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Bail-in and bank funding costs

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ABSTRACT

We evaluate the impact of the bail-in, the new resolution policy adopted in 2016 within the Bank Recovery and Resolution Directive, on the cost of funding for EU banks. We first estimate the change in spreads of credit default swaps on subordinated and senior bonds issued by EU banks through an event study around the period when the policy became effective. We find that risk premia of junior bail-in-able bonds raised more compared to senior bonds. The results, however, point to a great heterogeneity in the impact of the policy, both for individual banks and across countries, while a simple theoretical model suggests possible sources of this heterogeneity. We therefore regressed the abnormal values derived from the event study on bank characteristics and macroeconomic factors. We uncovered several factors explaining the larger cost of funds for some of the EU banks after the implementation of bail-in: banks with more problematic loans, less capitalized, and headquartered in countries with a higher risk premium on sovereign debt have experienced a larger rise in their funding costs when issuing subordinated bonds. Overall, our paper provides evidence that the adoption of bail-in has prompted a more accurate evaluation of bank risk by junior creditors, leading to an increase in the cost of funds for banks.

1. Introduction

Following the great financial crisis of 2007–2008, governments had to intervene to rescue several financial institutions in distress (e.g., Monte dei Paschi di Siena, Dexia, Hypo Alpe, among others) in order to prevent an even greater disruption to the real economy. When a bank fails, the real economy is affected by a contraction in credit supply and by the disruption of existing credit relationships. In addition, when a bank is in distress, other financial institutions may also be affected if interconnected with the weakest bank through their balance sheets, due to the spreading of the contagion. The remedy, since immediately after the financial crisis, has been to use public money to rescue the bank in distress. In the period 2008–2012, overall public intervention amounted to around 600 billion euro, that is, about 4.60% of GDP in Europe in 2012 (see Benczur et al., 2017).

This has generated a public outcry around the world for the use of public money to relieve shareholders and bondholders from the losses caused by the mismanagement of their banks. In addition, public authorities began to fear a surge in moral hazard by bank managers. In some European countries, there was a further risk of being trapped in a vicious circle (the so-called "doom loop"), by which the largest banks could not be rescued given the already high level of public debt, while, at the same time, injection of public money to prevent banks from failing required new issues of public bonds (see Farhi and Tirole, 2018).

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With the purpose of amending these imperfections of the financial system, a new set of regulations was designed. The European Parliament approved in April 2014 the Bank Recovery and Resolution Directive (BRRD), to be adopted by all Member States by the end of 2014, and in July 2014 the Single Resolution Mechanism (SRM) a new regulation that became European Law by the 1st January 2016. The objective of the BRRD was to increase the resilience of the financial system by guaranteeing an ordered resolution of banks in distress and to preserve the continuity of banks' critical functions through a new framework of rules, while the SRM set the framework for its implementation. These two pieces of legislation are complementary since the BRRD provides uniform rules for the whole EU market to improve efficiency and cohesion in ensuring a more integrated bank oversight and crisis management in the banking union, while the SRM sets out the institutional and funding architecture for the application of those rules in Member States.

One of the main tools of the SRM is the so-called "bail-in", that allows banks to recapitalize by converting (or writing down) debt owned by private creditors into equity. More specifically, it requires all shareholders and creditors (holding bail-in-able bonds) to bear at least 8% of the losses of the bank's total liabilities before allowed to call for government intervention. Debt subject to bail-in is commonly referred to as "bail-in-able" debt and it includes different categories of junior debt, such as unsecured, uninsured, and subordinated bonds. On the one hand, by reducing the possibility of rescuing failing banks with the use of public money, market discipline of bank creditors increases, while limiting moral hazard by bankers. On the other hand, the bank's default risk is transferred from taxpayers to investors who then face a higher credit risk and, consequently, demand a higher risk premium. This mechanism stimulates a more accurate evaluation of bank risk leading to a repricing of bail-in-able debt and, thus, to an increase in the cost of funds for banks, when issuing subordinated bonds. This is of great concern, given that European banks rely on bonds as a source of their liquidity (see ECB, 2009).

The main objective of this paper is to focus on the effect on banks' funding cost of the new resolution framework that came into force in January 2016 with the SRM, and, more specifically, to analyze the intensity of its impact across banks by disentangling their intrinsic vulnerability from country-specific factors.

To this aim, we first estimate the change in the price of bail-in-able debt through an event-study performed on the spreads of one year maturity credit default swaps (CDS) issued by EU banks located in countries where the new resolution framework was implemented in January 2016. To anticipate our results, we find a positive and statistically significant reaction for almost all banks in our sample, confirming that the adoption of bail-in contributed to an increase in the cost of junior debt for European banks. However, we find great heterogeneity in the reaction of individual banks. To help understanding this heterogeneity, we develop a theoretical framework from which we uncover possible economic channels: we show that a weaker capitalization or a greater loan portfolio risk amplify the negative effect on bank funding costs when switching from bail-out to bail-in.

We then examine the differences in the estimated abnormal values of the differential between senior and subordinated CDS through a cross-sectional analysis. More specifically, we explore the characteristics of banks for which the increase in funding costs has been more pronounced. The results show that banks with lower solvency ratios, with a higher proportion of problematic loans, or headquartered in countries with a greater risk of default on their sovereign debt have been more affected by the adoption of the new resolution framework. Furthermore, larger banks, previously protected by the "too-big-to-fail" paradigm, have been exposed to a more severe backlash from the introduction of this new resolution regime.

After a brief discussion of the related literature in Section 2, in Section 3 we describe the institutional setting that has lead to the new resolution mechanism. In Section 4 we develop a simple theoretical framework to suggest which economic mechanism links the change in the resolution regime to bank funding cost. In Section 5 we move to the empirical part: first, we estimate the abnormal returns of the differential of CDS spreads between bail-in-able and non-bail-in-able bonds; then we explore the possible channels of the estimated heterogeneity in the abnormal returns through a cross-sectional analysis on individual banks. Finally, Section 6 concludes the paper.

2. Related literature

The paper is related to a growing literature that gauges the impact of the Single Resolution Mechanism implemented in 2016 on bank risk.

There are two alternative approaches to measure the change in the risk of banks. A first approach uses the price of bonds. Cutura (2021) and Giuliana (2019) compare the prices of subordinated bonds of the same financial institution through a difference-in-difference approach: while Cutura (2021) focuses on different maturities around the 1st of January 2016, date of implementation of the bail-in, Giuliana (2019) uses bonds with different seniorities. Cutura (2021) finds a rise of 10 bps in the bonds affected by the bail-in framework. Similar evidence is found by Giuliana (2019) and Lewrick et al. (2019).

A second approach uses the CDS spreads as a measure of bank risk. Crespi et al. (2019) find a rise in the CDS spread of Italian banks between bail-in-able and senior bonds in the period 2013–2016. Pancotto et al. (2019) apply a difference-in-difference approach on CDS spreads of banks and corporations, exploiting the SRM as a natural experiment, to test the nexus between sovereign default and bank risk.

We have chosen to follow the second approach by exploiting the difference between the spreads of 1-year maturity CDS on subordinated and senior bonds of the same bank, capturing in this way the difference in the expected losses of the two CDSs[1], that is the implied risk of default for each class of bonds. The hypothesis is that for subordinated bond-holders the probability of incurring losses may increase following the introduction of bail-in, while senior bond-holders will be unaffected. Moreover, the two CDS spreads, when issued by the same bank, allow to control for differences across banks without having to choose between bonds with different characteristics.

Other papers have explored the reaction of asset prices to bail-in announcements. Pancotto et al. (2020) use event-studies on 5-years maturity CDS spreads and stock prices to test the changes following the various steps leading to the approval of the bail-in resolution in the period 2012–14. They also regress a multivariate cross-section to explain the heterogeneity in the reactions. Fiordelisi et al. (2020) find a negative abnormal stock price reaction to bail-in announcements. Giuliana (2019) finds a positive reaction in the price of bonds on specific events of banks' distress before the introduction of the new framework (Banca di Cipro (2013), Banco Espirito Santo (2014), SNS Reaal, Bankia (2012) among others). Schafer et al. (2016) find an increase in the CDS spread and a fall in the stock price for the same episodes (except for Bankia). Our objective, however, is to focus on the adoption of the SRM, rather than on its announcement in July 2014.

In the second part, we use the estimated abnormal values of the CDS differential as the dependent variable in a cross-sectional regression: our aim is to explain the heterogeneity in the response to the implementation of the bail-in across banks. For this analysis, we were inspired by papers gauging the determinants of bank funding costs. Babihuga and Spaltro (2014) evaluate the change in the price of unsecured bonds associated to the solvency ratio of the issuing bank. They show that in the short run an increase in capital leads to an increase in funding costs, due to adverse selection (as suggested by Myers and Majluf, 1984), but in the long run the reverse holds true. Santos and Bonfim (2005) show that the differences in funding costs across banks are explained by the quality of the asset side, capitalization, and liquidity. Arnould et al. (2020), Aymanns et al. (2016), Dent et al. (2021) and Schmitz et al. (2017) find that greater capitalization reduces bank funding costs. Finally, Gambacorta and Shin (2018) uncover a positive relation, driven by lower funding costs, between better capitalized banks and availability of credit in the economy.

Other papers connect bank risk to profitability such as Babihuga and Spaltro (2014), Santos and Bonfim (2005) and Pablos Nuevo (2020) or to sovereign risk as there is shortage of public money to resolve banks in distress (see for instance Arnould et al., 2020; Babihuga and Spaltro, 2014; and Acharya et al., 2014). Following this literature, in the second part of our paper we add bank-specific variables (such as the solvency ratio, liquidity, asset quality, and profitability) and country-specific variables to explain the different intensity by which bank funding costs have reacted to the adoption of the new resolution policy.

The paper is also related to the empirical evidence on market discipline by creditors (see for instance Flannery and Sorescu, 1996 and Sironi, 2003 among others), since the more accurate evaluation of bank risk following the application of the bail-in has led to a repricing of debt that is also the cause of the rise in funding costs.

In the paper, we develop a theoretical framework to ease the interpretation of the results of the cross-sectional analysis. The paper contributes to the scant theoretical literature linking the cost of funding for banks to the resolution regime. Dell'Ariccia et al. (2018), Cerasi and Montoli (2020), Walther and White (2020), and Pandolfi (2021), they all show, within different theoretical models where funding costs are endogenously derived, why switching from bail-out to bail-in will increase the cost of uninsured bonds for banks.

3. The new resolution framework

After the global financial crisis of 2007–09, the arguments against the use of taxpayers' money to save insolvent banks prompted a reform of the resolution mechanism both in Europe and in US. Resolving banks' distress through the use of public money, the so-called "bail-out", had to be confronted with two consequences: (i) expectations of public financial support to distressed banks had weakened market discipline, leading to excessive risk taking and relaxed lending standards; (ii) the financial losses caused by mismanagement of banks were shifted onto those who had no responsibility for the distress.

The new resolution framework had to respond to different and somehow contrasting objectives: to stimulate the involvement of investors in the management of their bank and, at the same time, to shield banks from macroeconomic shocks. The new framework allows for an orderly resolution with the contribution of bank investors' money, while maintaining some flexibility to provide public funding, when needed, to contain the macroeconomic consequences of a systemic crisis. Bail-out needs to become the exception rather than the rule. To this aim, the reform provides comprehensive statutory bail-in powers combined with guidelines for resolution. By clarifying *ex-ante* how losses would accrue to private creditors in resolution, this framework may help addressing the uncertainty related to the bankruptcy event. Still, the main purpose of the new resolution regime is to allocate losses effectively among bank stakeholders to allow recapitalization in a manner that ensures continuity of systemically important financial institutions' services and payment, clearing, and settlement functions, and avoiding unnecessary destruction of value.

[1] See Norden and Weber (2012) for a detailed discussion about the role of differences in CDS spreads between subordinated and senior bonds when doing inference about bank risk and Culp et al. (2016) for a survey on the subject.

Since the 1st January 2016 the Single Resolution Mechanism (SRM) has provided all countries belonging to the European Union with resolution authorities endowed with powers and tools to settle a plan detailing how to resolve a bank.[2]. The Single Resolution Board (SRB) (www.srb.europa.eu) is an independent body that ensures that resolution decisions across EU members are taken effectively and quickly, avoiding uncoordinated actions, minimizing negative impact on financial stability, and limiting the need for public financial support. When the ECB declares a bank to be failing or likely to fail, the SRB has the power to decide between liquidation and resolution. If the SRB decides that resolution is in the public interest, then the bank is placed under a resolution scheme that determines which tools are to be adopted. Among the tools, the bail-in achieves the objectives of minimizing the resolution costs borne by taxpayers and ensuring that systemic entities can be resolved without jeopardizing financial stability, by requiring shareholders and creditors to suffer appropriate losses and to bear an appropriate part of the costs arising from the failure of the entity (Article 73, Reg/806/2014). Recapitalization is then carried out by writing down creditors' claims or converting them into equity. Public money contribution is then possible only through the Single Resolution Fund and subject to several conditions including the requirement that at least 8% of total liabilities including bank's internal funds have already been absorbed with the bail-in tool (Article 78, Reg/806/2014). The SRM establishes that financial entities have to meet a minimum requirement for their own funds and liabilities eligible to bail-in, the Minimum Requirement for own funds and Eligible Liabilities (MREL). These claims include a wide range of unsecured liabilities, while secured, collateralized, or otherwise guaranteed claims would rather be excluded (Article 76, Reg/806/2014).

4. A theoretical framework

In this section we develop a simple framework[3] to analyze the relationship between the resolution regime and the return to bank bondholders.

Assume a bank is funded with D units of debt returning r_D to uninsured bondholders; in alternative bondholders may invest their money into an outside asset returning overall 1. Notice that the return for bondholders r_D is the cost of funding for the bank. The bank holds a risky portfolio returning R with probability p, 0 otherwise. Since the portfolio of loans is risky, the bank may not be able to repay with certainty its bondholders, as it defaults with probability $(1-p)$. Due to the banker's limited liability, bondholders are exposed to shortfalls on the face value r_D. The banker may hold some equity E to repay bondholders in case of shortfalls from the loan portfolio. Assume for a moment that there is no public money to resolve the bank in case of default.

The banker's profit is given by:

$$\Pi = p(R + E - r_D) + (1-p)\max\{E - r_D, 0\} - E - c \tag{1}$$

where c is the fixed cost of lending for the bank. Bondholders' expect to be repaid at least:

$$pr_D + (1-p)\min\{E, r_D\} \geqslant 1 \tag{2}$$

Assuming perfectly competitive financial markets, the constraint (2) is binding. We can rewrite the binding constraint as:

$$r_D - (1-p)\max\{r_D - E, 0\} = 1 \tag{3}$$

The second term in the LHS represents the expected shortfalls for bondholders, given by the probability of default $(1-p)$ and the loss given default. When the banker is strongly capitalized, i.e. $E \geqslant r_D$, the loss is zero; the level of equity matters in case $(r_D - E) > 0$ as it can be used to absorb the losses incurred by uninsured bondholders in case of default.

Now assume there is a resolution authority who can step in when the uninsured bondholders are not fully repaid and has the money to repay a fraction $\alpha \in [0, 1]$ of the losses. There are two extreme cases: when $\alpha = 0$ the loss is fully borne by bondholders (bail-in), while when $\alpha = 1$ the loss is fully repaid with public money (bail-out). We will consider α the fraction of bondholders' losses bailed-out with public money. We also assume that the government is credible when committing to repay.

The expected return for bondholders is now given by:

$$r_D - (1-p)(1-\alpha)\max\{r_D - E, 0\} = 1 \tag{4}$$

Proposition 1. For under-capitalized banks, the funding cost of the bank, r_D, decreases with the amount of equity E, with the degree of bail-out α and with the probability of success of the portfolio of loans p. For fully capitalized banks, there is no effect on funding cost.

Proof. See Appendix C.

[2] While the Directive No.59/2014 (BRRD) has set the general principles of the resolution framework to be translated into different national laws by Member State by the end of 2014, the Regulation No.806/2014 is a European Law stating a uniform institutional setting that applies to all EU countries from the 1st January 2016. The Regulation has established the Single Resolution Mechanism and the Single Resolution Board. For the details of the two pieces of legislation we refer to https://eur-lex.europa.eu/eli/dir/2014/59/oj and https://eur-lex.europa.eu/eli/reg/2014/806/oj

[3] Inspired by Cerasi and Montoli (2020)

The results in Proposition 1 show that the cost of funding for banks increases when moving from bail-out to bail-in (a decrease in α).

In this simple framework, capital has an effect similar to bail-out as it insures bondholders in case of bankruptcy. In addition, also the riskiness of the loan portfolio, measured by the probability of default $(1-p)$, has an impact on the cost of funding of the bank.

Proposition 2. When reducing the degree of bail-out, the negative impact on the funding cost of the bank is curtailed by the amount of equity E or by the probability of success of the portfolio of loans p.

Proof. See Appendix C.

One way to capture the expected losses for bondholders is through the definition of the Loss Given Default, whose mathematical expression is now:

$$LGD = (1-\alpha)\max\{r_D - E, 0\} \quad (5)$$

Following Proposition 1, we can also derive predictions on the impact of the expected losses for bondholders.

Proposition 3. For under-capitalized banks, the LGD is decreasing in the amount of equity E, in the degree of bail-out α and in the probability of success of the portfolio of loans p. For fully capitalized banks there is no effect on LGD.

Proof. See Appendix C.

The results in Proposition 3 show that the expected losses for the uninsured bondholders, represented by the LGD, is increasing when either α, the level of capital or the probability of success p decrease.[4]

Finally, it is possible to show that with some degree of bail-out, if banks were charged a fair premium to fund the resolution regime, bank shareholders would still earn the full surplus, $(pR - c - 1)$, for whatever level of equity they hold in the bank. When, instead, the premium was to be charged on taxpayers' money, shareholders would enjoy an additional rent, through a lower cost of funding, equal to the transfer to bondholders in the bail-out. (All the mathematical details are left in the Appendix C).

5. Impact on European banks funding costs

In this section, after a brief description of the data, we measure the impact of the SRM on funding costs of European banks and then, through a cross-sectional analysis, we analyze why individual banks reacted differently.

5.1. Data

Our analysis focuses on the different reaction of junior and senior creditors to the introduction of the new resolution regime. To do so, we retrieved information from SNL Financial database on 42 European banks (see the list of banks in our sample in Table 9 in the Appendix B) in the period between January 2015 and February 2016. For those banks, we collected the daily spreads of single-name credit default swap (CDS) with one-year maturity on subordinated and senior bonds. Also, several control variables such as the iTraxx Europe Index, the bid-ask spread of CDS quotes, and the Vstoxx Index were gathered from the same source, while the historical time series of the Vstoxx Index from the site https://www.stoxx.com/document/Indices/Current/HistoricalData/h_v2tx.txt. Summary statistics of the various indices are reported in Table 1, while Table 2 shows bid-ask spreads values. The stock prices for 39 banks of our sample (see column 4, Table 9) are sourced from Bloomberg database (summary statistics in Table 2).

To perform our cross-sectional analysis we added balance sheet records at individual bank level for the last quarter of 2015 from Bloomberg (see the list and summary statistics in Table 7) and the 10-year sovereign yield for the first quarter of 2016 from SNL Financial. This part of the analysis is indeed limited to the 35 banks for which data is available from Bloomberg in our period of observation (see Table 9, last column).

5.2. Abnormal reaction by CDS spreads

To measure the impact of the new resolution framework implemented in January 2016 on bank funding costs, we compare the reaction in the spreads of CDS of subordinated and senior bonds before and after the implementation of the SRM for banks affected by the change in regulation. The new regulation calls also subordinated creditors, in addition to shareholders, who were already affected in the old framework, to share the losses in case of bank distress. As a matter of fact, when bank losses exceed the level of equity, investors holding subordinated bonds have to participate with their claims through con-

[4] **Although counter-intuitive, the LGD in this model is affected by a change in the probability of success of the portfolio, through its indirect effect on r_D: when p decreases bondholders demand a higher return and this affects the amount of expected losses $(r_D - E)$.**

version into shares or write-off on the face value of their bonds. Non-insured senior debt-holders are partially protected, since their contribution comes after that of junior debt-holders. This new resolution mechanism may therefore affect the price of subordinated bail-in-able bonds by a greater amount compared to senior bonds. First, we estimate the abnormal values of the differential of the spreads of CDS on junior and senior bonds. Then, we use these estimated values to explore the heterogeneity in the impact of the SRM as explained by the characteristics of EU banks and the macroeconomic environment.

The spread on 1-year maturity CDS measures the premium paid by the bank to insure its bondholders against a default occurring within one year: notice that the maturity of the CDS is independent from the maturity of the underlying bond (see Bomfim, 2022). The CDS spreads are market-implied probabilities, obtained under the assumption that investors are risk-neutral and immune to shifts in risk aversion sentiment. Several papers (see among others Cutura, 2021,Giuliana, 2019) use secondary market prices on existing subordinated bonds to calculate the marginal cost of wholesale funding. However, even though bond spreads have been the traditional indicator of credit risk, they have drawbacks. Indeed, using directly the price of bonds can hide differences such as volumes, currency in which they are denominated, maturity, and face value, which could be a noisy signal of the true risk premium. CDSs, instead, have a constant maturity, the underlying instrument is always par valued, and they concentrate liquidity in one instrument. Moreover, Blanco et al. (2005) show that, although bond and CDS markets price credit risk equally, CDSs contain useful information: they are an upper bound on the price of credit risk (while credit spreads form a lower bound), and their prices lead in the price discovery process. Thus, they conclude that CDSs are a cleaner indicator compared to bond spreads for analysts interested in measuring credit risk.

In the light of these results, given that our sample consists of large European banks with a liquid market for their CDS, the spread is a measure of the risk premium on the cost of funding for the average bank.

As a preliminary analysis we provide graphical representations of the CDS spreads on subordinated bonds (see Fig. 1) and the differentials between the CDS spreads on junior and senior bonds (see Fig. 2). In the behavior of the CDS spreads on subordinated bonds, we see a jump from January to February 2016, i.e. around the date of the implementation of the SRM, which is suggestive of our narrative. We are aware of other papers (see Pancotto et al., 2020,Schafer et al., 2016) that found empirical evidence in support of an impact on 5-years maturity CDS spreads of European banks in response to the announcement of the SRM in 2014. The objective of our analysis is to look at the effect of the actual implementation of the bail-in tool, which occurred in January-February 2016[5]. By focusing on CDS with 1-year maturity, we limit the length of the insurance on the default of the underlying bond to 1 year, regardless of the maturity of the bond. In this way, a CDS issued right before the time of the announcement of the new resolution, say for instance at December 2013, will not capture the change in the risk of the bail-in-able bond, while a 5-years maturity CDS would capture it, at least partially, on its residual maturity from January 2016 to December 2018, i.e. around the date of the implementation of the SRM. It is important to notice that the bail-in was retroactive on subordinated bonds issued even before the date of the implementation of the SRM.

Looking again at Fig. 1 and Fig. 2, notice that in the months following the jump the effect does not disappear as the CDS spreads remain at a higher level compared to the previous months. We can also observe that the behavior of the differentials between CDS spreads on subordinated and senior bonds (from now on we refer to them simply as "differentials") mimics that of CDS spreads on subordinated bonds. Hence, we can conclude that the jump is to be attributed to the trend of CDS spreads on subordinated bonds. From now on, we will focus on the behavior of the differentials rather than the single series of CDS spreads on junior bonds.

To assess the statistical significance of this preliminary evidence, we perform an event study on the differentials between CDS spreads on subordinated and senior bonds around the date of the implementation of the SRM. The event window is set on the first 10 trading days of February 2016, since it took few weeks to creditors to elaborate the consequences of the SRM on the risk of bonds as it is evident from Fig. 1 and 2. The estimation period instead includes the 10 previous months, so that more than 200 trading days are taken into account.

For this event-study we apply a simple linear model[6] where we regress the daily differentials between CDS spreads on subordinated and senior bonds, our dependent variable, on the unique covariate, a dummy assuming value 1 in the event window:

$$\mathrm{CDSdifferential}_{it} = \alpha_i + \beta_i \mathrm{D}_t + \epsilon_{it} \tag{6}$$

The coefficient of interest for our analysis is β_i denoting the abnormal value of the differential between the two CDS spreads for bank *i*. In other words, the coefficient represents the difference between the average value of the differential in the previous 10 months and the observed value in the time window including the event. The results provided in Table 3 (first row) show that the differential between the CDS spreads on the two bonds, subordinated vs. senior, increased following the introduction of the SRM by a significant amount. From the point of view of European banks, this implies a rise in the cost of attracting funds from subordinated bondholders who ask for a greater risk premium.

The differential between the two CDS spreads is significantly different from zero, with an average value of **39.73 bps**[7]. This evidence supports an increase in the perceived risk of junior debt compared to the risk on senior debt due to the new regulation and, more specifically, it is due to the change in the CDS spreads on subordinated debt, as we observed while commenting on Fig. 1.

[5] Only in Sweden bail-in provisions came into force in February 2016, as stated in the document by ISDA available at https://www.isda.org//2016/12/02/isda-brrd-implementation-monitor-5.

[6] We refer to Campbell et al. (1997) for the methodology of event studies we have embraced.

[7] Cutura (2021) also finds a risk-premium of 10 bps on bail-in-able bonds due to bail-in, although less pronounced than our.

To challenge our result, we performed several placebo tests by anticipating the dummy in Eq. (6) on several event windows in the previous months (timing and results are provided in Table 3). The results show that the coefficients on the redefined dummies are negative and not statistically significant. These placebo tests reject the assumption that the positive effect is due to alternative events and proves that the effect on the differentials of CDS spreads was not anticipated by investors before January 2016.[8]

This result is robust to the inclusion among the covariates of an index capturing the fluctuations of CDS on investment grade European corporate entities, such as the iTraxx Europe Index when controlling for exogenous shocks in the European CDS market (see details and results in Table 4). We have also controlled for measures of market volatility, such as the Vstoxx Index, and liquidity, such as the bid-ask spread of CDS quotes, to rule out confounding effects coming from greater volatility or lack of liquidity in the market of CDSs (Table 5). Our results do not change and are robust to these additions.

As a way to complete this preliminary analysis, we study the complementary reaction of stock returns. The impact of the SRM may be on the overall cost of capital, including equity, and not only on debt. The new resolution regime implies an increase in the expected losses also for shareholders, who were before partially shielded by taxpayers money. To check for evidence, we perform an event-study similar to Eq. (6), where the dependent variable are the stock returns instead of the CDS spreads:

$$\text{Stockreturn}_{it} = a_i + b_i \text{D}_t + \epsilon_{it} \tag{7}$$

By the estimates reported in Table 6, we see a statistically significant drop after the introduction of the SRM, although smaller than that on CDS spreads.

So far, our exercise provides evidence of a statistically significant impact of the SRM on bank funding costs, pointing to an increase in the risk premia of subordinated compared to senior bonds. However, the impact on the risk premia was not uniform across banks. Indeed, we can see great variability in the intensity of this rise among European banks. In Fig. 3 we plot the estimated abnormal values of the differentials for the banks in our sample. Banks are clustered by country. For instance, the Italian banks (yellow dots) exhibit higher estimated values of CDS differentials compared to the Swedish banks (orange dots) as well as the French ones (light blue dots). Not only we see some clustering at country level but also heterogeneity across banks belonging to the same country. This variability calls for a multivariate model where bank-specific and country-specific characteristics are included as controls in the statistical analysis.

5.3. A cross-sectional analysis of the cost of funding

In this subsection we dig further into the heterogeneity of the estimated abnormal values. Our idea is that bank-specific characteristics as well as macroeconomic variables related to the country where the bank is located might play a role in explaining the differences in the impact of the SRM on European banks. The results from our theoretical framework in Section 4 suggest possible reasons why we may see differences in the impact of the bail-in on the cost of funding of individual banks. For instance the level of capitalization, the risk in the asset side of the bank's balance sheet and the credibility of the bail-in commitment by the government are possible explanations in the heterogeneity of the impact.

We use the abnormal values estimated in the previous event study as the dependent variable to be explained. The estimated coefficients of the dummy in Eq. (6) represent the abnormal returns of funding costs (summary statistics in Table 3, first row). These abnormal returns become the focus of our cross-sectional analysis in this subsection, while their heterogeneity is to be explained through bank characteristics and country-specific variables.

Abnormal values of the differential of 1-year maturity single named CDS spreads between subordinated and senior bonds refer to February 2016, while accounting records are available only at a quarterly frequency. We lag balance-sheet data by one quarter, thus using the last quarter of 2015, as proxies for bank-specific characteristics, to circumvent possible endogeneity issues.

We now discuss which factors protect or amplify the perception of bank default risk by creditors, following the implementation of the new resolution framework.

Among the protecting factors there is a high capital ratio, that is, a greater capacity to absorb losses. Greater capitalization may shield banks from an increase in the risk premium on their bonds. Following Proposition 2 in our theoretical framework, we expect a higher capital ratio to shield from a rise in the return of the most junior bonds, as the degree of bail-out decreases. We therefore add *Tier 1 ratio* as a measure of regulatory capital or alternatively *Total Capital Ratio* as the amount of voluntary capital among the explanatory variables to see whether under-capitalized banks suffered a greater increase in their cost of funding.

The quality of the assets in the balance-sheet also matters for the risk of bank default. Losses on the asset value can put at stake the solvency of the bank. We add among the covariates *Non-Performing Loans to total loans* to capture the quality of underlying assets and bank capacity to generate future profits. As alternatives, we use *Provisions for Loan Losses over Total Loans* and *Reserves for Loan Losses over Total Loans* as in Arnould et al. (2020),Schmitz et al. (2017) and Babihuga and Spaltro (2014). According to Proposition 2 a lower quality of the bank's assets amplifies the impact of the new resolution framework.

[8] Also, looking at the behavior of the volume of European single name CDSs in the period 2011–2017 (for instance, see Fig. 1 in Callsen and Hill, 2018) we do not detect any anomalous behavior at the time of the announcement of the SRM in mid-2014.

The size of the balance sheet of banks too may affect the perception of insolvency since bail-out was triggered by the fear that large banks would fail, causing large disruptions in the economy. If, with the introduction of the bail-in, those largest banks had lost their "too-big-to-fail" protection, say a lower α in our theoretical framework according to **Proposition 2**, we should see a larger rise in funding costs for the largest banks (as for instance argued in Dell'Ariccia et al., 2018). On the other hand Cerasi and Montoli (2020) show that larger banks by being more diversified are less affected in their funding costs when the resolution regime switches from bail-out to bail-in. To test for this effect, we add a measure of size such as *Total Assets* (both logarithm and without any transformation) among the explanatory variables. Without the "too-big-to-fail" protection, size should amplify the impact on funding cost, while diversification should have the opposite effect with the largest banks being less affected.

Another factor affecting the perception of insolvency risk by creditors is the level of profitability. We include in our regression alternatively *Return on Assets* and *Return on Equity* as covariates. A higher profitability, by increasing the cushion against losses, may protect from an increase in risk. The ROE represents the maximum amount of retained earnings to rebuild the bank equity in case of losses, thus protecting the most junior debt-holders. The ROA is the return for all stakeholders: a greater return may shield both senior and junior bond-holders at the same time.

Also the lack of liquidity may imply an increased risk for banks: as a proxy, we include *Deposits over total assets* to capture the ability to meet liabilities in the short-term. Greater liquidity may protect from a rise in risk.

Finally, there could be also an exogenous risk coming from the sovereign risk of the country where the bank is located. A greater risk of default on sovereign debt, may affect the risk of banks due to a "doom loop" effect (see, for instance, Farhi and Tirole, 2018). In countries with a large public debt, banks typically hold bonds of their sovereign country, due to a home-country bias. An increase in the spread of public bonds, exposes national banks to a greater insolvency risk coming from the risk of default on those bonds. With bail-out in place, assuming that the sovereign is capable of injecting public money to the distressed bank, this link is weak. However, with the implementation of bail-in, banks located in countries with a greater risk of default on their public bonds, will become riskier as they are not shielded anymore by the protection of their sovereign. To assess for the existence of this doom loop, we add as an explanatory variable the sovereign spread between the yield for a 10-year domestic sovereign bond for each European country and the German 10-year Bund. More specifically, we focus on countries characterized by a large public debt by interacting the sovereign spread with a dummy taking value 1 only for Portugal, Italy, Greece, and Spain, the so-called PIGS. We expect banks headquartered in PIGS countries, with a higher default risk on their public debt (compared to Germany), to face a greater risk with bail-in and thus greater vulnerability compared to other European countries.

Summary statistics of the explanatory variables are reported in Table 7.

To study which factors affect the intensity in the impact of the SRM, we regress the estimated abnormal values of the differential between CDS spreads of subordinated and senior bonds from the previous event study on several bank specific and macroeconomic variables, in a cross-section of EU banks, that is:

$$\hat{\beta}_i = \gamma_1 \text{Spread}_i \times \text{PIGS} + \gamma_2 \text{Tier1Ratio}_i + \gamma_3 \text{DepositsOverAssets}_i + \gamma_4 \text{ROA}_i + +\gamma_5 \textit{log}(\text{TotalAssets})_i \\ + \gamma_6 \text{NPLovertotalLoans}_i + u_i \tag{8}$$

where i denotes the individual bank. The dependent variable $\hat{\beta}_i$ is the estimated abnormal value for bank i of the CDS differential in the event window of February 2016 from Eq. (6).

The results are in Table 8. The goodness of fit, as measured by the R-squared, is nearly 0.7 or higher in all regressions, and the adjusted R-squared never below 0.6. The F-statistics is above 2.4, that is, far above the critical value for the joint significance of coefficients at the 5% level. Alternative explanatory variables are used as robustness check.

To help with the interpretation of the results, keep in mind that the event study in the first part of the analysis provides evidence of an increased cost of funding following the implementation of the SRM for all the European banks in our sample: hence, a positive coefficient in regression (8) implies that a bank with a higher level of that specific variable suffered a larger rise in its cost of funding due to bail-in, and vice versa for a negative coefficient.

- We observe a negative and strong association between *Tier 1 ratio* (or alternatively *Total capital ratio*) and the abnormal CDS differentials, that is, stronger capital ratios shield from an increase in bank risk. This result provides support to the idea that better-capitalized banks have seen a lower rise in funding costs due to the new resolution framework (in accordance with other papers, such as Cutura, 2021,Arnould et al., 2020; Aymanns et al., 2016;Dent et al., 2021; Santos et al., 2005; Schmitz et al., 2017).
- The estimated coefficient of *NPL to total loans* is positive and significant in several specifications, providing evidence that banks with loans of a lower quality in their portfolio have seen a greater rise in funding costs. This effect is confirmed by the analogous result related to *Reserves for loan losses* in column (10).

- The coefficient associated to bank size is positive and highly significant, suggesting that the new regulation has reduced the so-called "too-big-to-fail" protection. In fact, bail-in exposes also large banks to the insolvency risk, while before these national champions were protected by the government intervention as their default was considered too disruptive for the economy of their country.[9]
- Finally, the positive coefficient of *Sovereign spread* interacted with the dummy for PIGS provides evidence of the rise in funding costs for banks located in highly indebted countries. A bank located in a country with a large public debt, suffered a greater rise in funding costs after the implementation of bail-in (see Cutura, 2021,Arnould et al., 2020; Babihuga and Spaltro (2014)).

Notice that the variables that survive the empirical scrutiny coincide with the key variables in prudential regulation: the Supervisory Review and Evaluation Process jointly undertaken by the ECB and EBA compute the level of mandatory capital using predicted NPLs under different macroeconomic scenarios.

Overall, our results provide support to the intuition that bank-specific and macroeconomic factors explain differences in the reaction that the new resolution policy had on the perceived risk by junior creditors. This translates into a higher, yet diversified, funding costs for European banks as a consequence of the application of the SRM.

In conclusion from the evidence provided, also supported by our theoretical framework in Section 4, we conclude that stronger capital ratios and a better screening or monitoring of the credit risks in the portfolio of loans, may have shielded banks from a rise in their funding costs after the implementation of the new resolution regime. Also, banks located in countries with larger public debt paid a higher cost when borrowing funds compared to rivals located in other countries.

6. Conclusions

In this paper, we have assessed the impact of the implementation of the SRM on EU banks funding costs. On the one hand, we have documented a rise in bank funding costs due to the new resolution policy together with a measure of its intensity. On the other hand, we have analyzed the heterogeneity of this impact. By contributing to a more accurate evaluation of bank risk, the implementation of the SRM has reinforced market discipline in the EU. However, specific factors, such as lower capitalization, a larger amount of problematic loans, and higher sovereign risk, have exacerbated the rise in the cost of funding for the weakest banks, further threatening financial stability. We think that these results help policy makers to better address the negative consequences on bank funding costs of the new resolution policy. Although the new resolution framework increases the accountability of subordinated investors who must provide the capital to shield the bank from an excessive capital erosion, it increases the cost of issuing debt for banks. The evidence in this paper provides an additional rationale for increasing capital ratio and helping banks to recover non-performing loans, since also subordinated debt would become a cheaper source of funds for banks, giving rise to a virtuous circle. On the other hand, we have uncovered another cost of a high public debt, as the perception of bank risk is amplified through the cost of debt of a country for all banks in that country.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[9] Following Cutura (2021) and Pancotto et al. (2019), we added a dummy to denote the G-SIBs banks in our sample, but did not find any statistically significant impact. This negative evidence shows that there are no differences between systemically important institutions and large banks in our sample as, probably, they are all under the same Single Supervisory Mechanism.

Appendix A

Figs. 1–3 and Tables 1–8.

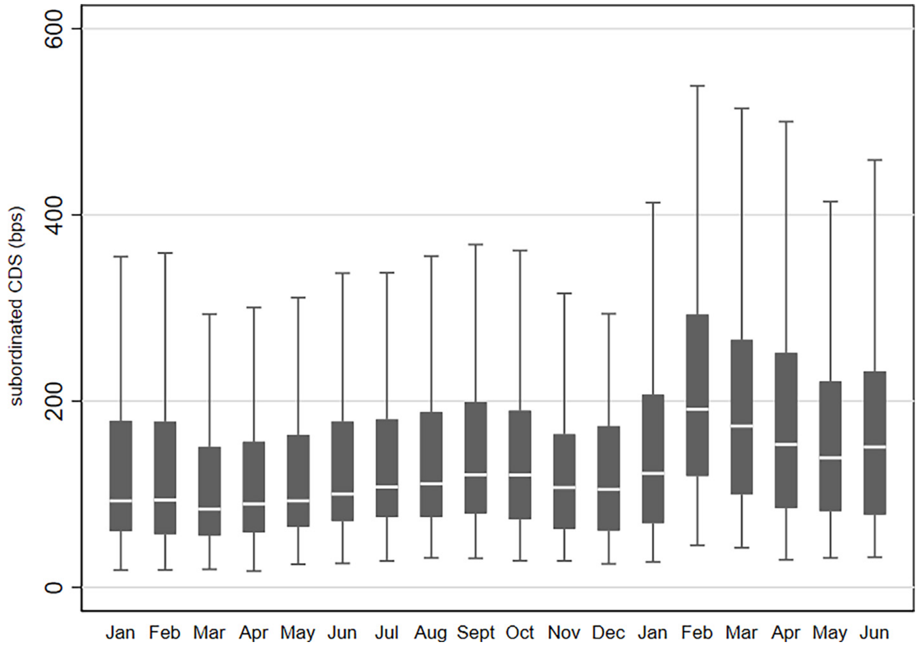

Fig. 1. This figure shows the **monthly 1-year maturity CDS spreads on subordinated bonds** from January 2015 to June 2016. Each box plot represents the distribution among the 42 European banks for which we have information on their CDS (see Table 9, column 5).

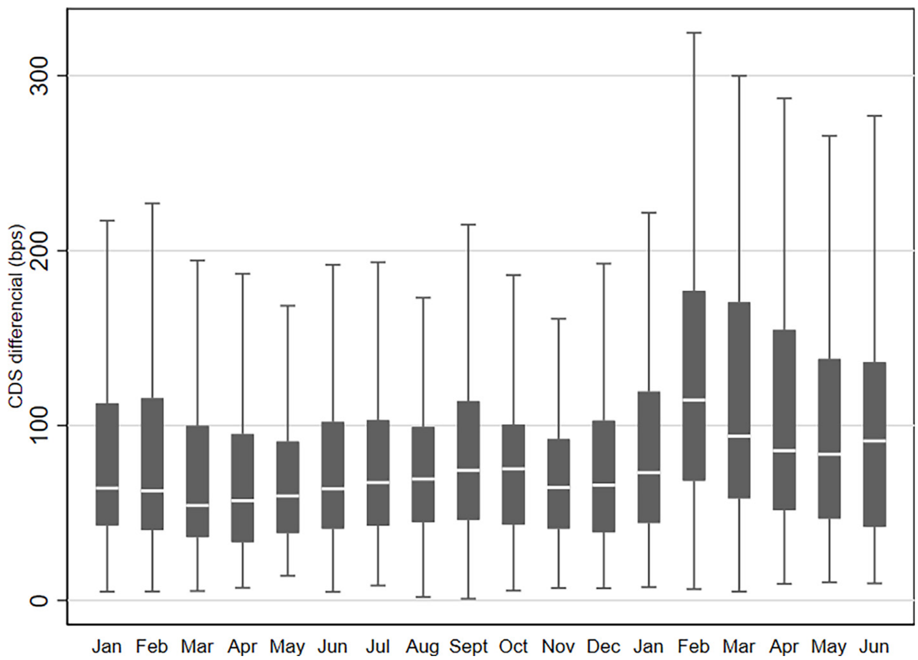

Fig. 2. This figure shows the **monthly 1-year maturity differentials between CDS spreads on subordinated and senior bonds** from January 2015 to June 2016. Each box plot represents the distribution among the 42 European banks for which we have information on their CDS (see Table 9, column 5).

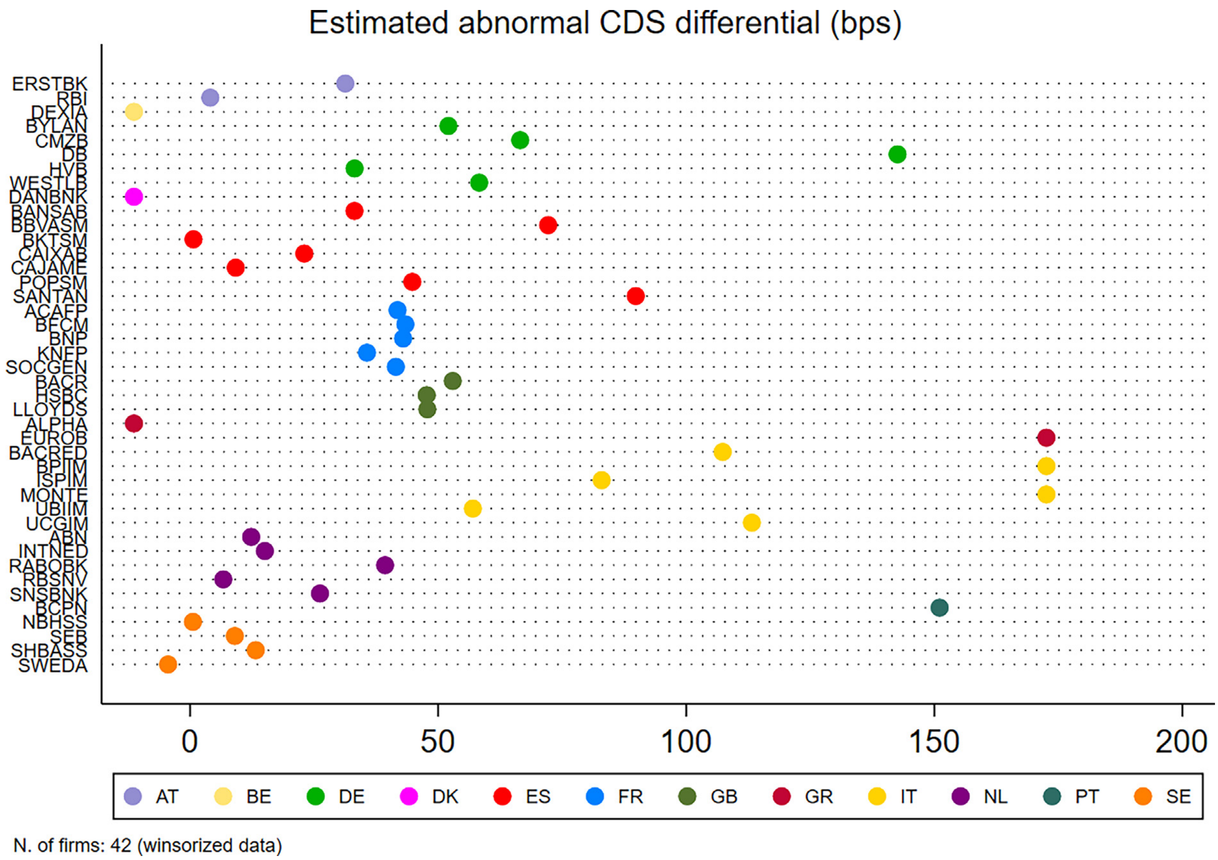

Fig. 3. This figure shows the abnormal spreads of the differential between junior and senior CDS estimated in Eq. (6). Summary statistics are reported in Table 3 (first row). Influent outliers are winsorized so that the entire sample of 42 European banks is represented (Table 9, column 5). Banks are sorted by country and each colour refers to a different country.

Table 1
This table reports summary statistics of iTraxx and Vstoxx indices included in Eq. (6) for the period between January 2015 and February 2016.

	Mean	Median	Std.Dev.	Min	Max	N.Obs
Vstoxx	24.958	23.918	4.833	17.352	40.803	294
iTraxx	71.128	69.334	15.459	47.669	125.719	298

Table 2
This table reports summary statistics of bid-ask spreads included in Eq. (6) (see Table 5) and equity prices of Eq. (7). Just for the bid-ask spread figures, we exclude three CDSs as their values are well outside the normal range (Alpha, Eurob, and Tpeirga).

	Mean	Median	Std.Dev.	Min	Max	N.Obs	N.Banks
Bid-ask spread	29.083	20.200	39.625	0.010	881.590	11919	40
Equity price	19.824	9.669	33.788	0.292	256.160	8740	38

Table 3
This table reports summary statistics of the abnormal values for the CDS differential spreads estimated in Eq. (6) through OLS. The sample comprises daily data for the European banks in Table 9 (column 5) for the period 27/1/2015–12/2/2016. The dependent variable is the differential between CDS spreads of subordinated and senior debt. A dummy variable that equals 1 in the event window, 0 otherwise, is the covariate and its coefficient is the abnormal CDS spread. All event windows cover 10 trading days, while the estimation period is set to the previous 200 trading days. The table reports in the first row the results of the event-study evaluating the actual impact of the SRM, while the other event windows are included as placebo tests. Thus the estimated abnormal values referring to these windows are expected to be not statistically significant or negative. Statistics are evaluated excluding influent outliers to avoid bias in the results and inference. *P*-values of t-tests are reported: *p*-values<0.05 mean that abnormal CDS differentials are significantly different from 0 at the 5% level on average.

Event windows	Mean	Median	Std. Dev.	Min	Max	Obs	t-test
1–12/2/2016	**39.7377**	**39.3092**	**35.3650**	**−11.4572**	**142.5823**	**37**	**0.0000**
18–29/1/2016	10.8552	8.5296	20.0463	−33.1826	54.1923	38	0.0019
4–15/1/2016	−0.5933	−2.5300	13.6471	−31.8299	32.5682	37	0.7929
17–31/12/2015	−2.7629	−2.5049	13.5511	−36.4608	28.9681	37	0.2229
3–16/12/2015	−2.6019	−1.2050	9.9889	−21.2289	24.2215	35	0.1326
19/11–2/12/2015	−3.5813	−2.8282	11.4806	−33.5551	18.5952	38	0.0622
5–18/11/2015	−2.2361	−1.8512	12.0496	−29.1539	23.2304	39	0.2537

Table 4
This table reports summary statistics of the abnormal values for the CDS differential spreads estimated in Eq. (6) through OLS, adding among the covariates the iTraxx Index as a robustness check. The iTraxx Europe Index comprises 125 equally weighted credit default swaps on investment grade European corporate entities and is retrieved from Bloomberg. The sample comprises daily data for the European banks in Table 9 (column 5) for the period 27/1/2015–12/2/2016. The dependent variable is the differential between CDS spreads of subordinated and senior debt. Besides iTraxx, a dummy variable that equals 1 in the event window, 0 otherwise, is included as regressor and its coefficient is the abnormal CDS spread. All event windows cover 10 trading days, while the estimation period is set to the previous 200 trading days. The table reports in the first row the results of the event-study evaluating the actual impact of the SRM, while the other event windows are included as placebo tests. Thus the estimated abnormal values referring to these windows are expected to be not statistically significant or negative. Statistics are evaluated excluding influent outliers to avoid bias in the results and inference. *P*-values of t-tests are reported: *p*-values<0.05 mean that abnormal CDS differentials are significantly different from 0 at the 5% level on average.

Event windows	Mean	Median	Std. Dev.	Min	Max	Obs	t-test
1–12/2/2016	**26.4269**	**21.0911**	**28.8828**	**−32.2915**	**109.4624**	**38**	**0.0000**
18–29/1/2016	4.1458	−1.6391	13.6107	−25.9446	40.6203	37	0.0721
4–15/1/2016	−6.9487	−8.1095	11.7839	−33.6092	22.4777	38	0.0008
17–31/12/2015	−8.2642	−7.5354	11.7690	−34.3131	19.1188	36	0.0002
3–16/12/2015	−6.8207	−6.8737	9.8169	−33.2032	17.6799	35	0.0002
19/11–2/12/2015	−5.4096	−3.7342	10.2159	−31.9113	12.6278	38	0.0024
5–18/11/2015	−4.5475	−3.0095	10.1580	−26.6385	20.8737	39	0.0081

Table 5
This table reports summary statistics of the abnormal values for the CDS differential spreads estimated in Eq. (6), adding among the covariates the Vstoxx Index to take into account market volatility and a proxy for CDS liquidity: the bid-ask spread of CDS quotes (Annaert et al., 2013). The estimation method is Seemingly Unrelated Regression (SUR). The sample comprises daily data for the European banks in Table 9 (column 5) for the period 27/1/2015–12/2/2016. The dependent variable is the differential between CDS spreads of subordinated and senior debt. Besides Vstoxx and the bid-ask spread, a dummy variable that equals 1 in the event window, 0 otherwise, is included as covariate and its coefficient is the abnormal CDS spread. All event windows cover 10 trading days, while the estimation period is set to the previous 200 trading days. The table reports in the first row the results of the event-study evaluating the actual impact of the SRM, while the other event windows are included as placebo tests. Thus the estimated abnormal values referring to these windows are expected to be not statistically significant or negative. Statistics are evaluated excluding influent outliers to avoid bias in the results and inference. *P*-values of t-tests are reported: *p*-values<0.05 mean that abnormal CDS differentials are significantly different from 0 at the 5% level on average.

Event windows	Mean	Median	Std. Dev.	Min	Max	Obs	t-test
1–12/2/2016	**30.2746**	**30.2825**	**33.9758**	**−32.6328**	**118.5881**	**40**	**0.0000**
18–29/1/2016	6.6297	3.9741	16.0119	−24.9626	42.9713	38	0.0150
4–15/1/2016	−3.9359	−4.3898	14.2614	−29.5577	31.6473	39	0.0929
17–31/12/2015	−2.2961	−1.8859	10.9228	−25.9622	24.6759	36	0.2155
3–16/12/2015	−4.2384	−4.1550	8.4286	−20.6116	19.3281	34	0.0061
19/11–2/12/2015	−2.2624	−2.7726	9.4851	−21.4507	22.4236	37	0.1555
5–18/11/2015	−1.4331	−2.5806	11.5442	−22.1917	20.7855	39	0.4430

Table 6
This table reports summary statistics of the abnormal stock returns estimated in Eq. (7) through OLS. The sample comprises daily data for the European banks in Table 9 (column 4) for the period 27/1/2015–12/2/2016. The dependent variable is the equity price of each bank and a dummy variable that equals 1 in the first 10 trading days of February 2016 (and 0 otherwise) is used as regressor. Statistics are evaluated excluding influent outliers since extreme abnormal performance may generate bias in the estimates and inference. *P*-values of t-tests are reported: *p*-values<0.05 mean that abnormal stock returns are significantly different from 0 at the 5% level on average.

Mean	Median	Std. Dev.	Min	Max	Obs	t-test
-4.0480	−2.3551	4.0805	−14.6632	0.0254	36	0.0000

Table 7
This table reports summary statistics of the explanatory variables in Eq. (8). The sample is restricted to 35 banks (see Table (9), last column) due to missing balance sheet data for Q4 2015. *Sovereign spread* is the spread between the 10-year sovereign yield and the German 10-year Bund yield for Q1 2016, this variable is winsorized in order to exclude extreme influent outliers and avoid bias in the estimates; *Tier 1 Ratio* is the ratio of Tier 1 capital to its total risk-weighted assets; *Deposits over assets* is the amount of deposits over total assets; ROE and ROA are the *Return on Equity* and *Return on Assets* measures respectively; *Total assets* is the value of total assets in millions of euros; *NPL to total loans* measures the amount of non-performing loans over the total value of loans; *Total capital ratio* is the ratio of risk-based capital to its risk-weighted assets, *Provisions for loan losses* is the value of provisions for loan losses over total loans; and *Reserves for loan losses* is the amount of reserves for loan losses over total loans. All bank-specific variables refer to Q4 2015.

	Mean	Median	Std. Dev.	Min	Max	Obs.
Sovereign spread	0.895	1.172	0.736	0.000	2.664	35
Tier 1 ratio	14.794	13.500	3.632	11.500	26.900	35
Deposits over Assets	43.306	42.681	13.813	7.617	66.078	35
ROE	4.349	5.930	7.847	−23.435	13.122	35
ROA	0.216	0.321	0.557	−1.929	0.915	35
Total Assets (ml Euro)	638.896	407.373	607.775	58.660	2217.600	35
NPL to total loans	9.063	4.538	10.361	0.437	39.170	35
Total capital ratio	17.733	16.6	4.123	12.73	30.3	35
Provisions for loan losses	0.878	0.542	1.198	−0.219	5.171	34
Reserves for loan losses	4.890	3.244	5.528	0.243	22.812	35

Table 8
This table reports the results of the regression in Eq. (8) where the dependent variable is the abnormal differential between CDS spreads on subordinated and senior bonds. The sample comprises 35 European banks (Table 9, last column) and the estimation period is the first quarter of 2016. Notice that all bank-specific variables are lagged by one quarter to avoid endogeneity issues. The covariates are the spread between the 10-year sovereign yield and the German 10-year Bund yield (*Sovereign spread*), the interaction between Sovereign spread and a dummy variable that takes value 1 for banks headquartered in PIGS countries and 0 otherwise, the ratio of Tier 1 capital to its total risk-weighted assets (*Tier 1 ratio*), the amount of deposits over total assets *Deposits over assets*, the Return on Assets measure (*ROA*), the logarithm of total assets (*log*(total assets)) and total assets in millions Euro (*Total assets (ml Euro)*), non-performing loans over the total value of loans *NPL to total loans*, the Return on Equity measure (*ROE*), the ratio of risk-based capital to its risk-weighted assets (*Total capital ratio*), the amount of provisions for loan losses over total loans value (*Provisions for loan losses*), and the amount of reserves for loan losses over total loans (*Reserves for loan losses*). R^2 and F-test for joint significance of coefficients are reported. Standard errors in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Sovereign spread × No PIGS		−1.941	−10.95		−23.18		−7.246	−12.10	−0.428		−10.73
		(26.12)	(26.24)		(28.44)		(25.94)	(24.40)	(26.04)		(26.34)
Sovereign spread × PIGS		**24.64**$^+$	22.42		**25.64**$^+$		**43.65***	**45.21****	23.20		22.52
		(14.28)	(14.45)		(14.30)		(16.78)	(15.34)	(14.29)		(14.51)
Sovereign spread	21.73			17.88		**34.40**$^+$				20.36	
	(14.06)			(14.25)		(17.06)				(13.95)	
Tier 1 ratio	**−4.025**$^+$	**−3.843**$^+$	**−3.847**$^+$		−0.168	**−4.395***	**−3.870**$^+$	**−3.308**$^+$	**−3.880**$^+$	**−4.050***	**−3.868**$^+$
	(1.984)	(1.986)	(2.000)		(1.299)	(2.094)	(2.000)	(1.900)	(1.972)	(1.960)	(2.004)
Deposits over assets	−0.705	−0.760	−0.619	−0.623	−0.261	−0.605	−0.673	−0.519	−0.765	−0.718	−0.621
	(0.560)	(0.561)	(0.566)	(0.563)	(0.486)	(0.595)	(0.565)	(0.531)	(0.557)	(0.554)	(0.566)
ROA	20.55	16.64		21.75	**33.92**$^+$	4.802	−8.222		21.00	25.63	
	(18.60)	(18.91)		(18.73)	(18.31)	(23.57)	(23.21)		(19.97)	(19.33)	
log(total assets)	**7.870***	**8.634***	**9.692****	**7.953***		**8.774***	**9.898****	**10.20****	**8.424***	**7.711***	**9.687****
	(3.087)	(3.160)	(3.115)	(3.292)		(3.219)	(3.098)	(2.866)	(3.155)	(3.058)	(3.123)
NPL to total loans	**2.029**$^+$	1.437	0.455	**2.059**$^+$	**2.459**$^+$						
	(1.119)	(1.245)	(1.186)	(1.128)	(1.210)						
ROE			−0.862					**−2.584**$^+$			−0.819
			(1.278)					(1.328)			(1.353)
Total capital ratio				**−3.452**$^+$							
				(1.836)							
Total assets (*ml* Eur)					**0.0394***						
					(0.0143)						
Provisions for loan losses						1.109	−12.39	**−22.94**$^+$			
						(14.35)	(15.10)	(12.19)			
Reserves for loan losses									3.297	**4.410**$^+$	0.873
									(2.493)	(2.194)	(2.381)
R^2	0.700	0.712	0.709	0.695	0.713	0.678	0.721	0.754	0.716	0.707	0.709
Adjusted R^2	0.638	0.640	0.636	0.632	0.641	0.608	0.649	0.690	0.645	0.647	0.636
F	11.30	9.905	9.750	11.02	9.940	9.805	9.969	11.84	10.10	11.68	9.744
Observations	35	35	35	35	35	34	34	34	35	35	35

$^+$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix B

Table 9

Table 9
The table reports the list of European banks included in our sample. To be included in our sample the bank must have issued a CDS on both subordinated and senior bonds and must be located in a country where the SRM was implemented by February 2016 (according to the information published by ISDA at the link https://www.isda.org//2016/12/02/isda-brrd-implementation-monitor-5). For a small number of banks, we have only equity data, these banks are solely included in Eq. (7). Columns 4 to 6 show for each bank whether it is included in the estimation of Eq. (7), Eq. (6) and Eq. (8) respectively, depending on the availability of each bank's equity price, CDS spread and balance-sheet data. Acronyms of each bank have been sourced from SNL Financial and Bloomberg.

Country	Ticker	Bank	Equity	CDS	Cross-section
AT	ERSTBK	Erste Group Bank	x	x	x
AT	RBI	Raiffeisen Bank International	x	x	x
BE	DEXIA	Dexia		x	
BE	KBC	KBC Group	x		
DE	BYLAN	Bayerische Landesbank		x	x
DE	CMZB	Commerzbank	x	x	x
DE	DB	Deutsche Bank	x	x	x
DE	HVB	Unicredit Bank	x	x	
DE	WESTLB	Portigon		x	
DK	DANBNK	Danske Bank	x	x	x
ES	BANSAB	Banco Sabadell	x	x	x
ES	BBVASM	Banco Bilbao Vizcaya Argentaria	x	x	x
ES	BKTSM	Bankinter	x	x	x
ES	CAIXAB	CaixaBank	x	x	x
ES	CAJAME	Caja Mediterraneo		x	
ES	POPSM	Banco Popular Espanol	x	x	x
ES	SANTAN	Banco Santander	x	x	x
FR	ACAFP	Credit Agricole	x	x	x
FR	BFCM	Banque Federative de Credit Mutuel		x	
FR	BNP	BNP Paribas	x	x	x
FR	KNFP	Natixis (subsidiary of Groupe BPCE)	x	x	x
FR	SOCGEN	Societe Generale	x	x	x
GB	BACR	Barclays Bank	x	x	x
GB	HSBC	HSBC Holdings	x	x	x
GB	LLOYDS	Lloyds Banking Group	x	x	x
GB	STAN	Standard Chartered	x		
GR	ALPHA	Alpha Bank	x	x	x
GR	ETE	National Bank of Greece	x		
GR	EUROB	Eurobank Ergasias	x	x	x
GR	TPEIR	Piraeus Financial Holdings	x		
IE	AIB	AIB Group	x		
IT	BACRED	Mediobanca	x	x	x
IT	BPIIM	Banco BPM	x	x	x
IT	ISPIM	Intesa Sanpaolo	x	x	x
IT	MONTE	Monte dei Paschi di Siena	x	x	x
IT	UBIIM	UBI Banca (Unione Di Banche Italiane)	x	x	x
IT	UCGIM	UniCredit	x	x	x
NL	ABN	ABN AMRO Bank		x	x
NL	INTNED	ING Group	x	x	x
NL	RABOBK	Cooperatieve Rabobank		x	
NL	RBSNV	Natwest Group	x	x	x
NL	SNSBNK	De Volksbank (SNS Bank)		x	
PT	BCPN	Banco Comercial Portugues	x	x	x
SE	NBHSS	Nordea Bank	x	x	x
SE	SEB	Skandinaviska Enskilda Banken	x	x	x
SE	SHBASS	Svenska Handelsbanken	x	x	x
SE	SWEDA	Swedbank	x	x	x

Appendix C

Proof of Proposition 1. Bondholders' expected revenue is:

$$r_D - (1-p)(1-\alpha)\max\{r_D - E, 0\} = 1 \tag{9}$$

where $\alpha \in [0,1]$ is the degree of bail-out in the resolution.
To solve for the interest rate r_D we have two cases:

- when $E \geqslant r_D$ (fully capitalized bank): $r_D = 1$;
- when $E < r_D$ (under-capitalized bank): $r_D(E,\alpha,p) \equiv \frac{1-(1-p)(1-\alpha)E}{p+(1-p)\alpha}$

It is enough to compute the derivatives:

$$\frac{\partial r_D}{\partial E} = -\frac{(1-p)(1-\alpha)}{[p+(1-p)\alpha]} < 0$$

$$\frac{\partial r_D}{\partial \alpha} = \frac{(1-p)(E-1)}{[p+(1-p)\alpha]^2} < 0$$

$$\frac{\partial r_D}{\partial p} = \frac{(1-\alpha)(E-1)}{[p+(1-p)\alpha]^2} < 0$$

assuming $E < 1$. □

Proof of Proposition 2. It is enough to compute the sign of the second order derivatives from Proposition 1:

$$sign\frac{\partial^2 r_D}{\partial E \partial \alpha} = sign\frac{(1-p)}{[p+(1-p)\alpha]^2} > 0$$

$$sign\frac{\partial^2 r_D}{\partial p \partial \alpha} = sign\frac{2-[p+(1-p)\alpha]}{[p+(1-p)\alpha]^4} > 0$$

when $E < r_D$. □

Proof of Proposition 3. The Loss Given Default can be written as

$$LGD = (1-\alpha)\max\{r_D - E, 0\} \tag{10}$$

Also here we have to consider two cases

- when $E \geqslant r_D$ (fully capitalized bank): $LGD = 0$;
- when $E < r_D$ (under-capitalized bank): $LGD = (1-\alpha)(r_D - E)$

It is enough to compute the derivatives:

$$\frac{\partial LGD}{\partial E} = (1-\alpha)\left[\frac{\partial r_D}{\partial E} - 1\right] < 0$$

$$\frac{\partial LGD}{\partial \alpha} = -(r_D - E) + (1-\alpha)\frac{\partial r_D}{\partial \alpha} < 0$$

$$\frac{\partial LGD}{\partial p} = (1-\alpha)\frac{\partial r_D}{\partial p} < 0$$

when $E < r_D$. □

For a given α, the banker's profit is:

$$\Pi = p(R + E - r_D) + (1-p)\max\{E - r_D, 0\} - E - \gamma - c \tag{11}$$

where $\gamma = (1-p)\alpha\max\{r_D - E, 0\}$ is the fair premium charged for the resolution regime (equal to the expected losses to be repaid to bondholders). Substituting the bondholders' constraint from Eq. (9) in the two cases, for $E \geqslant r_D$ and $E < r_D$ it is immediate to show that the profit in Eq. (11) always collapses to the overall surplus $(pR - c - 1)$. When instead the banker is not charged the fair premium γ, the expected profit of the banker is increased by an amount equal to $(1-p)\alpha\max\{r_D - E, 0\}$, namely the amount transferred to bondholders in case of partial bail-out. The banker in this case enjoys a rent as taxpayers' money subsidies the lower cost of funding.

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