research question under scrutiny. In this case, the question focuses on the effects of the bail-in introduction, which is a process including a series of events that have increased bail-in expectations. Hence, a discussion about the economic significance of the introduction process entails the cumulation of bail-in impacts through several events. It is not appropriate to use the estimated parameters at face value because they describe the effect of a single bail-in event for a bank in the top tercile. At the same time, we cannot calculate the average cumulated impact by multiplying the estimates by the total number of events in the sample (i.e., fifteen), because that would wrongly assume that the average bank is constantly present in the top tercile throughout the entire set of events. Since the frequency with which a random bank appears in the top tercile is equal to a third of the events' sample (i.e., five out of fifteen events), Table 7 calculates average cumulated impacts as the product of the estimates times five.

Given that Model (5) is a panel data regression where the variable of interest $TopBailinShock \times post$ contains both a panel- and time-dimension, Table 7 compares the average cumulated impact with three standard deviations for each dependent variable (i.e., between, within and overall standard deviations). The positive impact of bail-in expectations on capital ratios is generally economically significant, as shown at the bottom of columns 1 and 2. When capital ratio is proxied by equity to assets, the average cumulated impact induced by bail-ins is 1.1%, which is equivalent to 2.5 times the standard deviation within single banks (0.4%), approximately equal to the standard deviation between different banks (1.1%) and 0.7 times the overall standard deviation (1.5%). In column 2 capital ratio is proxied by equity to risk-weighted assets. The average cumulated impact is 1.7%, which is larger than one within standard deviation (1.4%), and equal to 0.8 times the standard deviation between different banks (0.2%) and 0.7 times the overall standard deviation (0.22%). The economic significance of the impact on risk-weights is weak. The average cumulated impact (-1.8%) is equivalent to 0.6 times the within standard deviation (2.6%), 1.7 times the between standard deviation (0.9%) and 0.1 times the overall standard deviation (10.5%). Columns 4 and 5 indicate that the bail-in induces an increase in retained earnings with evident economic significance. The cumulated impact on retention ratio (32.5%) is approximately equal to 1.1 times the within standard deviation (28.3%), two times the between standard deviation (15.6%) and 1.1 times the overall standard deviation (30.8%). The average cumulated impact on retained earnings to assets (7.7%) is equivalent to 3.1 times the within standard deviation (2.4%), and equal to 1.9 times the standard deviation between different banks (3.9%) and 1.6 times the overall standard deviation (4.6%).

Columns 6 to 8 show that also the magnitude of the bail-in's effect on funding costs is remarkable. The cumulated impacts on cost of debt (-0.8%), cost of equity (2.5%) and WACC (2.1%) are economically significant even when compared to the overall standard deviation. The total impact on cost of debt, cost of equity and WACC are approximately 1.2, 0.8 and 1.4 times the overall standard deviation, respectively.

As a robustness check, analyses in Table 11 mostly replicate the ones in Table 10 except for the fact that they exclude the interactions $\overrightarrow{Rating}_{jt} \times Post_t$, which control for non-linear impacts (with respect to time) of credit ratings on dependent variables. The fact that estimates are similar to Table 10 indicates that the identifier $TopBailinShock$ reflects selectively bail-in expectations, rather than generic credit risk.

Conclusions

This paper investigates the bail-in regime in the European context. This reform is supposed to limit the moral hazard and risk-taking typically linked to bail-outs, by stimulating market discipline. This paper tracks bail-in effects - from shocks on market expectations to banks' delayed adjustment of risk-taking - and provides three main findings. First, policymakers' decisions have an impact on bail-in expectations in the bond market. In fact, decisions related to the legislative process of the bail-in and its applications on failing banks cause a repricing of bailinable bonds of non-bailed-in banks that reflects higher bail-in expectations. The repricing measured through a Khwaja-Mian approach is strictly driven by bail-in expectations: the change in bail-in expectation is negative in response to resolutions involving large costs for taxpayers, and it is insignificant in placebo tests. Second, bail-in decisions increase the market discipline and address the too-big-to-fail problem and bank-sovereign nexus. Third, focusing on bank-level variables, bail-in effects on bank resilience appear mixed. While it incentivises banks to reduce risk-taking (e.g., increasing equity ratio by a third of Basel III minimum requirement), it also remarkably exacerbates total funding costs through an increase in cost of equity.

References

Acharya, V. V., Anginer, D., and Warburton, A. J. (2016). The end of market discipline? Investor expectations of implicit government guarantees (May 1, 2016).

Acharya, V. V. and Yorulmazer, T. (2007). Too many to fail. An analysis of time-inconsistency in bank closure policies. Journal of financial intermediation, 16(1):1–31.

Allen, F., Carletti, E., Goldstein, I., and Leonello, A. (2015). Moral hazard and government guarantees in the banking industry. Journal of Financial Regulation, 1(1):30–50.

Allen, F., Carletti, E., Goldstein, I., and Leonello, A. (2018). Government guarantees and financial stability. Journal of Economic Theory, 177:518–557.

Ashcraft, A. B. (2005). Are banks really special? New evidence from the FDIC induced failure of healthy banks. American Economic Review, 95(5):1712–1730.

Avdjiev, S., Bogdanova, B., Bolton, P., Jiang, W., and Kartasheva, A. (2020). CoCo issuance and bank fragility. Journal of Financial Economics, 138(3):593–613.

Bagehot, W. (1873). Lombard Street: A description of the money market. HS King&Company.

Balasubramnian, B. and Cyree, K. B. (2014). Has market discipline on banks improved after the Dodd–Frank act? Journal of Banking & Finance, 41:155–166.

Beber, A., Brandt, M. W., and Kavajecz, K. A. (2009). Flight-to-quality or flight-to-liquidity? Evidence from the Euro-area bond market. The Review of Financial Studies, 22(3):925–957.

Beck, T. (2011). Bank resolution: a conceptual framework. Financial Regulation at the Crossroads: Implications for Supervision, Institutional Design and Trade, 12:53.

Beck, T., Da-Rocha-Lopes, S., and Silva, A. F. (2021). Sharing the pain? Credit supply and real effects of bank bail-ins. The Review of Financial Studies, 34(4):1747–1788.

Behn, M. and Schramm, A. (2021). The impact of G-SIB identification on bank lending: evidence from syndicated loans. Journal of Financial Stability.

Benczur, P., Cannas, G., Cariboni, J., Di Girolamo, F., Maccaferri, S., and Giudici, M. P. (2017). Evaluating the effectiveness of the new EU bank regulatory framework: A farewell to bail-out? Journal of Financial Stability, 33:207–223.

Berg, T. and Kaserer, C. (2015). Does contingent capital induce excessive risk taking? Journal of Financial Intermediation, 24(3):356–385.

Berger, A. N., DeYoung, R., Flannery, M. J., Lee, D., and Oztekin, O. (2008). How do large banking organizations manage their capital ratios? Journal of Financial Services Research, 34(2):123–149.

Bertrand, M., Duflo, E., and Mullainathan, S. (2004). How much should we trust differences-in-differences estimates? The Quarterly Journal of Economics, 119(1):249–275.

Bianchi, J. and Mendoza, E. G. (2018). Optimal time-consistent macroprudential policy. Journal of Political Economy, 126(2):588–634.

Boccuzzi, G. and De Lisa, R. (2017). Does bail-in definitely rule out bailout? Journal of Financial Management, Markets and Institutions, (1):93–110.

Brunnermeier, M. K., Garicano, L., Lane, P. R., Pagano, M., Reis, R., Santos, T., Thesmar, D., Van Nieuwerburgh, S., and Vayanos, D. (2016). The sovereign bank diabolic loop and ESBies. American Economic Review, 106(5):508–12.

Calomiris, C. W. (1999). Building an incentive-compatible safety net. Journal of Banking & Finance, 23(10):1499–1519.

Calomiris, C. W. and Mason, J. R. (2003). Consequences of bank distress during the great depression. American Economic Review, 93(3):937–947.

Chan, J. S., Hong, D., and Subrahmanyam, M. G. (2008). A tale of two prices: Liquidity and asset prices in multiple markets. Journal of Banking & Finance, 32(6):947–960.

Chan-Lau, J. A. and Oura, H. (2016). Bail-in power, depositor preference, and asset encumbrance: The end of cheap senior unsecured debt? A structural pricing perspective. A Structural Pricing Perspective (March 1, 2016).

Clayton, C. and Schaab, A. (2020). Bail-ins, optimal regulation, and crisis resolution. Available at SSRN 3455684.

Conlon, T. and Cotter, J. (2014). Anatomy of a bail-in. Journal of Financial Stability, 15:257–263.

Cordella, T. and Yeyati, E. L. (2003). Bank bailouts: moral hazard vs. Value effect. Journal of Financial intermediation, 12(4):300–330.

Covitz, D. M., Hancock, D., and Kwast, M. L. (2004). A reconsideration of the risk sensitivity of US banking organization subordinated debt spreads: A sample selection approach. Economic Policy Review, 10(2).

Cutura, J. A. (2021). Debt holder monitoring and implicit guarantees: did the BRRD improve market discipline? Journal of Financial Stability, 54:100879.

Dam, L. and Koetter, M. (2012). Bank bailouts and moral hazard: Evidence from Germany. The Review of Financial Studies, 25(8):2343–2380.

De Bruyckere, V., Gerhardt, M., Schepens, G., and Vander Vennet, R. (2013). Bank-sovereign risk spillovers in the European debt crisis. Journal of Banking & Finance, 37(12):4793–4809.

Demirguc-Kunt, A. and Detragiache, E. (2002). Does deposit insurance increase banking system stability? An empirical investigation. Journal of Monetary Economics, 49(7):1373–1406.

DeYoung, R., Spong, K., and Sullivan, R. J. (2001). Who's minding the store? Motivating and monitoring hired managers at small, closely held commercial banks. Journal of Banking & Finance, 25(7):1209–1243.

Diamond, D. W. and Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. Journal of Political Economy, 91(3):401–419.

Diamond, D. W. and Rajan, R. G. (2012). Illiquid banks, financial stability, and interest rate policy. Journal of Political Economy, 120(3):552–591.

Duchin, R. and Sosyura, D. (2014). Safer ratios, riskier portfolios: Banks response to government aid. Journal of Financial Economics, 113(1):1–28.

ECB Board (2013). The implications of bail-in rules for bank activity and stability. Bocconi University, Milan, 30 September.

Farhi, E. and Tirole, J. (2012). Collective moral hazard, maturity mismatch, and systemic bailouts. American Economic Review, 102(1):60–93.

Fiordelisi, F., Minnucci, F., Previati, D., and Ricci, O. (2020a). Bail-in regulation and stock market reaction. Economics Letters, 186:108801.

Fiordelisi, F., Pennacchi, G., and Ricci, O. (2020b). Are contingent convertibles going-concern capital? Journal of Financial Intermediation, 43:100822.

Flannery, M. J. (1998). Using market information in prudential bank supervision: A review of the US empirical evidence. Journal of Money, Credit and Banking, pages 273–305.

Flannery, M. J. and Sorescu, S. M. (1996). Evidence of bank market discipline in subordinated debenture yields: 1983–1991. The Journal of Finance, 51(4):1347–1377.

Fontana, A., Langedijk, S., and Petracco Giudici, M. (2019). The bank-sovereign loop and financial stability in the Euro area. Publications Office of the European Union.

Gale, D. and Vives, X. (2002). Dollarization, bailouts, and the stability of the banking system. The Quarterly Journal of Economics, 117(2):467–502.

Gao, Y., Liao, S., and Wang, X. (2018). Capital markets' assessment of the economic impact of the Dodd–Frank act on systemically important financial firms. Journal of Banking & finance, 86:204–223.

Goncharenko, R. (2020). Fighting fire with gasoline: CoCos in lieu of equity. Journal of Money, Credit and Banking.

Goncharenko, R., Ongena, S., and Rauf, A. (2020). The agency of CoCos: Why contingent convertible bonds are not for everyone. Journal of Financial Intermediation, page 100882.

Goodhart, C., Avgouleas, E., et al. (2015). A critical evaluation of bail-in as a bank recapitalization mechanism. The New International Financial System: Analyzing the Cumulative Impact of Regulatory Reform, pages 267–305.

Gorton, G. and Huang, L. (2004). Liquidity, efficiency, and bank bailouts. American Economic Review, 94(3):455–483.

Gropp, R., Hakenes, H., and Schnabel, I. (2011). Competition, risk-shifting, and public bail-out policies. The Review of Financial Studies, 24(6):2084–2120.

Gropp, R. and Vesala, J. (2004). Deposit insurance, moral hazard and market monitoring. Review of Finance, 8(4):571–602.

Hadjiemmanuil, C. (2015). Bank resolution financing in the banking union.

Halaj, G., Huser, A.-C., Kok, C., Perales, C., Van der Kraaij, A., et al. (2016). Systemic implications of the European bail-in tool: A multi-layered network analysis. Financial Stability Review, 1.

Hilscher, J. and Raviv, A. (2014). Bank stability and market discipline: The effect of contingent capital on risk taking and default probability. Journal of Corporate Finance, 29:542–560.

Huertas, T. (2016). European bank resolution: making it work! CEPS Task Force Report.

Ignatowski, M. and Korte, J. (2014). Wishful thinking or effective threat? Tightening bank resolution regimes and bank risk-taking. Journal of financial Stability, 15:264–281.

Jagtiani, J., Kaufman, G., and Lemieux, C. (2002). The effect of credit risk on bank and bank holding company bond yields: Evidence from the post-FDICIA period. Journal of Financial Research, 25(4):559–575.

Jorion, P., Liu, Z., and Shi, C. (2005). Informational effects of regulation FD: evidence from rating agencies. Journal of Financial Economics, 76(2):309–330.

Keister, T. (2016). Bailouts and financial fragility. The Review of Economic Studies, 83(2):704–736.

Khwaja, A. I. and Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. American Economic Review, 98(4):1413–42.

Koziol, C. and Lawrenz, J. (2012). Contingent convertibles. Solving or seeding the next banking crisis? Journal of Banking & Finance, 36(1):90–104.

Laeven, L. and Levine, R. (2009). Bank governance, regulation and risk taking. Journal of Financial Economics, 93(2):259–275.

Laeven, L., Ratnovski, L., and Tong, H. (2016). Bank size, capital, and systemic risk: Some international evidence. Journal of Banking & Finance, 69:S25–S34.

Leone, P., Porretta, P. P., and Riccetti, L. (2017). Determinants of European large bank stock market volatility: Is there a bail-in effect? Available at SSRN 3078573.

Lewrick, U., Serena, J. M., and Turner, G. (2019). Believing in bail-in? Market discipline and the pricing of bail-in bonds.

Maddaloni, A., and Peydro´, J.-L. (2011). Bank risk-taking, securitization, supervision, and low interest rates: Evidence from the Euro-area and the US lending standards. The review of financial studies, 24(6):2121–2165.

Mendicino, C. and Nikolov, K and Suarez, J., (2017) Equity Versus Bail-In Debt in Banking: An Agency Perspective. CEPR Discussion Paper No. DP12104, Available at SSRN: https://ssrn.com/abstract=2992534

Neuberg, R., Glasserman, P., Kay, B., and Rajan, S. (2018). The market-implied probability of government support for distressed European banks. OFR WP, pages 16–10.

Nosal, J. B. and Ordonez, G. (2016). Uncertainty as commitment. Journal of Monetary Economics, 80:124–140.

Pablos Nuevo, I. (2020). Has the new bail-in framework increased the yield spread between subordinated and senior bonds? The European Journal of Finance, 26(17):1781–1797.

Pancotto, L., ap Gwilym, O., and Williams, J. (2019). The European Bank Recovery and Resolution Directive: A market assessment. Journal of Financial Stability, 44:100689.

Pandolfi, L. (2021). Bail-in and bailout: Friends or foes? Management Science.

Philippon, T. and Salord, A. (2017). Bail-ins and bank resolution in Europe. Geneva Reports on the World Economy Special Report, 4.

Philippon, T. and Schnabl, P. (2013). Efficient recapitalization. The Journal of Finance, 68(1):1–42.

Santos, J. A. (2014). Evidence from the bond market on banks "too-big-to-fail" subsidy. Economic Policy Review.

Schäfer, A., Schnabel, I., and Weder di Mauro, B. (2016). Bail-in expectations for European banks: Actions speak louder than words.

Schnabel, I. (2020). Are banks finally resolvable? A perspective from Europe. Journal of Money, Credit and Banking, 52(S1):77–86.

Shapiro, J. and Skeie, D. (2015). Information management in banking crises. The Review of Financial Studies, 28(8):2322–2363.

Sironi, A. (2003). Testing for market discipline in the European banking industry: evidence from subordinated debt issues. Journal of Money, Credit and Banking, pages 443–472.

Slovin, M. B., Sushka, M. E., and Polonchek, J. A. (1993). The value of bank durability: Borrowers as bank stakeholders. The Journal of Finance, 48(1):247–266.

Valiante, D. (2014). Framing banking union in the Euro area: some empirical evidence. CEPS Working Document, (389).

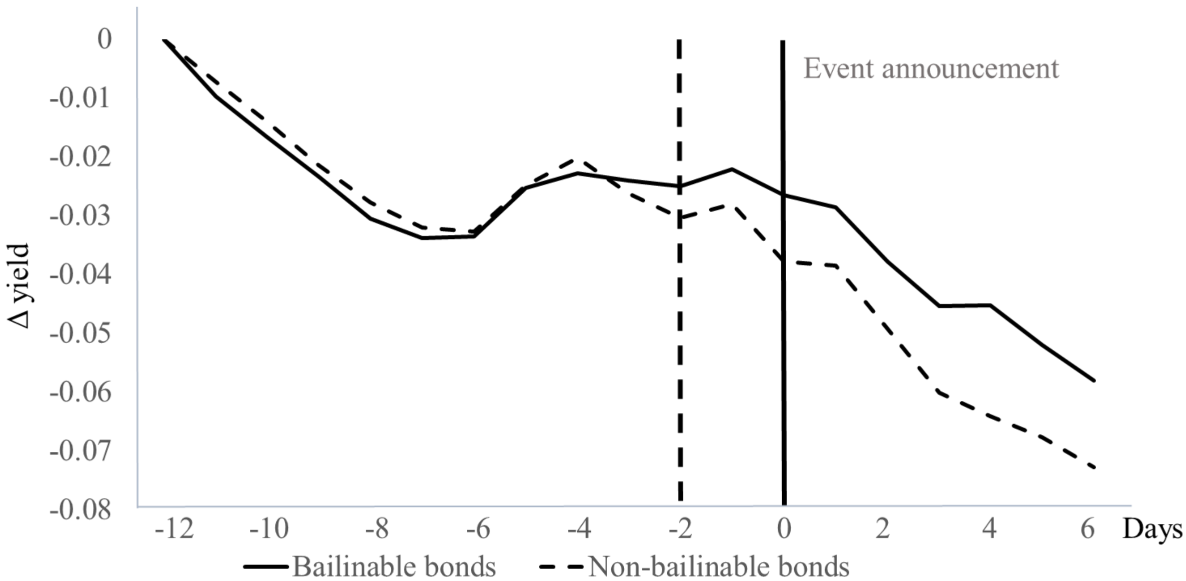
Völz, M. and Wedow, M. (2011). Market discipline and too-big-to-fail in the CDS market: Does banks' size reduce market discipline? Journal of Empirical Finance, 18(2):195–210.

Walther, A. and White, L. (2020). Rules versus discretion in bank resolution. The Review of Financial Studies, 33(12):5594–5629. 31

World Bank (2016). Bank Resolution and Bail-In in the EU: Selected Case Studies Pre-and Post-BRRD.

Figures

Figure 1. Unconditional averages of yields (bailinable and non-bailinable bonds).



Data: Bloomberg. The x-axis displays the trading days around the average bail-in event (from 12 days before to 6 days after the announcement). The y-axis shows the unconditional averages of yields of bailinable and non-bailinable bonds. Yield averages are expressed in terms of change with respect to the initial day of the chart (i.e., 12 days before the average bail-in event). Yield averages include only non-bailed-in banks and consider all events from 2012 to 2017. Thus, the average bail-in event is the result of the collapsing (i.e., time-averaging) of all events into a single one.

Tables

Table 1. Descriptive statistics.

Variables	Mean	St. deviation	N
Yield to Maturity	2.5%	2.4%	2,169,806
Non-bailinable	26.44%	37.65%	2,169,806
Bond Turnover (days)	28.6	2.8	2,169,806
Time to Maturity (days)	2,717	3,104	2,169,806
Total assets (€Ml)	736,600	577,988	2,169,806
1-year Probability of Default	0.53%	0.93%	2,169,806
Risk-Weighted Assets (€Ml)	234,276	237,414	2,169,806
Retained Earnings (€Ml)	12,953	26,189	2,169,806
Common Equity (€Ml)	35,349	36,888	2,169,806
DE 5yCDS	23.30	16	1,456
UK 5yCDS	30.17	12	1,456
FR 5yCDS	52.24	34	1,456
IT 5yCDS	177.95	92	1,456
SP 5yCDS	148.84	119	1,456
NE 5yCDS	32.91	20	1,456

Table 2. List of bail-in related events.

Date	Event	Jurisdictions	Article Title	Source
10.07.2012	Spanish bail-in plan	Spain	Savers face losses in Spain bank rescue	Financial Times
19.07.2012	Germany vote on bail-out	Spain	Spain bailout backed	Financial Times
23.08.2012	Spain Gov. proposes bail-in	Spain	Spain bank rules push	Financial Times
24.10.2012	Details on bail-in	Spain	ECB Said to Push Spain's Bankia to Swap Junior Debt for Shares	Bloomberg News
17.12.2012	No junior debt losses (MPS)	Italy	Italy Commission temporarily approves rescue aid for Italian bank MPS	EU Commission
28.12.2012	No junior debt losses (Dexia)	France, Belgium	EU Commission approves Dexia bailout plan	Reuters
01.02.2013	Bail-in SNS Reaal	Netherlands	Torrid week for European banks	Financial Times
18.03.2013	Cyprus rescue plan	Cyprus	Cyprus in crisis over tax on bank deposits	Financial Times
02.04.2012	Cyprus accord signed	Cyprus	Cyprus government spokesman says have finalized TroiKa talks	Bloomberg News
28.06.2013	Fin. Ministers back BRRD	EU	EU bank rules deal	Financial Times
18.12.2013	Bail-in Slovenian banks	Slovenia	Commission approves reseve or restructuring aid for five Slovenian banks	EU Commission
15.04.2014	EU Parliam. approves BRRD	EU	EU banking reforms mark the biggest shake-up	Financial Times
05.08.2014	BES bail-in	Portugal	BES locked on bail-in	Financial Times
12.08.2015	Greek banks bail-in	Greece	Greece Commits to Comprehensive Bank Plan	Bloomberg News
05.10.2015	Andelskassen bail-in	Denmark	Danish State Takes Over Lender Andekkassen J.A.K. Slagele	Bloomberg News
22.11.2015	Bail-in of four ITA banks	Italy	Bail-in of four banks Italy Commission approves resolution plans for four small Italian banks	EU Commission
10.04.2016	Bail-in of Heta	Austria	Austrian regulator imposes heta bal in cuts senior debt 54%	Bloomberg News
07.06.2017	No state-aid for Popular	Spain	The Single Resolution Board adopts resolution decision for Banco Popular	SRB
23.06.2017	No senior debt losses (ITA banks)	Italy	The SRB will not take resolution action in relation to BPV and VB	SRB
05.07.2017	No senior debt losses (MPS)	Italy	EU approval of Monte Paschi restructure paves way for state control	Financial Times

Table 3. Classification of bail-in cases.

Date	Main bank	Flexible	Subord. Debt Update	Sr. Unsec. Debt Update	Source	Public Aid	Period
10.07.12 19.07.12 23.08.12 24.10.12	Bankia	No	Downgraded to level 9	Downgraded to level 7	Moody's	Yes	Phase-in
17.12.12	MPS	Yes	Stable at level 7	Stable at level 4	Fitch	Yes	Phase-in
28.12.12	Dexia	Yes	Stable at level 7	Stable at level 4	Moody's	Yes	Phase-in
01.02.13	SNS Reaal	No	Downgraded to level 9	Downgraded to level 5	Moody's	Yes	Phase-in
18.03.13 02.04.13	B. of Cyprus	No	Downgraded to level 9	Downgraded to level 9	Moody's	Yes	Phase-in
18.12.13	NLB	No	Written down	Stable	Fitch	Yes	Phase-in
05.08.14	BES	No	Downgraded to level 9	Downgraded to level 7	Moody's	Yes	Phase-in
12.08.15	N.B. of Greece	No	Downgraded to level 9	Downgraded to level 9	Moody's	Yes	Phase-in
05.10.15	Andelskassen	No	Written down	Partially written down	WB	Yes	Phase-in
22.11.15	Etruria	No	Written down	Stable	DBRS	Yes	Phase-in
10.04.16	Heta	No	Written down	54% written down	WB	Yes	BRRD
07.06.17	Banco Popular	No	Downgraded to level 9	Stable at level 6	Moody's	No	BRRD
23.06.17	Veneto Banca	Yes	Downgraded to level 9	Downgraded to level 5	Moody's	Yes	BRRD
05.07.17	MPS	Yes	Stable at level 8	Stable at level 6	Moody's	Yes	BRRD

Table 4a. Bail-in expectation shocks for standard, flexible and placebo events.

	ΔYield						
	Standard		Flexible		Placebo		
					5 events	3 events	7 events
	1	2	3	4	5	6	7
Bailinable	**0.028*** **	**0.026*** **	**-0.024*** **	**-0.027*** **	**0.003**	**-0.009**	**0.005**
	[0.003]	[0.003]	[0.002]	[0.002]	[0.005]	[0.006]	[0.006]
Δ Bank Yield	2.614***		10.203***		1.062	3.807	1.651**
	[0.668]		[2.136]		[0.827]	[2.937]	[0.814]
Bond Turnover	-0.002*	-0.002**	-0.001*	-0.002**	-0.000	0.001	-0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.001]
Time to Maturity	0.000	0.001	0.001**	0.001*	0.001*	0.001	0.001*
	[0.002]	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Constant	-0.057***	-0.068***	-0.001	-0.004	-0.071*	-0.055	-0.033
	[0.017]	[0.018]	[0.008]	[0.008]	[0.041]	[0.046]	[0.029]
Bank FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y
N	61,105	61,105	15,193	15,193	11,402	9,614	13,834
Adj. R^2	0.09	0.08	0.11	0.09	0.08	0.08	0.08

Estimates from Model (1). Data: Bloomberg. The dependent variable is the bond-level change in average yield from before to after bail-in events. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event windows, [-2; +2]. Control variables include: (i) Δbankyld is the change in a bank's debt yield, (ii) bond turnover and time-to-maturity, and (iii) day and bank fixed effects. Columns 3 and 4 focus on flexible events only, i.e., bail-ins with less severe costs for investors, compared to standard events. Table 3 characterises standard and flexible events. Columns 5 to 7 focus on placebo events only, i.e., dates characterised by sector-wide banking distress that is not due to bail-in decisions. The sector-wide banking distress is proxied by the occurrence of an extreme drop in the MSCI Bank Europe index. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 4b. Bail-in expectation shocks for each standard bail-in event.

	ΔYield							
	10.07.2012	19.07.2012	23.08.2012	24.10.2012	01.02.2013	18.03.2013	02.04.2013	28.06.2013
	1	2	3	4	5	6	7	8
Bailinable	0.071***	0.045***	0.021*	0.063***	0.080***	0.017	0.040***	0.070***
	[0.013]	[0.011]	[0.011]	[0.011]	[0.010]	[0.011]	[0.005]	[0.018]
Δ Bank Yield	Y	Y	Y	Y	Y	Y	Y	Y
Bond Turnover	Y	Y	Y	Y	Y	Y	Y	Y
Time to Maturity	Y	Y	Y	Y	Y	Y	Y	Y
Constant	Y	Y	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
N	5,314	5,474	4,955	4,045	4,126	3,748	3,656	3,557
Adj. R^2	0.17	0.11	0.12	0.22	0.41	0.05	0.33	0.08
	ΔYield							
	18.12.2013	15.04.2014	05.08.2014	12.08.2015	05.10.2015	22.11.2015	10.04.2016	07.06.2017
	9	10	11	12	13	14	15	16
Bailinable	-0.018***	0.001	0.033***	0.029***	0.016***	-0.002	-0.003	0.036***
	[0.006]	[0.005]	[0.004]	[0.003]	[0.004]	[0.003]	[0.006]	[0.011]
Δ Bank Yield	Y	Y	Y	Y	Y	Y	Y	Y
Bond Turnover	Y	Y	Y	Y	Y	Y	Y	Y
Time to Maturity	Y	Y	Y	Y	Y	Y	Y	Y
Constant	Y	Y	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
N	3,305	3,247	3,237	3,238	3,205	3,220	3,282	3,496
Adj. R^2	0.06	0.12	0.11	0.17	0.17	0.05	0.09	0.01

Estimates from Model (1). Data: Bloomberg. The dependent variable is the bond-level change in average yield from before to after bail-in events. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event windows, [-2; +2]. Control variables include: (i) ΔBankYield is the change in a bank's debt yield, (ii) bond turnover and time-to-maturity, and (iii) day and bank fixed effects. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 4c. Bail-in expectation shocks for each flexible bail-in event.

	ΔYield			
	17.12.2012	28.12.2012	23.06.2017	05.07.2017
	1	2	3	4
Bailinable	-0.048***	-0.028***	-0.015***	-0.001
	[0.005]	[0.005]	[0.002]	[0.002]
Δ Bank Yield	Y	Y	Y	Y
Bond Turnover	Y	Y	Y	Y
Time to Maturity	Y	Y	Y	Y
Constant	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
N	4,084	4,094	3,506	3,509
Adj. R^2	0.16	0.11	0.05	0.03

Estimates from Model (1). Data: Bloomberg. The dependent variable is the bond-level change in average yield from before to after bail-in events. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event windows, [-2; +2]. Control variables include: (i) ΔBankYield is the change in a bank's debt yield, (ii) bond turnover and time-to-maturity, and (iii) day and bank fixed effects. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 5. Bail-in effects on market discipline. Standard and flexible events.

	Yield			
	Standard			Flexible
	1	2	3	4
PD	**0.723*** **	0.554***	0.551***	0.853***
	[0.019]	[0.018]	[0.016]	[0.048]
Bailinable×PD		**0.449*** **	0.442***	-0.311*
		[0.055]	[0.051]	[0.156]
Bailinable×Post×PD			**0.028*** **	**-0.007*** **
			[0.004]	[0.002]
Bailinable×Post			0.296***	-0.086***
			[0.025]	[0.014]
PD×Post			0.010***	-0.009
			[0.001]	[0.010]
Post			0.060***	0.038***
			[0.007]	[0.002]
Constant	6.788***	6.673***	6.595***	6.588***
	[0.172]	[0.154]	[0.153]	[0.378]
Bond FE	Y	Y	Y	Y
Bank×Post FE	N	N	N	N
Day FE	N	N	N	N
N	555,517	555,517	555,517	151,126
Adj. R^2	0.21	0.23	0.23	0.39

Estimates in columns 1 to 2 are related to Model (2) and (3), while columns 3 and 4 are related to Model (4). Data: Bloomberg. The dependent variable is bond yield to maturity. PD is the natural logarithm of Bloomberg's 1-year default probability. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event window, [-2; +2]. Control variables include bond fixed effects. Column 4 focuses on flexible events only, i.e., bail-ins with less severe costs for investors, compared to standard events. Table 3 characterises standard and flexible events. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 6. Bail-in effects on market discipline. Standard and flexible events.

	Yield			
	Standard		Flexible	
	[-7; +2]	[-20; +20]	[-7; +2]	[-20; +20]
	1	2	3	4
Bailinable×Post×PD	**0.022*** **	**0.011*** **	**-0.001**	**-0.004**
	[0.004]	[0.003]	[0.001]	[0.004]
Bailinable×Post	0.182***	0.116***	-0.042**	-0.035**
	[0.022]	[0.029]	[0.019]	[0.014]
PD×Post	-0.008***	-0.009***	-0.005***	-0.009**
	[0.001]	[0.002]	[0.001]	[0.004]
Bailinable×PD	0.392***	0.435***	0.156**	0.151**
	[0.044]	[0.036]	[0.070]	[0.071]
PD	-0.119***	-0.139***	-0.015	-0.017
	[0.020]	[0.016]	[0.053]	[0.066]
Post	-1.913***	-2.127***	-1.273***	-1.648***
	[0.136]	[0.125]	[0.121]	[0.133]
Bond Turnover	-0.013***	-0.011***	-0.007	-0.008**
	[0.002]	[0.002]	[0.005]	[0.004]
Time to Maturity	0.002***	0.002***	0.002***	0.002***
	[0.000]	[0.000]	[0.000]	[0.000]
Constant	5.069***	7.911***	3.744***	2.815***
	[0.122]	[0.159]	[0.092]	[0.099]
Bond FE	Y	Y	Y	Y
Bank×Time FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
N	555,517	2,026,926	151,126	527,430
Adj. R^2	0.71	0.72	0.48	0.46

Estimates from Model (4) with additional control variables. Data: Bloomberg. The dependent variable is bond yield to maturity. PD is the natural logarithm of Bloomberg's 1-year default probability. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event windows, [-2; +2] or [-2; +20]. Control variables include: (i) bond turnover and time-to-maturity, (ii) day and bond fixed effects, and (iii) bank×post fixed effects. Columns 3 and 4 focus on flexible events only. Table 3 characterises standard and flexible events. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 7. Market discipline effects across terciles of bank size.

	Yield									
	Standard					Flexible				
	Terciles of size			Diff. across terciles		Terciles of size			Diff. across terciles	
	Low	Mid	Top	Mid-Low	Top-Mid	Low	Mid	Top	Mid-Low	Top-Mid
	1	2	3	4	5	6	7	8	9	10
Bailinable×Post×PD	**0.003**	**0.029*****	**0.036*****	**0.026*****	**0.007**	**0.001**	**-0.001**	**-0.025*****	**-0.002**	**-0.024*****
	[0.006]	[0.004]	[0.004]	[0.007]	[0.005]	[0.004]	[0.005]	[0.005]	[0.006]	[0.007]
Bailinable×Post	0.052	0.227***	0.240***			-0.004	-0.027	-0.175***		
	[0.042]	[0.023]	[0.032]			[0.004]	[0.021]	[0.022]		
PD×Post	-0.002	-0.010***	-0.025***			0.005***	-0.008	0.006*		
	[0.002]	[0.001]	[0.004]			[0.002]	[0.005]	[0.003]		
Bailinable×PD	0.267***	0.700***	0.675***			0.131	0.503	0.486*		
	[0.065]	[0.132]	[0.105]			[0.121]	[0.425]	[0.271]		
PD	-0.034	-0.135**	-0.329***			-0.057	0.368*	-0.159		
	[0.025]	[0.064]	[0.081]			[0.241]	[0.194]	[0.191]		
Post	-1.657**	-1.864***	-3.258***			-0.771	-1.260***	-1.872***		
	[0.665]	[0.159]	[0.183]			[0.552]	[0.466]	[0.475]		
Controls	Y	Y	Y			Y	Y	Y		
Bond FE	Y	Y	Y			Y	Y	Y		
Bank×Post FE	Y	Y	Y			Y	Y	Y		
Day FE	Y	Y	Y			Y	Y	Y		
Constant	Y	Y	Y			Y	Y	Y		
N	189,978	179,617	185,922			51,667	48,864	50,595		
Adj. R^2	0.74	0.63	0.69			0.45	0.17	0.65		

Estimates are related to Model (4) with additional control variables. Data: Bloomberg. The dependent variable is bond yield to maturity. PD is the natural logarithm of Bloomberg's 1-year default probability. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event windows, [-2; +20]. Columns 4 and 5 show the difference in triple-interaction estimates between middle and lowest terciles and between top and middle terciles. Control variables include: (i) bond turnover and time-to-maturity, (ii) day and bond fixed effects, and (iii) bank×post fixed effects. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 8. Market discipline effects across different terciles of rating-implied public support.

	Yield									
	Standard					Flexible				
	Terciles of public support			Diff. across terciles		Terciles of public support			Diff. across terciles	
	Low	Mid	Top	Mid-Low	Top-Mid	Low	Mid	Top	Mid-Low	Top-Mid
	1	2	3	4	5	6	7	8	9	10
Bailinable×Post×PD	**-0.004**	**0.028*****	**0.041*****	**0.024*****	**0.013**	**-0.001**	**-0.009***	**-0.019*****	**-0.008**	**-0.010****
	[0.009]	[0.009]	[0.011]	[0.010]	[0.012]	[0.005]	[0.005]	[0.004]	[0.005]	[0.005]
Bailinable×Post	0.006	0.179***	0.286***			-0.006	-0.043	-0.183***		
	[0.051]	[0.062]	[0.059]			[0.005]	[0.035]	[0.036]		
PD×Post	-0.001	-0.011***	-0.024***			0.011***	-0.013*	0.008*		
	[0.005]	[0.004]	[0.006]			[0.004]	[0.007]	[0.004]		
Bailinable×PD	0.485***	0.220	0.908***			0.345	0.671	0.574*		
	[0.136]	[0.134]	[0.092]			[0.299]	[0.605]	[0.319]		
PD	-0.194***	0.014	-0.524***			-0.093	0.368	-0.629*		
	[0.064]	[0.049]	[0.113]			[0.456]	[0.334]	[0.351]		
Post	-0.041	-2.697***	-0.120***			-0.569	-1.143***	-1.923***		
	[0.034]	[0.201]	[0.040]			[0.731]	[0.541]	[0.319]		
Controls	Y	Y	Y			Y	Y	Y		
Bond FE	Y	Y	Y			Y	Y	Y		
Bank×Post FE	Y	Y	Y			Y	Y	Y		
Day FE	Y	Y	Y			Y	Y	Y		
Constant	Y	Y	Y			Y	Y	Y		
N	127,285	120,343	124,568			34,617	32,739	33,899		
Adj. R^2	0.72	0.56	0.65			0.41	0.31	0.51		

Estimates from Model (4) with additional control variables. Data: Bloomberg. PD is the natural logarithm of Bloomberg's 1-year default probability. Bailinable is a dummy variable taking the value of 1 when the bond is "senior subordinated" or less senior. Post is a dummy variable taking the value of 1 in the post-bail-in event windows, [-2; +20]. Columns 4 and 5 show the difference in triple-interaction estimates between middle and lowest terciles and between top and middle terciles. Control variables include: (i) bond turnover and time-to-maturity, (ii) day and bond fixed effects, and (iii) bank×post fixed effects. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 9. Impact of bail-in events on bank-sovereign nexus.

	Yield			
	Standard		Flexible	
	[-7; +2]	[-20; +20]	[-7; +2]	[-20; +20]
	1	2	3	4
Bailinable×Post×SovCDS	**-0.009***	**-0.002***	**0.003**	**0.002**
	[0.005]	[0.001]	[0.004]	[0.003]
Bailinable×Post	0.084***	0.063***	-0.038**	-0.031*
	[0.021]	[0.016]	[0.019]	[0.018]
SovCDS×Post	-0.000***	-0.000***	-0.003	-0.004
	[0.000]	[0.000]	[0.003]	[0.003]
Bailinable×SovCDS	0.055	0.064	0.051	0.072
	[0.083]	[0.079]	[0.062]	[0.084]
SovCDS	0.173***	0.182***	0.145***	0.152***
	[0.046]	[0.049]	[0.041]	[0.046]
Bond Turnover	-0.015***	-0.012***	-0.003	-0.004
	[0.002]	[0.002]	[0.004]	[0.005]
Time to Maturity	0.003***	0.003***	0.001***	0.001***
	[0.000]	[0.000]	[0.000]	[0.000]
Constant	3.582***	3.278***	3.356***	2.229***
	[0.187]	[0.198]	[0.084]	[0.082]
Bond FE	Y	Y	Y	Y
Bank×Post FE	Y	Y	Y	Y
Day FE	Y	Y	Y	Y
N	555,517	2,026,926	151,126	527,430
Adj. R^2	0.68	0.41	0.45	0.44

Estimates from Model (5) with additional control variables. The dependent variable is yield to maturity. SovCDS is the sovereign CDS spread. Control variables include: (i) bond turnover and time-to-maturity, (ii) day and bond fixed effects, and (iii) bank×post fixed effects. Columns 3 and 4 focus on flexible events only. Table 3 characterises standard and flexible events. All standard errors are robust to heteroscedasticity and clustered at bank level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 10. Impact of bail-in events on bank-level risk-taking and funding costs.

	Equity/TA	*Equity/RWA*	*RWA/TA*	*Ret.Ratio*	*Ret.Earn./RWA*	*Cost of Debt*	*Cost of Equity*	*WACC*
	1	2	3	4	5	6	7	8
TopBailinShock×Post	**0.002*** **	**0.003*** **	**-0.003** **	**0.065* **	**0.015*** **	**-0.001*** **	**0.005*** **	**0.004*** **
	[0.001]	[0.001]	[0.002]	[0.038]	[0.004]	[0.000]	[0.001]	[0.001]
TopBailinShock	-0.001**	-0.000	-0.002	0.037*	-0.019***	0.005***	-0.001	-0.011***
	[0.000]	[0.001]	[0.002]	[0.021]	[0.003]	[0.001]	[0.001]	[0.003]
Mid-Rating	0.001	-0.001	0.021***	-0.014	-0.011**	0.006***	-0.001	-0.035***
	[0.001]	[0.003]	[0.005]	[0.049]	[0.005]	[0.001]	[0.002]	[0.008]
Low-Rating	0.001	-0.004	0.020***	0.072	0.002	0.004***	-0.001	-0.032***
	[0.001]	[0.004]	[0.007]	[0.056]	[0.006]	[0.001]	[0.003]	[0.008]
Low-Rating × Post	0.001***	0.002**	-0.001*	0.023**	0.004	0.003***	0.002***	0.002***
	[0.000]	[0.001]	[0.000]	[0.011]	[0.005]	[0.001]	[0.001]	[0.001]
Mid-Rating × Post	-0.000*	0.004	-0.001*	0.015	0.003	0.002***	0.001	0.001***
	[0.000]	[0.004]	[0.000]	[0.031]	[0.006]	[0.000]	[0.002]	[0.000]
BondTurnover	Y	Y	Y	Y	Y	Y	Y	Y
TimeToMaturity	Y	Y	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Day FE	Y	Y	Y	Y	Y	Y	Y	Y
Country×week FE	Y	Y	Y	Y	Y	Y	Y	Y
Constant	Y	Y	Y	Y	Y	Y	Y	Y
N	33,318	33,318	33,318	33,318	33,318	33,318	33,318	33,318
Adj. R^2	0.44	0.54	0.36	0.20	0.22	0.76	0.86	0.48
Average Cum. Impact	0.011	0.017	-0.018	0.325	0.077	-0.008	0.025	0.021
Dep.Var. Within SD	0.004	0.014	0.026	0.283	0.024	0.005	0.023	0.014
Dep.Var. Between SD	0.011	0.020	0.009	0.156	0.039	0.004	0.028	0.010
Dep.Var. SD	0.015	0.022	0.105	0.308	0.046	0.007	0.032	0.015

Estimates from Model (6). Data: Bloomberg. Dependent variables include risk-taking metrics (i.e., Equity/Tot.Assets, Equity/RWA, RWA/Tot.Assets, Retention Ratio, Ret.Earn./RWA), and funding cost metrics (i.e., Cost of Debt, Cost of Equity, WACC). TopBailinShock is the dummy variable separating banks in the top tercile of bail-in expectation shock from banks in the bottom tercile. It is identified through the bail-in expectations resulting from the estimation of the Khwaja-Mian approach for each bank and event. Post is the dummy variable taking the value of one in the 3 months after bail-in events, and zero 3 months before bail-in events. Top-Rating is the dummy variable separating banks in the top tercile of credit risk from any other bank. Mid-Rating is the dummy variable separating banks in the middle tercile of credit risk from any other bank. Control variables include: (i) bank-level bond turnover and time-to-maturity, (ii) day and bank fixed effects, and (iii) country×week fixed effects. All standard errors are robust to heteroscedasticity and clustered at country level. Average cumulated impact is equal to the interaction's estimate times five (i.e., the number of times a random bank is part of the top TopBailinShock tercile). For each dependent variable, the table shows the between, within and overall standard deviations. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table 11. Impact of bail-in events on bank-level risk-taking and funding costs (excluding specific control variables).

	Equity/TA	*Equity/RWA*	*RWA/TA*	*Ret.Ratio*	*Ret.Earn./RWA*	*Cost of Debt*	*Cost of Equity*	*WACC*
	1	2	3	4	5	6	7	8
TopBailinShock×Post	**0.003*** **	**0.003*** **	**-0.003*** **	**0.073***	**0.017*** **	**-0.001*** **	**0.006*** **	**0.004*** **
	[0.001]	[0.001]	[0.001]	[0.041]	[0.004]	[0.000]	[0.001]	[0.001]
TopBailinShock	-0.002***	-0.000	-0.002	0.054*	-0.022***	0.004***	-0.001	-0.014***
	[0.000]	[0.001]	[0.002]	[0.031]	[0.003]	[0.001]	[0.001]	[0.003]
Rating FE	Y	Y	Y	Y	Y	Y	Y	Y
BondTurnover	Y	Y	Y	Y	Y	Y	Y	Y
TimeToMaturity	Y	Y	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Day FE	Y	Y	Y	Y	Y	Y	Y	Y
Country×week FE	Y	Y	Y	Y	Y	Y	Y	Y
Constant	Y	Y	Y	Y	Y	Y	Y	Y
N	33,318	33,318	33,318	33,318	33,318	33,318	33,318	33,318
Adj. R^2	0.43	0.52	0.35	0.18	0.21	0.74	0.83	0.44

Estimates from Model (6). Data: Bloomberg. Dependent variables include risk-taking metrics (i.e., Equity/Tot.Assets, Equity/RWA, RWA/Tot.Assets, Retention Ratio, Ret.Earn./RWA), and funding cost metrics (i.e., Cost of Debt, Cost of Equity, WACC). TopBailinShock is the dummy variable separating banks in the top tercile of bail-in expectation shock from banks in the bottom tercile. It is identified through the bail-in expectations resulting from the estimation of the Khwaja-Mian approach for each bank and event. Post is the dummy variable taking the value of one in the 3 months after bail-in events, and zero 3 months before bail-in events. Control variables include: (i) bank-level bond turnover and time-to-maturity, (ii) day and bank fixed effects, and (iii) country×week fixed effects. All standard errors are robust to heteroscedasticity and clustered at country level. N is the total number of observations in each regression. ***, **, and * indicate significance at the 1%, 5%, and 10% two-tailed levels, respectively.

Table A1. Table for credit rating conversions.

Moody's Rating		Fitch Rating		S&P Rating	Conversion
Standard (incl. support)	Excluding support	Standard (incl. support)	Excluding support	Standard (incl. support)	
Aaa	aaa	AAA	A	AAA	1
Aa	aa	AA	A/B	AA	2
A	a	A	B	A	3
Baa	baa	BBB	B/C	BBB	4
Ba	ba	BB	C	BB	5
B	b	B	C/D	B	6
Caa	caa	CCC	D	CCC	7
Ca	ca	CC	D/E	CC	8
C	c	C	E	C	9

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Raffaele Giuliana
Central Bank of Ireland, Dublin, Ireland; email: **Raffaele.Giuliana@centralbank.ie**

Postal address	60640 Frankfurt am Main, Germany
Telephone	+49 69 1344 0
Website	**www.esrb.europa.eu**

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