Effects of the EU Resolution Framework on Moral Hazard and Market Discipline

Von der Mercator School of Management, Fakultät für Betriebswirtschaftslehre, der

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von

Julian Scholz

aus

Rheine

Referent: Prof. Dr. Bernd Rolfes

Korreferentin: Prof. Dr. Anette Köhler

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Abstract

Due to the negative consequences of extensive bank bailouts during the global financial crisis, EU member states adopted the Bank Recovery and Resolution Directive (BRRD) to end the too big to fail dilemma. Additionally, the euro area countries implemented the Single Resolution Mechanism (SRM) as part of the banking union, centralizing decision making and resolution financing. This research assesses both regulations' effectiveness in counteracting the adverse effects of implicit guarantees by ending morally hazardous behavior and strengthening market discipline.

The author uses rating information to identify affected banks that would have profited from bailouts before the regulations came into effect. Using difference-in-differences models, the author shows that, first, treated banks reduce their risk more drastically in relation to unaffected banks, suggesting the SRM to mitigate moral hazard effectively. Second, other bank-level characteristics like additional capital buffers and high charter values seem to amplify prudent bank behavior. Third, the author provides evidence that the SRM helps restore market discipline, as affected banks are exposed to a relative rise in funding expenses and react accordingly by avoiding risk-sensitive funding. Interestingly, the BRRD does not evoke the aforementioned effects on moral hazard and market discipline.

The results are supported by CDS and equity investors' short-term responses to the new regulation. Partly, CDS investors display even stronger reactions to the BRRD than to the SRM. Moreover, additional results confirm implicit guarantees to increase risk-taking during the time preceding the policy change, particularly for SRM banks. Furthermore, the investigation of the long-term relation between government support and CDS spreads reveals a structural break in CDS pricing. After adopting the regulation, banks do not benefit from implicit guarantees any longer.

Altogether, the negative consequences of implicit guarantees were significantly higher in the euro area. The SRM seems to be the appropriate remedy for the too big to fail dilemma, increasing market discipline and reducing moral hazard. On its own, the BBRD does not appear to suppress the negative consequences of implicit guarantees, possibly because of lower incentives for moral hazard in the non-eurozone in general.

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Index of Abbreviations

AMV ..... *asset management vehicle*
API ..... *assessment of public interest*
ATT ..... *average treatment effect on the treated*
BCA ..... *Baseline Credit Assessment*
BCBS ..... *Basel Committee on Banking Supervision*
BF ..... *Bureau van Dijk's Bank Focus*
BRRD ..... *Bank Recovery and Resolution Directive*
BSR ..... *Fitch's bank Support Rating*
BTA ..... *book value of total assets*
BVL ..... *book value of liabilities*
CD ..... *customer deposits*
CET1 ..... *Common Equity Tier 1*
CRD IV ..... *Capital Requirements Directive IV*
CRR ..... *Capital Requirements Regulation*
DD ..... *difference-in-differences*
DGS ..... *deposit guarantee scheme*
DS ..... *Thomson Reuters Datastream*
DSGE ..... *Dynamic Stochastic General Equilibrium*
E ..... *equity*
EBA ..... *European Banking Authority*
ECB ..... *European Central Bank*
EDIS ..... *European Deposit Insurance Scheme*
EFC ..... *European Fiscal Compact*
EFSF ..... *European Financial Stability Facility*
ELA ..... *emergency liquidity assistance*
ESM ..... *European Stability Mechanism*
expNCD ..... *expenses on non-customer deposit liabilities*
FC ..... *Fitch Connect*
FOLTF ..... *failing or likely to fail*
FSB ..... *Financial Stability Board*
G20 ..... *Group of Twenty*
GFC ..... *global financial crisis*
GFST ..... *government financial stabilization tool*
GIIPS ..... *Greece, Italy, Ireland, Portugal, Spain*
G-SIB ..... *global systemically important bank*
G-SII ..... *global systemically important institution*
H ..... *Hypothesis*
HHI ..... *Herfindahl-Hirschman Index*
IBL ..... *interest-bearing liabilities*
IGG ..... *implicit government guarantee*
IntExp ..... *total interest expense*
IntInc ..... *gross interest and dividend income*
IRB ..... *internal ratings-based*

ISDA ..... *International Swaps and Derivatives Association*
LCR ..... *liquidity coverage ratio*
LEI ..... *Legal Entity Identifier*
LLR ..... *loan loss reserves*
LoanImp ..... *loan impairments*
LR ..... *leverage ratio*
LSI ..... *less significant institution*
LTFCDR ..... *long-term foreign currency deposit rating*
LTIDR ..... *Long-Term Issuer Default Rating*
MMF ..... *money market funding*
MS ..... *market share*
MVE ..... *market value of equity*
N ..... *number*
NF ..... *No Floor*
NIM ..... *net interest margin*
NN ..... *nearest neighbor*
NPL ..... *non-performing loan*
NSFR ..... *net stable funding ratio*
OJ ..... *Official Journal of the European Union*
OLA ..... *Orderly Liquidation Authority*
OLS ..... *ordinary least squares*
O-SII ..... *other systemically important institution*
rec ..... *recital*
RoA ..... *return on assets*
RT ..... *risk-taking*
RTS ..... *regulatory technical standards*
RWA ..... *risk-weighted assets*
SecImp ..... *security impairments*
SI ..... *significant institution*
SRB ..... *Single Resolution Board*
SREP ..... *Supervisory Review and Evaluation Process*
SRF ..... *Support Rating Floor, Single Resolution Fund*
SRM ..... *Single Resolution Mechanism*
SRR ..... *Special Resolution Regime*
SSM ..... *Single Supervisory Mechanism*
STF ..... *other short-term funding*
TARP ..... *Troubled Asset Relief Program*
TBTF ..... *too big to fail*
TFEU ..... *Treaty on the Functioning of the European Union*
TL ..... *total liabilities*
TRI ..... *total return index*
WDCC ..... *write-down or conversion of capital instruments*
WF ..... *wholesale funding*

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Introduction

In the recent global financial crisis (GFC), the failure of Lehman Brothers demonstrated the devastating outcomes of a large-scale bank insolvency to policymakers around the world. The abandonment of the once practiced policy of bailing out large banks was a massive shock for wall street insiders, soon leading to a loss of worldwide market confidence. The failure first caused domino effects to insurers, counterparties, and creditors, who were connected to Lehman Brothers through contractual agreements, highlighting the ongoing subprime crisis. Because of banks' interconnectedness, either through direct business relationships or by having similar portfolios, and the insolvency of a bank once deemed too big to fail, interbank markets almost came to a complete breakdown.[1] A reassessment of credit risk followed, quickly expanding to a global level because of highly intertwined financial markets, all whilst affecting the real economy.[2] Ironically, the attempt of setting an example by refusing to bail out a large investment bank led to a revival of too big to fail policies. The absence of reliable resolution tools for ailing banks and the fear of deteriorating financial stability motivated decision-makers to provide vast bailout programs in favor of banks, financed by tax funds. Especially large and complex banks profited from sovereign support, reinforcing their too big to fail status. The combination of these circumstances resulted in implicit government guarantees for banks, manifesting themselves in investors' and creditors' assumptions to receive support in a crisis, without prior commitments having been made.

After most European governments took national actions of bailing out troubled financial institutions, policymakers concluded that the lack of a supranational resolution scheme was a critical problem that needed to be addressed. Not only the financial stability and the economy of member states were in danger, but the crisis even spilled over to the sovereign level, resulting in the European debt crisis.[3] Moreover, implicit guarantees were suspected of incentivizing banks to engage in excessive risk-taking, further destabilizing financial markets. Commissioned by the G20 Leaders, the FSB developed a policy framework addressing the problems associated with systemically important financial institutions whose failure would pose a significant risk to global financial stability. The FSB (2011) identified the lack of an international standard setting the minimum level for resolution schemes as a blind spot for solving problems emerging from morally hazardous risk-taking.[4]

Policymakers in the European Union (EU) learned from the GFC by tightening banking regulation and supervision. The *EU resolution framework*, regulated within the Bank Recovery and Resolution Directive (BRRD), is the initiative directly designed to dissolve the too big to fail problem. This regulation formulates minimum standards of bank resolution that are binding for all EU member states. The euro area member states additionally implemented the Single Resolution Mechanism (SRM) as part of the banking union. The SRM establishes a joint resolution fund and centralizes resolution decisions for large banks to the Single Resolution Board (SRB) as a supranational agency. With these legislative measures, the long-standing tradition of bank rescues shall be abandoned once and for all. The new rules constitute a regime change from

1 See *Hellwig* (2009).
2 See *Allen/Carletti* (2010); *Goddard/Molyneux/Wilson* (2009).
3 See *Lintner et al.* (2016): 19.
4 See FSB (2011b).

bailout policies to bail-in intending to restore market discipline and strengthen bank resilience. Bank investors shall be incentivized to monitor banks and require risk premia according to banks' risk profiles, resulting in more prudent bank behavior.

This work analyzes the effects of the EU resolution framework on banks' and investors' behavior with two primary research objectives. First, the author examines whether the EU resolution framework reduces moral hazard by analyzing banks' risk-taking after the policy change. Second, the author explores the effects on market discipline by investigating changes in banks' debt expenditures and funding structures. To the best of the author's knowledge, this paper is the first to investigate the effect of the new bank resolution rules on moral hazard and market discipline.

The research conducted in this paper makes several contributions to different fields of existing literature on the consequences of implicit guarantees. A large body of literature is theoretical, examining the effects of implicit guarantees on bank behavior while touching two partly conflicting concepts. The moral hazard hypothesis states that implicit guarantees lead to weaker market discipline of shareholders and investors, ultimately resulting in higher risk-taking, as profit maximization dominates stability concerns [*Cordella/Dell'Ariccia/Marquez* (2018); *Goodhart/Huang* (2005); *Stern/Feldman* (2004); *Cordella/Yeyati* (2003); *Boot/Greenbaum* (1993); *Freixas*]. In contrast, the opposing hypothesis suggests implicit guarantees to induce funding cost advantages, culminating in higher charter values. To preserve this advantageous market position, guaranteed banks would follow a more risk-averse business strategy [*Cordella/Dell'Ariccia/Marquez* (2018); *Hakenes/Schnabel* (2010b); *Gropp/Vesala* (2004); *Cordella/Yeyati* (2002)].

The empirical literature on the consequences of implicit guarantees focuses either on moral hazard or on market discipline. Contrary to theoretical work, empirical evidence on morally hazardous bank behavior is scarce. Nevertheless, prior research has linked implicit guarantees to an increased risk-taking of banks [*Brandao-Marques/Correa/Sapriza* (2018); *Afonso/Santos/Traina* (2014); *Damar/Gropp/Mordel* (2014); *Prabha/Wihlborg* (2014); *Dam/Koetter* (2012)]. More specifically, this work relates to contributions analyzing the changes in banks' risk-taking after implicit guarantees have been abolished due to policy changes [*Fischer et al.* (2014); *Gropp/Gründl/Güttler* (2014); *Ignatowski/Korte* (2014); *Körner/Schnabel* (2013)]. All of these contributions support the moral hazard channel finding a risk-decreasing effect after implicit guarantees have been removed, except for *Fischer et al.* (2014), who show that German Landesbanken increased their risk-taking, trying to compensate for increased funding costs. This thesis borrows from these contributions' research design by using the introduction of the EU resolution framework as a quasi-natural experiment. The results show that banks deemed to receive sovereign support in a crisis reduced their risk-taking after the new regulation has been implemented.

Another part of empirical literature investigates the general relationship between bank charter values and bank behavior, irrespective of implicit guarantees [*Jiménez/Lopez/Saurina* (2013); *De Nicolo* (2000); *Demsetz/Saidenberg/Strahan* (1996); *Keeley* (1990); *Marcus* (1984)]. The results are mixed but predominantly support the idea of low charter values leading to risk-taking incentives. Only a few researchers empirically investigate the divergent forces of moral hazard and charter values in conjunction with implicit guarantees [*Schenck/Thornton* (2016);

Damar/Gropp/Mordel (2014); *Gropp/Hakenes/Schnabel* (2011). This paper contributes to the literature on bank charter values by showing that banks with high charter values have greater incentives to reduce their risk-taking after the resolution framework has suspended implicit guarantees. To the best of the author's knowledge, the effect of bank charter values after implicit guarantees were removed by a policy change has not yet been empirically analyzed.

A relatively large body of empirical literature focuses on the lack of market discipline for bank debt guaranteed by the bank's sovereign, finding that those banks enjoy funding cost advantages. Some of those researchers measure implicit government guarantees by absolute or relative bank size [*Jacewitz/Pogach* (2018); *Cubillas/Fernández/González* (2017); *Acharya/Anginer/Warburton* (2016); *Balasubramnian/Cyree* (2014a); *Bertay/Demirgüç-Kunt/Huizinga* (2013)], whereas others use rating information [*Brandao-Marques/Correa/Sapriza* (2018); *Schich/Toader* (2017); *Ueda/Weder di Mauro* (2013)] and some derive implicit guarantees from market data [*Zhao* (2018); *Barth/Schnabel* (2013); *Balasubramnian/Cyree* (2011)]. Most of the contributions mentioned above deliver consistent evidence on the funding cost advantage of banks enjoying implicit guarantees, indicating weakened market discipline.

Although only a few empirical contributions have been made analyzing the impact of the paradigm change evoked by the EU resolution framework. Existing research focuses on the impact on market discipline, finding that investors require bail-in premia after the introduction of the resolution mechanism [*Fiordelisi et al.* (2020b); *Balke/Wahrenburg* (2019); *Giuliana* (2019); *Lewrick/Serena/Turner* (2019); *Cutura* (2018); *Schäfer/Schnabel/Weder di Mauro* (2017)]. Others find little or no evidence of an increased market discipline after the new resolution rules have been implemented [*Pablos Nuevo* (2019)]. A shortcoming of most contributions is the insufficient distinction between banks likely to benefit from implicit guarantees and banks who do not, as those authors proxy potential support by banks' size or whether they are declared as systemically important. Also, not all authors distinguish between countries that adopted only the BRRD and those who additionally adopted the SRM Regulation. It has also been analyzed whether the new resolution framework affects the extent of implicit guarantees and the bank sovereign nexus, which has been affirmed [*Covi/Eydam* (2020); *Fiordelisi et al.* (2020a); *Fratzscher/Rieth* (2019); *Pancotto/Gwilym/Williams* (2019)].

This paper makes several contributions to the existing literature on market discipline. First, this work contributes by constructing a unique measure of implicit government guarantees derived from different bank ratings. Second, the author shows that the introduction of the EU resolution framework is associated with a rise in funding costs for banks who previously enjoyed implicit guarantees, while this is not the case for banks not enjoying implicit guarantees. Moreover, indications of increased market discipline are observed for the long-term and the short-term perspective. Third, that banks act accordingly by reducing their ratio of risk-sensitive funding to avoid higher funding expenses due to increased market discipline.

The rest of the thesis is structured as follows: Section one describes the EU resolution framework in detail, distinguishing between the BRRD and SRM Regulation. Section two discusses the related literature on risk-taking and market discipline related to implicit guarantees, then deduces the hypotheses to be tested and explains the research strategy. Section three describes the data and sample selection and the empirical strategy. The analysis of moral hazard and

market discipline is conducted in sections four and five, respectively. Section six contains additional analyses on short- and mid-term effects and indications on the general relationship between government support and moral hazard or market discipline, respectively. The conclusion summarizes the key findings.

1 Development of the EU resolution Framework

This section describes the development of the EU resolution framework in response to the bailout programs during the GFC in the EU. Section 1.1 briefly describes the European bailout measures and early national and European approaches to regulating government support. Section 1.2 explains the details of statutory components forming the resolution framework. The framework's effectiveness is conclusively assessed in section 1.3.

1.1 Early Response to Ailing Banks

1.1.1 Bailout Measures in Europe

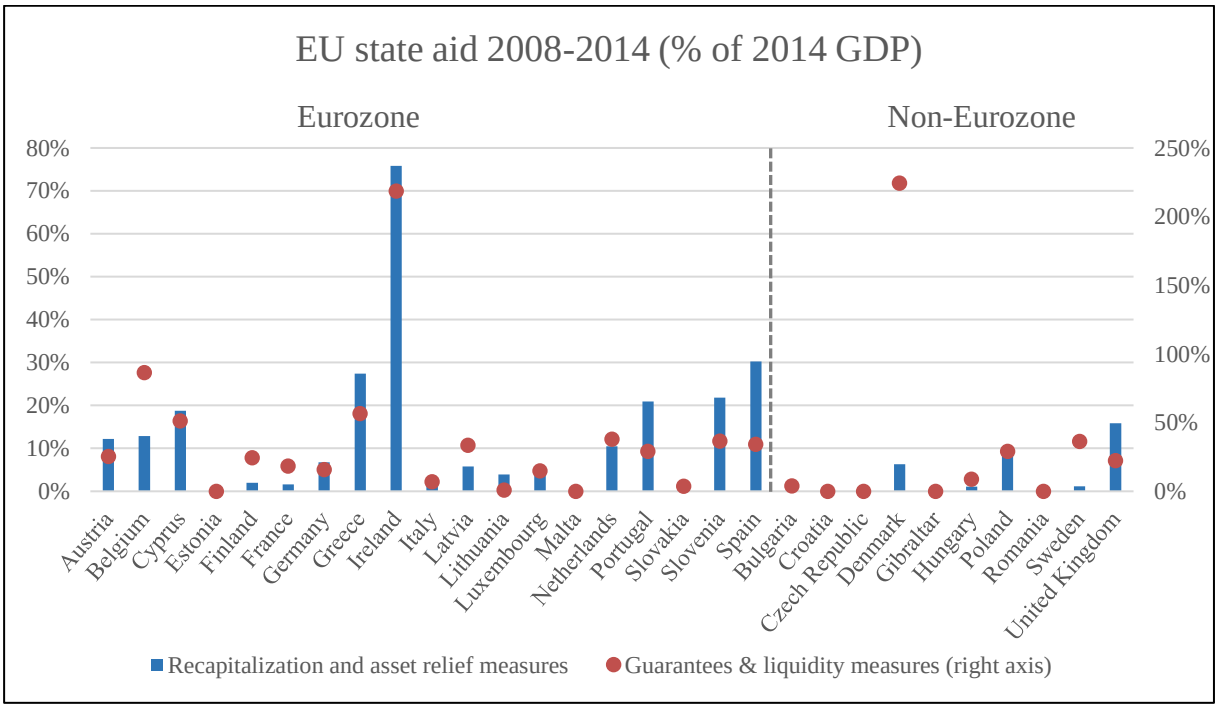
During the Global Financial Crisis (GFC), governments in nearly every member state of the European Union offered support to troubled banks via liquidity provision, capital injections, and debt guarantees.[5] Most EU member states provided unlimited support, and the burdens to receive aid were relatively low. Policymakers mainly reacted so determinedly and liberal because they were afraid of the consequences of numerous bank insolvencies.[6] The regulatory systems both at the supranational level in the EU and at the national level within member states had not been prepared for such a situation, completely lacking any resolution schemes that could give orientation in how to liquidate ailing banks.

Government support can be provided through four main channels: (i) recapitalizations; (ii) asset relief programs; (iii) explicit guarantees; and (iv) liquidity measures. All four sources of support were used in the aftermath of the crisis, but the extent varied drastically among EU member states. Interestingly, the amount and magnitude of bailout measures were not determined by the amount of accumulated losses in the respective banking sector. That supports the preliminary conclusion that political factors play a crucial role in the decision about bailout measures.[7]

Figure 1.1 shows the average approved recapitalization and asset relief measures for banks from 2008 to 2014 in EU member states. The total amount of those measures resulted in EUR 1,405 billion, where about 70% of the approved measures are attributable to the eurozone and 30% to the non-eurozone EU member states. A more detailed description of state aid measures is presented in Table A.1 on page 169 in the appendix.

[5] See *Petrovic/Tutsch* (2009): 68.
[6] See *Allen et al.* (2015); *Woll* (2014).
[7] See *Grossman/Woll* (2014); *Petrovic/Tutsch* (2009). For an overview and a discussion on state aid in the European banking sector, see *Gropp/Tonzer* (2016).

Figure 1.1: State aid in the EU 2008-2014



This figure shows the recapitalization and asset relief measures (bars) and guarantees and liquidity measures (dots) of the EU member states between 2008-2014 in percentage of each member state's 2014 GDP. Source: State aid 2018 Scoreboard of the European Commission, World Bank statistics and author's calculations.

Member states within the eurozone (left-hand panel of Figure 1.1) provided far more extensive recapitalization and guarantee schemes than the remaining EU member states (right-hand panel of Figure 1.1). Estonia, Malta, Croatia, Czech Republic, and Romania provided no state aid falling within the European Commission's jurisdiction.

1.1.2 The EU Commission's State Aid Rules

When no resolution scheme was in place, and even an understanding of how to deal with banking crises was missing, the first government interventions to safeguard financial stability in favor of troubled banks were provided solely on a national basis. The delayed reaction on the EU level was twofold: support was provided by national governments and partly by special European funds to banks and sovereigns in distress, and state support to banks was subsequently regulated. Policymakers in the European Union reacted mainly for two reasons: First, bailing out banks, although it was regarded as necessary, was a costly endeavor that caused serious fiscal trouble for some member states of the European Union, finally leading to the European sovereign debt crisis in 2011.[8] Second, it was believed that implicit bank debt guarantees reinforced banks' risk-taking beyond their risk-bearing capacity, thus leading to a vicious cycle. Early attempts to address the problems arising from implicit guarantees were made by the European Commission's proposals presented in communications to harmonize the EU's crisis management by establishing a supranational resolution mechanism.[9] These two communications

[8] See, e.g., *Lintner et al.* (2016): 19; *Acharya/Drechsler/Schnabel* (2014).

[9] The European Commission consecutively published two proposals on how to implement a harmonized resolution scheme that accounts for the various difficulties observed during the recent crisis. See COM (2009) 561

were later the basis for the European institutions' consultations and led to the first proposals for the Bank Recovery and Resolution Directive (BRRD) on 6 June 2012.[10]

No specific regulations applied to state aid measures provided to the financial industry when the GFC's first repercussions hit European banking sectors. Nevertheless, the Treaty of the Functioning of the European Union (TFEU), where the state aid framework is outlined, allows some legal provisions under which governmental support to firms is tolerable. The member states need to formally request these legal exemptions from the European Commission, which decides whether the designated support is in line with the state aid rules. By designing those rules and having the final authority over state aid permission to banks, the Commission became the de facto crisis-management and resolution authority.[11]

At the beginning of the crisis, the only instructions to governments facing difficulties with ailing banks were to follow the Rescue and Restructuring Guideline,[12] which is based on Article 107(3) (c) TFEU.[13] This legal exception of state aid permits "aid to facilitate the development of certain economic activities […] where such aid does not adversely affect trading conditions to an extent contrary to the common interest." The guidelines and the decision on the first appeals for government support relied upon Article 107 (3) (c), since it was initially assumed that difficulties in banking would not affect the health of a member state's economy but were instead the results of individual problems requiring tailored solutions.[14] By underestimating the scope of the impending crisis, decision-makers believed that the conditions for Article 107(3), requiring support to be provided to "remedy a serious disturbance in the economy of a Member State," were not fulfilled.[15]

When the scope and magnitude of the crisis emerged, and essential market players needed emergency aid,[16] it soon became apparent that state aid rules, initially created for rescuing firms during normal times, required a fast and diligent revision. That led to the re-evaluation of state aid reasoning and resulted in the Commission opting for Article 107(3) (b) as a reason for state aid, finally acknowledging the threat to financial stability by ailing banks.[17] To moderate the conflict of interest between financial stability and a level playing field, the European Commission published several successive communications since 2008, commonly referred to as the ***Crisis Communications***. They explain how the Commission sets boundaries for state aid, making financial stability the prime reasoning for support based on Article 107(3) (b).[18] Several Communications give sound guidance on how support should be provided according to principles like non-discrimination, a limitation in time, a limited amount of aid, behavioral

'An EU Framework for Cross-Border Crisis Management in the Financial Sector' and COM (2010) 579 'An EU Framework for Crisis Management in the Financial Sector'.

10 See See*Véron* (2017).

11 See *Almunia* (08.03.2013).

12 See European Commission (2004).

13 See *Iftinchi* (2017): 54.

14 See the decision by the European Commission [(2008) 1628] on rescue aid to WestLB (Case NN 25/2008); *Reynolds/Macrory/Chowdhury* (2009): 1676.

15 In Applying that principle, the commission assessed state aid to institutions like Crédit Lyonnaise, BAWAG-PSK, Banco di Napoli, Bankgesellschaft Berlin, and WestLB. See *Iftinchi* (2017): 54f.

16 Fortis, Dexia, Bradford & Bingley, and Hypo Real Estate were among the first important market participants in need of external support after the Lehman failure in October 2008. See *Iftinchi* (2017): 58.

17 See *Miserendino* (2018): 205.

18 European Commission (05.12.2019).

commitments, and the provision of a restructuring and liquidation plan. The new rules enlarged the early 2004 Rescue and Restructuring Guideline's scope and allowed some sector-specific measures, like liquidity support for longer than six months.[19]

The ***2013 Banking Communication***[20] addresses the need for fast and immediate government interventions in order to prevent ailing banks from endangering the financial markets' functioning through spillover effects, eventually harming a member state's economy. The Commission's final post-crisis guideline on the application of state aid rules is still in place.[21] Compared to prior versions, the main changes are the implementation of a more effective restructuring process and strengthened burden-sharing requirements.[22] Before state aid can be granted, equity, convertible capital instruments, and subordinated debt need to contribute fully to offset any losses. Hybrid capital or subordinated debt holders must either contribute via conversion into Common Equity Tier 1 (CET1) or a write-down of the principal amount.[23] The Commission does not require senior debt holders' contributions, e.g., insured deposits, uninsured deposits, bonds, and other seniority instruments.[24] For the application of Article 107(3) (b), the Banking Communication points out that "genuinely exceptional circumstances where financial stability at large is at risk" are required.[25]

Furthermore, that government support is in line with the Banking Communication, when the beneficiary of support is a systemically important bank in a member state, the collapse of which could affect the financial sector, and in turn, affect the real economy.[26] An exception to burden-sharing requirements can be made by the Commission for subordinated debt instruments when implementing those measures would endanger financial stability.[27] The Banking Communication is intended to restrict the exercise of the Commission's discretion when approving state aid. However, as the European Court of Justice has ruled, the Commission might approve state aid notified by member states that do not comply with the Banking Communication principles in exceptional circumstances. In that regard, the Commission has a wide margin of discretion in deciding the appropriate balance between distortions of competition, moral hazard, and safeguarding financial stability, without excluding the possibility of bailouts.[28]

1.1.3 Single Country Resolution Approaches

Given the conflicting goals of preserving financial stability and limiting the adverse effects of government interventions, some EU member states developed special bank resolution schemes before the EU approach was developed. Many countries inside and outside the EU adapted their

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[19] See *Iftinchi* (2017): 59.

[20] 'Communication from the Commission on the application, from 1 August 2013, of State aid rules to support measures in favor of banks in the context of the financial crisis' OJ C216/1, hereafter referred to as 2013 Banking Communication.

[21] European Commission (2017b).

[22] See *Iftinchi* (2017): 70.

[23] 2013 Banking Communication paras 41 & 44.

[24] 2013 Banking Communication para 42.

[25] 2013 Banking Communication para 6.

[26] 2013 Banking Communication para 25. See *Iglesias-Rodríguez* (2019): 206.

[27] 2013 Banking Communication para 45.

[28] Case C-526/14 Kotnik and others ECLI:EU:C:2016:570 para 38-44. See *Schillig* (2019): 250f; *Micossi/Bruzzone/Cassella:* 14–17.

national insolvency and banking laws to establish special crisis management tools for failing banks. The policies adopted differ regarding the powers and tools assigned to national authorities and range from special resolution regimes to crisis management regimes.[29] Germany,[30] Denmark, Sweden, Switzerland, and the United Kingdom[31] are examples of countries with approaches close to special resolution regimes.[32]

The new crisis management frameworks, treating bank failures differently from non-financial firms, were mostly implemented by omnibus laws that adapt existing bank insolvency laws. Thus, those approaches primarily do not represent comprehensive resolution regimes as the supervisory powers to act against the will of shareholders and creditors are limited. The only exception is the Special Resolution Regime (SRR) for failing banks adopted in the UK, which provides an explicit legal basis for its supervisors to make rules regarding recovery and resolution plans.[33] The SRR crisis management tools include share transfers for failing banks on a going concern basis in favor of a buyer against existing shareholders' approval.

Denmark, Spain, and the UK included all banks to be part of the regulation, whereas Germany and Belgium specified special procedures to be exclusively applicable to systemically relevant banks, likely causing financial instability when entering ordinary insolvency proceedings. The crisis management tools include share or property transfers but usually need shareholders' approval. The only countries that included some regulations on the liability cascade next to the existing insolvency law are Ireland and Germany.[34] For the German crisis management tools, the court is similar to ordinary insolvencies, allowed to pass measures against shareholders' will. The ranking of claims can deviate from the insolvency proceeding when this is required to preserve financial stability. As the restructuring act's primary goal is to guarantee financial stability and thus explicitly allow government assistance, a bailout for creditors of systemically important banks has even become more likely.[35]

Concluding, the new bank resolution regimes are an improvement regarding the management of banking failures but are incomplete concerning the key attributes of effective resolution regimes developed by the FSB.[36] They do not provide the resolution authorities with enough powers to bail-in shareholders and creditors and, therefore, do not provide strong incentives for investors to monitor banks' management effectively. Only a few jurisdictions equipped their respective authorities with enough powers to bail-in shareholders and creditors.[37] Instead, in most cases, shareholders need to approve the resolution measures when their rights are affected, which does not provide incentives for market discipline. Moreover, other key attributes like cross-border banking resolutions remain unaddressed. Therefore, national resolution regimes

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29 See Basel Committee on Banking Supervision (2011b).

30 Bank Restructuring Act (Restrukturierungsgesetz) of 9 December 2011 Bundesgesetzblatt Teil 1, p. 1900. See *Paulus* (2011) for an introduction and an assessment of the act.

31 Banking Act 2008 and Banking Act 2009, http://www.legislation.gov.uk/ukpga/2009/1/pdfs/ukpga_20090001_en.pdf. For an introduction, see, e.g., *Brierley* (2009).

32 See EBA/CP/2014/16 p. 32, Basel Committee on Banking Supervision (2011b).

33 See *van der Zwet* (2011); *Brierley* (2009).

34 See *van der Zwet* (2011).

35 See Moody's Investor Service (2011); *Muller* (2011).

36 See FSB (2014).

37 The resolution regimes of Spain and Switzerland enable authorities to perform write-downs of equity or conversion of unsecured debt. For Spain, the powers are limited to subordinated debt and expired in 2013. See FSB (2013b).

instead provide a framework of action for banks and authorities to solve bank failures but cannot be regarded as policies that prevent future bailouts [*Hadjiemmanuil* (2013)].

Rating agencies and investors also regard national bank resolution systems as insufficient to provide solutions to complex problems associated with bank failures. *Schich/Lindh* (2012) study the evolution of implicit guarantees for banks and show that they generally have been reduced recently. However, they fail to provide evidence that this can be attributed to the introduction of new resolution regimes. Similarly, *Schich/Kim* (2012) observe that implicit guarantees are still in place, and their decline is due to the sovereign's shrinking financial capacities rather than the development of special resolution regimes. Moreover, they exhibit that even after introducing the new rules, investors of senior unsecured debt rarely incur any losses, undermining incentives for market discipline. Comparing Fitch's Bank Support Rating between 2007 and 2012, *van Roy/Vespro* (2012) conclude that the recent changes in resolution regimes did not reduce the level of sovereign support to banks. *Toader* (2015) measures the value of implicit guarantees by the difference between Moody's all-in and stand-alone credit rating for banks and finds that the introduction of special resolution regimes did reduce government guarantees to banks. However, when controlling for the sovereign rating, the effect is significantly weaker, suggesting that the deterioration of sovereigns' financial capacity explains a large fraction of the decrease in guarantees. Nevertheless, *Schäfer/Schnabel/Weder di Mauro* (2016b) document that equity and CDS investors indeed reacted to the implementation of restructuring laws, but conclude that the effects are too small to eliminate bailout expectations entirely.

1.2 Introduction of the BRRD and SRM Regulation

The final regulatory response to the dangers and disadvantages associated with implicit bank bailout guarantees was achieved by implementing the EU resolution framework. The framework consists mainly of the Bank Recovery and Resolution Directive (BRRD),[38] which formulates the material law covering resolution matters to end the too big to fail dilemma. Additionally, the Single Resolution Mechanism Regulation (SRMR)[39] was introduced for the euro area to coordinate the resolution of large banking institutions. The material law behind both systems is the same,[40] only that the Single Resolution Mechanism shifts competencies from national to supranational authorities. Notably, both systems consider their use of powers as the exception and the ordinary insolvency proceedings as a rule.[41] In the following subsections, the provisions of the BRRD will be explained first, and then the extensions of competencies through the SRM are discussed.

[38] Directive 2014/59/EU, hereafter referred to as BRRD.

[39] Regulation (EU) No 806/2014, hereafter referred to as SRM Regulation or SRMR.

[40] Resolution rules in the BRRD are the foundation of the SRMR. However, they are repeated in the SRMR since the existing EU treaties do not offer a sufficient legal foundation for providing the SRB with extensive decision-making powers. Therefore, the SRM only instructs national resolution authorities on how to resolve banks under the SRB's remit. See *Gleeson* (2019): 217–220; Deutsche Bundesbank (2014): 45–49.

[41] Rec. 45 BRRD & Rec. 59 SRMR.

1.2.1 The Bank Recovery and Resolution Directive

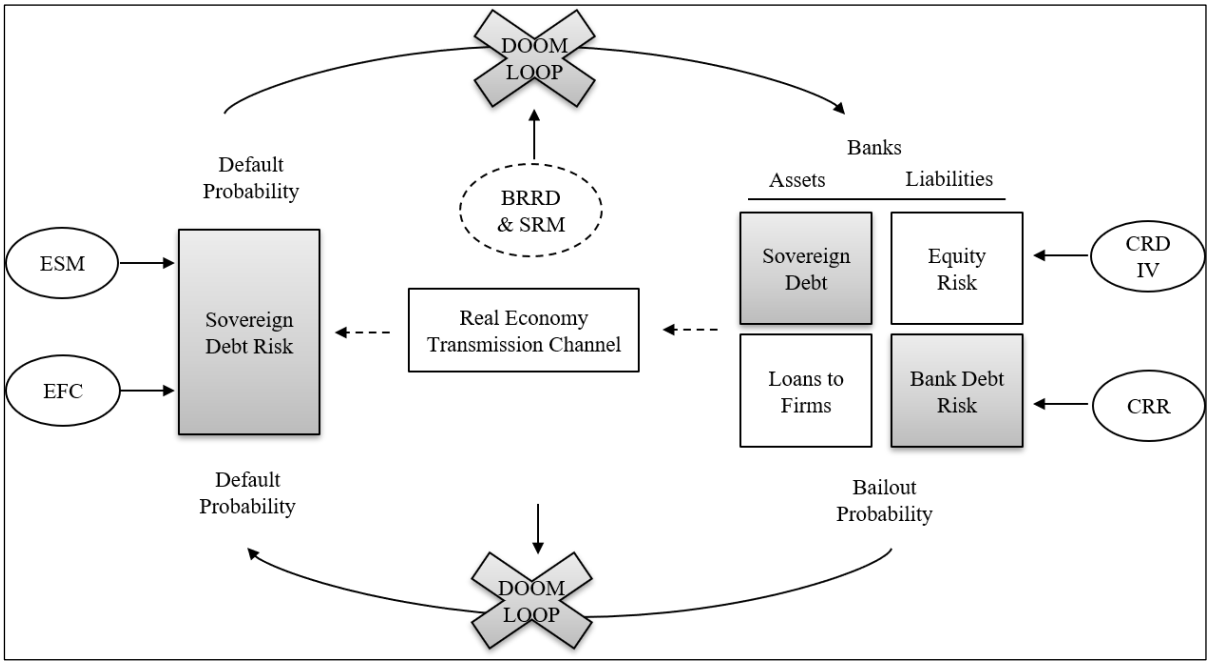
1.2.1.1 The Rationale for the BRRD

The rationales for introducing the BRRD are the numerous disadvantages and dangers associated with sovereigns providing implicit bailout guarantees to banks. Due to the banks' systemic importance, sovereigns mostly were compelled to bail out banks as their liquidation under ordinary insolvency proceedings would likely endanger financial stability. Moreover, as the sovereign debt crisis revealed, sovereigns' and banks' default risks were highly correlated, forming a sovereign-bank nexus. Figure 1.2 illustrates the sovereign-bank nexus by emphasizing the doom-loop relationships between bank risk, bank holdings of sovereign debt, and sovereign financial soundness. As *Shambaugh* (2012) and *Mody/Sandri* (2012) argue, the rise of sovereign debt levels after bailing out banks impacts their bond yields, causing declining bond market values. Banks hold a large fraction of debt issued by their respective sovereigns so that bailouts can have a deteriorating effect on banks' balance sheets and financial soundness. In turn, weak banks may restrict their lending, which causes harm to the real economy. The EU aims to prohibit member states from bailing out banks.[42] Restricting member states to act as lender of last resort is intended to avoid banks' morally hazardous behavior and strengthen market discipline.[43] As some member states acted in advance by introducing resolution schemes on a national basis, the BRRD harmonizes resolution concepts and maintains the internal market by preventing bank failures in one member state from adversely affecting other member states' stability.[44]

The principal objective of the BRRD is to guarantee that systemically relevant banks can be resolved promptly by avoiding the inappropriate use of sovereign funds while at the same time reducing the risk of financial instability emanating from distressed banks. Consequently, the BRRD procedure leads to a binary decision on distressed banks, which are either wound down according to BRRD rules or are subject to national insolvency proceedings. The decision on that ultimately depends on banks' systemic importance, which must be assessed by the competent resolution authority. Achieving the regulation's objectives involves four key areas regulated by the BRRD: (i) recovery and resolution planning, (ii) the ability of supervisory authorities to take early intervention measures, (iii) the application of resolution tools to moderate bank failure, and (iv) the cooperation and coordination between national authorities.[45]

[42] Rec. 5, 67 BRRD.
[43] Rec. 43, Art. 31(2) (b) BRRD.
[44] Rec. 3-5 BRRD.
[45] See *Lintner et al.* (2016): 31.

Figure 1.2: Sovereign-bank nexus and regulatory response



Source: *Covi/Eydam* (2020). The regulatory responses to end the doom-loop of banks' and sovereign's default risk are the Credit Requirements Directive (CRD IV) and Capital Requirements Regulation (CRR), for bank resilience on the one hand, and the European Stability Mechanism (ESM) and the European Fiscal Compact (EFC) for member states' debt sustainability on the other hand. The BRRD is a regulatory initiative that aims to break the ties between sovereign and bank default risk.

The BRRD is based on the recommendations of the Financial Stability Board (FSB), fulfilling key attributes of effective resolution regimes for financial institutions.[46] It applies to all institutions falling under the regulatory framework for financial institutions outlined in the Capital Requirements Directive (CRD IV). It refers to all credit institutions, large investment firms with an initial capital of at least EUR 730,000, and financial holding companies established in the EU.[47] The BRRD is a directive that, unlike regulations like the Capital Requirements Regulation, needs to be implemented into national law by all member states of the EU.[48] Thereby, it determines the minimum level of harmonization for resolution tools and their application. Member states are obliged to comply with the minimum standards but are free to go beyond the BRRD in implementing additional tools for crisis management as long as they are in line with the overall resolution framework.[49] The BRRD distinguishes between two phases of troubled banks. On the one hand, a recovery process that leaves the autonomy of action to distressed but financially sound banks, monitored by the national supervisory authority, and, on the other hand, the resolution process that is solely led by federal resolution authorities. The BRRD,

[46] See FSB (2011a). The key attributes were updated in 2014, see FSB (2014).
[47] Art. 1(1) (a), Art. 2(23) BRRD. See *Lintner et al.* (2016): 29.
[48] Most member states implemented the BRRD timely or with some delay by mid-2015. However, some states implemented the BRRD with a significant delay during 2016. See ISDA (2016). See also *Koetter/Krause/Tonzer* (2019) on the delay determinants.
[49] Art. 37(9); Rec. 29 BRRD. So far, no member state has imposed such additional tools or powers to its resolution authority. See *Busch/Rijn/Louisse* (2019): 6.

therefore, stipulates that all banks under its remit are obliged to submit recovery plans on the group level to national resolution authorities.[50]

1.2.1.2 Recovery and Resolution Planning

The BRRD augments the notion of moral hazard and financial distress, as being notably only during crisis times, to the careful preparation for financial distress during normal times. Thus, the BRRD also addresses banks under going concern, acknowledging the long process of deteriorating financial soundness that accompanies bank failures by introducing a ***recovery process*** that preempts, if possible, any recovery actions.[51] Banks are involved in this process through the obligation to draw up ***recovery plans*** that define precautionary measures as a crisis-management framework they can rely on in the event of distress. The nature of recovery plans is, therefore, both preemptive and preparatory. They shall foster banks' crisis management tools and reduce the probability of bank failures due to idiosyncratic or systemic stress. Additionally, they prepare banks and resolution authorities for a potential resolution process and are the foundation of resolution plans prepared by resolution authorities.[52]

The Assessment of recovery plans is done by national supervisory authorities, embedded in the Supervisory Review and Evaluation Process (SREP).[53] The recovery plans need to be compiled at the highest level of consolidation[54] in line with the European Banking Authority (EBA) regulatory technical standards (RTS) on the content of recovery plans and the EBA guidelines on recovery indicators and recovery plan scenarios.[55] The plan needs to be updated at least annually or when relevant organizational structure changes are made.[56] Although the bank needs to compile and maintain the plan, the national supervisory authority reviews it and assesses its feasibility during the Supervisory Review and Evaluation Process (SREP).[57]

Recovery plans start with a strategic analysis containing a detailed description of the banking group, its business model, and vulnerabilities. That implies the identification of critical functions and core business lines via a self-assessment. Critical functions are structured sets of activities, services of operations performed by a bank, the discontinuance of which is likely to cause financial instability or harm to a member state's real economy.[58] Those would probably need to be maintained during the resolution process. Core business lines are more important from the bank's economic point of view as they describe major sources of the bank's revenue

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50 Art. 5 & Art. 7 BRRD.

51 See *Farina/Scipione* (2019): 271f; *Grünewald* (2017): 290f.

52 See *Farina/Scipione* (2019): 274f.

53 Art. 2(21), 6(2) BRRD; Art. 4(20) Regulation (EU) No 575/2013 (CRR); Art. 74 Directive 2013/36/EU (CRD IV).

54 Individual recovery plans only need to be compiled when the entity is not part of a group. Art. 5, 6 BRRD.

55 The BRRD defines in Article 5(10) that the EBA will first develop draft guidelines on the content of recovery plans. See EBA regulatory technical standard on the content of recovery plans, EBA/RTS/2014/11. The Standard was adopted by the European Commission, see Commission Delegated Regulation (EU) 2016/1075. For the guideline on recovery scenarios, see EBA/GL/2014/06, and for the guideline on recovery indicators, see EBA-GL-2015-02.

56 Art. 5(2) BRRD.

57 Art. 2(21), 5(1), 6(1), 6(2) BRRD; Art. 4(20) Regulation (EU) No 575/2013 (CRR); Art. 74 Directive 2013/36/EU (CRD IV).

58 Art. 2(35) BRRD; Section A pt. (7) of the Annex of the BRRD and rec. (9) Commission Delegated Regulation (EU) 2016/1075.

stream or business value vital for the bank's going concern. Banks further need to define thresholds for key indicators like capital ratios and liquidity ratios and some indicators for market risk and macroeconomic developments that trigger the recovery process when indicators fall below a defined threshold.[59] Those early warning thresholds are supposed to enable troubled banks to take quick countermeasures that stabilize the bank and avert its failure. Moreover, the definition of recovery indicators is indirectly liked to the supervisory authority's legitimization to exert its powers if the recovery process fails to succeed.[60] The definition of indicators is consequently an area of the resolution plan with less discretion and will most likely result in prudent recovery thresholds.[61]

A key area of recovery plans is the description of recovery options to be taken by the bank in order to return to viability as soon as possible.[62] Each recovery option must contain a set of different actions in bank risk management to be taken to restore the bank's viability independently. Banks need to describe how they seek to restore capital ratios through internal and external measures, reduce the level of risk and leverage, restructure business lines and liabilities, and preserve adequate access to contingency funding sources.[63] Besides, banks also need to address the possible risks associated with the execution of each resolution option and address impediments and possible solutions to the impediments.[64]All operations in the recovery process are done under private law without the use of sovereign powers by national authorities. Hence, there is no interference with the rights of shareholders and creditors during the recovery process, although those are free to make concessions to improve recovery.

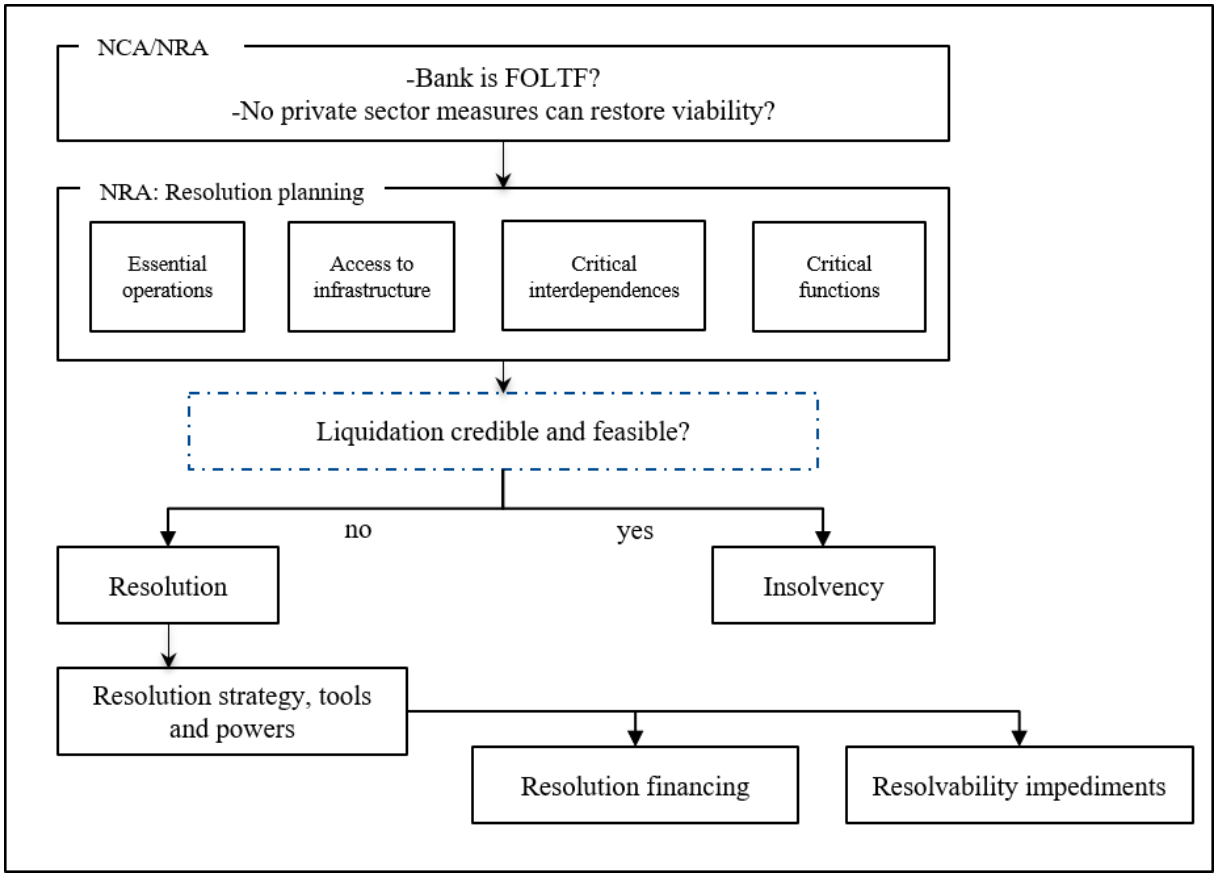
Despite the independent character of the recovery process, the BRRD provides national supervisory authorities with sufficient power to act in certain situations when recovery actions show insufficient effects. When recovery is not initiated promptly, authorities are entitled to take ***early intervention measures*** that guarantee an adequate response to deteriorating solvency or liquidity conditions that probably lead to an infringement of regulatory requirements. Authorities can, for example, demand that certain recovery measures defined in the recovery plan get to be implemented, that some persons of the management body are removed or replaced, or that necessary changes to the bank's business strategy are performed.[65]

When the recovery process does not deliver a significant improvement of the bank's financial soundness or when the bank's prospect is that it will fail right away, the bank will either enter the ***resolution process*** or will be wound up under national insolvency laws. The initial point for resolution purposes is the bank's financial condition in the case of a negative outlook being failing or likely to fail (FOLTF) determined by the national supervisor or national resolution authority.[66] In this way, the BRRD anticipates the ordinary concept of insolvency by outlining a status that precedes a bank's insolvency in legal terms.[67] In that respect, the FOLTF condition

[59] See EBA-GL-2015-02 guidelines on the minimum list of qualitative and quantitative recovery plan indicators.
[60] Art. 27(1) BRRD. The BRRD distinguishes between the recovery and the resolution process.
[61] Art. 18 EBA/GL/2014/06, EBA Guideline on recovery indicators.
[62] Art. 8 BRRD.
[63] Art. 9(1) BRRD.
[64] See Annex, Section A point 6 BRRD; Art. 11(1) Commission Delegated Regulation (EU) 2016/1075. See *Binder* (2014): 10.
[65] Art. 27(1), 28 BRRD.
[66] Art. 32(2) BRRD. The BRRD allows member states to empower their resolution authorities to assess whether a bank is failing or likely to fail.
[67] See *Grünewald* (2017).

is met when a bank fulfills or is about to fulfill one or all of the following conditions: (i) infringement of regulatory requirements (e.g., its CET1 ratio); (ii) asset values are below liability values; (iii) inability to pay debt or liabilities as they fall due; and (iv) requirement for extraordinary public financial support in the sense of Article 107(1) TFEU to prevent insolvency.[68] The open wording of the BRRD in defining the FOLTF requirements provides national supervisors with enough discretionary power to act early enough before much of a bank's wealth is destroyed.[69] The FOLTF condition can be understood as an insolvency forecast performed regularly during the SREP by national supervisory authorities. Naturally, the forecast remains an expert judgment, requiring the respective EBA guidelines and, on top of that, some discretion.[70]

Figure 1.3: Resolution planning process



Source: Own figure based on *Lintner et al.* (2016): 74.

In contrast to ordinary insolvency proceedings that aim for maximal shareholder protection, the BRRD focuses mainly on financial stability and the protection of public funds. The ***resolution objectives*** are outlined in Article 31 and include (i) the continuity of critical functions, (ii) the

[68] Art. 32(4) (d) (I-III) BRRD; Art. 18(4) (d) (I)-(III) SRMR. There are exemptions where public financial support will not trigger the FOLTF status. See chapter 1.2.3

[69] Rec. 41 BRRD; Rec. 57 SRMR

[70] See EBA/GL/2015/07, EBA Guidelines on the interpretation of different circumstances when an institution shall be considered as failing or likely to fail under Article 32(6) of Directive 2014/59/EU.

avoidance of adverse effects to the financial system through contagion[71], (iii) the protection of public funds, and (iv) the protection of depositors and client funds and client assets.[72]

The condition for banks to enter the resolution process are presented in Article 32(1) BRRD: supervisors assess that the FOLTF condition is fulfilled; alternative private sector measures would not prevent the failure and the return to the institution's viability; and resolution of the institution is in the public interest, meaning that the resolution objectives defined in Article 31 would otherwise not be met.[73] Banks' main attribute to enter the resolution process, qualifying them as systemically important, is that the normal insolvency proceedings would likely harm the financial sector. This requirement will presumably be met by institutions that enjoyed implicit guarantees before the crisis because they were deemed "too big to fail." When banks are considered to be resolvable under normal insolvency proceedings, the resolution tools and powers are unavailable and simplified obligations for drawing up a resolution plan apply instead.[74]

The crucial decision on whether banks enter the resolution process is made in the assessment of their resolvability (Figure 1.3). National resolution authorities need to evaluate the role a bank plays in its economic environment and which repercussions its failure would cause for financial stability. This step is the origin of the resolution planning process performed by the resolution authority and needs to be conducted for every bank operating in the EU.[75] ***Resolution plans*** define in great detail how banks are wined down in the event of a failure with regard to the BRRD objectives. In analogy to recovery plans, resolution plans are preparative for resolution authorities by arranging a detailed procedure that needs to be accomplished when the recovery process will not return an institution's viability, serving as guidance in the event of resolution. Moreover, they intend to increase transparency and market discipline and induce banks to reduce their complexity and adapt their corporate structures to favor a higher resolvability.[76] They need to cover various measures to be taken by the resolution authority (referred to as "resolution strategy") in accordance with different resolution scenarios, e. g., the resolution event being either idiosyncratic or systematic distress.[77] The key elements resolution plans must cover are:

(i) Description of the resolution strategy with relevant tools and powers;[78]
(ii) Arrangements to ensure operational continuity of critical functions and core business lines, including preparatory steps like valuations;[79]
(iii) Financing of the resolution strategy;

[71] As a side goal, market discipline shall be strengthened by the resolution process. That implies that the European decision-makers believe that bailout expectations will affect bank behavior.
[72] See Art. 31(2) BRRD.
[73] Art. 32(1) (c) IWC 32(5) BRRD, Art. 18(5) SRMR. See chapter 1.2.1.3 on p. 17 for the resolvability assessment.
[74] Art. 4(3) BRRD.
[75] See EBA/RTS/2014/15, p. 8. The EBA is mandated by Art. 10, 12 and 15 BRRD to produce regulatory technical standards on the content of resolution plans. The RTSs were first published as drafts and later published as Commission Delegated Regulation (EU) 2016/1075 of 23 March 2016, published in the Official Journal of the European Union.
[76] See *Farina/Scipione* (2019): 288.
[77] Art. 10(3), 10(7) (j) BRRD.
[78] Art. 25 Commission Delegated Regulation (EU) 2016/1075.
[79] Art 10(7) (c) BRRD.

(iv) Preservation of access to market infrastructures, e.g., payment and clearing systems.[80]

A resolution strategy refers to a set of actions necessary for resolving a group or entity depending on its business model, its operational structure, and other circumstances that influence its resolvability.[81] A link between the recovery and resolution process is the identification of banks' "critical functions" and "core business lines." The resolution authority picks up the self-assessment of recovery plans for preparing resolution plans. It thereby needs to demonstrate how critical functions and core business lines could be legally and economically separated from the remaining less systemically important functions.[82] That is vital for maintaining critical functions under resolution, as they might be indivisibly connected to other businesses. The funding sources need to be mentioned, including private sources like the bail-in and the deposit guarantee scheme, and public sources like the national resolution fund (financing arrangements). The financing of the resolution depends on the resolution strategy, especially which resolution tools are involved and if critical functions need to be maintained, e.g., by recapitalizing a bridge institution.

The possible outcomes are either that an institution is resolvable under normal insolvency proceedings or that financial stability would be at stake. In the latter case, during the resolvability assessment, possible impediments for resolvability need to be identified, and it needs to be guaranteed that an institution can be resolved with limited risk to financial stability. If the authorities evaluate that a liquidation would be appropriate, the resolvability assessment should also identify and address impediments to the application of ordinary insolvency proceedings.

1.2.1.3 Resolvability Assessment

The resolution planning procedure starts with an assessment of banks' resolvability, assembling the evaluation of banks' systemic importance. The possible outcomes are: (i) the institution is resolvable under normal insolvency proceedings; (ii) the institution is resolvable under the application of resolution tools and powers; or (iii) the institution is not resolvable.

The FSB (2014) offers advice in their key attributes on how resolution authorities can evaluate banks' resolvability.[83] The EBA uses the FSB key ideas to guide national resolution authorities through its Regulatory Technical Standard on resolution planning.[84] The BRRD's guiding principle is portrayed in Article 15, defining a bank as resolvable "[…] if it is feasible and credible for the resolution authority to either liquidate it under normal insolvency proceedings or to resolve it by applying the different resolution tools and powers to the institution while avoiding to the maximum extent possible any significant adverse effect on the financial system […]."[85] Since liquidation shall be the rule and resolution the exception, the resolvability assessment starts with evaluating possible repercussions to the financial system if the entity is going to be resolved under ordinary insolvency proceedings.[86] The national resolution authorities conduct

[80] See *Lintner et al.* (2016): 75.
[81] Art. 2(2), 23(3), 25(3) Commission Delegated Regulation (EU) 2016/1075.
[82] Art. 10(7) (g) BRRD.
[83] See FSB (2014): 37–42.
[84] See EBA/RTS/2014/15, p. 5.
[85] Art. 15(1), 16(1) BRRD.
[86] Rec. 45 BRRD & Rec. 59 SRMR.

the ***resolvability assessment*** on three stages embedded in the resolution planning, which requires information from the institutions being assessed and the supervisory authorities in charge. The three stages are (i) assessment of systemic importance; (ii) identification of resolution strategy; and (iii) evaluation of resolution strategy.

At the first stage, the assessment of resolvability starts with an evaluation of the likely effects a bank failure could have on financial stability.[87] The four channels of contagion considered are (i) effects on general financial market confidence; (ii) effects on financial market infrastructures an institution performs; (iii) effects on other financial institutions; and (iv) effects on the real economy.[88] This initial step results in deciding whether banks enter either the ordinary insolvency proceedings or are wound-down within the resolution framework of the BRRD. If liquidation is regarded as feasible, simplified obligations for drawing up and maintaining resolution plans are applicable.[89] If the authorities evaluate that a liquidation would be appropriate, the resolvability assessment should also identify and address impediments to the application of ordinary insolvency proceedings.

At the second stage, national resolution authorities need to evaluate the resolution strategies' feasibility and credibility regarding their suitability and appropriateness for the resolution goals. Potential side effects of resolution measures on the financial system and the real economy shall be separately addressed considering the four contagion channels. Additionally, possible impediments of the implementation of resolution strategies need to be assigned to one of the following categories: (i) structure and operations; (ii) financial resources; (iii) information; (iv) cross-border issues; and (v) legal issues.

A crucial step in assessing the resolvability is to determine if an institution performs "critical functions," meaning activities, services, or operations whose discontinuance would likely lead to financial trouble because of the institution's size, market share, internal or external interconnectedness, or cross-border activities with "particular regard to the substitutability of those activities, services or operations."[90] Practically, identifying critical functions involves a case-by-case analysis conducted by resolution authorities when preparing resolution plans. Furthermore, the BRRD requires the authorities in charge to consider the need to maintain critical functions and avoid significant negative consequences from the resolution to the financial system and the real economy of a Member State.[91]

To support resolution authorities in specifying critical functions for institutions, the EBA has published a piece of technical advice on the identification of critical functions and core business lines.[92] The approach specified in the advice can be split into an impact assessment on third parties and into a supply-side analysis. The EBA recommends prudence concerning the reliance on thresholds like market shares to identify critical functions and emphasizes the need for a good case by case analysis. Although the guidelines deliver some advice on assessing banks' resolvability, the process and the final decision remain highly dependent on the information

[87] Art. 23 Commission Delegated Regulation (EU) 2016/1075, *Lintner et al.* (2016): 79.
[88] Art. 24(2) Commission Delegated Regulation (EU) 2016/1075.
[89] EBA/GL/2015/16, p. 6.
[90] Art. 2(1) pt. 35 BRRD.
[91] Art. 15(1) BRRD; Art. 10(3) & (5) SRMR. See *Capolino* (2019): 259.
[92] See EBA/Op/2015/05.

available and the more or less personal opinion of the resolution team.[93] Even if the decision is based on a sound framework on qualitative and quantitative information, the definition of definite cutoffs for resolvability might lead to error-prone decisions.[94]

1.2.1.4 Resolution Tools

If banks are FOLTF and insolvency has been identified as inappropriate to meet resolution objectives, resolution authorities have various resolution tools at their disposal. Authorities choose and combine several measures within the resolution framework, including the bail-in tool, the sale of business tool, the bridge institution tool, the asset separation tool, and the government stabilization tool. As liquidation is the competing procedure, the resolution does not lead to the abrupt and complete termination of business. Except for the asset separation tool, which must be used in combination, all resolution tools can be used separately or in combination with other tools as long as they promote the resolution objectives.[95]

When implementing the resolution strategy by applying the different resolution tools, ***general principles*** dictated by the BRRD must strictly be adhered to.[96] The principles are:

(i) Shareholders bear first losses, followed by creditors in accordance with the reverse order of priority of their claims under normal insolvency proceedings;
(ii) Management and senior management are replaced;
(iii) Natural and legal persons responsible for the failure are held liable, subject to member state law;
(iv) Creditors of the same class are treated equally (*pari passu*);
(v) No creditor shall incur greater losses than he would have incurred if the entity had been wound up under normal insolvency proceedings (*no creditor worse off*);
(vi) Covered deposits are fully protected;

Those principles are binding for the resolution authorities, except the BRRD explicitly provides different rules. Essential for the bail-in tool are the principles of liability among creditors. First, the *pari passu* principle states that all liabilities among the same class are treated equally. Second, the *no creditor worse off principle* formulates that creditors must not suffer any disadvantages in resolution compared to an ordinary insolvency procedure. Both principles are mainly implemented to protect creditors and ensure legal certainty when bailing-in investors.[97]

The ***sale of business tool*** is the resolution tool first mentioned, and the simplest one as it involves the least action from resolution authorities, is operationally reliable, and legally certain.[98]

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93 See EBA/RTS/2014/15, p. 25.
94 Nevertheless, the development of detailed standards on how to proceed to assess resolvability may render the arbitrariness and contribute to a more comprehensive decision-making process. The EBA has addressed problems that may arise because of information asymmetries between resolution authorities and banks. These could lead to morally hazardous behavior of bank management in the prospect of bank bailouts. Moreover, the EBA evaluates that the lack of a binding standard in assessing financial institutions' resolvability may result in an uneven playing field where several national authorities would evaluate an institution's resolvability differently. See *Fucile* (2019): 267–271.
95 Art. 31(1) BRRD.
96 Art. 34(1), 74(1) BRRD; Art. 15 SRMR.
97 See *Fucile* (2019): 267–271.
98 Art. 38 BRRD & Art. 24 SRMR. See *Binder* (2019): 310.

It authorizes the resolution authority to sell the entire business or parts of it to one or more purchasers without its shareholders' approval. The scope of its application will cover at least those parts of the entity declared as systemically relevant since they involve critical functions whose discontinuance will probably disrupt financial stability.[99] When exercising the sale of business tool for transferring only parts of the entity's shares or assets and liabilities to a purchaser, the residual entity, which alone is not systemically important, will enter the national insolvency proceedings.[100]

The sale of business can be practically conducted via a share deal, a merger, or by designing a special purpose entity with selected assets and liabilities being transferred, depending on the entity's systemic importance and the purchaser's interest. Naturally, the tool's success depends on the availability of a private investor who is willing and capable in terms of financial and logistical matters to engage in the investment of a systemically important institution.[101] The sale shall be organized in an open and public process and be conducted on commercial terms in order to yield the highest share price possible. Nevertheless, if the circumstances require quick action to preserve financial stability, the marketing phase can be shortened by presenting the entity to a presorted list of potential acquirers.[102] Those considerations seemed to be present when the SRB transferred Banco Popular Espaniol for one symbolic Euro in the initial application of the resolution procedure. However, the resolution valuation has not ruled out that the pre-resolution business value could have been higher.[103]

The ***bridge institution tool*** aims for a temporary solution where critical functions of a bank need to be preserved, and an acquirer cannot be found immediately. The tool allows the transfer of shares or assets and liabilities of one or more entities under resolution to a newly established bridge institution. The bridge institution can operate and conduct business for up to two years until an acquirer has been found or the institution is wound-down.[104] The bridge bank must either wholly or partially be owned by the resolution financing arrangement institutions or other public authorities and will be supervised by the resolution authority.[105]

Opposed to the bridge institution tool, the ***asset separation tool*** is designed to separate especially those assets whose impairment is troublesome for the institution under resolution into a special asset management vehicle (AMV), a so-called bad bank. This procedure has proven to be an effective way of dealing with troubled institutions in the GFC and was a prominent approach for many member states.[106] The AMV needs to be wholly or partly state-owned and cannot be used without the combination of other resolution tools, e.g., the bridge institution tool, the sale of business tool, and the bail-in tool. The AMV is obliged to maximize the fair value of its assets under management through eventual sales or orderly wind-downs while maintaining the institution's critical functions.[107] The BRRD in Article 42(5) points out four scenarios in which resolution authorities are allowed to make use of the instrument: (i) an orderly

[99] Art. 2(1) (35) BRRD & Art. 14(2) (a) SRMR.
[100] Art. 37(6) BRRD & Art. 22(5) SRMR. See *Lintner et al.* (2016): 121.
[101] See *Binder* (2019): 311.
[102] Art. 39(2) (3) BRRD & Art. 24 (3) SRMR.
[103] See *Binder* (2019): 311.
[104] See *Lintner et al.* (2016): 126.
[105] Art. 40(2) (a) BRRD.
[106] See *Binder* (2019); *Lintner et al.* (2016): 131.
[107] Art. 42(3) BRRD.

liquidation of the assets would have adverse effects on at least one financial market; (ii) the separation of assets is necessary to ensure the smooth functioning of the institution under resolution or a bridge institution; or (iii) the separation of assets is necessary to maximize liquidation proceeds.[108] However, this tool is outlined in a rather basic and sketchy way in the BRRD so that a proper execution would need a more detailed set of rules.[109]

The most innovative and radical instrument by far is the ***bail-in tool***, regulated in Articles 43-55 BRRD and 27 SRMR. The bail-in is a statutory imposition of bank losses on liabilities, which are, by their terms, not intended to absorb losses outside of insolvency proceedings.[110] Technically, the bail-in involves the write-down or conversion of liabilities in order to set-off losses that are too high to be solely compensated by equity. As long as the write-down or conversion of capital instruments (WDCC)[111] is conducted on instruments designed to bear losses outside any insolvency proceeding, such as additional Tier 1 or Tier 2 instruments, these measures are not considered as the bail-in tool. The bail-in instead leads to debt holders participating in loss sharing, regardless of the liability contracts' exact terms. Either bail-in scenarios are recapitalizing institutions for their resolution, or reducing the amount of claims or debt instruments that need to be transferred to a bridge institution, or under the sale of business tool or the asset separation tool.[112] If the institution needs to be recapitalized to continue operating under going concern, the bail-in would also involve converting liabilities into equity (WDCC). When the bail-in involves such conversions, the creditors will obtain the same rights as original equity holders and participate in future economic success via dividend payments or increased share prices.

The bail-in can be used on all forms of liabilities if they are not explicitly excluded from the bail-in. These are:

- Covered deposits to the amount that is guaranteed by the EU Deposit Guarantee Scheme (DGS);
- Liabilities relating to holding client assets or cash that is protected from loss-sharing by national insolvency law;
- Liabilities to other financial institutions with an original maturity of fewer than seven days;
- Liabilities to payment or settlement institutions with a remaining maturity of fewer than seven days;
- Employee remuneration that is not variable;
- Liabilities to tax and social security services that are preferred by law;
- Liabilities for contributions to deposit insurance schemes; and
- Liabilities up to the secured amount, including covered bonds and hedging instrument liabilities.[113]

[108] Art. 42(5) BRRD. Art. 26 SRMR makes reference to Art. 42 BRRD.
[109] See *Binder* (2019): 313.
[110] See *Lintner et al.* (2016): 111.
[111] The WDCC instrument acts as an additional crisis management tool that can be applied outside the resolution process. Its application is then restricted to convertible capital instruments.
[112] Art. 43(2) (b) BRRD.
[113] Art. 44(2) BRRD & Art. 27(3) SRMR. See *Lintner et al.* (2016): 113.

The rationale behind excluding some liabilities from bail-in is that loss participation from any of those creditors conflicts with the resolution goals. Similarly, the resolution authority can exclude inherently bail-inable liabilities from bail-in in exceptional circumstances, where: (i) the bail-in of liabilities cannot be conducted in a reasonable time; (ii) the exclusion is necessary to maintain critical functions of the institution under resolution; (iii) the exclusion is necessary to prevent contagion to other financial institutions; or (iv) the bail-in of those liabilities would impose higher losses to the remaining creditors compared to their exclusion.[114]

1.2.1.5 Resolution Financing: the Burden-Sharing Cascade

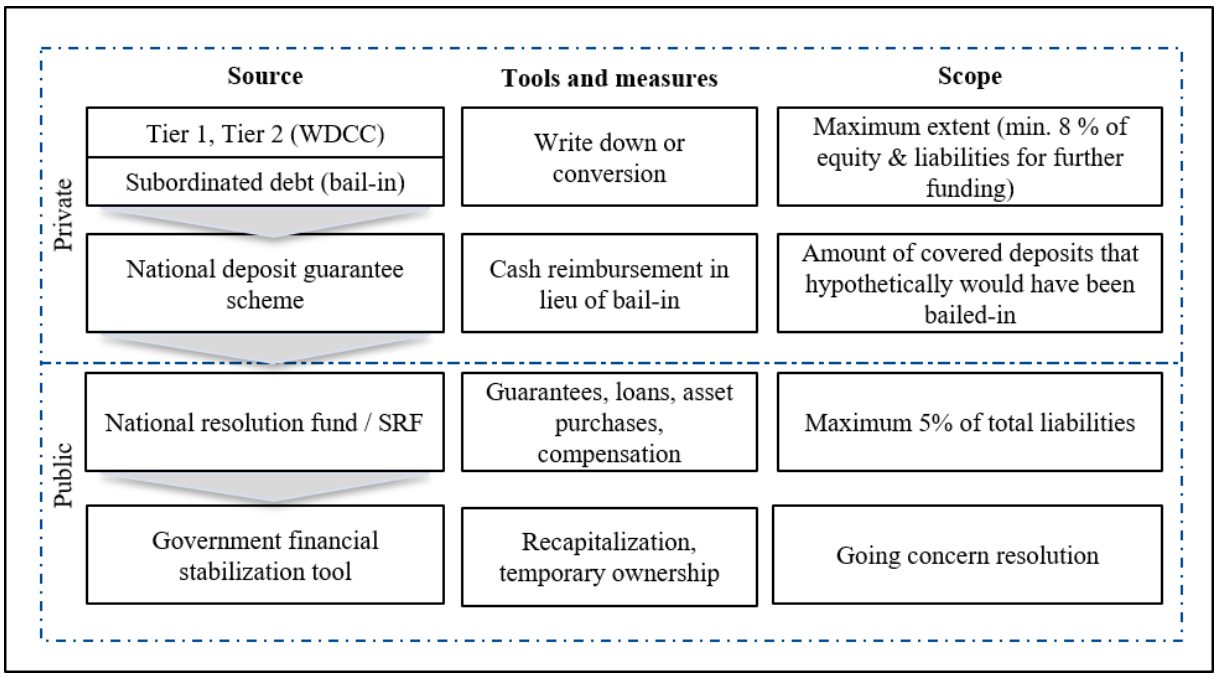
The resolution framework dictates a strict order on how investors and creditors must make contributions to resolution financing. The liability cascade reduces the amount for extraordinary public support in resolution matters to an absolute minimum, thereby enforcing market discipline.[115] In that regard, the bail-in instrument serves as a precondition to any form of sovereign support going beyond the 2013 Banking Communication by requiring that at least 8% of total equity and eligible liabilities, including senior debt, must be contributed unless explicitly excluded.[116] Together, both policies dictate a burden-sharing cascade favoring private over public sources of funds and restricting the use of public sources to extraordinary circumstances.[117] The burden-sharing-cascade is shown schematically in Figure 1.4.

Shareholders are the first group that needs to fully contribute to offset the amount required for resolution via write-downs of their instruments. This typically refers to holders of instruments classified as CET 1.[118] Moreover, when there is still a need for further contributions, Additional Tier 1 capital, e.g., convertible instruments, is reduced to the principal amount required for resolution. In the same fashion, Tier 2 capital, e.g., subordinated debt, is reduced to the notional amount to trim down the volume needed for resolution financing. Only when CET1 is entirely exhausted, Additional Tier 1 and Tier 2 capital instruments are fully depleted to their principal amounts, and there is still a demand for capital to offset losses or to restore capital levels, the remaining forms of eligible liabilities are converted into equity or written down following the reverse hierarchy of claims of the national insolvency proceedings.[119] The national Deposit Guarantee Scheme (DGS) is also involved in resolution financing. Because covered deposits are by law excluded from the bail-in tool, member states are required by Article 109 BRRD to guarantee that their DGSs will reimburse the volume of covered deposits that would hypothetically have been bailed-in.[120] Since payments for losses of insured deposits cannot logically result without the institution's net worth being negative, the DGS compensation is restricted to

[114] Art. 44(3) BRRD.
[115] Principles for burden-sharing were already outlined in the 2013 Banking Communication, although the contribution of senior debt holders is not required for state aid purposes. See the burden-sharing requirements in chapter 1.1.2 on p. 8.
[116] See *Grünewald* (2017): 289.
[117] See *Hadjiemmanuil* (2015): 23–25. The burden-sharing cascade is depicted in Figure 1.4 on p. 23.
[118] Art. 48(1) & Art. 60(1) BRRD.
[119] See *Lintner et al.* (2016): 146.
[120] Rec. (71), Art. 109 BRRD; Rec. (81) & (110), Art. 79 SRMR.

bringing the net worth back to zero. Recapitalizations of the institution (going concern) or the bridge bank via DGS compensation is prohibited by the BRRD anyhow.[121]

Figure 1.4: Burden-sharing cascade



Only when all bail-inable liabilities have been written down or converted into equity, and the resolution requires further funding, ***national resolution funds*** can be used as a supplementary source. Member states are required to build national financing arrangements (funds) to set up national resolution funds.[122] National funds ensure the effective application of resolution tools and powers and are particularly relevant when the resolution objectives would otherwise not be met. Those funds are financed by ex-ante contributions through a levy depending on the bank's liabilities and risk profiles.[123] The respective government collects the levy, and the fund is governed by national resolution authorities who decide on its use. Regardless of the source of funds, its use needs to be formally approved by the European Commission. The use of the fund is further restricted to a prior bail-in to the minimum extent of at least 8% of the institution's liabilities and own funds.[124] National resolution authorities can make use of the fund for the following purposes: (i) to guarantee assets or liabilities of the institution under resolution; (ii) to make loans to the institution under resolution, a bridge vehicle or an asset management vehicle (AMV); (iii) to purchase assets of the institution under resolution; (iv) to compensate shareholders and creditors that suffer higher losses compared to a regular insolvency proceeding; and (vi) to contribute to the institution under resolution in lieu for certain forms of liabilities that have been excluded from the bail-in.[125]

[121] Rec. (110), Art 109(1) BRRD; Art. 79(1) SRMR. See *Hadjiemmanuil* (2015): 24.
[122] Art. 100 BRRD. For the euro area, the SRM Regulation specifies that the national resolution funds are combined to a Single Resolution Fund (SRF) governed by the Single Resolution Board (SRB), Art. 68 SRMR. Details on the SRF are discussed in section 1.2.2.4.
[123] Art. 103(2), 104(1) BRRD & Art. 70(2) (a) (b) SRMR distinguish between ex-ante and ex-post contributions.
[124] Art. 44(5) (a) BRRD & 27(7) (a), Art. 19(1) SRMR.
[125] Art. 101(1) BRRD & Art. 76(1) SRMR.

The condition for the fund's use is also that the amount provided does not exceed 5 percent of the entity's liabilities.[126] This threshold has additionally been established to avoid that a bank can be recapitalized by the fund after the bail-in has eroded at least 8 percent of equity and eligible liabilities. Recapitalizing institutions under resolution has not been incorporated in the fund's functions, perhaps to avoid existing shareholders to benefit from using the fund.[127] If the fund is going to be used to support a resolution process that would end up with the bank under resolution (or parts of it) to continue existing, the Commission will probably link its approval on the appropriateness of the measures and to what extent distortions of competition are going to be expected.[128]

Although saving tax-payers money is one of the main concerns of the BRRD, extraordinary support from government sources is not entirely prohibited but remains a strictly regulated option. The use of public funds remains an option when all other sources of resolution financing have been exhausted (either because they were depleted or because their minimum levels have been reached and further contribution would seem impractical) and the maintenance of the bank as a going concern is obligatory to preserve financial stability.[129] For banks under resolution, the legitimate support is called the ***government financial stabilization tool*** (GFST) and is the last line of defense for sovereigns to execute their function as a lender of last resort.[130] The support can either be provided via public equity support or temporary public ownership.[131] For the tool to be used, certain conditions need to be met cumulatively according to article 56(1) BRRD:

- Other resolution tools have been exploited to the maximum extent practicable while maintaining financial stability;
- All other forms of resolution finance have been consumed (including a minimum bail-in of 8% and the use of national resolution funds up to the maximum amount of 5% of the institution's liabilities);[132]
- Omitting the government financial stabilization tool would lead to "significant adverse effects on the financial system," or it is used to protect public interest where prior emergency liquidity assistance or equity support have been granted;[133] and
- The support given must be in line with the union state aid framework and needs to be approved by the European Commission.

The GFST is not a resolution tool itself but can be regarded as an additional option to intervene when national resolution authorities and the government agree to provide public support.[134] As government support itself triggers the resolution (FOLTF condition), the tool can only be used in the resolution process. Nevertheless, the burden for government support via this tool is set high, requiring the need for exceptional circumstances that justify the use of taxpayer's funds to bail out banks. That is when a systemic crisis needs to be prevented by maintaining financial

[126] Art. 44(5) (b) BRRD & 27(7) (b) SRMR.
[127] Art. 101(2) BRRD & Art. 76(3) SRMR & Art. 44(3) to (8) BRRD. See *Gleeson* (2019): 234.
[128] See *Iftinchi* (2017): 84.
[129] See *Hadjiemmanuil* (2015): 25.
[130] Art 37(10) BRRD.
[131] Art. 56(5) & Art. 57 & Art. 58 BRRD.
[132] Art. 37(10), 56(3) BRRD.
[133] Art. 56(4) & Art. 32(4) (d) BRRD.
[134] Although described as a regular resolution tool, the GFST is covered in the bail-in section of the BRRD.

stability or avoiding threats to the real economy, the bank's failure would evoke. The BRRD points out that the resolution of an institution that will be maintained as a going concern may involve the use of support via the GFST as a last resort.[135] This statement suggests the GFST tool be used only in going concern resolution cases, intended to mitigate potential misuse of public funds. The inclusion of temporary public ownership shall thereby ensure that the taxpayers are the beneficiaries of any resolution surpluses.

1.2.2 The Single Resolution Mechanism in the Banking Union

1.2.2.1 The Rationale for the SRM

Shortly after policymakers in the EU agreed on a common resolution scheme, euro are representatives decided to build a banking union with closer cooperation in banking supervision and resolution among the eurozone-members. The decision was mainly driven by the observation that the member states sharing the Euro as a single currency are more interconnected and consequently exposed to higher risks. The need for a more stable banking system was fueled by the recent Eurozone crisis, which drastically revealed the sovereign-bank-nexus.[136] Banks' and sovereigns' solvencies proved to be highly interdependent because banks tend to have a home bias for investing large amounts in domestic sovereign debt.[137] Banking regulation provided some incentives for banks to invest in public debt as the Eurozone's sovereign funding principle relies on the willingness and readiness of institutional investors, mainly banks, to invest in public debt.[138] That led to a feedback loop of credit risk as banks' solvency worsens with deteriorating sovereign fiscal capacity resulting from bank bailouts necessary for preserving financial stability. Some researchers provide evidence that the home bias was more pronounced for banks domesticated in Greece, Italy, Ireland, Portugal, and Spain (GIIPS) and for banks with close relationships to policymakers [*Ongena/Popov/van Horen* (2019); *Marco/Macchiavelli* (2016); *Acharya/Steffen* (2015); *Acharya/Drechsler/Schnabel* (2014)].

The sovereign bank nexus is problematic for the eurozone, as the member states depend on the ECB and cannot conduct monetary policy independently. European banks' tendency to engage in cross-border banking operations completes the need for a central supranational authority in charge of banking resolution.[139] With an interconnected internal market, one bank's failure in the euro area might adversely affect another member state's financial markets stability, the economy, or even the stability of the internal market as a whole.[140] Effectively mitigating the risk associated with failures of large banking institutions involves, at least in the view of the legislator, the establishment of one single authority in charge of bank resolutions.[141] Obviously, the minimalistic approach of the BRRD with each national resolution authorities being

[135] Rec. (8) BRRD. See *Iftinchi* (2017): 76.
[136] See *Pisani-Ferry et al.* (2012).
[137] See *Battistini/Pagano/Simonelli* (2014).
[138] In the Basel capital regulations, euro area sovereign debt is treated with zero risk weight, leading to no capital claims at all for such holdings. Furthermore, the ECB accepts eurozone government bonds as collateral. Nevertheless, public debt investments have a variety of genuine features that make them favorable for banks to invest in. They are usually highly liquid and have a low issuer default risk.
[139] See *Schoenmaker* (2016).
[140] Rec. 12 SRMR.
[141] Rec. 12 SRMR. See *Iglesias-Rodríguez* (2019): 193.

responsible for domestic resolution matters is regarded as insufficient, providing too much national discretion in bank resolution.

These problems were addressed at the Euro Area Summit of 12 June 2012 by agreeing to create the Banking Union. In order to form a more stable and resilient banking sector, a harmonized banking market is aimed at the unifying commitment of Eurozone members to be subjected to standardized regulations concerning banking supervision and resolution.[142] This understanding resulted in the European Banking Union, composed of the Single Supervisory Mechanism (SSM), the Single Resolution Mechanism (SRM), and the European Deposit Insurance Scheme (EDIS). The approach is accompanied by the Capital Markets Union initiative, which aims to integrate all euro area capital markets into one single market.

1.2.2.2 Scope and Competencies of the SRB

The Single Resolution Mechanism (SRM) is one pillar of the Banking Union and adopts the BRRD resolution rules and tools but centralizes the decision-making process and resolution financing. Both extensions of the SRM are arranged in the SRM Regulation, which the European Parliament adopted on 15 July 2014 and became binding for all Eurozone member states on 1 January 2015.[143] The SRM is administered by a newly founded agency based in Brussels, the Single Resolution Board (SRB), responsible for all resolution decisions concerning significant banks within the Banking Union. Moreover, the SRB manages the Single Resolution Fund (SRF), a joint source for external resolution financing.[144] A significant difference between the SRB and national resolution authorities that either co-exist alongside the SRB in the eurozone or have sole responsibility for resolution matters in the non-eurozone states is its central decision-making power and independence. The members of the SRB are full-time employed and hold no other office.

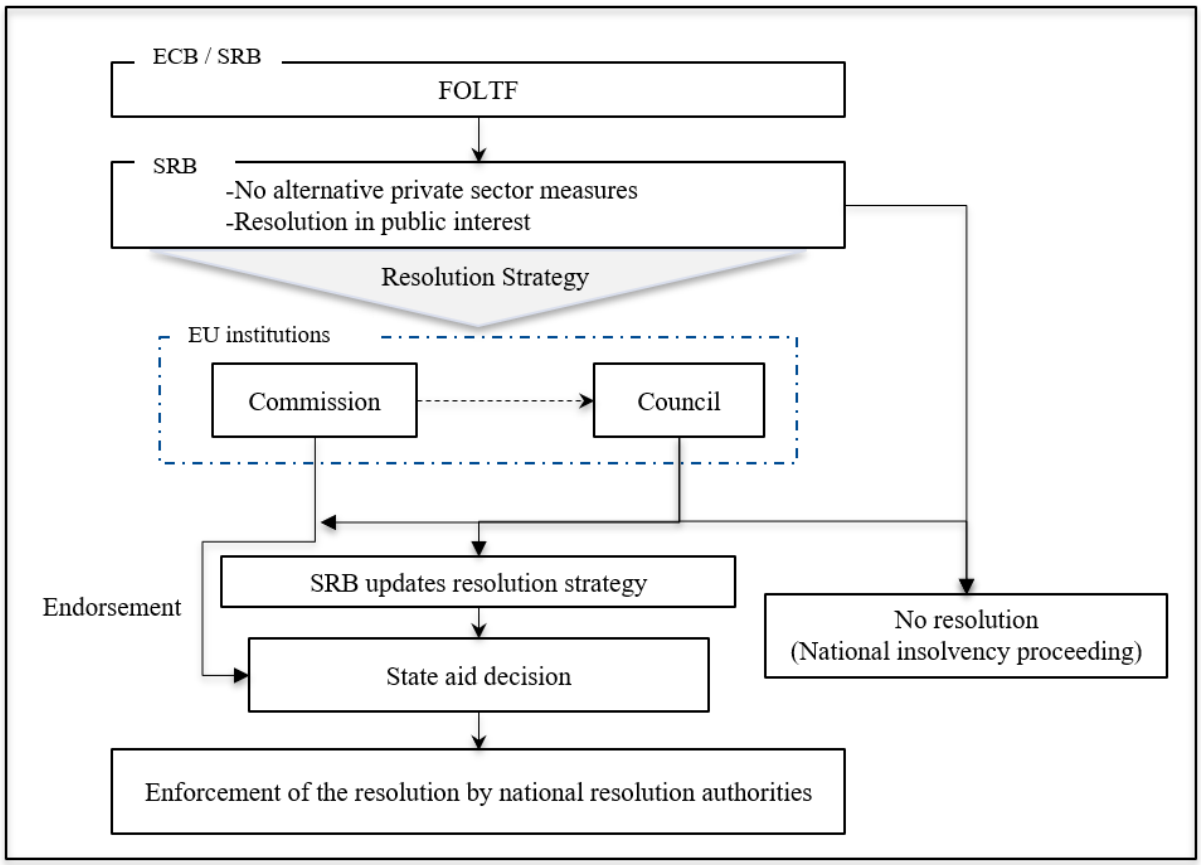
The SRM shares the identical scope as the SSM, meaning that the SRB powers apply to the resolution of significant institutions (SI) directly supervised by the ECB.[145] Next to those significant institutions, the Less Significant Institutions (LSI) performing cross-border activities are as well within the SRB's remit to prevent trouble caused by resolution measures needing to be orchestrated between member states. As each member state of the European Union needs to implement a national resolution authority required by the BRRD, all relevant resolution powers are transferred to the SRB. All remaining LSIs with no significant cross-border activities are within the remit of national resolution authorities.[146]

The SRB's crucial role in examining whether a significant bank needs to enter the SRM procedure is first to assess if private sector measures seem appropriate to avert the bank's failure. Second, the SRB considers whether the application of resolution measures defined in the SRM Regulation is in the public interest once a bank reaches the point of non-viability.[147] The

[142] See *Iftinchi* (2017): 75.
[143] Regulation (EU) No 806/2014, referred to as SRM Regulation or SMRM.
[144] See *Schillig* (2019): 238.
[145] Art. 7(2) SRMR & Art. 6(4) SSM Regulation. See section 3.2.1.2 on details about the definition of significant institutions.
[146] Rec. 28, Art. 7(3) SRMR.
[147] Art. 18(1) (a)-(c) SRMR.

assessment of banks' financial condition and the classification as being failing or likely to fail (FOLTF) belongs to the ECB's responsibilities as the supreme supervisory authority. However, the SRB itself can trigger an examination to prevent that supervisory omissions delay resolution decisions.

Figure 1.5: SRB resolution process



Source: Own figure based on *Lintner et al.* (2016): 105; Deutsche Bundesbank (2014): 50.

If the resolution is in the public interest, the SRB shall develop a bank resolution scheme. The resolution plan offers some guidance regarding the bank's crucial functions and core business lines and the preferred resolution strategy. However, the SRB practically determines the application of resolution tools and the need for external financial supply to be covered by the Single Resolution Fund (SRF), depending on actual circumstances, regardless of the resolution plan's recommendations.[148] When the resolution requires SRF resources to be used below EUR 5 or 10 billion for liquidity assistance, SRB's executive session can immediately approve the resolution strategy. When the resolution would require higher SRF funds, SRB's plenary session needs to decide on them. The European Commission and the Council can then comment on the resolution strategy. The resolution proposal is transmitted to the Commission, which can either endorse the scheme, object to it, or amend it. The Council will be involved if the Commission proposed it to act but bypassed if the Commission immediately endorses the proposal. If involved, the council can then object or approve the SRB's positive assessment on the public interest in resolution or object to the use of the SRF for resolution financing.[149] If the council

[148] Art. 18(6) SRMR.
[149] Art. 19(8) SRMR.

objects to the SRB's assessment of public interest, the SRB is no longer in charge, and the entity will enter the national insolvency proceeding. In case of objections regarding the use of SRF, the SRB needs to adopt the proposal within eight hours. Once the proposal is approved, national resolution authorities need to implement the resolution strategy (Figure 1.5).[150]

1.2.2.3 The SRB Assessment of Public Interest

In analogy to the BRRD procedure for less significant institutions (LSI), the entry of significant institutions (SI) into the SRM procedure depends on whether the SRB finds the resolution to be in the public interest. The main difference between the BRRD and the SRM jurisdiction is that the SRB performs the assessment of public interest (API) for SIs as the supreme resolution authority. National resolution authorities will assess the remaining LSIs. The basic parameters for evaluating the public interest in resolution matters are the same in the BRRD and SRM Regulation.[151] Both are linked to the resolution goals and determine that banks need to be resolved if an ordinary insolvency proceeding would lead to a serious threat to a member state's economy.

Like national resolution authorities, the SRB conducts the API by examining whether the consequences of insolvency jeopardize the achievement of resolution objectives.[152] Consequently, the SRB considers first whether the bank performs any critical functions that would need to be preserved. For that aim, the SRB builds upon five relevant banking service areas a bank performs identified by the FSB:[153] deposit-taking; lending and loan services; payments, clearing, custody & settlement; wholesale funding markets; and capital markets and investment activities. As a second step, the SRB considers potential effects on financial stability and related concepts, involving the financial system's functioning, adverse effects to financial markets or the real economy of one or more member states, direct and indirect contagion, and market discipline.

Consequently, one could assume that the assessment of public interest and the decision to resolve SIs is a matter of form. However, recent cases showed that not all SIs pass the API test, indicating that the SRB sets the burden for public interest relatively high. By 2020, the SRB has performed five API tests on significant institutions and only confirmed public interest for Banco Populare.[154]

1.2.2.4 Use of the Single Resolution Fund

The Single Resolution Fund (SRF) is the SRM's financing vehicle and shall ensure the effective application of resolution tools and powers. Article 100 of the BRRD requires each member state to set up a resolution financing arrangement that resolution authorities have available in case of

[150] Art. 7(3) SRMR. See *Lintner et al.* (2016): 109f. The EU treaties prohibit to authorize a supranational institution with sufficient decision-making powers to enforce resolution actions. See *Gleeson* (2019): 218–220; Deutsche Bundesbank (2014): 45–49.
[151] Art. 18(5) & 14(2) SRMR vs. Art. 32(5) & 31(2) BRRD.
[152] See SRB (2019): 7.
[153] See FSB (2013a).
[154] See *Iglesias-Rodríguez* (2019): 202; *Schillig* (2019): 257.

an external need for resolution financing. This obligation is satisfied by member states within the euro area through their membership in the resolution financing arrangement established by the SRM Regulation, which is the SRF governed by the SRB.[155] The euro area member states have agreed to transfer their contributions to the SRF and therefore abandoned their national sovereignty on the use of their contributions.[156] Although the use of the SRF is restricted to resolution matters that are centrally decided by the SRB, the SRM Regulation does not prohibit member states from providing public support to banks in resolution.[157]

Like national resolution funds, the SRF has a target volume of at least 1% of all covered deposits in the Banking Union, which shall be reached within eight years from 1 January 2016 onwards.[158] That amounts to EUR 60 billion, of which the SRB has collected EUR 33 billion until 2019. The SRF remains divided into national sections corresponding to each member state during the transition phase until the SRF reaches its target level.[159] During this period, the SRB will use the fund only to the extent equivalent to the accumulated contributions of the member state where the bank in resolution is located. If those funds corresponding to a member state are not sufficient for resolution purposes, it is possible to use the entire funds' capacity. If the whole SRF capacity would not satisfy the resolution needs, additional support from member states to the SRF and the option to require ex-post contributions will be considered.[160]

1.2.3 Exemptions for Public Support

External support from national governments or the ECB outside the EU resolution framework can be legitimate under certain conditions. Support can still be provided as emergency liquidity assistance (ELA) by the ECB or through recapitalizations and debt guarantees by national governments. The precondition for external support to be granted is that the requirements for a resolution under the BRRD and SRM Regulation are not met.[161] State aid has been treated as a critical but necessary part of national economic policy among member states. Therefore, state aid is not entirely forbidden but only allowed under a strict application of the "internal market" framework proclaimed in Article 107 of the Treaty on the Functioning of the European Union (TFEU). Governmental support for banks is more precisely regulated by the 2013 Banking Communication in order to guarantee a level playing field with undistorted competition among firms in different member states.[162] State aid exemptions for banks are still in place and co-exist next to the European resolution scheme, leaving the final decision about governmental support to the European Commission.[163] The Commission fears that the current market conditions, with their high volatility and interconnectedness among financial institutions, could result in the need for a permanent option of immediate government assistance, along with the resolution

[155] Art. 68 SRMR. See *Gleeson* (2019): 233.
[156] See *Xanthoulis* (2019): 278.
[157] Rec. 19, Art. 6(6) & 57(2) SRMR.
[158] Art. 69(1) SRMR.
[159] Art. 77(2) SRMR.
[160] See *Gleeson* (2019): 280f.
[161] See *Schillig* (2019): 239. See chapter 1.2.1.2 on p. 16 on the BRRD requirements for bank resolutions.
[162] See section 1.1.2 on p. 6.
[163] See *Véron* (2017): 34f.

framework. The 2013 Banking Communication also points out that exceptional regulations of government support shall apply as long as required by market conditions.[164]

State aid is allowed for banks when the assistance they receive is in line with market conditions and out of scope of, or consistent with, the BRRD/SRM framework because they do not trigger the FOLTF status. The EU rules and regulations leave three possibilities where the Commission can approve state aid: (i) solvent banks that receive ***precautionary support*** to remedy a serious disturbance of the economy of one or more member states;[165] (ii) solvent ***public banks*** where the government as shareholder decides to recapitalize the bank; and (iii) banks that are FOLTF but the ***SRB denies public interest***.[166]

(i) Precautionary support

The introduced rules for Bank resolution tools and rules for their application explicitly allow the use of public funds to support ailing financial institutions. Under normal conditions, the institution's need for extraordinary public support triggers the resolution process, as the institution is then regarded as failing or likely to fail (FOLTF).[167] The policymakers introduced a temporary possibility of extraordinary support stated in Article 32(4) of the BRRD that allows national authorities to immediate action for banks outside of resolution or insolvency procedures to safeguard a member state's economy from serious damage.[168] The decision about the usage of public funds is up to the respective member state. Therefore, it also depends on the member state's financial capacity and willingness to use public funds. The option of precautionary recapitalization has been introduced to provide solvent banks with assistance to cover potential losses identified in supervisory stress tests or asset quality reviews.

The BRRD legalizes three types of ***precautionary support*** from national governments that will not trigger the resolution requirements: (i) state guarantees to back liquidity facilities by the ECB; (ii) a state guarantee of newly issued liabilities; or (iii) injections of own funds or purchase of capital instruments. For all of the above-mentioned forms of support, the following conditions must be fully met:

- The support is provided in order to prevent severe disturbances to a member state's economy;
- The support is provided precautionary and only temporary;
- The taken measures are proportionate to remedy the severe disturbance of a member state's economy;
- The support is not used to offset losses the institution has incurred or will incur in the future; [169]
- The Commission has approved the support;
- The institution receiving support is solvent and not failing or likely to fail;[170]

[164] 2013 Banking Communication OJ C216/1, published on 30 July 2013. See *Iftinchi* (2017): 70.
[165] Art. 32(4) (d) (I)-(III) BRRD; Art. 18(4) (d) (I)-(III) SRMR.
[166] Art. 32(5) BRRD; Art. 18(5) SRMR. See *Schillig* (2019): 239.
[167] Art. 32(4) (d) (I)-(III) BRRD; Art. 18(4) (d) (I)-(III) SRMR.
[168] See *Véron* (2017): 3.
[169] Article 32(4) BRRD, Art. 18(4) SRMR
[170] See *Lintner et al.* (2016): 67.

The institution's solvency needs to be confirmed by the ECB as the ultimate supervisory institution before precautionary support can be approved. The first two options of public measures are to remedy liquidity shortages of solvent banks. The last option is referred to as ***precautionary recapitalization***, and its legality is subject to additional conditions. When support is provided via precautionary recapitalization, the measures are limited to injections necessary to offset capital shortfalls identified in EU authorities' adverse stress test scenarios performed by the EBA and confirmed by the ECB. Any capital shortfalls identified in baseline scenarios or through asset quality reviews need to be offset by private means.[171] Although the funds for the precautionary recapitalization can stem from national public and private funds, its permission is anyhow linked to the EU State aid framework. The injections of own funds or the purchase of capital instruments must be done "on terms and conditions that do not confer an advantage on the institutions."[172] Therefore, the remuneration for the aid must be made at arm's length principle to be in line with the internal market framework and shall further depend on the amount in need and the depth of the restructuring process. These constraints aim to prevent competitive distortions that may arise due to the uneven use of precautionary recapitalizations.[173]

Consequently, the requirements of the *2013 Banking Communication* about appropriate burden-sharing with the contribution of shareholders and subordinated debt holders and a viable restructuring plan must be met. Any support a member state provides under the conditions of Article 32(4) (d) is independent of the eight percent loss absorbency requirement of Art. 37(10) BRRD. The EU Commission's Banking Communication of 2013 actually requires loss absorption from shareholders and creditors up to subordinated creditors for legitimizing extraordinary public support. That makes the precautionary support under the BRRD/SRMR rules the only way to provide public support without burden-sharing by junior creditors through write-downs or conversions of capital instruments.[174] To avoid distortions from moral hazard, the Commission links the amount needed for recapitalizations to prior burden-sharing contributions made by shareholders and creditors.[175] Furthermore, competitive distortions that may arise due to public support need to be limited by proportionate counter-measures.[176] So far, this instrument was used in three cases. In 2017, Italy's Banca Monte dei Paschi di Siena, and in 2015, Greek's Piraeus Bank and the National Bank of Greece were recapitalized.[177]

(ii) Support for public banks

In case of recapitalizations of publicly owned banking institutions, it is not necessary to invoke the exception under Article 107(3)(b) TFEU, according to which state support may be compatible with the state aid framework only in order to prevent a severe disturbance in the economy of a Member State. As the state aid framework does not distinguish between ownership, those

[171] See *Lintner et al.* (2016): 70–72.
[172] Art. 32(4) (d) (III) BRRD; Art18(4) (d) (III) SRMR.
[173] See *Iftinchi* (2017): 80.
[174] See *Miserendino* (2018): 206; *Lintner et al.* (2016): 70.
[175] Commission Decision of 29 November 2015 in State aid SA.43364 (2015/N), "Amendment of the restructuring plan approved in 2014 and granting of new aid to Piraeus Bank" (OJ C 104, 18.3.2016, p. 8); Commission Decision of 4 December 2015 in State aid SA.43365 (2015/N), "Amendment of the restructuring plan approved in 2014 and granting of new aid to National Bank of Greece" (OJ C 220, 17.6.2016, p. 6).
[176] See point 6.2 on conditions for the authorization of liquidation aid of the 2013 Banking Communication.
[177] See *Véron* (2017).

recapitalizations can be approved by the commission because public banks cannot raise capital even when they are financially sound. Those measures are out of the EU resolution framework's scope and are therefore legitimate.[178] Recent examples of this process were the recapitalizations of the Portuguese Bank Caixa Geral de Depósitos in March 2017 and of the German Landesbank Nord LB in November 2019. Both banks were wholly state-owned and received extraordinary state aid through recapitalization measures and debt guarantees on usual market terms.[179]

(iii) SRB denies public interest

Government support can also be legitimized when the SRB denies significant institutions to enter the resolution scheme. After the SRB denied public interest in resolving the significant institutions Veneto Banca and Banco Populare di Vicenza, the Italian government developed a plan for winding-down both banks involving the sale of parts of their assets to the Italian bank Intesa Sanpaolo. Italian officials argued that without a buyer who would guarantee the continuity of critical functions, Veneto's regional economy would suffer due to the rapid breakup of credit supply. And further, that without providing state aid in the form of cash injections and guarantees, the acquisition of both banks would not be economically attractive to potential buyers.[180] The Commission approved state aid as a liquidation under national insolvency proceedings was not found credible, relying on the application of Article 107(3) (b) TFEU for justification. Among other conditions, the Commission explicitly outlined that the Banking Communication framework for state aid (appropriate burden-sharing by equity and debt holders) needs to be satisfied.[181] The Commission's approval of state aid for banks, where the SRB denied public interest beforehand and thus favored national insolvency proceedings, underscores the different notions of systemic importance. The SRB seems to focus more on the stability of the entire euro area while the Commission is sensitive to low-level distortions of financial stability that merely affect a single region or a single member state.[182]

It is doubtful whether the Commission would approve state aid to banks outside the Banking Union when a bank meeting the FOLTF condition is considered resolvable under national insolvency law. It seems that the separation between the resolution decision on significant banks taken by the SRB and the accomplishment of resolution action by national resolution authorities strongly favored the situation in which the Commission regarded state aid was necessary despite the opposed SRB decision. Resolution decisions on less significant institutions taken by national resolution authorities would probably be more in line with the understanding of the national government.

1.3 Discussion of the Framework's Effectiveness

To conclude the previous sections, government support on the scale of the first post-crisis responses is incompatible with the new regulations. Some exceptions allow certain kinds of state aid, but they require extraordinary situations where a member state's stability is in jeopardy. In

[178] European Commission (2017b).
[179] State aid needs to be formally approved by the European Commission. See European Commission (05.12.2019), (10.03.2017).
[180] European Commission (2017a). See *Iglesias-Rodríguez* (2019): 204f.
[181] European Commission (2017a)para 138 para 138. See also 2013 Banking Communication paras 65f.
[182] See *Iglesias-Rodríguez* (2019): 204–207.

terms of moral hazard, state aid is most relevant to banks when provided on a going concern and then requires burden-sharing by shareholders and creditors.[183] Even when support is provided via precautionary recapitalization, which constitutes the most liberal exception, the 2013 Banking Communication requires burden-sharing of subordinated debt holders. Equity, convertible instruments, and subordinated debt instruments must fully contribute to offset losses before any state aid can be granted. It is doubtful whether the exception of para. 45 of the Banking Communication applies to the Commission, according to which the burden-sharing requirements can be resigned when financial stability is at stake. Considering the relatively strict construction of application cases for precautionary recapitalizations in the BRRD (economy-wide disturbance and systemic stress, capital shortfall identified through a stress test, otherwise solvent and viable bank), using this instrument to resolve bank distress stemming from long-term management errors seems unlikely. Rather, abrupt deterioration of bank viability in economy-wide financial distress could be a justification.[184]

Notwithstanding that the EU resolution framework is probably the most extensive policy initiative, causing a paradigm shift from bailout to bail-in, some question the regulation's credibility. *Admati/Hellwig* (2013) argue that even perfectly designed resolution regimes do not constitute credible commitments to abandon bailouts. Banks' size and interconnectedness would make a prompt resolution of failing banks unlikely, as financial stability would be regarded as the higher good. Similarly, *Walther/White* (2020) reason that regulators' discretion in designing a bail-in can be harmful and that burden-sharing needs to be binding in order to send the desired signal to investors.

The EU resolution framework's unique design and the low number of bank failures that would put the new regime under a test impede the evaluation of its effectiveness. From a legal perspective, all relevant FSB key attributes of effective resolution schemes are met [*Coleman/Georgosouli/Rice* (2018)]. *Hadjiemmanuil* (2015) emphasizes that although the BRRD dictates a binding burden-sharing cascade, regulators have some discretion in excluding several liabilities from being bailed-in. Additionally, *Philippon/Salord* (2017) argue that the discretion in interpreting the BRRD conditions for a precautionary recapitalization and the exclusion of liabilities from bail-in lead to a lack of credibility. Moreover, *Avgouleas/Goodhart* (2019) highlight the potential problems that could arise during a systemic crisis. When markets are stressed and the accumulated losses in a member state's banking sector exceed the capacity for burden-sharing measures compatible with preserving financial stability, member states might be prone to consider bailouts, although formally forbidden, as an appropriate response.

While doubts about the strict application of the burden-sharing cascade in very exceptional circumstances may be reasonable, the occurrence of such extreme situations is highly improbable. In particular, the extent of such a systemic crisis would have to exceed that of the GFC in 2008, as *Conlon/Cotter* (2014) show. The authors hypothetically apply the BRRD bail-in tool to ailing banks that received government support and conclude that shareholders and subordinated creditors would have borne a large fraction of losses and that depositors would have suffered losses only in a few events. *Benczur et al.* (2017) perform a detailed investigation of accumulated bank losses for a simulated crisis similar to the GFC. They show that the EU post-

[183] See *Busch/Rijn/Louisse* (2019).
[184] See *Hadjiemmanuil* (2017).

crisis banking regulation reduced external financing demands to cover incurred bank losses by 90%, with the bail-in and capital regulation contributing the most to this effect. Next to the contributions showing that the EU measures effectively reduce adverse consequences of banking failures, drastically decreasing the need for future bank bailouts, *Breuss/Roeger/in't Veld* (2015) examine the adverse output effects of a financial shock comparable to the recent crisis via a DSGE model. They find that the banking union rules, and foremost the bail-in tool, reduce aggregate GDP output losses up to two-thirds for the periphery and up to 50 percent for core euro area countries. Considering the existing research on the effectiveness of the post-crisis reforms in lessening adverse effects of systemic crises, the new regulations should provide sufficient incentives for formerly guaranteed banks and their investors to reassess the probability of being bailed out. The EU resolution framework is consequently found to be successful in reducing moral hazard and increasing market discipline [*Avgouleas/Goodhart* (2015)].

2 Related Literature and Key Hypotheses

This section will first describe the economic and political foundation of implicit guarantees and later introduce leading theories on the relationship between implicit guarantees, moral hazard, and market discipline. Afterward, the empirical evidence relevant to this work is discussed. Then, the main hypotheses to be tested in the empirical analysis are developed from the findings of the literature review in this section, as well as from the insights of the discussion of the EU resolution framework in section one.

2.1 The Political Economy of Implicit Guarantees

2.1.1 Implicit Guarantees within the Financial Safety Net

The banking and finance sector is one of the most subsidized privately-held industries in developed countries in terms of emergency aid programs.[185] Therefore, the question arises as to why governments find justification to intervene heavily with taxpayers' money in order to bail out banks in distress. The answer can probably be found by looking at the unique characteristics of banks in general. Banks can be viewed as an extraordinary case compared to other industry sectors offering goods and services to the economy, as certain features make them prone to receive government support in case of emergency.

First, banks have the exclusive right to provide central bank money and are therefore crucial for transmitting central bank policies and maintaining the payment and settlement system.[186] That makes banks both indispensable for the economy and exposed to macroeconomic risks. Second, an essential source of banks' income stems from maturity transformation by providing long-term loans, which in turn are funded by short-term deposits that can be withdrawn on short notice. Therefore, banks are generally unable to fulfill all legitimate claims for deposits at any time. Moreover, banks are opaque as a large fraction of their assets, like loans, trading assets, and structured finance products, are hard to assess and susceptible to sudden decreases in value.[187] These features imply the rational incentive for depositors to withdraw deposits whenever a bank's financial stability is in question, even when depositors themselves believe in a bank's soundness.[188] Together with banks' tendency to be highly leveraged with relatively little capital available to absorb losses, banks are unstable during financial turmoil.[189] Furthermore, banks are highly interconnected through interbank borrowing and derivative contracts, so that one bank's failure could adversely affect another bank's stability.[190] Even the information of a bank failure could cause contagious bank runs to other banks expected to be exposed to the failure, eventually resulting in the banking market's dysfunction.[191]

The unique bank characteristics make building trust among market participants a necessity to prevent self-fulfilling behavior and guarantee the smooth functioning of financial markets.[192] Broadly speaking, a reliable financial safety net consists of four key elements: (i) deposit

[185] See *Laeven/Valencia* (2010); European Commission (2009).
[186] See *Cerutti/Claessens/McGuire* (2012): 235–238; *Disyatat* (2011); *Davis* (1995): 117.
[187] See Efraim Benmelech and Jennifer Dlugosz (2010); *Morgan* (2002).
[188] See *Gorton* (1988); *Diamond/Dybvig* (1983).
[189] See *Schich* (2018): 1258; *Feldkircher* (2014); *Gorton* (1988).
[190] See *Allen/Gale* (2000); *Rochet/Tirole* (1996).
[191] See *Chen* (1999); *Kaufman* (1996).
[192] See *Schoenmaker* (2015).

insurance schemes; (ii) the lender of last resort function; (iii) resolution mechanisms; and (iv) a prudent regulatory and supervisory framework, whereas the first two elements are mainly providing bank debt guarantees.[193] Although financial safety nets reduce the probability of bank runs, they cannot entirely prevent a banking crisis when, for example, the value of banking system assets suddenly deteriorates or when the safety net is not credible or reliable.[194]

Guarantees in banking and finance are merely a concept of risk-sharing, as risk-averse market participants could engage in risky activities instead of avoiding such activities altogether. One can roughly differentiate between two forms of guarantees: implicit, where their nature implies an uncertain component, and explicit guarantees. Explicit guarantees are characterized by their legal enforceability and make up a large part of the financial safety net.[195] They can stem from multiple sources, involving both internal (provided by a parent or any bank group related prevention scheme) and external (sovereign or central bank) sources and can cover different parts of bank debt. For example, explicit guarantees can arise due to deposit guarantee schemes that exclusively cover customer deposits, mostly up to a certain amount.[196] Alternatively, they can occur from shareholders' obligations to cover banks' liabilities. All forms have in common that the guarantees are legally binding or promised, and decision-makers know about their existence and rely upon them.[197]

The problems associated with guarantees for bank debt are the potential side effects suspected of harming the financial system. Prospective guarantee recipients could rely on guarantees as a form of backstop and therefore engage in riskier activities or reduce capital for loss absorption. That kind of behavior would leave government authorities and bank regulators with the trade-off of providing guarantees in order to keep the system functioning, and in doing so, creating incentives for moral hazard. This trade-off situation leads to different compromises to the extent and magnitude of explicit guarantees, resulting in the lender of last resort function to be solely provided via implicit guarantees.[198] Deposit insurance, for example, is limited to private customer deposits up to a certain threshold.[199]

Unlike explicit guarantees, implicit guarantees are assumed and not explicitly stated in a contract or recognized by law. Nevertheless, market participants, specially protected banks, rely on them when support for an entity seems likely. Such a supposition of support might arise due to decision-makers' statements, their obligations for financial stability, or any past actions in favor of bank debt guarantees. Decision-makers mostly feel compelled to act in favor of troubled institutions to avert more extensive damage from the financial system and the affected economy, regardless of any opposing announcements that may have been made beforehand. Once implicit guarantees become effective in the event of financial distress of protected entities, they often turn into blanket debt guarantees, covering a large part of bank liabilities, providing adequate protection against liquidity pressure.[200] It can primarily be distinguished between four

[193] See *Schich* (2009): 76.
[194] See *Allen et al.* (2015).
[195] See *Schich* (2018): 1258.
[196] See *Demirgüç-Kunt/Kane* (2002): 178f.
[197] See *Schich* (2018): 1259.
[198] See *Bengui/Bianchi/Coulibaly* (2019).
[199] See *Schich* (2009): 92.
[200] See *Laeven/Valencia* (2012): 1221.

forms of state aid emerging from implicit guarantees: (i) recapitalization measures, (ii) explicit guarantees, (iii) asset relief interventions, and (iv) liquidity measures.[201]

Analyzing the effects of suspending implicit guarantees makes it necessary to discuss their emergence. The phenomena of situations within which banks have reason to believe ex-ante that they will receive extraordinary support in the event of financial distress have been a topic of academic debate for a long time. Early research emphasizes the instances where central banks act as a lender of last resort. Recently, during the global financial crisis (GFC), the term "too big to fail" (TBTF) has been reintroduced,[202] describing instances of banks enjoying a certain status that implicitly guarantees them nearly unlimited governmental support.

Implicit guarantees are closely linked to the doom loop concept of bank and sovereign credit risk. They are the origin of the sovereign-bank-nexus, recently analyzed by multiple researchers. *Fratzscher/Rieth* (2019) and *Alter/Schüler* (2012) show that credit risk has been transferred from the banking sector to the sovereign sector in the eurozone and vice versa between 2004 and 2013. Their research further indicates that bailout policies and the ECB's monetary policy eased the transfer of credit risk.

2.1.2 Determinants of Implicit Guarantees

Implicit guarantees can arise due to several reasons that may be found within or outside the financial system. Three dimensions influencing the existence and magnitude of implicit guarantees can be classified: bank characteristics, financial market conditions, and political circumstances. The first dimension is the bank itself that may enjoy any form of guarantee. Specific bank characteristics promote the possibility of a bailout within a crisis. A bank is more likely to receive support if its failure is assumed to cause more harm to the financial system and provoke more costs than its bailout would.[203] The thought of a bank bailout being the lesser evil than its failure is closely related to the systemic risk attributable to a bank. Systemic risk describes the jeopardy a bank failure would impose on the remaining financial system and must not be mistaken with its insolvency risk.[204] Bank size is the most clear-cut characteristic propelling systemic risk and, consequently, implicit guarantees.[205] Large banks are not only more likely to perform crucial functions for the financial system; they are also are more complex and also interconnected with other financial institutions to a higher degree. Their failure would subsequently impose significant damage to the financial system and the real economy. Banks enjoying implicit guarantees are, therefore, mostly large banks deemed TBTF.

Although the extent and magnitude of implicit guarantees can only be estimated by approximation, some determinants prove to be of empirical importance. Most empirical literature investigating implicit guarantees uses credit ratings or CDS spreads to estimate the size, funding cost advantage, and other determinants. *Zhao* (2018) and *Toader* (2015) find bank size, complexity, and interconnectedness positively related to the volume of implicit guarantees. Their findings are in line with theoretical considerations of large banks causing more harm in the event of a

[201] See State aid 2018 Scoreboard of the European Commission.
[202] The term TBTF appeared first when Continental Illinois was bailed-out by the FDIC in 1984.
[203] See *Kaufman* (2014).
[204] See *Levitin* (2011).
[205] See *Laeven/Ratnovski/Tong* (2016); *Weiß/Bostandzic/Neumann* (2014); *Pais/Stork* (2013).

failure, and derivatives contributing to bank complexity, possibly influencing decisions on bailout or insolvency. *Cariboni et al.* (2013) examine the effects and determinants of implicit guarantees for a sample of 112 large banks in the EU. Their main finding is that the size of guarantees increases in relation to weaker financial condition of banks, higher sovereign solvency, and bank size. Besides, their research suggests that extremely interconnected banks with higher proportions of interbank loans, greater reliance on wholesale funding, and high leverage receive higher implicit guarantees.

Banks may as well enjoy implicit guarantees because they are publicly owned or because of the institutional and political setting in their country of domicile, as *Grossman/Woll* (2014) and *Duchin/Sosyura* (2012) suggest. Close relationships between policymakers and bank managers thus contribute to unbalanced funding of bailout packages beneficial for bank investors. *Ignatowski/Korte/Werger* (2015) confirm political factors and show that banks are more likely to expect government support when they engage in lobbying.

Some researchers investigated to what extent bank characteristics increased the probability of being bailed out in a crisis. *Fernandes et al.* (2016) analyze 72 bank failures in Europe during the GFC, finding bailed out banks on average larger in size, although board characteristics, the international exposure of the banking market, and its concentration have greater influence. *Gerhardt/Vennet* (2017) find evidence that bank size, leverage, and asset risk are positively associated with bailouts.

Next to bank attributes, political circumstances, especially the guarantor’s characteristics, influence banks' implicit guarantees. The willingness to support banks is a necessary constraint, but the value of implicit guarantees also depends on the sovereign's financial capacities. Therefore, banks located in countries with better sovereign ratings obtain more extensive implicit guarantees, as *Estrella/Schich* (2015); *Toader* (2015); *Estrella/Schich* (2011) show. Furthermore, the authors show that banks with deteriorating financial strength, indicated by their standalone credit rating, have a higher probability of sovereign support. *Zhao* (2018) uses CDS data for a sample of European banks to derive government guarantees. He finds that banks domiciled within the euro area enjoy higher subsidies than banks in other European countries. The common currency is suggested to lead to a higher willingness of supporting banks, as distress more easily spreads through member states. *Behn et al.* (2016) investigate the political factors determining bank bailouts. They show that German savings banks are less likely to be bailed out by policymakers in the year before elections, that bailed out banks performed worse than banks supported by their responsible association in the long-run, and that policymakers' proximity to bailed-out banks worsens their performance. These findings emphasize the role of political factors when bailout measures are designed.

Some authors highlight the impact of varying financial market conditions on the magnitude of implicit guarantees [*Zhao* (2018); *Kelly/Lustig/van Nieuwerburgh* (2016); *Ueda/Weder di Mauro* (2013); *Acharya/Yorulmazer* (2007)]. Governments are more likely to bail out banks when financial markets are stressed, and bank failures would additionally threaten financial stability and market confidence. *Tsesmelidakis/Merton* (2013) and *Schweikhard/Tsesmelidakis* (2011) find a structural break in the pricing of US bonds and CDS contracts during the GFC, suggesting that policy and market conditions lifted the value of guarantees to higher levels. The International Monetary Fund (2014) highlights that implicit government subsidies are the

highest in the euro area, peaking around the euro crisis when the codependence between banks and sovereigns emerged.

2.2 Literature on Implicit Guarantees

2.2.1 Theory on the Effects of Implicit Guarantees

Ideas on the effects of implicit guarantees have been intensively discussed, not only after the GFC in Europe. Basically, there are two partly conflicting theories on the impact of implicit guarantees on bank behavior. The idea of moral hazard dominates in academic debate, stating that once its sovereign guarantees a bank, shareholders and managers obtain incentives to engage in morally hazardous behavior, which might be beneficial for themselves but harmful to society [*Giannini* (1999); *Bordo* (1989)].

The primary rationale of ***moral hazard*** is that shareholders and decision-makers rely on implicit guarantees ex-ante, resulting in the separation of risk and reward, leading to different bank behavior. Within the moral hazard dilemma, shareholders and bank managers obtain incentives to follow riskier business strategies, as they do not fear bankruptcy but seek rewards with higher returns.[206] It can be assumed that both follow similar interests, as shareholders usually align bank managers' interests by incentive-based compensation schemes.[207] Accordingly, enhanced risk-taking could be beneficial for both parties since the bank would be bailed out in the case of failure. Banks then might engage in excessive risk-taking as the chosen level of risk would exceed their risk-bearing capacity.[208]

Furthermore, the mechanisms of moral hazard may be reinforced by a weakened ***market discipline*** due to implicit guarantees. Market discipline is a concept of two components: market monitoring and market influence [*Bliss/Flannery* (2002)]. The former assumes that market participants can correctly assess banks' risk profiles by considering publicly available information and are willing to act accordingly, which means adapting the price and volume of equity and debt instruments to banks' risk levels. The second part, market influence, describes the reactions of bank managements to risen security prices or funding costs by reducing their risk profile, hoping to counteract adverse changes in a bank's condition.[209] Theoretically, this mechanism could just as well lead to prudent bank behavior, since bank management might preempt the debt investor's punishment when they have reason to believe that a worsening of the bank's condition would be sanctioned.[210] Shareholders and creditors of banks have partly conflicting interests. Since their compensation is not profit-related, creditors' participation in any riskier

[206] See *Carletti/Leonello* (2016).

[207] *Jensen/Meckling* (1976) describe the agency conflict arising from the separation of ownership and control, which can be mitigated by compensation schemes. Moreover, managers may even have incentives to decrease bank default risks to protect their human capital, see *Saunders/Strock/Travlos* (1990).

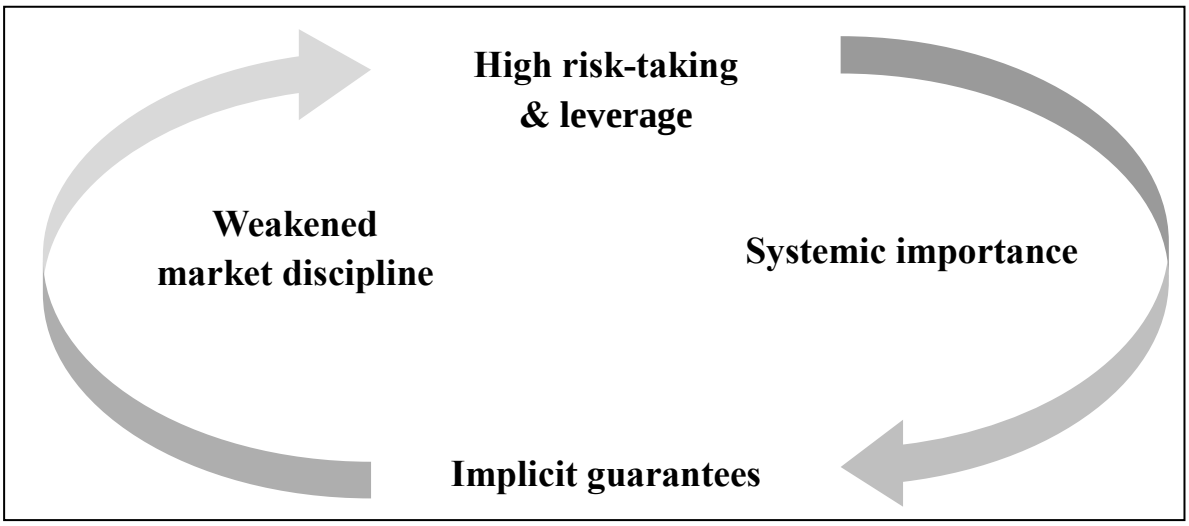
[208] See *Schwarcz/Jones* (2017): 2f.

[209] See *Bliss/Flannery* (2002): 362f. The authors describe market discipline as asymmetrical since good behavior is not rewarded.

[210] That was the rationale behind the introduction of the third pillar of the Basel capital accord. Banks should disclose enough information to enable investors to perform their monitoring function. Banks would be influenced by the investors' sensitivity for risk and return by readapting their risk level. See Basel Committee on Banking Supervision (2001). See also *Flannery/Bliss* (2019), who distinguish between ex-ante and ex-post market discipline.

but higher rewarding strategies is unfavorable. Thus, without any guarantees in place, creditors rather obtain incentives to impose market discipline on banks.[211] Accordingly, market discipline becomes ineffective when debt is covered by guarantees, as monitoring incentives for debt investors vanish in the absence of default risk.[212] The immediate outcomes are relatively low refinancing costs, causing incentives for banks to increase their leverage to reduce their funding costs further.[213] Moreover, banks have incentives to increase their size in order to expand their TBTF status.[214] The lack of market discipline is subsequently assumed to cause or intensify incentives for moral hazard, leading to higher risk-taking [*Gropp/Vesala* (2004); *Blum* (2002); *Flannery* (1998)]. Finally, implicit guarantees result in a vicious cycle of increased risk-taking and higher systemic importance, eventually resulting in even higher bailout probabilities [*Morrison* (2011); *Moosa* (2010)].[215] The moral hazard channel is schematically displayed in Figure 2.1

Figure 2.1: Schematic model of the moral hazard channel



The extent to which weak market discipline contributes to moral hazard is ambiguous. Even theoretically, the degree to which bank debt holders can impose not only market discipline but also market influence is questionable. Banks are usually highly leveraged,[216] and bank liabilities consist to a large extent of deposits protected by explicit deposit guarantee schemes. Thus, only depositors with amounts above the coverage threshold and investors of unsecured debt or equity have incentives to monitor banks.[217] As a consequence, investors' capability to influence bank

[211] Debt investors, though, need to be exposed to the risk so that any sort of debt protected by the financial safety net is not qualified for market discipline. See *Avery/Belton/Goldberg* (1988) for early evidence that subordinated debt yields are sensitive to bank risk.
[212] See, e.g., *Gropp/Vesala/Vulpes* (2006); *Sironi* (2003); *Cooper/Ross* (2002); *Flannery/Sorescu* (1996).
[213] See *Admati et al.* (2013); *Skeel* (2011).
[214] See *Brewer/Jagtiani* (2013); *Penas/Unal* (2004); *Stern/Feldman* (2004); *Ennis/Malek*.
[215] The recent European debt crisis is a prime example of that relationship. See section 1.2.1.1 on p. 11.
[216] See *Bliss/Flannery* (2002): 364.
[217] Interestingly, European banks have relatively low levels of customer deposits to total funding compared to other economic areas. Only 30-40% of their liabilities stem from customer deposits. See *Le Lesle* (2012); International Monetary Fund (2013): 105-131. From a theoretical perspective, European banks may, therefore, be more sensitive to market monitoring compared to banks domiciled in other regions.

behavior probably depends on banks' funding structure and the extent of the increases in funding costs.[218]

Contradicting the concept of moral hazard, the ***charter value theory*** postulates lower risk-taking incentives for banks whose liabilities are guaranteed.[219] The rationale is based on the absence of sufficient market discipline for banks enjoying guarantees, resulting in lower funding costs compared to competitors not enjoying implicit guarantees. Lower funding expenses constitute a competitive advantage for guaranteed banks as they can offer better credit conditions for customers, thereby enlarging their market shares. Bank managers and shareholders are then rather afraid of losing prospective rents and are consequently keen to protect firm values by following low-risk strategies.[220]

The net effect of persistent implicit guarantees is hardly predictable in theory and probably depends on which of the two channels is more intense.[221] Once implicit guarantees diminish, market participants would reevaluate bank default probabilities and likely request higher rates for bank debt. This leaves the topic to be of particular interest in empirical finance since it is probable that the respective circumstances vary across jurisdictions and periods. Nevertheless, both theoretical and empirical indications suggest that removing public guarantees will change banks' risk-taking incentives. Depending on which channel dominates, the charter value or mora hazard channel, the removal of implicit guarantees would either lead to lower (moral hazard) or higher risk-taking (charter value).

2.2.2 Evidence for Moral Hazard

Some empirical work already exists that investigates the effects of implicit guarantees on ***moral hazard***, which is proxied by banks' risk-taking in most cases. Some contributions find that deposit insurance weakens market discipline and subsequently increases risk-taking, providing evidence for the moral hazard channel [*Calomiris/Jaremski* (2019); *DeLong/Saunders* (2011); *Hovakimian/Kane* (2000)]. Many authors compliantly assume that large banks considered TBTF engage in excessive risk-taking. [*Hagendorff/Keasey/Vallascas* (2018); *Bhagat/Bolton/Lu* (2015); *Mattana/Petroni/Rossi* (2015); *Gulamhussen/Pinheiro/Pozzolo* (2014); *Gropp/Hakenes/Schnabel* (2011); *De Nicolo* (2000); *Boyd/Runkle* (1993)]. However, the proof of a causal relation between implicit guarantees and moral hazard is much more challenging, as other factors might as well explain higher risk-taking [*Schwarcz* (2017); *Soussa* (2000)]. Therefore, this section focuses mainly on literature that examines the relationship between implicit guarantees and moral hazard more thoroughly by exhausting more sophisticated approaches.

[218] The link between market discipline and moral hazard is hard to prove empirically. Although both phenomena are relatively well documented, it is not clear whether weak market discipline causes moral hazard. See section 2.2.3.

[219] See the early work from *Keeley* (1990), who provides theoretical and empirical evidence that risk-taking under the FDIC Deposit Insurance in the United States depends on bank charter values. A high market-to-book value (high charter value) leads to a decrease in risk-taking and vice versa.

[220] See *Marcus* (1984).

[221] See *Hakenes/Schnabel* (2010a); *Cordella/Yeyati* (2003).

The research sharing the most resemblances with this work is the approach followed by *Ignatowski/Korte* (2014), who use the introduction of the Orderly Liquidation Authority (OLA), a resolution mechanism in the United States comparable to the EU resolution framework, as a quasi-natural experiment to exploit the variation in banks' risk-taking. Using a difference-in-differences model, they show that banks falling under the regulation of the OLA reduced their risk-taking after its introduction. The reduced risk-taking holds for the overall bank risk measures and the borrowers' riskiness in their loan portfolios. Interestingly, very large banks seem to be unaffected by the new resolution mechanism as their resolution is unlikely.

Similarly, some researchers used the removal of institutional and guarantor liability for German savings banks in 2001 as a quasi-natural experiment to investigate changes in banks' risk-taking behavior.[222] The explicit support was guaranteed until 2001 but then removed due to a lawsuit filed by private banks against Germany for providing comparative advantages for publicly-owned banks. By using a difference-in-differences approach, *Gropp/Gründl/Güttler* (2014) find a reduced risk-taking of affected savings banks indicated by a lower insolvency risk after implicit guarantees were removed. Moreover, by exploring an exclusive dataset of bank-borrower relationships, they show that savings banks reduced the average loan size and shifted their loan portfolio towards more stable creditors. Because the authors also provide evidence of savings banks reducing the ratio of risk-sensitive debt and relying more on insured deposits and equity, they conclude that banks were facing a higher level of market discipline after the reform. *Fischer et al.* (2014) examine the behavior of German Landesbanken, which are publicly-owned and were, therefore, as well affected by the removal of explicit guarantees. They find that the increased funding costs resulted in declining business values, which in turn lead to a higher risk-taking, suggesting that the charter value-channel is prevalent for German Landesbanken. *Körner/Schnabel* (2013) focus on the network effects between Landesbanken and savings banks, which are connected through lending relationships and ownership structures. They confirm that the loss of government guarantees led to increased funding costs for Landesbanken. The authors also show that increased funding costs induced higher risk-taking for savings banks connected to their regional Landesbanken, supporting the charter value hypothesis.

Numerous researchers used bank ratings to explore the relationship between implicit guarantees and risk-taking. For example, *Afonso/Santos/Traina* (2014) use a dynamic panel data model of rated banks across 25 countries to observe banks' risk-taking depending on the variation of support ratings. They measure implicit guarantees by Fitch's Support Rating Floor (SRF), a pure measure of government support, and find that a rise in the SRF is positively associated with an increase in the impaired loan ratio in subsequent periods. *Brandao-Marques/Correa/Sapriza* (2018) use cross-sectional and panel analysis for a large sample of rated banks and find that government support measured by rating uplifts are associated with increased risk-taking. To address the endogeneity problem between bank risk and bailout expectations, the authors implement an instrumental variable regression and confirm the cross-sectional relationship between risk-taking and government support. In another instrumental variable approach, *Dam/Koetter* (2012) investigate if political factors on the federal state level in Germany explaining the probability of bank bailouts influence bank risk-taking. They show that the rise in

[222] This explicit guarantee consisted of two parts called "Anstaltslast" and "Gewährträgerhaftung" and was provided to German savings banks regulated by the respective federal savings bank law. These regulations guaranteed support to any publicly owned banks so that these banks technically could not become insolvent.

bailout expectations by 1 % increases the likelihood of distress by 0.22 %, providing evidence for the moral hazard channel of government support. Also, *Behn et al.* (2016) show that sovereign designed bailouts from politicians have adverse long-run outcomes on savings bank performance compared to bailouts from the savings banks association.

A large strand of literature analyses the overall effects of bank ***charter values*** on risk-taking with mixed results [*Boyd/Nicolo* (2005); *De Nicolo* (2000); *Keeley* (1990)]. Only a few contributions analyze the relationship of bank charter values and risk-taking in combination with bailout expectations. An early approach from *Gropp/Hakenes/Schnabel* (2011) uses bank ratings to estimate banks' bailout probability. Moreover, they also construct a measure of the bailout probability of competitor banks. In a cross-sectional regression, the authors provide evidence that a high bailout-probability does not lead to increased risk-taking of the guaranteed bank but increases competitor banks' risk-taking. Overall, their results promote the charter value channel instead of the moral hazard channel. *Damar/Gropp/Mordel* (2014) test both the charter value and the moral hazard channel by using a sudden change in rating methodologies as a quasi-natural experiment. They confirm the positive relationship between government guarantees and risk-taking. Further, they reveal that guaranteed banks with low charter values take on less risk than non-guaranteed banks. *Schenck/Thornton* (2016) find that the US bailout program TARP, designed in response to the GFC, incentivizes banks with low charter values to take on more risk than non-TARP recipients in subsequent periods, while the opposite is true for banks with high charter values.

2.2.3 Evidence for Market Discipline

Much empirical work analyzing the mechanisms of market discipline by examining the dependence of bank funding costs or security prices on bank risk-taking already exists. Most researchers focus on investigating ***market monitoring*** and mostly support the stance of investors correctly assessing and discriminating bank risk.[223] However, a crucial factor for effective monitoring is whether investors must assume to bear losses. Thus, whenever banks enjoy government guarantees, investors seem to have only insufficient monitoring incentives.

Sironi (2003) examines the yield spreads of European banks' subordinated bonds and finds that investors distinguish between banks' risk profiles. That risk profile distinction does not apply to public sector banks, indicating that implicit guarantees prevent investors from monitoring. Other researchers yielded comparable results conveying whenever debt investors are not secured and will participate in losses; the pricing of debt is influenced by banks' risk profiles.[224] By investigating the yield spreads of subordinated bonds, *Balasubramnian/Cyree* (2011) validate that investors were less sensitive to the risk-taking of large US banks after the bailout of Long-Term Capital Management (LTCP), providing evidence for a too big to fail (TBTF) discount on bank funding expenses. *Acharya/Anginer/Warburton* (2016) investigate the bond credit spreads of US financial institutions between 1990 and 2012, showing that they are sensitive to bank's risk-taking with the exception of very large institutions regarded as being TBTF. This discount on funding costs for TBTF banks tends to vary over time and was higher during

[223] See, e.g., *Kwast et al.* (1999).
[224] See, e.g., *DeYoung et al.* (2001); Levonian (2001); *Avery/Belton/Goldberg* (1988).

the years of the GFC and the subsequent periods. *Jacewitz/Pogach* (2018) show in an extensive study that large banks not only enjoy a TBTF discount for uninsured deposits, but that the discount was exceptionally high in the post-crisis period.

Ueda/Weder di Mauro (2013) analyze the effect of Fitch's Bank Support Rating on the long-term default rating, which is a significant factor of banks' funding costs. Translating government support into funding cost advantages, they conclude that implicitly guaranteed banks enjoy a funding cost advantage of 60 to 80 basis points in funding expenditures. More importantly, they analyze the deviation of funding costs for supported banks by using an ordered probit regression for 2007 and 2009, showing even higher advantages after the crisis. *Körner/Schnabel* (2013) examine the abolishment of public guarantees for German savings banks, showing how savings banks were exposed to higher funding costs. The risen funding costs resulted from increased market discipline, experienced by their parent companies, the Landesbanken, which therefore passed the funding costs on to their subsidiaries. Using the same experiment, *Gropp/Gründl/Güttler* (2014) deduct evidence on increased risk-taking, demonstrating that the removal of implicit guarantees influenced banks' funding structure and funding costs. Their analysis reveals that savings banks shifted their funding towards more risk insensitive debt sources. Moreover, the authors compare bond market data and show in an event study that the yield spread increased in comparison to the control group's yield spread. The higher yield spread indicates that banks experienced market discipline and reacted to it by changing their funding structure.

Bearing resemblances to this research, some recent literature examines the effects accompanied by the introduction of the EU resolution tools. Most contributions analyze either the effects on market discipline or uncover the impact on the sovereign-bank-nexus. *Balke/Wahrenburg* (2019) consider the risk sensitivity of corporate deposit holders, finding an increased market discipline after the introduction of the BRRD. Depositors demanded an increased risk premium, dependent on banks' CDS spreads, after the EU-Council adopted the regulation. The observed effect increased in subsequent periods when the Single Resolution Fund (SRF) and the bail-in instrument became fully operational. *Schäfer/Schnabel/Weder di Mauro* (2017) explore the reaction of stock prices and CDS spreads in reaction to different steps of the negotiation process of the SRM Regulation in an event study. They find significant effects of abnormal CDS returns and a drop in stock returns, especially for the provisional agreement of the SRM proposal between the Council and the European Parliament on the construction of the SRM on 20 March 2014. However, the observed consequences are weaker for the adoption of the SRM Regulation than those of bail-in events. The results can be confirmed by *Fiordelisi et al.* (2020b), who include non-eurozone countries in the sample. They reveal that larger banks show an adverse stock market reaction to the adoption of the BRRD, which could be interpreted as the cancellation of the TBTF discount on stock returns. Moreover, they show that the stock markets' reactions are more vital for euro area countries, indicating that the SRM-Regulation may have more potent disciplining effects than the BRRD.

Leone/Porretta/Riccetti (2019) analyze how the stock market reacts to different risk determinants for euro area banks, finding increased volatility for some risk determinants after the bail-in resolution tool was in place in 2016. By employing a yield spread analysis, *Giuliana* (2019) shows that the yield spread between bail-inable and non-bail-inable bonds widens for several bail-in events. The difference-in-differences analysis reveals wider spreads for large banks,

which are likely to have enjoyed an implicit guarantee before the introduction of the BRRD. The results are confirmed by *Cutura* (2018), who shows that bail-inable bonds yield an average 0.1 percentage point spread over non-bail-inable bonds issued by the same bank after the BRRD has been introduced. Similarly, *Lewrick/Serena/Turner* (2019) compare the yield of senior unsecured debt for bail-inable bonds and find that bondholders demand a bail-in premium from global systemically important banks (G-SIBs). The premium varies pro cyclically with market risk and stand-alone risk resulting in even higher premiums. *Pablos Nuevo* (2019) finds a convergence of yield spreads between subordinated and senior bonds for G-SIBs and non-G-SIBs after the BRRD has been implemented. However, the convergence can largely be explained by adaptions of G-SIB's risk profiles. *Cucinelli/Gai/Ielasi* (2020) analyze bond yields for banks in the eurozone, illustrating that bail-inable bonds have higher yield spreads compared to non-bail-inable bonds after the bail-in tool was applicable in 2016.

Another strand of literature investigates whether the sovereign-bank nexus affects implicit guarantees for banks. *Pancotto/Gwilym/Williams* (2019) explore the relationship between sovereign and bank or firm CDS spreads, respectively, using a difference-in-differences regression within which the introduction of the BRRD is construed as a treatment for banks. They find a narrowing gap between sovereign and bank CDS spreads, concluding that the BRRD seems to be an implausible resolution framework that is not suitable for ending the sovereign-bank nexus. Nevertheless, for Italy, they obtain evidence that investors fear the bail-in as the gap for CDS spread widened after the BRRD had been established. To analyze whether the introduction of the BRRD led to a reduction of the sovereign-bank-nexus, *Covi/Eydam* (2020) investigate the evolution of bank and sovereign interconnectedness via CDS spreads between 2012 and 2016. They show that the connection between bank and sovereign CDS spreads decreased after the BRRD had been implemented. Opposed to previous periods, the authors find no evidence of sovereign CDS spreads influencing bank CDS spreads and vice versa in 2015 and 2016.

Mäkinen/Sarno/Zinna (2020) calculate risk premia for CDS and equity returns arising from expected government support, finding the premia to largely depend on sovereign risk. Most interestingly, the risk premia vanish after the bail-in activation in the EU. Previous research seems to support the presumption that the resolution framework has abolished implicit guarantees. In contrast to the impact on market discipline, the resolution framework's potential implications for bank risk-taking are so far unexplored. A shortcoming of most of the discussed studies is their lack of distinction between banks enjoying implicit guarantees and banks who do not. As theory predicts and some evidence shows, the EU resolution framework will predominantly affect banks having enjoyed implicit guarantees beforehand. Also, not all studies differentiate between banks inside the eurozone, where the SRM Regulation applies, and banks in the remaining EU, where the BRRD is the solitary regulation.

For market discipline to be effective, banks need to react to investors' monitoring (a mechanism known as market influence) by reducing their risk, creating a link between market discipline and moral hazard. Without proof of ***market influence***, bank management is assumed to make decisions independently from market signals. Observed collinearity of bank risk-taking and investors' market signals would then result from two independent mechanisms rather than from causality. Evidence for market influence is scarcer, probably because banks' reaction to investors' discriminatory behavior is challenging to prove empirically. Nevertheless, some authors investigate if banks adapt their risk-taking, capital composition, or funding structure in

dependence on investors' monitoring. *Bliss/Flannery* (2002) were among the first to empirically test whether bank managers are motivated by bond price movements and subsequently respond by reducing their risk-taking, but find little evidence for market influence.

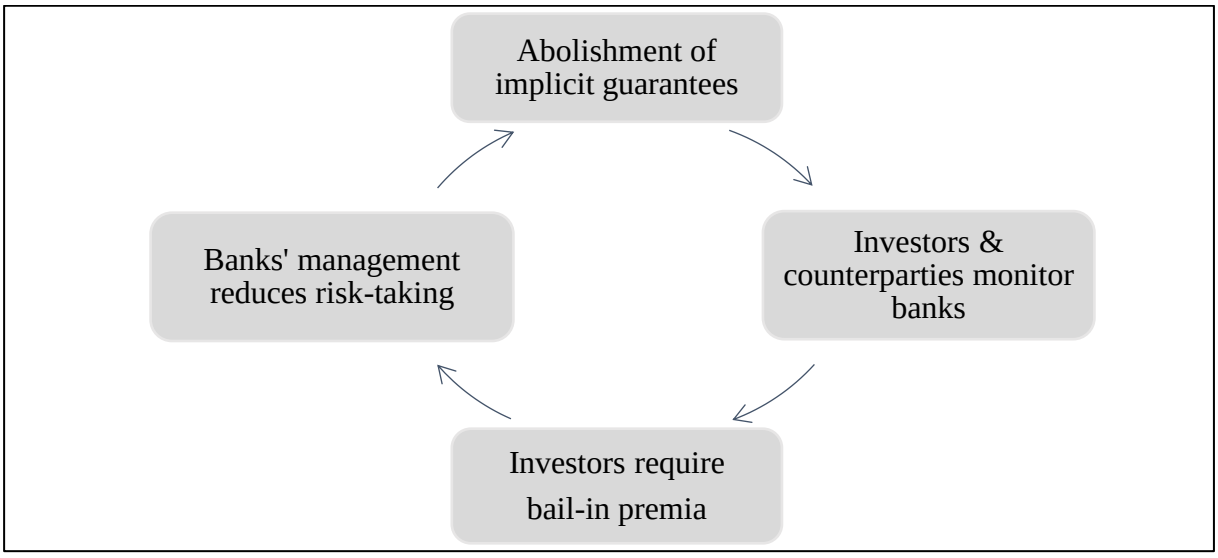
On the other hand, *Calomiris/Powell* (2001) learn that bondholders indeed influence bank managers in Argentina. *Nier/Baumann* (2006) discover that banks' capital asset ratio largely depends on provided government support, the banks' ratio of uninsured liabilities, and the disclosure of banks' risk choices, indicating that banks may adapt to investors' monitoring. *Ashcraft* (2008) additionally shows that the scope to which debt investors can discipline banks depends on the use of restrictive covenants or equity stakes. By investigating the interbank borrowing behavior, *Dinger/Hagen* (2009) observe that increased interbank borrowing is associated with reduced risk-taking by the borrowing bank. Concerning the liability side, some contributions uncover how banks adapt their funding structure to avoid investors' punishment when banks' conditions deteriorate. *Bennett/Hwa/Kwast* (2015) learn that banks that failed during the GFC in 2008-2010 increased their share of insured deposits and reduced uninsured liabilities in return prior to their failure. This finding is supported by *Chen et al.* (2018), who find that banks with weaker profitability raise their rates for insured deposits to offset the withdrawal of uninsured deposits. *Adelino/Ferreira* (2016) explore the asymmetric effects of sovereign rating downgrades on bank funding and lending decisions. Their findings suggest that banks affected by sovereign downgrades have less access to wholesale funding and, in turn, decreased their lending. The above contributions might indicate a causal link between investors' monitoring and banks' funding decisions.

2.3 Research Design

2.3.1 Hypotheses Development

Based on previous literature and the assessment of the EU resolution framework, the author assumes that the policy reduces implicit guarantees and expects banks and investors to adapt to the new conditions. In particular, the *moral hazard channel* is assumed to have prevailed in periods preceding the resolution mechanism, encouraging implicitly supported banks to higher risk-taking. Losing sovereign support will subsequently reduce incentives for moral hazard, resulting in less risk-taking. It may also be conceivable that risk-taking incentives remain unchanged for affected banks, as losing their funding cost advantage involves declining charter values. Nevertheless, the moral hazard channel is expected to outperform charter value effects since all guaranteed banks in the EU experience the same shock, creating a level playing field. Naturally, this involves banks and investors believing in the credibility of the EU resolution framework. Since investors show adverse reactions, requiring bail-in premia, *market discipline* is assumed to improve. The assumed effects are summarized in Figure 2.2.

Figure 2.2: Assumed effects of the EU resolution framework



Hypothesis 1a: The EU resolution framework effectively abolishes implicit guarantees, whereupon affected banks take on less risk after its implementation.

Likely, the EU resolution framework will not provide equal credibility for all banks. As the resolution of systemically important institutions is more challenging at the beginning of the application phase, investors and bank managers may expect more reluctance in the strict application of resolution tools by competent authorities. Consequently, very large banks deemed TBTF are assumed to reduce their risk-taking less drastically.

Hypothesis 1b: Banks of global systemic importance will decrease their risk less drastically than the remaining banks that have enjoyed implicit bailout guarantees.

As other bank risk-taking drivers remain in place and probably gain importance since implicit guarantees were abolished, banks with higher charter values are expected to decrease their risk-taking more vigorously. More is at stake for banks with high charter values, and they thus have even higher incentives to follow more prudent strategies to protect their market position. Conversely, banks with lower charter values may be concerned about their competitive position and decrease their risk less severely.

Hypothesis 1c: Implicitly guaranteed banks with high (low) charter values decrease their risk-taking (less) stronger when losing implicit guarantees.

Losing implicit guarantees is likely associated with a change in bank creditors' and investors' behavior, as other contributions have already shown. Increased monitoring raises bank debt prices because investors are expected to require a premium for bail-inable debt.

Hypothesis 2a: Implicitly guaranteed banks will be exposed to increased market discipline, resulting in a relative rise in funding costs compared to banks not enjoying implicit guarantees.

Depending on the extent of the increase in funding costs, banks subject to increased market discipline will probably be prone to change their funding structure by avoiding risk-sensitive

funding sources. Therefore, banks will likely shift their funding towards secured deposits, not suitable to be bailed-in, and are thus insensitive to market discipline.

Hypothesis 2b: Implicitly guaranteed banks will avoid risk-sensitive funding in favor of stable funding after the policy change.

Since the EU resolution framework is manifested in the BRRD and SRM Regulation, the author assumes the effects on market discipline and moral hazard to vary between the two jurisdictions. Because the SRM Regulation centralizes resolution decisions, the SRM is assumed to be stricter than the BRRD. Moreover, the average level of post-crisis support was higher for eurozone countries, suggesting higher incentives for moral hazard preceding the SRM.

Hypothesis 3: The effects on risk-taking and market discipline are more potent for banks operating in the SRM than those operating in the BRRD region.

2.3.2 Research Strategy

Empirical research on implicit guarantees and moral hazard is challenged by an identification problem causing endogeneity.[225] Since government support remains unspoken until granted in the event of bank distress, the relationship between bank bailouts and moral hazard is ambiguous to investigate. Many contributions proxy implicit guarantees, if at all, by bank size or TBTF status to analyze risk-taking [*Cabrera/Dwyer/Nieto* (2018); *Hagendorff/Keasey/Vallascas* (2018)] or market discipline [*Jacewitz/Pogach* (2018); *Cubillas/Fernández/González* (2017); *Acharya/Anginer/Warburton* (2016); *Völz/Wedow* (2011)] since large banks are assumed to benefit more from bailouts.

Although these approaches attempt to control for other factors influencing bank risk or market discipline, results might still be endogenous, as those models may suffer from omitted variables or unobserved heterogeneity. Deriving implicit guarantees from received support involves simultaneity issues, as increased risk can be explained by bailouts and vice versa. Banks receiving support through bailouts are financially stressed, and since the origin of such stress cannot always be explained by moral hazard, the relationship between risk-taking and implicit guarantees remains vague. Therefore, other authors used ratings capturing the likelihood of government support as an explanatory variable for banks' risk-taking [*Brandao-Marques/Correa/Sapriza* (2018); *Afonso/Santos/Traina* (2014); *Prabha/Wihlborg* (2014); *Gropp/Hakenes/Schnabel* (2011)]. The problem of such an approach is that bailout probabilities and bank risk are codetermined by economic factors causing simultaneity. When banks' financial stability is in danger, bank ratings will adapt, reflecting the risen likelihood of government support,[226] ultimately impeding the identification of cause and effect.

When testing the hypotheses empirically, endogeneity problems are addressed via two features of the research strategy. First, guaranteed banks are detected by their estimated non-crisis bailout probability, avoiding simultaneity issues. This is done by translating bank ratings capturing the likelihood of government support into bailout probabilities. Second, the implementation of the EU resolution framework intended to end sovereign subsidies for banks is used as

[225] See *Dam/Koetter* (2012).
[226] See Moody's Investor Service (2018a).

a quasi-natural experiment to derive causal inference for moral hazard and market discipline. The enactment of the EU resolution framework is the ideal event to investigate the relationships between implicit guarantees, moral hazard, and market discipline. The author assumes the new rules to affect only those banks, which, according to their bailout probability, were likely to receive support in case of need before the rules applied. Those affected banks are subsequently assumed to reduce their risk-taking to non-guarantee levels, while investors and creditors are assumed to monitor those banks more closely. Banks, never expected to benefit from implicit guarantees, remain untreated, and are not assumed to respond.

For policy changes expected to affect specific treatment units, the difference-in-differences (DD) approach is an appropriate method for causal inference [*Wooldridge* (2010); *Angrist/Pischke* (2009)]. The DD approach has been used by many authors exploring the effectiveness of policy changes applied to specific groups but not others [*Garvey/Hanka* (1999); *Meyer* (1992); *Classen* (1979)]. Recently, numerous contributions employed DD models investigating the effects of regulatory or policy changes on banks [*Behr/Wang* (2020); *Fiordelisi et al.* (2020b); *Calomiris/Jaremski* (2019); *Banerjee/Mio* (2018); *Adelino/Ferreira* (2016); *Lee/Lu* (2015); *Damar/Gropp/Mordel* (2014); *Gropp/Gründl/Güttler* (2014); *Hryckiewicz* (2014); *Ignatowski/Korte* (2014); *Black/Hazelwood* (2013); *Karas/Pyle/Schoors* (2013)]. In this work, the effects on risk-taking and market discipline are investigated by comparing changes in risk-taking and funding for treated and untreated banks before and after the regulation applies. Using panel data in a pre-post-treatment design is advantageous, as observed effects can be directly linked to the policy change and are less likely endogenous due to omitted variables or simultaneity. Moreover, panel models allow controlling for unobserved heterogeneity by adding individual fixed effects to the regressions.

The effects on both moral hazard and market discipline are estimated by applying various DD models for long- and short-term perspectives. Multiple risk and funding measures are used to receive robust results from the analysis of incentives for moral hazard and market discipline. Next to various DD regressions, the results are validated by propensity score and nearest neighbor matching techniques. When estimating short-term impacts, a subsample containing accounting and market proxies in quarterly frequency is used to extend the analysis. The author also utilizes pooled OLS regressions to show the divergent impact of implicit guarantees on banks' risk-taking prior to the treatment. OLS panel data regressions are further applied for a more general investigation of implicit guarantees and market discipline, exploiting the dependence of monthly CDS spreads on support ratings. The resolution mechanism effects are estimated separately for its two components, the SRM-Regulation and the BRRD, for two reasons. First, since the SRM-Regulation adjusts the responsibilities for resolution matters within the eurozone, treatment effects might vary among regulations. Second, treatment effects may differ due to region heterogeneity (e.g., economic development), resulting in potential threats to external validity [*Meyer* (1995)].

3 Empirical Approach

3.1 Data and Sample Selection

For empirically testing the hypotheses, an unbalanced panel dataset is compiled using banks' financial reporting data, downloaded from the Fitch Connect database provided by Fitch Ratings Inc. The main research is conducted with annual accounting data, as annual reports are available for most banks. For a smaller number of banks, a subsample containing quarterly accounting data is compiled. The Fitch Connect database covers a broad set of banks and contains accounting data and rating information. Starting the sample selection with banks operating in Europe,[227] banks are required to fulfill certain conditions to be included in the final sample. The first condition refers to the business model: Islamic banks, development banks, trust and processing banks, and central banks are not included in the final sample as their business models and major purposes are irrelevant for the research interests. Furthermore, to avoid bias by sample attrition, only active banks are included. As this work's focus is on bank risk-taking after the introduction of the resolution mechanism, leaving inactive banks in the sample that may have failed, e.g., due to distress, would overstate the level of risk-taking. In addition, banks must have a minimum size of EUR 2 billion in total assets. The size-cutoff is chosen to enhance the comparability between treated and untreated entities since implicit guarantees are highly driven by bank size.[228]

Therefore, having excluded 2,242 inactive and 3,971 small banks, the sample includes 1,591 banking institutions. Consolidated financial statements at the highest level of consolidation are used, if available, as this work investigates the effects of government guarantees, which are mainly provided on the parent company level. Therefore, subordinated banks whose parents are already included are omitted to avoid double-counting, resulting in a sample of 1,113 entities. Foreign banking institutions are left out as they most likely would not benefit from any bailout policies. Moreover, banks with less than six consecutive observations are also excluded, leaving 1,033 banks in the master sample with a total number of 13,516 observations (N) (Table D.1). The IFRS reporting standard is preferred to local reporting standards, as IFRS is the most uniformly used standard in Europe and is therefore regarded as enhancing the data comparability. Missing data on some key variables[229] are substituted using information from the BankFocus database provided by Bureau van Dijk. All bank-level variables in the master sample are winsorized at the 1% and 99% level, avoiding that outliers bias the results. Bank ratings are as well obtained from the Fitch Connect database. As ratings are not provided in a time series format, they are hand collected for the specific rating dates and then merged to the accounting data by the Fitch Entity ID and the respective accounting date. All capital market data are obtained from Thomson Reuters Datastream.

[227] All member states of the European Union plus Norway, Liechtenstein, Switzerland, and Iceland are included in the master sample. See Table D.1 for summary statistics on the master sample by country.

[228] Prior research has linked small banks to a lack of diversification, leading to a higher vulnerability to financial distress, see *Beltratti/Stulz* (2012); *Stiroh* (2004). Moreover, *Afonso/Kovner/Schoar* (2011) show the limited ability of small banks to receive funds from the interbank market once they are distressed. Other researchers often set the cutoff for small banks at USD 1 bn, see *Berger/Irresberger/Roman* (2019). As those numbers are somewhat arbitrary, the size cutoff is set at EUR 2 bn to increase sample homogeneity.

[229] See Table C.1 in the Appendix for further information on data sources and variable definitions.

Since the hypotheses of moral hazard and market discipline are separately tested for the SRM and the BRRD regulation, the EU master sample is divided into region subgroups. The SRM sample covers all 19 eurozone-member states (Table D.2), and the BRRD sample the remaining EU member states (Table D.3). Both samples vary in total observations, depending on the explanatory variable used to identify treated banks (either *IGG* or a dummy variable for systemically important banks, *O-SII* or *G-SII*), as observations from countries without treated entities are excluded.[230]

A sample of quarterly accounting data is compiled for a complimentary analysis of short-term outcomes on bank risk-taking and market discipline. Quarterly reports are downloaded from Fitch Connect for all banks within the annual sample, having four quarterly financial statements per year available. Stock market variables are then calculated from weekly observations of the total return index provided by Thomson Reuters Datastream and matched by bank names with the quarterly sample. For the investigation of market discipline, daily CDS spreads are additionally downloaded from Datastream. The author relies on senior CDS contracts with a maturity of five years as this maturity has the highest trading liquidity.[231] CDS contracts with the modified-modified restructuring clause are selected since they are available for a large fraction of banks in Thomson Reuters Datastream.[232] CDS contracts in Euro are preferred to other currencies, representing a large body of CDS observations. For a few banks, CDS contracts denoted in British Pound are collected when contracts in Euro were unavailable. Summary statistics for the quarterly subsample is presented in Table D.4 and Table D.5 in appendix D.

Since only 25 banks with available CDS spreads can be matched with quarterly accounting data, an additional sample is compiled, containing only CDS spreads and bank ratings in monthly frequency. Relying solely on bank ratings and CDS spreads is beneficial as the frequency of observations increases, allowing a closer examination of rating changes or relevant regulatory events. Assuming that bank ratings remain current until they are revised, each rating's observation is recurrently matched with subsequent monthly CDS spreads until a new rating was assigned. Table D.6 in the appendix provides summary statistics for the monthly sample.

3.2 Variable Definition

3.2.1 Explanatory Variables

One of this work's challenges is to approximate the extent of government support as precisely as possible. Government support is commonly provided via implicit guarantees that are naturally not legally promised or officially mentioned before state aid is given.[233] That said, the identification of banks accredited to implicit guarantees is challenging and error-prone, as a certain degree of uncertainty remains. For this analysis, two approaches for approximating

[230] Results remain qualitatively the same when observations from countries without treated entities are in the sample. Those observations are removed, however, to dispel doubts that country heterogeneity may bias the results.

[231] See British Bankers' Association (2006).

[232] This contract clause was introduced by the International Swaps and Derivatives Association (ISDA) in 2003 and defines different restructuring events, e.g., debt restructurings. This term limits that deliverable obligations must be shorter than 60 months for restructured obligations and 30 months for all other obligations. See *Packer/Zhu* (2005).

[233] See *Schich/Kim* (2012).

implicit guarantees are followed. This work's main identification strategy is a *rating-based approach* based on rating agencies' opinions about the probability of government support. For robustness, the author also uses the identification of *important* banks by supervisory assignments. The latter approach is performed to validate the baseline identification strategy and beyond to estimate the impact of supervision and regulation for these institutions. By comparing the results obtained from various identification strategies, one can further assess to what extent the results are driven by implicit guarantees or regulation and supervision.

3.2.1.1 Rating-Based Approach

As pointed out in section 2.1.1, implicit guarantees are not outspoken and legally promised, so the extent of government support can only be estimated. To assess banks' financial health and the derived probability of external support, one could rely on specific bank ratings. According to an OECD survey conducted in 2013, consulting rating information to estimate the magnitude of implicit guarantees for bank debt is by far the most favorable among policymakers.[234] This can be done following two different approaches: Either by using ratings that immediately estimate the probability of government support in the event of a bank failure or by deriving such estimates by computing the difference between two types of ratings that evaluate banks' financial stability on the one hand (stand-alone credit ratings) and the value of their overall debt on the other hand (all-in credit ratings). The latter approach is commonly referred to as the calculation of rating uplifts and has been widely used for estimating the value of implicit guarantees in empirical finance and by policymakers.[235]

The three major bank rating agencies provide two types of bank ratings. Bank stand-alone ratings are assigned to give an assessment about a bank's financial soundness, estimating the likelihood of financial distress, without considering the possibility of any external support. Instead, bank all-in ratings are opinions about the likelihood that bank debtors will face losses, incorporating any source of external support an entity may receive. Sources of potential support may be the company's parents or the government. To assess the possibility of external support in the event of a failure, rating agencies consider the ability and willingness of the guarantor to do so.[236] Rating agencies accomplish this by considering the history of bank failures and resolution cases, incorporating existing resolution tools while regarding their individual scope.[237]

Subtracting the stand-alone rating from the all-in rating yields a difference in rating notches referred to as the *rating uplift*. This uplift expresses the rating agency's view about the magnitude of external support provided by the parent or government [*Schich/Lindh* (2012)]. Although the empirical analysis focuses on the highest bank consolidation level available,[238] and the calculated uplifts hence should largely reflect government support, another rating from Moody's is considered, assessing the probability of government support even more precisely. Moody's introduced a new bank rating in 2012, the Adjusted Baseline Credit Assessment (Adjusted

[234] See *Schich/Aydin* (2014): 6f.
[235] See, e.g., *Brandao-Marques/Correa/Sapriza* (2018); *Schich/Toader* (2017); *Toader* (2015).
[236] See *Packer/Tarashev* (2011): 42.
[237] See *Schich/Kim* (2012): 4f.
[238] Please note that for a few banks in the sample, information on their respective parents are lacking or the parent company itself is not available. Anyhow, that is mostly the case for banks belonging to the untreated control group.

BCA), an all-in rating that regards affiliate support but not government support, thereby expressing the probability of default after having exhausted any support from affiliates.[239] In this work, the difference between *Moody's long-term foreign currency deposit rating* (LTFCDR) and Moody's Adjusted BCA is used as a proxy for the likelihood of government support.[240] This approach's advantage is that the calculated rating uplift reflects government support only since the Adjusted BCA already incorporates all external sources, except government support.[241] Therefore, the difference between the adjusted BCA and the all-in credit rating results in an uplift that exclusively measures the magnitude of government support.[242]

Fitch Ratings follow a different approach, providing two types of bank ratings, estimating the probability of either parental or governmental support. Fitch's bank Support Rating (BSR) does not assess the likelihood of a bank failing to meet its financial obligations, but the probability of a bank receiving extraordinary support from its shareholders or the government. This rating does not distinguish between support sources, lacking a distinction between internal and external support. To isolate the probability of sovereign support, Fitch provides a second rating that reflects the agency's assessment of the likelihood of sovereign support if the entity would otherwise fail to meet its financial obligations.[243] Subsequently, the Support Rating Floor (SRF) does not include any institutional support but the government's ability and willingness to provide support. It is presented on a long-term rating scale with an additional point on the scale, the so-called No Floor (NF), indicating the agency's view that there is no reasonable presumption about any level of sovereign support. According to Fitch Ratings, the NF accounts for a probability of less than 40 percent.[244] Fitch's BSR and SRF have one significant advantage compared to the concept of uplifts since changes in rating uplifts may arise because of either change in the underlying all-in or stand-alone ratings, impeding inference.[245]

Fitch's SRF is not available for all rated banks in the sample. Even banks rated by Fitch sometimes do not receive a BSR or a SRF. Therefore, to form a comprehensive picture of sovereign support for rated banks, information concerning implicit guarantees need to be combined from different sources. To do so, the approach from Gropp/Hakenes/Schnabel (2011) is followed by calculating the respective bailout probability combining assessments from different all-in and stand-alone credit ratings. The bailout probability for both Fitch's support measures can simply be derived as the BSR and the SRF exclusively appraise the chance of sovereign support, disregarding any stand-alone perspective. For Fitch's SRF, the bailout probability is calculated immediately from the rating scale. As the lowest rating level (NF for "No Floor") represents an estimated probability of less than 40 percent, it is concluded that an SRF rating level of 1

[239] See Moody's Investor Service (2018b): 67.

[240] For some banks, Moody's LTFCDR is unavailable. Their long-term rating is substituted with Moody's long-term issuer credit rating.

[241] Many other researchers have calculated the uplift from Moody's by subtracting the all-in rating by other ratings not incorporating parental support. By focusing on the highest corporate level, the chance of other sources of government support would be reduced anyway. Nevertheless, the above approach is preferred to guarantee the clearest possible result.

[242] To the best of the author's knowledge, this approach was first carried out by *Schich/Lindh* (2012): 7.; and so far has only been reproduced by *Käfer* (2015).

[243] See Fitch Ratings (2019).

[244] See Fitch Ratings (2019), (2010).

[245] See *Afonso/Santos/Traina* (2014). This is negligible in this work's DD analysis as government guarantees are only relevant in the pre-treatment period, but this may induce some bias for other panel regressions.

represents a bailout probability of 40 percent. Starting with 40 percent on the first rating level, the remaining 60 percent are linearly assigned among the remaining 18 rating notches, each with a 3.33 (60/18) percentage point surcharge, resulting in a bailout probability of 1 for the highest SRF rating. Fitch's BSR is represented on a five-point scale, with one indicating the highest chance of support. In line with the procedure for the SRF, each rating notch is assigned a bailout probability starting with 0% for the lowest and 100% for the highest rating in equal steps of 0.25 percentage points (Table B.1).[246]

The procedure for Moody's ratings is different since the information from the all-in and stand-alone ratings need to be combined to estimate the extent of sovereign support.[247] Therefore, each rating is translated into the one-year-ahead default probability, published by Moody's. To derive the bailout probability p, the following relationship is utilized:

$$td_{i,t} = d_{i,t}(1 - p_{i,t}), \tag{3.1}$$

where $td_{i,t}$ stands for the all-in default probability (including implicit guarantees) and $d_{i,t}$ represents the stand-alone default probability. Rearranging the equation, one can compute the conditional probability of a government bailout as

$$p_{i,t} = 1 - \frac{td_{i,t}}{d_{i,t}}.^{248} \tag{3.2}$$

The default rates for long-term ratings are retrieved from Moody's[249] and assigned to the all-in rating and the adjusted BCA rating.[250] The calculated bailout probabilities (*bailoutp*) from Fitch and Moody's are then combined as follows to construct a comprehensive measure of government support:

(i) The derived bailout probability from Fitch's SRF is preferred to all other sources of ratings.

(ii) If the SRF is unavailable, the bailout probability is derived from Equation (3.2) with default rates assigned to Moody's all-in and adjusted BCA ratings as this approach delivers the second-best measure of pure government support.

For robustness, banks' bailout probabilities are solely derived from Fitch ratings using the SRF supplemented with the BSR, when the SRF is unavailable. Not incorporating the BSR delivers a much more genuine estimate of government support and is therefore preferred, although the number of those banks where a bailout probability can be estimated shrinks.[251]

To the best of the author's knowledge, the approach of a combined bailout probability, initially proposed by *Gropp/Hakenes/Schnabel* (2011), has so far not been applied using information

[246] Fitch's Bank Support Rating (BSR) is only used for robustness as the Support Rating Floor (SRF) is found to be a purer measure of implicit guarantees. See Table F.1 in the Appendix for estimations involving Fitch's BSR.

[247] The long-term ratings are either proxied by Moody's Long-Term Deposit Ratings or, if unavailable, by Moody's Long-Term Issuer Credit Rating. In both cases, the foreign currency version is preferred.

[248] See *Gropp/Hakenes/Schnabel* (2011): 2092.

[249] See Moody's Investor Service (2018a): 37.

[250] Following *Gropp/Hakenes/Schnabel* (2011), the author uses non-financial firm default rates as bank default rates are biased by past bailouts. See Table B.2 in the Appendix on Moody's rating scale and the assigned rates.

[251] This is probably the reason why most researchers focused on rating uplifts to measure the extent of government support as the sample size is then larger.

from Fitch's SRF and Moody's adjusted BCA. Moreover, the approach has so far not been applied to a panel estimation setup.[252] The authors themselves use a cross-sectional analysis; applying the approach to a panel estimation requires some caution since changes in rating uplifts and the estimated bailout probability can be accounted to either variation in the stand-alone or the all-in rating. As the bailout probability is used to identify banks enjoying implicit guarantees at one point in time, changes in the bailout probability are not a concern.

Considering the DD research design with a pre- and post-treatment comparison, the measurement of government support needs to fit a binary approach. Consequently, it is necessary to define a cutoff for the probability of bank bailouts. Splitting the sample into a treatment and a control group with a continuous treatment variable is naturally error-prone since the definition of a cutoff is somewhat arbitrary. In this work, banks with an estimated bailout probability of at least 50 percent in 2013 are labeled as enjoying implicit government guarantees (IGG) and are identified by the dummy variable ***IGG***. The cut-off is motivated by the fact that the average level of support was below 50 percent most of the time, as Figure 3.1 reveals. By choosing a relatively low cutoff, it is guaranteed that the treatment group contains as many treated entities as possible, avoiding a control group with a high number of wrongfully allocated entities.[253] Treated banks are identified by their 2013 bailout probability as this point in time represents the pre-bail-in era and a relatively calm banking sector since the European debt crisis had ceased at that time.

Figure 3.1 shows the evolution of the estimated bailout probabilities derived from Fitch and Moody's. The level and development of implicit government support vary drastically, especially in the wake of the European debt crisis in 2011. Except for a short period in 2009, the level of average support is higher for the SRM region compared to the BRRD. The BRRD region follows a similar trend, but the average support remains below the SRM level. The agreement on EU resolution rules achieved in 2014 triggered an adaption of support ratings and led to a sharp drop in support levels in both the SRM and BRRD region. For non-EU countries, the average level of government support is less volatile. In 2007, the support level was the lowest at about 25% and increased sharply in 2011. The bailout probabilities increased again in 2015, the beginning of the post-bailout era in the EU. The opposite reaction of average support is probably due to the delayed development of resolution schemes in non-EU countries. However, the average support in non-EU countries declined from 2016 onwards to slightly above 30 percent, indicating the highest support of all regions in Europe. The differences between jurisdictions before 2015 are likely related to their bailout policies during the financial crisis. The euro area offered the most extensive support and exhibited the highest average bailout probabilities before the SRM implementation.

[252] See *Brandao-Marques/Correa/Sapriza* (2018) for a similar approach in a cross-sectional setting.
[253] Alternative cutoffs are employed as robustness tests, presented in section 4.3.1.

Figure 3.1: Bailout probabilities by region

This figure presents the average bailout probabilities by region. The probabilities are estimated for each bank by relying on rating information from Fitch's and Moody's. Depicted are the mean bailout probabilities for each region. SRM are all members of the eurozone. BRRD includes all non-eurozone EU members and non-EU are Iceland, Liechtenstein, Norway and Switzerland.

3.2.1.2 Supervisory Assignment

Next to the *rating-based approach*, supervisory judgments on banks' systemic importance are used to identify banks with high bailout probabilities. This approach is particularly appealing as it fits the binary treatment design. Anyhow, it neglects governments' actual willingness and ability to support those banks and is therefore assumed to deliver weaker results compared to the main identification strategy. The author relies on three different groups identified by various supervisory agencies. The first two groups are defined in Article 131 CRD IV as systemically important banks and fall either in the category of ***global systemically important institutions (G-SIIs)*** or ***other systemically important institutions*** (***O-SIIs***) depending on their systemic importance for the EU or any single member state. National authorities identify those banks based on systemic indicators like size, interconnectedness, substitutability, complexity, and cross-border activities, following an indicator-based approach developed by the EBA, initially proposed by the Basel Committee on Banking Supervision (BCBS).[254] The EBA publishes the list

[254] Art. 131(2) (3) CRD IV. The indicator-based approach for identifying global systemically important banks was originally proposed by the Basel Committee on Banking Supervision (2011a). The identification of G-SIIs is the EU approach of defining and dealing with banks of global systemic importance. They involve all G-SIBs and additional institutions operating in the EU.

of both groups together with details on each bank's systemic importance. Next to G-SIIs identified by their systemic indicators by national authorities, the EBA defines all banks with a minimum leverage ratio exposure of EUR 200 billion as G-SIIs. G-SIIs are allocated into one of five buckets with regard to their systemic importance, leading to additional capital buffers between 1 and 3,5 percentage of Common Equity Tier 1 (CET1).[255]

National authorities solely identify O-SII by their respective score resulting from the calculation of the indicator-based approach.[256] The purpose of the identification is to impose higher loss absorbency requirements on O-SIIs in conjunction with Article 131(5) of CRD VI of up to 2 percentage points to enhance their resilience and reduce incentives for moral hazard.[257] The EBA itself assumes that those institutions will be subject to the provisions on resolution plans because they will probably not enter the ordinary insolvency proceedings.[258] Thus, it is highly likely that those institutions were expected to be bailed out and receive treatment by the implementation of the EU resolution framework.

The last regulatory assigned group of banks analyzed more closely in this work are ***significant institutions (SI)*** supervised by the European Central Bank (ECB). The identification and supervision process is embodied in the Single Supervisory Mechanism (SSM), one of the three pillars of the Banking Union. Banks are identified by fulfilling one of the following conditions: the value of their total assets exceeds EUR 30 billion, their ratio of total assets to GDP exceeds 20 percent, unless their total assets are below EUR 5 billion, or national supervisory authorities classify those entities as significant in terms of crucial functions they perform for their domestic banking market.[259] Additionally, entities that received funds from the European Financial Stability Facility (EFSF) or the European Stability Mechanism (ESM) and entities with a substantial cross-border banking activity in more than one member state are declared as significant as well. Those entities are under the ECB's direct supervision and the remit of the Single Resolution Board (SRB). The SRB's responsibility for SI makes them interesting to examine.[260]

3.2.2 Proxies for Bank Risk-Taking

A group of risk risk-taking proxies is used as dependent variables to investigate the effects of the EU resolution framework on moral hazard. They are based on different accounting and market data and shall indicate banks' risk appetite. Several risk-taking proxies are computed to gain a deep understanding of banks' risk-taking.[261] The primary risk measure is the ***z-score*** originally introduced by *Boyd/Graham/Hewitt* (1993), which proxies banks' insolvency risk. When insolvency can be defined as the situation when realized losses cannot be offset by the remaining equity ($\pi > E$), where π is loss and E is equity. Consequently, the probability of insolvency can be expressed as prob ($-RoA < CAR$), where $RoA(= \frac{\pi}{A})$ is the return on assets

[255] Art. 131(9) CRD IV.
[256] EBA (2014): 12f. The EBA Guidelines are based on the Framework for domestic systemically important banks published by the Basel Committee in 2012.
[257] See EBA (2014): 5.
[258] See EBA/CP/2014/16, p. 33.
[259] Art. 6(4) Council Regulation (EU) No 1024/2013 (Single Supervisory Mechanism Regulation), OJ L287/63 published on 29 October 2013.
[260] For details on the SRM, see section 1.2.2.2.
[261] All variable definitions can be found in Table C.1 in the Appendix.

and $CAR(=\frac{E}{A})$ is the capital asset ratio. Assuming that profits are normally distributed, the inverse of the probability of insolvency is:

$$z - Score = \frac{RoA + CAR}{(\sigma RoA)}, \tag{3.3}$$

where σRoA is the standard deviation of RoA.[262] It is a proxy for the bank's insolvency risk measuring its distance to default and is a standard risk indicator in empirical finance.[263] Moreover, the z-score's ability to predict bank defaults has been recently confirmed by *Chiaramonte/Croci/Poli* (2015). As the z-score is highly skewed, the natural logarithm of the z-score, which is normally distributed, is used in the empirical analysis. As the main sample contains annual accounting data, the standard deviation of return on assets is calculated separately for the pre- and post-treatment periods.[264] Besides the z-score, the standard deviation of return on assets ($\boldsymbol{\sigma RoA}$), a z-score component, is analyzed as an additional proxy for banks' earnings risk. A higher standard deviation of asset returns is likely to be caused by investing in higher profitable but riskier assets.[265]A relatively intuitive proxy of banks' asset risk is the density of risk-weighted assets (***RWA density***), computed as risk-weighted assets to total assets:

$$RWA\ density = \frac{Risk - weighted\ assets}{Total\ assets} * 100. \tag{3.4}$$

This proxy appears to be particularly suitable as a higher level of risk-weighted assets might result from an active decision for a certain degree of risk in a portfolio made by banks' management.[266] This measure has been widely used in prior research,[267] and its suitability to capture a banks' risk appetite has been approved.[268]

Many authors proxy banks' risk appetite by impairment charges for loans or other businesses.[269] Those contributions are followed by defining two risk measures built on loan and security charge-offs. First, the author calculates the ratio of net loan impairment charges (***LoanImp***) to outstanding gross loans as follows:

$$Loan\ impairments = \frac{LoanImp}{Total\ gross\ loans} * 100 \tag{3.5}$$

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262 See *Laeven/Levine* (2009): 262; *Boyd/Graham/Hewitt* (1993): 48.

263 See, e.g., *Brandao-Marques/Correa/Sapriza* (2018); *Prabha/Wihlborg* (2014); *Pathan* (2009); *Lepetit et al.* (2008); *Nicoló/Jalal/Boyd* (2006).

264 The standard deviation of return on assets (σRoA) is calculated over 2010-2014 for the pre-treatment and over 2015-2018 for the post-treatment period for the main difference-in-differences analysis.

265 See *Laeven/Levine* (2009). In this work, σRoA is used as dependent variable mainly in additional robustness test and supplementary results in sections 4.3.4 and 6.1.

266 *Behn/Haselmann/Vig* (2016) show that banks use internal models to reduce their risk-weighted assets. Therefore, this measure might seem unsuitable to compare the risk levels of different banks, as the ratios differ depending on which approach was used to calculate the risk-weighted assets. Nevertheless, as the panel data models with bank-level controls and fixed effects in this work capture banks' change in risk-weighted asset ratio from one year to another, those variations should correlate with the change in each bank's risk-taking. See *Smith/Grill/Lang* (2017): 31.

267 See, e.g., *Caiazza et al.* (2018); *Khan/Scheule/Wu* (2017); *Ignatowski/Korte* (2014).

268 See *Das/Sy* (2012). The authors show that banks with a low level of RWA performed better during the crisis, although this result is weaker for Europe, where banks can use internal models to calculate their RWA.

269 See, e.g., *Paligorova/Santos* (2017); *Bouwman/Malmendier* (2015); *Afonso/Santos/Traina* (2014).

The variable ***loan impairments*** captures banks' realized credit risk of outstanding loans. For the total impairments, the sum of net security impairment charges (SecImp) and net loan impairment charges (LoanImp) is divided by total assets to calculate banks' total net charge-offs.

$$Total\ impairments = \frac{(SecImp) + (LoanImp)}{Total\ assets} * 100 \tag{3.6}$$

The next proxy for bank risk-taking is the *non-performing loan ratio* (***NPL-ratio***). It is defined as the ratio of non-performing loans to total gross loans and is a well-established indicator of banks' loan portfolio quality.[270] In this regard, a higher NPL-ratio indicates a higher level of realized credit risk in prior periods as, for example, a shift towards riskier borrowers could result in higher ratios of non-performing loans.

$$NPL - ratio = \frac{Non - performing\ loans}{Total\ gross\ loans} * 100 \tag{3.7}$$

Another risk measure again proxies the quality of banks' loan portfolios. Instead of the NPL-ratio, the ratio of *loan loss reserves to total gross loans* (***LLR-ratio***) is a rather forward-looking variable. Banks need to set aside a fraction of the lending as reserves for expected future loan losses. Therefore, a higher LLR-ratio indicates banks' anticipation of its current realized credit risk that may become immanent in future loan losses.[271]

$$LLR - ratio = \frac{Loan\ loss\ reserves}{Total\ gross\ loans} * 100 \tag{3.8}$$

As theoretical considerations and prior research has shown, trading activities in banking can be associated with an increased level of risk.[272] This is probably due to the nature of bank trading activity, as it is often done for a short-term realization of profits and produces mainly intermittent profit streams. If banks are about to decrease their risk-taking due to the removal of implicit guarantees, they may decide to shift their business activities in favor of less risky strategies. In line with Afonso/Santos/Traina (2014), trading activity is taken as an indirect proxy for bank risk. As changes in business models can also achieve changes in banks' risk-taking, the variable ***trading securities*** captures the extent of trading activities. It is defined as total tradable securities to total assets to proxy the size of the trading portfolio:

$$Trading\ securities = \frac{Securities\ held\ for\ trading}{Total\ assets} * 100 \tag{3.9}$$

To confirm the results of the accounting-based measures discussed above, the volatility of equity returns (***σStock***) is used as an alternative risk variable. The annual or quarterly volatility of

[270] For prior research using the NPL-ratio as a measure of bank risk, see *Berger/DeYoung* (1997), *Delis/Kouretas* (2011), *Baselga-Pascual/Trujillo-Ponce/Cardone-Riportella* (2015).

[271] See *Bushman/Williams* (2015); *Lepetit et al.* (2008).

[272] See *Köhler* (2014); *King/Massoud/Song* (2013); *Stiroh* (2006); *Chen/Huang/Zhang* (2017); *Boot/Ratnovski* (2012); *Demirgüç-Kunt/Huizinga* (2010). Some researchers find opposite results, indicating that benefits of both revenue diversification and liquidity in times of bank distress play a role, see *Blundell-Wignall/Atkinson/Roulet* (2014). By controlling for the ratio of liquid assets, a change in the ratio of tradable assets to total assets indicates a change in banks' business strategy.

stock returns is computed from the total return index (TRI) of weekly stock returns downloaded from Thomson Reuters Datastream and denoted in percent.[273]

$$\sigma Stock = SD(TRI_{weekly}) \tag{3.10}$$

With this risk measure, the sample size is reduced to banks with available stock market data. Nevertheless, this risk-measure offers an interesting compensation of accounting-based measures and enriches the assessment of risk-taking with a market perspective. Moreover, the annual or quarterly ***stock returns*** are calculated as a second measure of market risk from the weekly TRI, denoted in percent.

$$Stock\ returns = \ln(\frac{TRI_t}{TRI_{t-1}}) \tag{3.11}$$

Although it requires investors to correctly assess bank risk for stock market data to be a valid indicator of bank risk-taking, numerous contributions used stock market data for that purpose.[274]

3.2.3 Proxies for Market Discipline

As stated in ***Hypothesis 2a***, the removal of implicit guarantees may result in increased market discipline. Debt holders may react to a decreased bailout probability by demanding higher risk premia for uninsured forms of bank debt. That does not account for customer deposits as they are primarily covered by deposit insurance and therefore do not incentivize investors to monitor banks. But subordinated debt, wholesale funding,[275] and (interbank) money market funding are sensitive to banks' risk profiles and hence expose banks to market discipline.[276] To formally test if the removal of public guarantees led to enhanced market discipline, a variable for funding costs of non-customer deposits is calculated. Previous research, e.g., from *Ashcraft* (2008); *Flannery/Sorescu* (1996), showed that creditors are able to monitor banks' risk profile and accordingly demand compensation for bank risk. Therefore, it can be concluded that banks' risk-sensitive funding costs are a reasonable indicator of creditors' perception of banks' default risk.[277]

The variable ***funding expenses*** exclusively captures banks' cost for debt assumed to respond to creditors' monitoring, hence guaranteeing to reduce the influence of other market trends. It

[273] See *Laeven/Levine* (2009).

[274] See, e.g., *Brandao-Marques/Correa/Sapriza* (2018); *Cabrera/Dwyer/Nieto* (2018); *Zardkoohi et al.* (2016); *Bhagat/Bolton/Lu* (2015); *Ignatowski/Korte* (2014).

[275] Wholesale funding is a blanket term mostly used for non-core deposits and alternative sources of funding. It mainly refers to brokered deposits and foreign deposits offered by institutional investors from inside and outside the financial system. It can be offered on an insured or uninsured senior basis with short-term as well as long-term maturities. See *Le Lesle* (2012): 3–6.

[276] For theoretical considerations, see *Calomiris* (1999) and *Gropp/Vesala* (2004). Several empirical studies have shown that uninsured sources of funding expose banks to market discipline by debt investors. See, e.g., *Danisewicz et al.* (2018); *Nier/Baumann* (2006).

[277] See *Flannery/Bliss* (2019).

is calculated by dividing the expenses on all non-customer deposit liabilities (expNCD) by the difference between total liabilities (TF) and customer deposits (CD).[278]

$$Funding\ expenses = \frac{expNCD}{(TL - CD)} * 100 \tag{3.12}$$

This approach is generally in line with previous literature in defining a balance sheet measure for risk-sensitive funding expenses.[279] If banks are exposed to an increase in funding costs due to a higher level of market discipline, they might be prone to shift their funding towards more risk-insensitive sources like customer deposits. ***Hypothesis 2b*** is tested by measuring the ratio of risk-sensitive debt to total assets (***sensitive funding***). It is calculated by taking total assets (A), subtracting non-financial customer deposits (CD) and equity (E), divided by total assets (A):

$$Sensitive\ funding = \frac{A - CD - E}{A} * 100 \tag{3.13}$$

In order to receive a comprehensive insight into the adaptation of banks' debt structure, the wholesale funding ratio is utilized as an additional outcome variable. Especially wholesale funding (WF) is a source of debt that exposes banks to market discipline, as shown by theoretical and empirical contributions.[280] It is calculated as money market funding (MMF) and other short-term funding (STF) to total funding (TF) and equity (E).

$$Wholesale\ funding = \frac{MMF + STF}{(TF + E)} * 100 \tag{3.14}$$

The ratio of customer deposits (CD) to total funding (TF) is also used to check whether banks shifted their funding sources towards customer deposits, which are relatively insensitive to banks' risk as deposits are covered by explicit deposit insurance.[281]

$$Customer\ deposits = \frac{CD}{TF} * 100 \tag{3.15}$$

By incorporating the three above variables that individually capture the extent to which banks expose themselves to market discipline by choosing the degree of risk-sensitive funding, the probability that changes in banks' funding mix are due to measurement errors is reduced.

Market-based measures are also used to analyze investors' monitoring in the short and medium term, estimated with the quarterly or monthly subsample. Since markets react immediately to changes in default probabilities, CDS spreads and stock returns are employed as short-term indicators of market monitoring.[282] Using either a quarterly or monthly frequency allows the analysis of the market reaction to critical events regarding the introduction of the resolution

[278] This measure can rather be interpreted as an approximation of risk-sensitive funding, given its simplicity. Thus, the variabe produces many outliers, which is why it is winsorized at the 5 instead of the 1 percent level. However, the author provides an additional robustness test to meet this concern. See section 5.3 and Table F.3 in the Appendix.

[279] See, e.g., *Oliveira/Raposo* (2019); *Aymanns et al.* (2016); *Körner/Schnabel* (2013).

[280] See *Huang/Ratnovski* (2011); *King* (2008); *Park/Peristiani* (1998); *Hannan/Hanweck* (1988).

[281] See *Demirgüç-Kunt/Huizinga* (2004).

[282] Previous event studies have shown that CDS spreads and stock prices quickly respond to events that can be linked to changes in banks' default or bailout probabilities, see, e.g., *Schäfer/Schnabel/Weder di Mauro* (2017); *Schäfer/Schnabel/Weder di Mauro* (2016a); *Moenninghoff/Ongena/Wieandt* (2015); *Spiegel/Yamori* (2003); *O'Hara/Shaw* (1990).

framework. Quarterly stock returns (***stock returns***) and quarterly equity volatility (***σstock***) are used to proxy the stock market reaction.[283] Although previous literature used stock market data to proxy both bank risk-taking and investors' monitoring behavior,[284] the author assumes stock market data to be suitable in the short term for capturing investor's assessment of the resolution framework.

CDS spreads are used to capture investors' reactions to the resolution framework.[285] CDS contracts set out the seller's obligation to buy bank liabilities at par for certain kinds of specified credit events. Therefore, CDS spreads provide a market estimation of expected credit losses investors would need to bear in case of a default.[286] Thus, they are suitable to assess banks' default risk since bond yield spreads contain additional factors like liquidity premiums [*Longstaff/Mithal/Neis* (2005)]. Moreover, CDS spreads are fast responding, anticipate debt downgrades [*Hull/Predescu/White* (2004); *Norden/Weber* (2004)] and have a lead over bond spreads in pricing credit risk [*Blanco/Brennan/Marsh* (2005)]. As CDS spreads are also sensitive to implicit guarantees [*Hett/Schmidt* (2017); *Acharya/Anginer/Warburton* (2016); *Balasubramnian/Cyree* (2014b)], it is reasonable to assume CDS investors to anticipate changes in bailout probabilities in a timely manner. ***CDSmean*** captures the mean CDS spread for the respective period calculated from daily CDS spreads, and ***CDS*** is the latest CDS spread quote for the respective quarter or month.

3.2.4 Bank Control Variables

All models control for main non-stationary determinants as many internal and external factors usually influence banks' risk-taking. Many constant risk-taking determinants are not controlled for as the change in risk-taking due to the change in implicit government guarantees is the main interest. Controlling for constant determinants (e.g., for corporate governance, shareholder structure, or business models)[287] would not lead to a more precise view concerning the desired estimation of the treatment effect on banks' risk-taking.[288]

Among the most widely used covariates in the literature are banks' total assets to control for bank size as this is an essential factor of bank risk. It captures diversification benefits and banks' market power, both important determinants of banks' risk-taking.[289] In line with previous literature, the variable *total assets* is transformed into its natural logarithm as they are highly skewed. Values denoted in foreign currencies are transformed into EUR using the 2010 exchange rate to adjust for inflation. In addition, the growth rate of banks' business volume is used as a covariate, assuming that high growth rates, e.g., realized by the pursuit of growth

[283] See the definition of equity volatility (3.7) and stock returns (3.8) as risk-taking proxies in the previous section.
[284] See, e.g., *Andrieș et al.* (2020); *Schäfer/Schnabel/Weder di Mauro* (2016b); *Bongini/Nieri/Pelagatti* (2015); *Moenninghoff/Ongena/Wieandt* (2015); *Kleinow et al.* (2014).
[285] Numerous authors used CDS spreads to proxy market discipline imposed on banks. See, e.g., *Demirgüç-Kunt/Huizinga* (2013); *Völz/Wedow* (2011).
[286] See *Demirgüç-Kunt/Huizinga* (2013).
[287] These are examples of stationary bank risk determinants. For some evidence, see *Laeven/Levine* (2009); *Iannotta/Nocera/Sironi* (2007).
[288] Note that constant covariates would be omitted from the estimation in fixed effects models anyway.
[289] See *Shim* (2013): 765; *Demsetz/Strahan* (1997).

strategies or by increased demand due to macroeconomic developments,[290] may be associated with higher risk. For example, the rapid growth of outstanding loans may reflect the relaxation of banks' lending standards resulting in higher levels of credit risk.[291]

$$Revenue\ growth = \frac{Gross\ revenue_{t0} - gross\ revenue_{t-1}}{Gross\ revenue_{t0}} * 100 \tag{3.16}$$

The growth rate of gross revenue[292] (***revenue growth***) is used to proxy growth for two reasons: first, for incorporating all levels of business growth and not only lending growth, and second, since revenue growth already controls for a fraction of risk associated with business growth, assuming that banks generate higher revenues for higher risk.[293] Further, the return on assets (***RoA***) is calculated as pre-tax profit to total assets to control for banks' profitability, since profitable banks may be less prone to engage in risk-taking, while banks with low RoA may be motivated to increase their earnings by taking over more risk (charter value theory).[294]

$$RoA = \frac{Pre - tax\ profit}{Total\ assets} * 100 \tag{3.17}$$

Another well-documented channel for risk-taking is liquidity, proxied by the ratio of liquid assets to total assets (***liquidity***). A higher rate of liquid assets makes banks more flexible to react to economic stress, e.g., by selling liquid assets such as government bonds as a reaction to remain solvent. A higher degree of liquid assets to total assets can potentially influence banks' solvency and the respective risk-taking proxies.[295] Moreover, the liquidity coverage ratio (LCR) requirements need to be met in stages since 2015, potentially affecting banks' risk-taking incentives.[296]

$$Liquidity = \frac{Liquid\ assets}{Total\ assets} * 100 \tag{3.18}$$

The funding liquidity may also influence the degree of banks' level of risk-taking. A higher degree of deposits to total assets (***deposit ratio***) may affect bank managers' risk appetite as they feel overconfident regarding potential liquidity shortages. Bank managers may, therefore, decide to increase lending by lowering lending standards.[297] Besides, the deposit ratio controls for potential effects of the net stable funding ratio (NSRF) on bank behavior.

$$Deposit\ ratio = \frac{Total\ deposits}{Total\ assets} * 100 \tag{3.19}$$

Another factor influencing bank risk is the capital asset ratio (***CAR***). An increase in equity will ceteris paribus reduce the return on equity, and as a reaction to a reduced yield, shareholders

[290] This could be the case for the euro area, as the persistently low interest rate level can influence banks' willingness to extend lending to risky customers and therefore affect business growth. See *Borio/Gambacorta* (2017).
[291] See *Berger/Udell* (2004).
[292] Gross revenue is computed as net interest income plus non-interest operating income.
[293] That would not be the case for the growth rate of lending or total assets, as an increase in low-risk assets would result in the same growth rate. See *Brandao-Marques/Correa/Sapriza* (2018); *Laeven/Levine* (2009).
[294] See *Berger/Klapper/Turk-Ariss* (2017): 185–204. See also the discussion in section 2.2.1.
[295] See *Shim* (2013).
[296] See *Calomiris/Heider/Hoerova* (2015).
[297] See *Khan/Scheule/Wu* (2017).

and bank managers could be determined to compensate and restore the initial level of profitability by engaging in riskier activities.[298] As banks need to increase their capital levels to meet the new regulatory requirements, this will likely influence their risk-taking incentives. The opposite and more recent view is that higher capital ratios increase a bank's "skin in the game" by ensuring that investors are more involved in loss-sharing.[299] Moreover, capital increases bank resilience against shocks, resulting in lower levels of risk.[300]

$$CAR = \frac{Total\ equity}{Total\ assets} * 100 \tag{3.20}$$

Some further bank-level controls are added when proxies for bank funding are used as dependent variables to estimate effects on market discipline. For robustness tests, the overall borrowing costs are added to show that the variation in risk-sensitive funding is not driven by the development of the general expenses for debt. They are calculated as the total interest expenses to total interest-bearing liabilities (IBL) and thus represent the consolidated expenditures for risk-sensitive and risk-insensitive sources of debt.

$$Borrowing\ costs = \frac{Interest\ expenses}{Interest - bearing\ liabilities\ (IBL)} * 100 \tag{3.21}$$

The extent to which banks are responsive to market discipline depends on the composition of debt. The ratio of subordinated debt to total assets is thus used as a further covariate calculated as:[301]

$$Subdebt = \frac{Subordinated\ borrowings}{Total\ assets} * 100. \tag{3.22}$$

3.2.5 Country Control Variables

Prior research has shown that external factors also have an influence on banks' risk-taking that needs to be controlled for. The annual real growth rate of GDP (***GDP growth***) enters the regression equation to control for the influence of the economic environment. Banks are likely to show lower levels of risk-taking during economically stable times with higher growth rates and fewer losses from insolvent customers. The same counts for the inflation rate, where a negative relationship is expected as well.[302]

[298] See *Delis/Kouretas* (2011).
[299] See, e.g., *Allen/Carletti/Marquez* (2011); *Dell'Ariccia/Marquez* (2006); *Furlong/Keeley* (1989).
[300] See, e.g., *Berger/Bouwman* (2013); *Beltratti/Stulz* (2012).
[301] See *Yhenning/Iftekhar* (2011); *Goyal* (2005); *Sironi* (2003); *Blum* (2002).
[302] See *Baselga-Pascual/Trujillo-Ponce/Cardone-Riportella* (2015); *Haq/Heaney* (2012).

Among macroeconomic variables like economic development and regulation, bank supervision can also be a critical factor. Tighter oversight is associated with more prudent behavior of banks.[303] The dataset of *Barth/Caprio/Levine* (2013) is exploited to control for potential differences before the introduction of common supervisory and regulatory standards through the single rulebook and the SREP. The dataset contains indices built from the Bank Regulation and Supervision Survey conducted by the World Bank in four examinations between 2001 and 2019. The Surveys are a collection of questions from researchers to supervisory institutions about banking regulation and supervision practices. For the empirical analysis, the indices from survey III in 2006 are used for the years from 2006 to 2010, and the indices from survey IV in 2011 are used for the following years.

The ***capital stringency index*** evaluates the strictness of capital regulation and shows country differences in the acceptance of different capital parts, such as equity. The index ranges from 1 to 10, with higher levels indicating a stricter regulation and a higher quality of bank equity components in that country. The index for ***official supervisory power*** ranges from 0-14 and shows the extent to which banking supervisory institutions can enforce actions and press charges to banks. The index was constructed from information of questions concerning whether the supervisory agency has the right to meet with external auditors of banks, which information the supervisory agency can retrieve from banks, and whether the supervisory agency can force banks to undertake structural changes, suspend banks' decision on dividends, management bonuses and order the bank's directors to constitute provisions to cover actual or potential losses. Again, higher levels are associated with less risk-taking by banks. The third index covers to what extent banks are allowed to engage in atypical banking activities, covering the areas of real estate, insurance, and securities. The index ranges from 4 to 16, with higher values indicating more activity restrictions.

Contrary to the other indices, even from a theoretical point of view, it is unclear which direction activity restrictions will influence banks' risk-taking. On the one hand, some of the activities banks are prohibited from performing are risky; restricting those activities may reduce bank risk. On the other hand, engaging in atypical banking activities may augment banks' diversification benefits and lead to less risk-taking in the long run.[304]

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[303] See *Kandrac/Schlusche* (2018); *Maddaloni/Peydró* (2011); *Buch/DeLong* (2008).

[304] Research on the relationship between bank activities and risk-taking has not resulted in a clear result so far. *Demirgüç-Kunt/Huizinga* (2010) find that trading activities can result in low-level diversification benefits and lower bank risk. *Köhler* (2015) finds that a high share of non-interest income in the revenue mix of retail-oriented banks is associated with diversification benefits, whereas investment-oriented commercial banks will become less stable and less profitable when they increase their share of non-interest income. *DeYoung/Torna*

The models estimating the resolution framework's effects on market discipline involve additional control variables. When estimating the long-term impact on market discipline, the models control for investor's ability and incentives to monitor banks by including the private monitoring index from *Barth/Caprio/Levine* (2013). The index ranges from 0 to 12, with higher values indicating a stronger encouragement for monitoring by private investors. The index is built from information on bank transparency regarding reporting practices and structural factors like management liability and the presence of rating agencies.

The models exploring bank funding differentials also control for the short-term interest rate (*short-term rate*), since interest rate changes may influence banks' funding costs and funding decisions. The level of competition among banks in a country is also expected to impact bank funding.[305] Competitive funding markets are likely to decrease banks' offered deposit rates and may also change the preference for specific funding sources. Therefore, the Herfindahl-Hirschman Index (***HHI***) enters the regressions as a measure for banking market competition.[306] The HHI expresses the relative size of a bank compared to the squared market share (MS) of the remaining banks in one country. Each banks' market share is proxied by total bank assets, and the index is calculated on an annual basis.

$$HHI = \sum_{i=1}^{n} (MS)^2 \tag{3.23}$$

(2013) emphasize the different sources of non-interest income and find that fee-based atypical activities like security brokerage and security sales will decrease bank risk, but asset-based atypical activities such as venture capital, asset securitization, and investment banking will increase bank risk.

[305] See *Craig/Dinger* (2013); *van Leuvensteijn et al.* (2008); *Graeve/Jonghe/Vennet* (2007).

[306] For previous research using the HHI as a measure for bank competition, see *Berger/Klapper/Turk-Ariss* (2017); *Jiménez/Lopez/Saurina* (2013).

3.3 Difference-in-Differences Model

The main regressions use difference-in-differences (DD) models to estimate the causal effects of the EU resolution framework on moral hazard and market discipline. Its basic design fits the research question best, as this work's primary goal is to estimate the impact on affected banks' changes in risk-taking and funding.

$$Risk_{i,t} = \alpha + \beta_1 post15_t + \beta_2 treated_i + \beta_3(post15_t * treated_i) + X_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (3.24)$$

For the effects on risk-taking (3.24), the dependent variable $Risk_{i,t}$ is one of the risk measures defined in section 3.2.2. The primary explanatory variable is the interaction term of the variables $post15_t$ and $treated_i$, the difference-in-differences (DD) estimator, which indicates the treatment effects. The variable $post15_t$ is a dummy taking the value of one for all periods after the EU resolution framework has been implemented and zero otherwise. The variable $treated_i$ takes the value of one for banks identified as treated by one of the strategies described in section 3.2.2 and zero otherwise. $X_{i,t}$ is a vector of bank and country control variables and γ_i and δ_t represent bank and time fixed effects, respectively. Bank fixed effects are included to control for unobserved bank characteristics that are constant over time and may affect risk-taking. For example, that could be bank managers' risk appetite, the management's ability, or banks' corporate governance structure [*Laeven/Levine* (2009); *Bertrand/Schoar* (2003)]. Alternatively, some models also use country instead of bank fixed effects to control for unobserved heterogeneity among countries.

A modification of Equation (3.24) is used to estimate the causal effects of the resolution framework on market discipline. The dependent variable $funding_{i,t}$ is either a measure of banks' expenditures on risk-sensitive funding or one of the measures capturing banks' funding structure described in section 3.2.3. Next to different dependent variables, some control variables are exchanged to adapt for factors that could influence either funding expenses or funding structure.

$$Funding_{i,t} = \alpha + \beta_1 post15_t + \beta_2 treated_i + \beta_3(post15_t * treated_i) + X_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (3.25)$$

As the DD model is a version of a fixed effects estimation,[307] one might argue that unobserved variables play a minor role. However, unobserved heterogeneity between the treatment and control group could still bias the results since unobserved factors could correlate with the dependent variable. Besides, the Heckman specification test reveals that bank fixed effects play a role in the regression framework. The time fixed effects, represented by δ_i, are included to control for unobserved influences that are constant across banks in a country and change over time. They aim to adapt for the time trend of particular interest in the underlying research design, as many recent regulatory changes can influence the results. The combination of time and bank fixed estimates the pure within variation by eliminating aggregate time trends.[308]

[307] See *Angrist/Pischke* (2009): 228f.

[308] Note that the dummy variables for treated banks and the treatment period are omitted due to collinearity with bank and time fixed effects.

Homoscedasticity and autocorrelation

Since the applied difference-in-differences (DD) estimator still uses OLS technique, the underlying Gauss-Markov assumptions need to be fulfilled to estimate unbiased estimators and standard errors. Two crucial assumptions are homoscedasticity and random sampling. The assumption of homoskedasticity states that the variance of the error term $\varepsilon_{i,t}$ is constant for all combinations of explanatory variables and controls.[309] That assumption is likely to be violated. For example, the variance of risk measures may vary with banks' size, capital ratio, and whether or not the bank enjoys implicit guarantees.[310] In order to receive unbiased standard errors, all regressions use heteroskedasticity-robust standard errors.[311] The random sampling assumption ("no autocorrelation") is about the time dimension, as the panel data structure contains observations for the same bank for multiple years. Observations in panel data are not independently distributed within banks but are related to each other, which leads to autocorrelated error terms. That means the above assumption is violated, and statistical inference becomes harder because OLS is no longer efficient and understates standard errors. Cluster robust standard errors are used to circumvent this flaw and draw statistical inference from OLS estimates. That leads to the decision on what to cluster over. Because serial and interclass correlation (Moulton factor) can be of importance, some practitioners argue that clustering at the country level estimates robust standard errors and accounts best for the within-cluster variation.[312] As this work's primary interest is the within bank variation, and as the inter-cluster (country) variation is assumed to be of minor importance, the standard errors are clustered at the bank level and reported in parenthesis.[313]

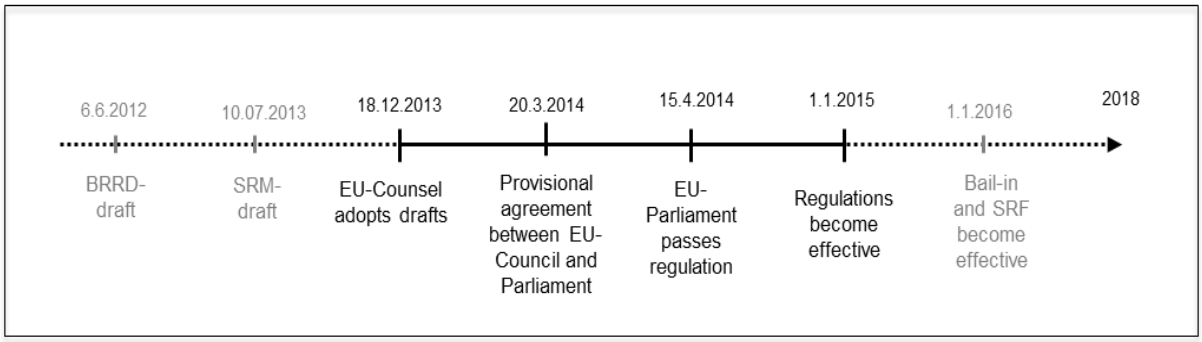
Timing of the treatment

In difference-in-differences regressions, the identification of the treatment time is crucial. The legislative process for the EU resolution framework lasted over three years, starting with the first draft presentation in mid-2012 and resulting in the passage of the bill at the end of 2013.

As for all policy amendments, it is quite ambiguous to predict whether banks started to adapt their risk-taking early before the passage of the regulations or after they became effective. Prior research has shown that the strongest response of CDS spreads and stock returns was observed when the EU Parliament passed the regulation.[314] Thus, the author assumes that investors have increased monitoring after the EU parliament's adoption and that banks reacted by adapting their risk-taking (Figure 3.2).

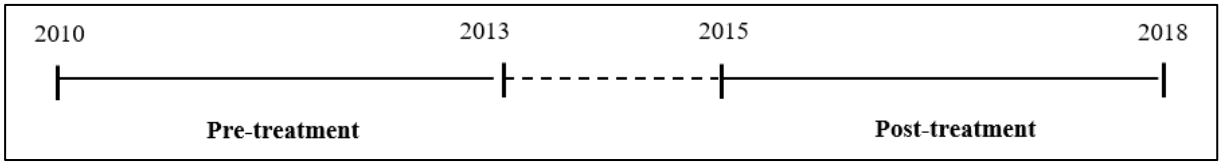
[309] See *Wooldridge* (2016): 317-320; 373-374.
[310] Large banks tend to be riskier and usually show a greater variability in the realized risk, depending of the risk measure employed.
[311] See *White* (1980).
[312] See *Cameron/Miller* (2015); *Angrist/Pischke* (2009): 315–318. The usual recommendation is to cluster at the highest level available, that is the country level in this approach.
[313] See *Abadie et al.* (2017). Anyhow, the number of countries resulting in clusters is probably too small and would overstate the estimated standard errors resulting in a too conservative statistical inference.
[314] See *Schäfer/Schnabel/Weder di Mauro* (2017).

Figure 3.2: Timeline of the BRRD & SRM legislative development



Given the main sample's annual structure and the fact that the regulation became effective in 2015, the post-treatment period starts from that date. The treatment period 2014 is excluded from the analysis since it is unclear whether banks anticipated the regulation or reacted with delay to it. The BRRD and the SRM-Regulation became fully effective one year later, at the beginning of 2016, when the bail-in tool was applicable, and the Single Resolution Fund (SRF) became operative. The dataset is restricted to four years before and after the treatment period to avoid bias from structural breaks (Figure 3.3).

Figure 3.3: Periods for the difference-in-differences analysis



4 Results on Risk-Taking

This section contains all results for the effects of the EU resolution mechanism on risk-taking. Since the author expects different responses to the regulation depending on banks' jurisdiction, the effects are estimated separately for eurozone (SRM region) and non-eurozone (BRRD region) member states. For both areas, the analysis begins by exploring the univariate difference in means (section 4.1.1 and 4.2.1). After presenting the results of the main difference-in-differences analysis, robustness checks are performed to validate the obtained results. In the main approach, the treatment variable *IGG* identifies banks having a bailout probability of at least 50 percent in 2013. Observations from banks accommodated in Cyprus, Estonia, Latvia, Lithuania, and Slovakia are excluded since banks in these countries have estimated bailout probabilities below 50 percent in 2013.

4.1 Effects of the SRM on Risk-Taking

4.1.1 Univariate Difference in Means Analysis

Table 4.1 contains the results of the univariate difference-in-differences regression. Depicted are the means of the dependent variables for the pre- and post-treatment periods of the treatment and control group.[315] The univariate analysis reveals some remarkable differences among groups and treatment periods. The difference in levels shows that treated banks (column 1) are on average riskier than non-treated banks (4) during the pre-treatment period, except for the RWA density. Banks enjoying implicit guarantees have a lower distance to default (z-score), higher credit risk, engage more in trading activities, have a higher standard deviation of earnings (σRoA), and are more leveraged (CAR). Only the RWA density indicates lower asset risk for treated banks, probably due to the use of internal ratings-based (IRB) approaches. Both groups' risk measures indicate less risk-taking and increased bank stability after the treatment (columns 3 and 6), but guaranteed banks decreased their risk more sharply.

From a univariate perspective, the reduction in risk measures for treated banks is statistically significant against the control group for the z-score, impairment variables, trading securities, and the standard deviation of earnings (7). The pre-post differences are also economically meaningful, as columns (3) and (6) show, with treated banks having increased their z-score by 36 percent (8 percent for untreated) and reduced their total impairments by 52 percent (22 percent for untreated). The decreases in earnings volatility (46 vs. 16 percent) and trading securities (25 vs. 3 percent) suggest that guaranteed banks changed their business policies seeking less riskier strategies. However, banks without the prospect of support reduced their average NPL and LLR ratios to a slightly higher degree than supported banks (column 7). The difference in levels between both groups has decreased considerably after the treatment but remains apparent (columns 2 and 5).

As both groups significantly reduced their risk, the observed changes must also be attributed to other regulatory adjustments or economic developments. Nevertheless, banks with implicit guarantees reduce their risk more severely compared to their peers, providing preliminary

[315] All variable definitions are presented in Table C.1 in the Appendix.

evidence for a treatment effect following ***Hypothesis 1a***. Column (7) shows the univariate treatment effects attributable to the EU resolution framework's reduction of implicit guarantees.

Table 4.1: Univariate difference in means for risk-taking | SRM

This table presents univariate difference in means results for the SRM region. The treatment variable (*IGG*) separates the sample into two groups, where the treated group consists of banks with a minimum bailout probability of ≥ 50%. The pre-treatment period reaches from 2010 to 2013 and the post-treatment period from 2015 to 2018. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

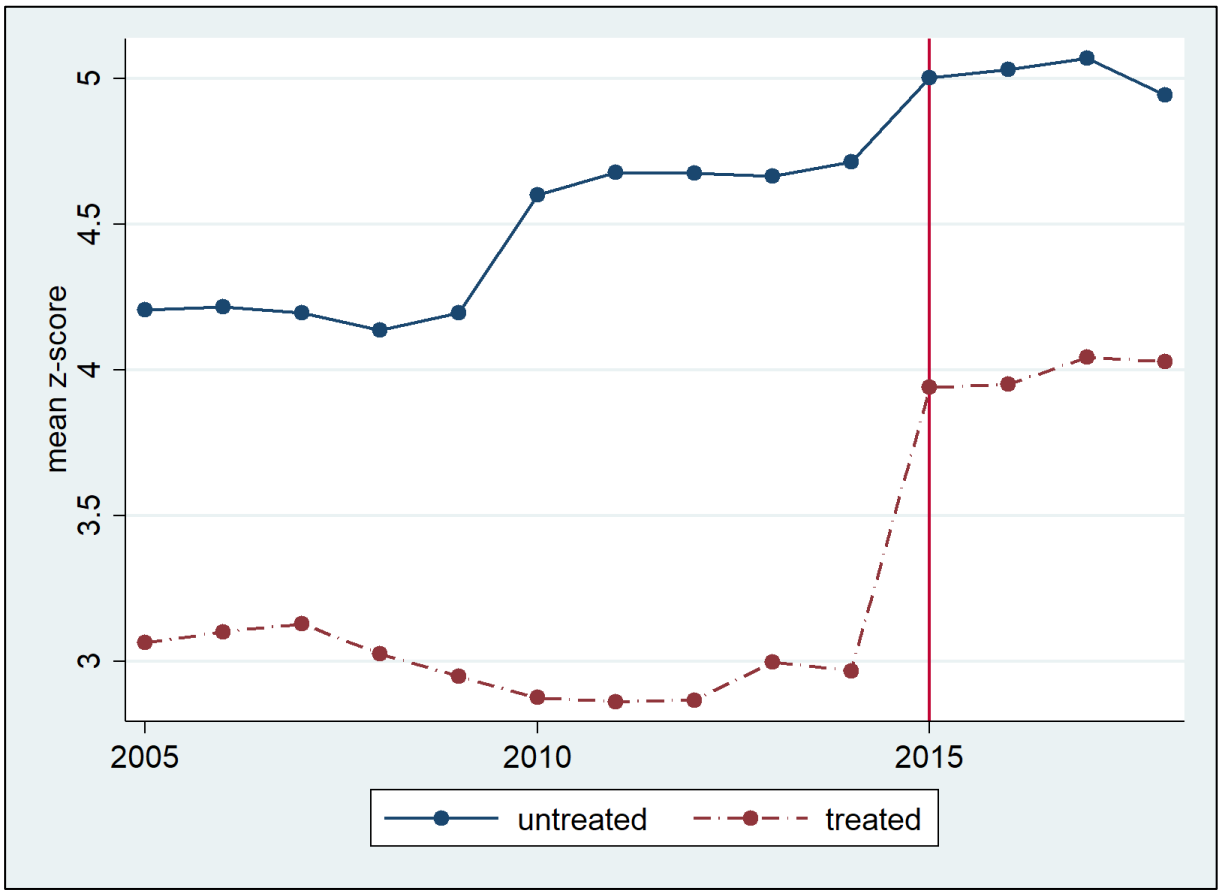
	Treated			Non-treated			
	(1)	(2)	(3) = (2) - (1)	(4)	(5)	(6) = (4) - (3)	(7) = (3) - (6)
Dependent variables	Pre	Post	Diff	Pre	Post	Diff	DD
z-Score	2.75	3.75	1.00***	4.00	4.34	0.34***	0.656***
RWA density	47.07	42.04	-5.03***	54.01	51.23	-2.77***	-2.25
Loan impairment	1.00	0.46	-0.55***	0.37	0.33	-0.04	-0.50*
Total impairments	0.69	0.30	-0.39***	0.27	0.21	-0.06**	-0.331***
NPL-ratio	7.53	7.46	-0.07	5.15	4.44	-0.72**	0.65
LLR-ratio	3.99	3.95	-0.04	2.70	2.50	-0.20*	0.17
Trading securities	10.50	7.87	-2.63***	2.04	1.97	-0.067	-2.56***
CAR	5.31	7.67	2.36***	8.99	10.41	1.41***	0.95
RoA	-0.03	0.40	0.43***	0.345	0.369	0.02	0.405***
σRoA	0.77	0.42	-0.36***	0.36	0.31	-0.05**	-0.30***
σStock	5.73	4.86	-0.87***	4.59	4.04	-0.56	-0.319
Stock returns	-9.69	-15.54	-5.85	-11.37	-9.14	2.23	-8.09

Testing for Parallel Trends

The assumption that the treatment and control group are both exposed to similar circumstances and, therefore, developed equally until treatment is crucial for correct inference from the difference-in-differences analysis. The presumption cannot be tested with specific measures leading to exact results. However, it can be assessed by plotting the dependent variable's graph to see whether the parallel trend assumption holds. Parallel trends of several risk measures are hence depicted for different treatment and control groups. The yearly development of risk measures is illustrated to provide a precise picture of the realized trends. Relying on means for only a few different points in time could distort the conclusion.[316] For a proper investigation of long-term pre-treatment trends, the sample is extended to another five periods beginning in 2005.

[316] See *Angrist/Pischke* (2009).

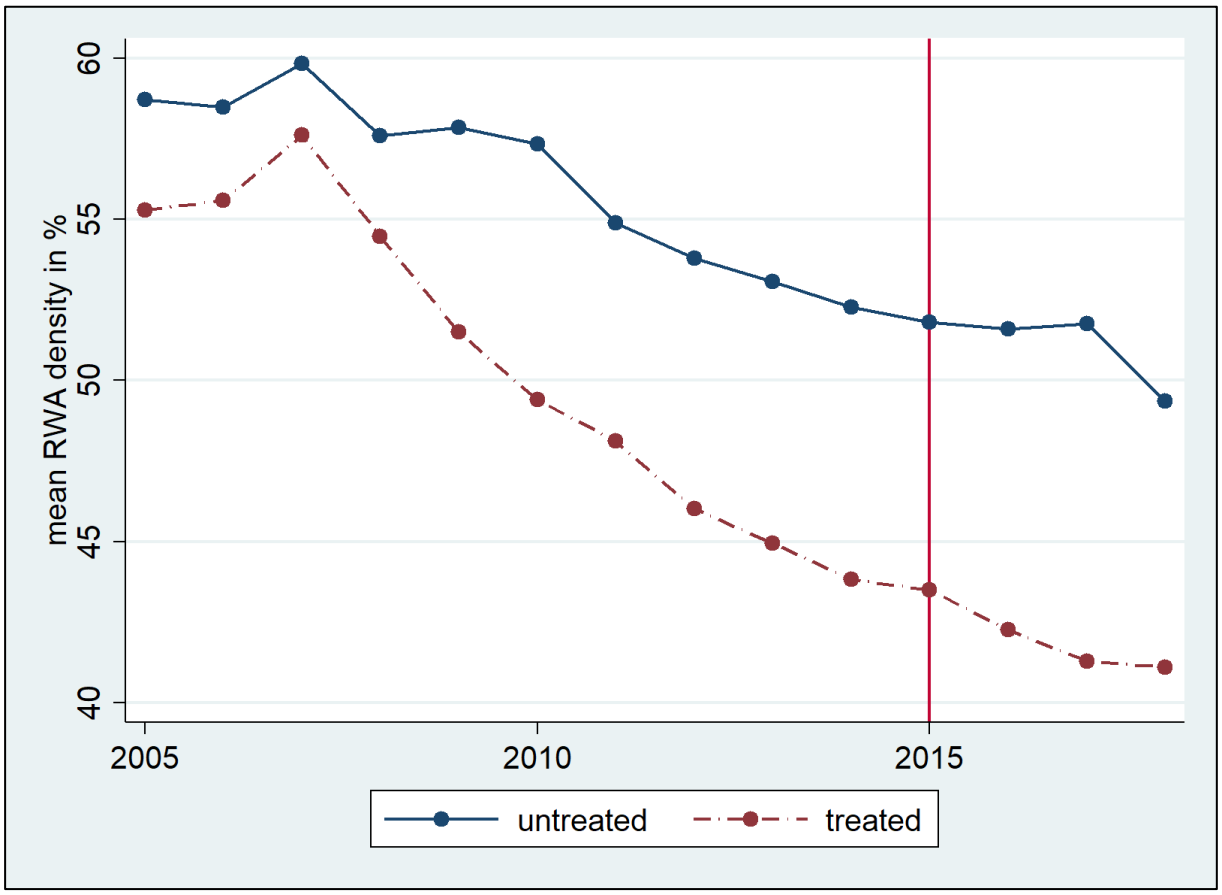
Figure 4.1: Parallel trends of z-scores | IGG



This figure presents parallel trends of the mean z-scores (defined as return on assets plus the capital ratio divided by the standard deviation of return on assets). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥50% in 2013 and zero otherwise. The standard deviation of the return on assets which enters the z-score as the denominator is calculated for the following periods: 2005-2009, 2010-2014 and 2015-2018. The treatment period 2014 is included.

The visual inspection of the z-score development reveals that both groups follow the same trend for most of the sample periods (Figure 4.1). The untreated group increased their z-score in 2010, not accompanied by the treated group enjoying implicit guarantees. The treatment group's decline in z-score could be due to higher risk-taking during the eurozone crisis, fueled by rising implicit guarantees. Both groups increased their z-score rapidly in 2015, but treated banks improved their distance to default even more. The overall increase in bank stability may result from the eurozone crisis having ceased and the implementation of capital requirements and additional regulations through the single rulebook. The divergence may be regarded as a first suggestion for the treatment group's reaction to the SRM. The difference in levels is most likely a result of implicit guarantees, leading to higher risk-taking for treated banks throughout the entire sample period. Nevertheless, the treatment in 2015 results in a much smaller z-score difference between treated and untreated banks.

Figure 4.2: Parallel trends of RWA densities | IGG



This figure presents parallel trends of the mean RWA density (defined as the risk weighted assets to total assets in %). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥50% in 2013 and zero otherwise. The treatment period 2014 is included.

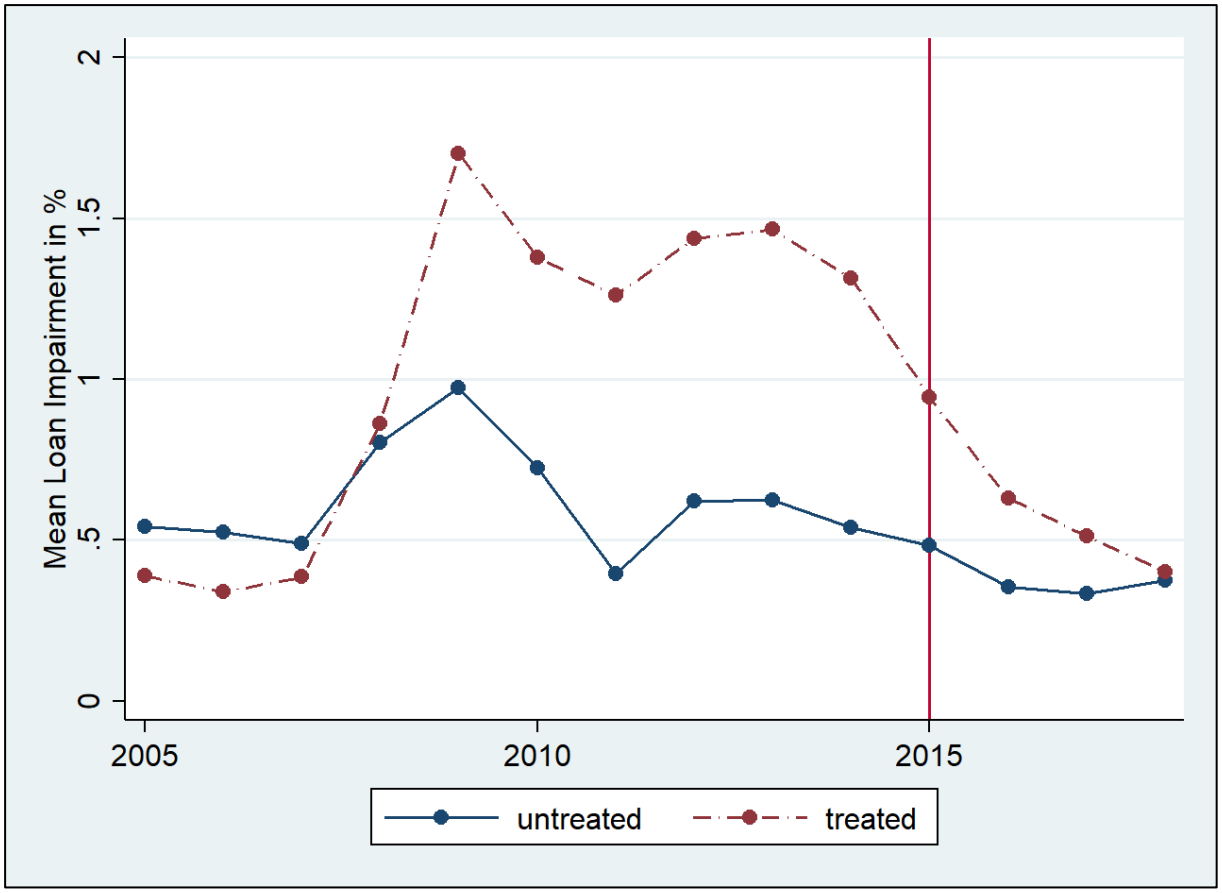
Figure 4.2 shows the mean of the RWA density for the treatment group and the control group. Employing a yearly comparison allows for a more apparent distinction of whether both groups have the same underlying trend. Although the RWA density levels vary, both groups seem to be exposed to the same factors. The reduction of the RWA density already starts in 2008 with treated banks sharply reducing average asset risk. The early decline might be due to the use of the IRB approaches for calculating risk-weighted assets, exacerbating the interpretation of differences in levels. Moreover, higher capital requirements might also induce banks to lower asset risk.[317] Unlike the z-score, the treatment did not significantly narrow the difference in levels of treated and untreated banks. Nevertheless, the SRM seems to amplify the reduction of asset risk as the mean RWA density decreases sharply after 2015, which is not followed by the treatment group.

The results for the parallel trend assumption are robust to changes in risk measures and treatment variables. A similar view is obtained when Other Systemically Important Institutions (O-SIIs) identified by the EBA are used as the treatment group and the loan impairments as risk measure. Figure 4.3 reveals that O-SII and non-O-SII banks followed the same trend from 2005 onwards. However, the treated banks took on much greater credit risk during the GFC and subsequently had higher loan impairment levels throughout the pre-treatment period. From 2014 onwards, both groups reduced their ratio of loan impairments notably. Nevertheless, O-

[317] See, e.g., *Garel/Petit-Romec* (2017).

SIIs show a much more aggressive reduction until both groups have equal levels. The development of credit risk underscores the extent of implicit guarantees provided. Guaranteed banks are exposed to a more significant increase in bad loans and managed to diminish the difference in levels shortly after the SRM removed implicit guarantees.

Figure 4.3: Parallel trends of loan impairments | O-SII



This figure presents the development of the mean loan impairments (defined as loan impairment charges to total gross loans in %). The treatment variable is a dummy taking the value of one for banks identified as O-SII by the EBA and zero otherwise. The treatment period 2014 is included.

Combining the insights from the visual inspections, the author concludes that first, the treatment and the control group follow similar trends, which makes it possible to compare these groups in a difference-in-differences analysis to draw causal inference. Second, although the overall direction for the risk measures discussed above is decreasing, the introduction of the resolution scheme in 2015 seems to have accelerated the risk reduction.

4.1.2 Multivariate Difference-in-Differences Analysis

This part presents the main DD regressions with bank and country controls and bank, country, and time fixed effects. For all regressions, the treatment period (2014) is excluded. All models in this section use the same bank and country-level covariates. The number of observations deviates between models due to the data availability of the dependent variables.

Table 4.2: SRM effects on risk-taking | baseline

This table presents baseline results from DD regressions of the SRM effects on risk-taking (H-1a). The interaction term *post15 * IGG* is the DD estimator taking the value of one for banks with bailout probabilities ≥ 50% in all periods after the SRM has been established and zero otherwise. Three risk measures are used as dependent variables: the z-score (defined as return on assets plus the capital ratio divided by the standard deviation of return on assets), RWA density (defined as the risk-weighted assets to total assets in %), and the loan impairments (defined as loan impairment charges to total gross loans in %). Models (1) to (3) include bank and time fixed effects, models (4) to (6) include country and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-Score	RWA density	Loan impairments	z-score	RWA density	Loan impairments
Post15 * IGG	0.518***	-2.695***	-0.195**	0.448***	-2.370*	-0.219**
	(0.140)	(1.020)	(0.092)	(0.140)	(1.343)	(0.094)
Total assets	0.030	-5.736***	-0.086	0.008	-0.956**	0.020
	(0.107)	(1.422)	(0.113)	(0.036)	(0.470)	(0.027)
Revenue growth	-0.001	-0.006	0.001	-0.000	-0.007	0.002*
	(0.001)	(0.007)	(0.001)	(0.001)	(0.012)	(0.001)
RoA	0.176***	-0.568	-0.539***	0.052	-1.375	-0.395***
	(0.038)	(0.601)	(0.072)	(0.059)	(1.027)	(0.065)
CAR	0.016*	0.095	0.013	0.019***	1.343***	0.035**
	(0.010)	(0.375)	(0.018)	(0.007)	(0.326)	(0.014)
Liquid assets	-0.008***	-0.283***	-0.001	-0.008***	-0.479***	-0.001
	(0.003)	(0.059)	(0.004)	(0.003)	(0.039)	(0.002)
Deposit ratio	-0.001	-0.068	0.003	0.011***	0.112***	-0.007**
	(0.003)	(0.049)	(0.006)	(0.003)	(0.040)	(0.003)
GDP growth	0.044**	-0.162	-0.137***	0.054***	-0.521*	-0.145***
	(0.018)	(0.225)	(0.029)	(0.019)	(0.311)	(0.030)
Inflation rate	0.156***	1.611***	-0.293***	0.200***	0.845	-0.352***
	(0.034)	(0.548)	(0.050)	(0.037)	(0.622)	(0.057)
Supervisory power	-0.049***	-0.112	-0.018	-0.047***	-0.005	-0.024
	(0.012)	(0.252)	(0.023)	(0.015)	(0.289)	(0.026)
Activity restrictions	0.077**	1.359	-0.214***	0.089***	0.885	-0.250***
	(0.031)	(0.962)	(0.039)	(0.034)	(1.179)	(0.042)
Capital stringency	0.038*	-1.228**	0.034	0.032	-1.321**	0.035
	(0.021)	(0.535)	(0.031)	(0.025)	(0.634)	(0.035)
Constant	2.516	191.256***	4.539	2.456***	62.221***	2.536***
	(2.534)	(36.615)	(2.974)	(0.946)	(17.154)	(0.866)
Observations	4,795	3,180	4,708	4,795	3,180	4,708
Number of banks	631	561	621	631	561	621
Adjusted R^2	0.254	0.220	0.199	0.0914	0.395	0.118

As Table 4.2 reveals, the DD estimator (*post15 * IGG*) is significant and shows the predicted sign for all three risk measures for both bank (models 1 to 3) and country (models 4 to 6) fixed effects.[318] Treated banks show an increased z-score by 0.52 higher than the z-score of non-treated banks. That result is highly statistically significant and of great magnitude, meaning that treated banks increased their distance from insolvency due to the SRM by 19 percent, given their pre-treatment level. Treated banks also decreased their RWA density by about 2.7 percentage points more compared to the control group, equivalent to a decrease of 6 percent from the pre-treatment level. The effects on loan impairments are economically weaker, with a higher

[318] The sample size varies depending on the data availability of the dependent variables.

reduction of loan impairments to total gross loans by about 0.2 percentage points against untreated banks. The results are entirely in line with ***Hypothesis 1a*** build in section 2.3.1. The models' fit is also respectable, with the adjusted R^2 displaying that the model explains about 20% of dependent variables' variation.

Table 4.3: SRM effects on risk-taking | alternative risk measures

This table presents DD regression results of the SRM effects on risk-taking (H-1a) using alternative risk-measures: Total impairments (defined as total impairment charges to total assets), NPL-ratio (defined as non-performing loans to total loans), LLR-ratio (defined as loan loss reserves to total loans), trading securities (defined as tradable securities to total assets), trading securities (defined as tradable securities and available for sale assets to total assets), σStock (defined as the annual standard deviation of stock returns, and market z-score (defined as capital ratio and annual stock returns divided by σStock). Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Total impairments	(2) NPL-ratio	(3) LLR-ratio	(4) Trading securities	(5) σStock	(6) Stock returns
Post15 * IGG	-0.117**	-1.192**	-0.718**	-1.657***	-0.764*	-13.991**
	(0.056)	(0.607)	(0.344)	(0.588)	(0.450)	(6.188)
Constant	2.274	9.789	4.239	-22.432	8.985	475.799
	(1.411)	(16.466)	(7.797)	(17.896)	(21.653)	(370.199)
Observations	4,740	3,516	3,802	3,937	509	509
Number of banks	624	594	606	572	72	72
Adjusted R^2	0.290	0.288	0.241	0.133	0.340	0.326

Although three risk measures have already been employed, alternative proxies for bank risk-taking are engaged for an augmented recognition of banks' risk-taking.[319] The accounting-based risk measures are total impairments, NPL-ratio, LLR-ratio, and trading securities, capturing banks' trading activity. σStock and stock returns are market-based measures to offer some alternative specifications, robust against accounting manipulation. The sample size for the market-based risk measures naturally decreases to listed banks, of which 33 have bailout probabilities above the treatment threshold.

Table 4.3 shows the results for alternative risk proxies, which are generally in line with the results obtained for the main risk proxies. All DD coefficients are significant or highly significant (4) and have the expected sign, indicating a risk-decreasing effect on treated banks exceeding that of the reference group. Even the DD estimators for the NPL and LLR ratios, which were insignificant in the univariate analysis, now reveal a more pronounced risk reduction for implicitly supported banks when covariates and fixed effects are used. Among listed banks, treated banks reduced σStock by 0.8 standard deviations against untreated banks. Treated banks also show a decline in stock returns, exceeding the control group's drop in returns by 14 percentage points (6), suggesting that losing implicit guarantees is associated with avoiding high rewarding and risky business strategies.

[319] The dependent variables are exchanged with alternative risk measures. The models remain otherwise unchanged, containing the same covariates as the models depicted in Table 4.2.

4.1.3 Risk-Taking of Systemically Important Banks

An interesting research question for assessing the SRM's credibility is whether very large banks and those identified as Global Systemically Important Institutions (G-SIIs) show the same effect of reduced risk-taking after the implementation of the resolution mechanism. As pointed out in ***Hypothesis 1b***, it is questionable whether the SRM can credibly remove implicit bailout guarantees for very large banks. Since the resolution of large and complex institutions, while maintaining financial stability may seem implausible, their response to the SRM is unclear. Hence, different subsamples are formed by dropping banks below certain size thresholds, starting with EUR 40 billion.[320] Since the selection of size limits is not free from arbitrariness, multiple approaches are used to increase the robustness of the results.[321] Examining large banks above certain size thresholds is furthermore assumed to reduce potential bias from bank heterogeneity, increasing the results' expressiveness.

Table 4.4: SRM effects on risk-taking | large banks (40 and 50 bn)

This table presents DD regression results using a reduced sample of banks with total assets of at least EUR 40 (panel A) or EUR 50 bn (panel B) in 2013 (H-1b). The interaction term *post15 * IGG* is the DD estimator taking the value of one for banks with bailout probabilities ≥ 50% in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	z-Score	RWA density	Loan imp.	NPL-ratio	LLR-ratio	σStock	Stock returns
Panel A: 40 bn.							
Post15 * IGG	-0.054	-3.402**	-0.068	-2.785**	-2.211**	1.724*	-26.472
	(0.256)	(1.528)	(0.130)	(1.191)	(0.872)	(0.927)	(16.665)
Constant	20.532**	164.519***	-3.211	-15.461	-3.650	31.537	895.874
	(8.767)	(59.141)	(6.498)	(41.501)	(26.861)	(37.864)	(601.771)
Observations	554	513	558	518	537	253	253
Number of banks	73	71	72	69	69	34	34
Adjusted R^2	0.472	0.255	0.503	0.433	0.375	0.482	0.370
Panel B: 50 bn.							
Post15 * IGG	-0.182	-3.688**	-0.052	-3.349***	-2.485***	1.288	-18.679
	(0.279)	(1.527)	(0.140)	(1.215)	(0.920)	(1.058)	(16.997)
Constant	24.268**	173.511***	-4.274	-40.626	-12.132	14.158	1,358.521**
	(9.451)	(59.163)	(7.787)	(39.944)	(29.261)	(42.751)	(575.678)
Observations	484	455	486	451	468	230	230
Number of banks	64	62	63	60	60	30	30
Adjusted R^2	0.436	0.267	0.474	0.468	0.393	0.490	0.395

Table 4.4 shows the results for banks with total assets of EUR 40 billion (Panel A) and EUR 50 billion (Panel B) in total assets.[322] Although most of the coefficients show a reduced risk-taking of treated banks, the results for the z-score and the market-based risk-measures are

[320] The first threshold is motivated by the ECB's identification strategy for significant institutions. Choosing a higher level above EUR 30 billion avoids overlapping with that group (see section 3.2.1.2).

[321] Size has been identified as the number one driver of systemic importance, see *Black et al.* (2016); *Laeven/Ratnovski/Tong* (2016), (2014); *Pais/Stork* (2013). It is hence reasonable to assume that those banks are harder to wind-down as they are more complex and more interconnected. See section 2.1.2.

[322] Panel A contains 49 and Panel B 42 treated banks.

weaker compared to the baseline models in the previous section. Turning to the higher size limits of EUR 60 and 80 billion in Table 4.5 supports this view.[323] The effects on risk-taking become weaker with increasing size thresholds. Treated banks appear to face lower incentives to decrease their risk compared to untreated banks of similar size, as suggested by ***Hypothesis 1b***. Nevertheless, the results could still be biased as the number of untreated banks decreases with rising size thresholds.[324]

Table 4.5: SRM effects on risk-taking | large banks (60 and 80 bn)

This table presents DD regression results using a reduced sample of banks with total assets of at least EUR 60 (panel A) or EUR 80 bn (panel B) in 2013 (H-1b). The interaction term *post15 * IGG* is the DD estimator taking the value of one for banks with bailout probabilities ≥ 50% in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(12)
Dependent variables	z-Score	RWA density	Loan imp.	NPL-ratio	LLR-ratio	Trading securities	Total impairments
Panel A: 60 bn.							
Post15 * IGG	-0.255	-2.865*	-0.036	-3.384***	-2.735***	-1.464	0.202**
	(0.290)	(1.521)	(0.154)	(1.261)	(0.971)	(1.268)	(0.100)
Constant	22.205**	188.396***	-4.121	-39.377	-15.777	18.102	0.370
	(9.559)	(58.489)	(7.968)	(40.510)	(29.133)	(52.650)	(4.273)
Observations	464	436	465	432	447	457	467
Number of banks	61	59	60	57	57	59	60
Adjusted R^2	0.436	0.307	0.446	0.478	0.410	0.415	0.565
Panel B: 80 bn.							
Post15 * IGG	-0.018	-1.684	0.069	-2.982	-1.459	-2.747**	0.009
	(0.423)	(2.072)	(0.177)	(1.801)	(1.030)	(1.186)	(0.144)
Constant	24.958*	90.040	9.671	-40.260	-20.280	43.251	-4.446
	(13.062)	(65.672)	(8.492)	(59.195)	(37.918)	(39.147)	(6.988)
Observations	363	340	353	329	343	349	359
Number of banks	47	46	46	44	44	45	46
Adjusted R^2	0.353	0.321	0.555	0.346	0.270	0.477	0.511

To conclude, there is evidence that the SRM reduces moral hazard among big banks, but the effects are smaller and verifiable for fewer risk measures. This finding is broadly in line with the results from *Ignatowski/Korte* (2014), who conclude that the resolution tools in the United States are not a credible threat for very large banks.

Another appealing research question from an academic and an economic point of view is whether banks identified as Global Systemically Important Institutions (G-SIIs) reduced their risk-taking. Research on the post-treatment response of G-SIIs contributes to investigating the SRM's credibility for the biggest and most systemically important banks previously considered highly likely to be bailed out.

[323] The market-based risk measures are replaced by trading securities and total impairments as the control group among listed banks shrinks dramatically with size thresholds above EUR 50 billion.

[324] In Table 4.4, panel A contains 49 treated and 24 untreated, whereas panel B contains 42 treated and 22 untreated banks. In Table 4.5, panel A contains 41 treated and 20 untreated, whereas Panel B contains 35 treated and 12 untreated banks.

Table 4.6: SRM effects on risk-taking | G-SIIs

This table presents DD regression results of G-SIIs' risk-taking (H-1b). The interaction term *post15 * G-SII* is the DD estimator taking the value of one for G-SIIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. Models (1) to (3) include bank and time fixed effects, models (4) to (6) include country and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	RWA density	Loan impairments	z-score	RWA density	Loan impairments
post15 * G-SII	0.414***	1.838*	-0.232***	0.337**	3.718***	-0.248***
	(0.153)	(1.047)	(0.086)	(0.156)	(1.252)	(0.087)
Constant	3.402	167.650***	7.777***	3.815***	54.136***	3.393***
	(2.612)	(35.394)	(2.328)	(1.131)	(15.703)	(1.008)
Observations	4,597	3,017	4,527	4,597	3,017	4,527
Number of banks	602	537	596	602	537	596
Adjusted R^2	0.221	0.249	0.149	0.0881	0.414	0.0721

The risk-taking analysis is performed with the basic difference-in-differences setup with G-SIIs forming the treatment group. Observations from countries not having any G-SIIs operating in their banking sectors are excluded from the sample to construct a homogenous control group.[325] Table 4.6 shows the results for the primary risk measures with bank and time (1) - (3) or country and time fixed effects (4) - (6). The results for the z-score are economically weaker compared to the baseline identification but still indicate a tougher reduction of G-SII's distance to default against the control group. The loan impairments are as well decreased more strongly, generally supporting ***Hypothesis 1b***. In contrast to the baseline definition of treated banks, G-SIIs increased their RWA density on average by 1.8 percentage points compared to the control group, although the coefficient is only significant at the 10%-level.

The risk-taking of G-SIIs is more closely examined by using alternative risk measures in the same difference-in-differences setup, presented in Table 4.7. All additional risk measures except for stock returns (6) deliver statistically significant results, consistently displaying that G-SII's reduction in risk-taking exceeds that of the comparison group. The magnitude of the risk-decreasing effect induced by the SRM on the G-SIIs is meaningful. The NPL ratio is reduced by 1.7 percentage points, and the level of trading securities by 3.8 percentage points compared to the control group. The results of the accounting-based risk measures can be confirmed by σStock as an indicator of investors' perception of risk.

[325] This leaves Austria, Belgium, Finland, France, Germany, Italy, Netherlands, and Spain in the G-SII sample.

Table 4.7: SRM effects on risk-taking | G-SIIs (alternative risk measures)

This table presents results from the DD regressions of G-SIIs' risk-taking (H-1b). The interaction term *post15 * G-SII* is the DD estimator taking the value of one for G-SIIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Total impairments	(2) NPL-ratio	(3) LLR-ratio	(4) Trading securities	(5) σStock	(6) Stock returns
Post15 * G-SII	-0.133***	-1.714***	-0.912***	-3.757***	-1.006**	-0.143
	(0.047)	(0.498)	(0.279)	(0.754)	(0.426)	(5.172)
Constant	3.365***	11.226	1.770	-30.238	34.243	-406.746
	(1.255)	(15.628)	(7.134)	(19.457)	(23.396)	(363.918)
Observations	4,554	3,349	3,619	3,743	452	452
Number of banks	598	571	580	544	64	64
Adjusted R^2	0.195	0.270	0.216	0.163	0.318	0.369

The regressions are re-estimated with reduced samples to obtain more reliable results. Performing this analysis involves the decision about the correct control group. Banks with total assets below EUR 40 or 60 billion are excluded forming a more homogenous peer group as the G-SIIs distinguish from other banks, mainly in terms of size.[326] Table 4.8 shows the results of the analysis for the risk-taking of G-SII. In the reduced sample for large banks with at least EUR 40 billion in total assets in panel A, the coefficients capturing credit risk yield significant results. Moreover, G-SIIs decreased their trading portfolio on average by 3.6 percentage points against the control group. The results of panel B, containing all banks above EUR 60 billion, increase in significance and magnitude. With a reduction in loan impairments exceeding that of non-G-SIIs by 0.37 percentage points, the effect is even higher than the baseline results for the whole sample, depicted in Table 4.2.

This section's results support ***Hypothesis 1b***, revealing that very large banks are less affected by the regulation. One can see that compared to other large banks, G-SIIs significantly decreased their risk regarding their loan quality and their trading portfolio. Concluding, G-SIIs may face weaker incentives to lower their risk assuming that the SRM is not suitable to wind down large and complex banking groups and hence still expect to be bailed out. Another explanation is that large and complex banks may have trouble to reduce their risk-taking as their operational structure and complexity may impede changes.[327] The effect of post-crisis reforms on global systemically important banks has been analyzed by some scholars before, obtaining mixed results on their risk-taking [*Goel/Lewrick/Mathur* (2019); *Cabrera/Dwyer/Nieto* (2018)].

[326] See *Kleinow/Nell* (2015).
[327] See, e.g., *Correa/Goldberg* (2020).

Table 4.8: SRM effects on risk-taking | G-SIIs (different control groups)

This table presents DD regression results of G-SIIs' risk-taking (H-1b). Panel A includes all banks with a minimum value of EUR 40 bn in total assets. Panel B includes all banks with a minimum value of EUR 60 bn. in total assets. The interaction term *Post15 * G-SII* is the DD estimator taking the value of one for G-SIIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(12)
Dependent variables	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	Trading securities	Total impairments
Panel A: 40 bn							
Post15 * G-SII	-0.010	1.394	-0.250***	-1.681**	-0.685*	-3.568***	-0.070
	(0.251)	(1.560)	(0.090)	(0.689)	(0.378)	(0.753)	(0.061)
Constant	28.232***	76.298	0.673	23.392	7.533	-38.094	0.500
	(9.459)	(75.025)	(6.966)	(38.053)	(21.878)	(37.244)	(3.270)
Observations	491	446	486	446	465	478	488
Number of banks	64	62	63	60	60	62	63
Adjusted R^2	0.471	0.298	0.560	0.323	0.275	0.502	0.611
Panel B: 60 bn							
Post15 * G-SII	0.358	2.270	-0.365***	-2.071***	-0.876**	-3.070***	-0.126*
	(0.269)	(1.671)	(0.107)	(0.754)	(0.433)	(0.870)	(0.070)
Constant	31.662***	107.881	-2.471	-11.885	10.914	-19.226	1.046
	(10.483)	(68.475)	(8.639)	(33.327)	(18.107)	(47.331)	(4.247)
Observations	409	373	401	368	383	393	403
Number of banks	53	51	52	49	49	51	52
Adjusted R^2	0.434	0.415	0.461	0.307	0.263	0.533	0.539

4.1.4 The Impact of Charter Values

As pointed out in ***Hypothesis 1c***, banks' charter value may influence risk-taking even when implicit guarantees evoked moral hazard beforehand. It is hard to predict whether charter values affect banks' behavior after implicit guarantees have been abolished. Because despite implicit guarantees, banks with high charter values may face fewer incentives to engage in moral hazard than banks with low charter values. Moreover, banks with lower charter values may subsequently obtain relatively low incentives to reduce risk-taking when losing implicit guarantees, as they are more concerned about catching up with their competitors. To the best of the authors' knowledge, the effect of charter values on banks' risk-taking after removing implicit guarantees has not yet been directly analyzed.[328]

Tobin's q is employed as the main proxy for market power to examine the effect of bank charter values on risk-taking after the SRM has been introduced.[329] It is calculated in line with the literature[330] on bank charter values as:

[328] *Damar/Gropp/Mordel* (2014) analyze the effect of charter values on risk-taking with implicit guarantees in place.

[329] The use of Tobin's q as a proxy for market power has initially been proposed by *Lindenberg/Ross* (1981). Its rationale is the expectation that when a firm's market value exceeds its replacement costs, the firm is able to earn rents above a competitive return, reflecting a high monopoly power.

[330] See *Damar/Gropp/Mordel* (2014); *De Nicolo* (2000); *Demsetz/Saidenberg/Strahan* (1996); *Keeley* (1990).

$$Tobin's\ q = \frac{MVE + BVL}{BTA}. \tag{4.1}$$

MVE is the market value of banks' equity, BVL is the book value of liabilities, and BTA is the book value of total assets. As Tobin's q is only available for listed banks, one accounting-based proxy for the charter value is used to validate the results. Following the approach of *Schenck/Thornton* (2016), the net interest margin (NIM) is used as a proxy for banks' charter value. The NIM is defined as gross interest and dividend income (IntInc) subtracted by total interest expense (IntExp) divided by total assets.

$$NIM = \frac{(IntInc - IntExp)}{Total\ assets} * 100 \tag{4.2}$$

It appears to be a suitable indicator for banks' market power as a high NIM reflects banks' ability to charge higher interest rates by maintaining low refinancing costs. Several contributions to the literature have shown that banks' net interest margin represents their competitive position in the market.[331] The proxies for high charter values are employed as additional explanatory variables so that the regression entails two DD estimators, β_4 and β_5:

$$\begin{aligned} Risk_{i,t} = \alpha + \beta_1 post15_t + \beta_2 IGG_i + \beta_3\ IGG\_highCV_i + \ \beta_4(post15_t * \ IGG_i) \\ + \beta_5(post15_t * \ IGGhighCV_i) + \gamma_i + \delta_t + X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{4.3}$$

IGG_HighCV is a dummy variable taking the value of one for implicitly guaranteed banks having an average pre-treatment charter value above the pre-treatment median charter value of each bank's country and zero otherwise.[332] The second interaction term *(Post15 * IGG_highCV)* captures the effect of high pre-treatment charter values on treated banks' risk-taking after the SRM has been established. When the charter value is proxied by Tobin's q, 21 treated entities have a high, and ten entities have a low charter value. When a bank's charter value is proxied by NIM, 23 treated entities have a high, and 55 treated entities have a low charter value.

[331] See *Maudos/Fernández de Guevara* (2004); *Ho/Saunders* (1981).

[332] It is straightforward to compare each bank's charter value with the median charter value of remaining competitors in each country as banks usually compete within the same country. When the charter value is proxied by Tobin's q, which is only available for listed banks, a high charter value is identified differently. Due to the limited number of listed banks in Europe, each bank's charter value is then compared with the charter value of all listed banks in Europe. The pre-treatment charter values are computed using the 2013 numbers.

Table 4.9: SRM & charter value effects on risk-taking

This table presents results of the charter value effect on risk-taking (H-1c). The interaction term *post15 * IGG * highCV* is the DD estimator taking the value of one for banks with bailout probabilities ≥ 50% and a high charter value for all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σStock
Panel A: Tobin's q						
Post15 * IGG	0.267	-3.190	0.237	0.473	0.811	-0.446
	(0.251)	(2.994)	(0.210)	(1.765)	(1.010)	(0.573)
Post15 * IGG_highCV	0.555**	2.931	-0.063	-2.627**	-1.392*	-0.897*
	(0.236)	(2.244)	(0.153)	(1.181)	(0.708)	(0.498)
Constant	22.612***	276.315***	-3.443	60.900	25.023	8.308
	(6.930)	(69.135)	(5.800)	(44.574)	(29.551)	(21.587)
Observations	495	421	509	485	506	509
Number of banks	72	70	72	72	72	72
Adjusted R^2	0.433	0.600	0.343	0.559	0.567	0.340
Panel B: NIM						
Post15 * IGG	0.341**	-1.571	-0.102	-0.168	-0.219	-0.556
	(0.163)	(1.111)	(0.102)	(0.691)	(0.394)	(0.539)
Post15 * IGG_highCV	0.973***	-5.398***	-0.446***	-3.525***	-1.942***	-1.068**
	(0.241)	(1.767)	(0.145)	(0.953)	(0.540)	(0.418)
Constant	2.968	187.694***	4.313	6.945	2.957	6.610
	(2.536)	(36.208)	(3.052)	(16.053)	(7.640)	(21.205)
Observations	4,795	3,180	4,664	3,516	3,802	509
Number of banks	631	561	612	594	606	72
Adjusted R^2	0.260	0.223	0.200	0.300	0.250	0.341

Table 4.9 shows the effect of charter values on risk-taking. The second interaction term (*post15 * IGG_highCV*) of panel A shows the SRM effects on risk-taking of guaranteed banks with a high charter value, proxied by Tobin's q. The coefficients for the z-score, the NPL-ratio, σStock, and stock returns indicate a risk-reduction significant at the 5 or 10 percent level. The coefficients of the first interaction term (*post15 * IGG*) show only statistically insignificant results with even opposite signs in some models. In panel B, the charter value is proxied by the NIM, revealing consistent results for a risk-decreasing impact of charter values on previously guaranteed banks. All coefficients show a substantial and mostly highly significant risk reduction for guaranteed banks with a high charter value compared to the control group. Conversely, implicitly supported banks with low charter values only increased their z-scores. The strong response of banks with high stakes is remarkable, considering that they form a relatively small group of 23 banks.

The amplifying effect of high charter values on the decline of guaranteed banks' risk-taking is not unambiguous. Since most of this research presents a risk-reduction after the removal of implicit guarantees, moral hazard effects seem to prevail against charter value effects. Nevertheless, this does not mean that charter values do not play a role for formerly guaranteed banks. Implicitly guaranteed banks with high stakes are even more keen to align their risk-taking. On

the other hand, guaranteed banks with low charter values struggle to maintain or improve their current market position and subsequently face lower incentives for risk reduction.

4.1.5 Risk-Taking for Other Systemically Important Banks

Looking at the various groups of banks identified as systemically relevant by several authorities, one naturally wonders if those groups vary regarding the adaption of their risk-taking behavior after the SRM has been implemented. The motivation for analyzing O-SII's post-treatment behavior is to extend the identification of banks enjoying implicit guarantees. Furthermore, the impact of additional capital requirements can be investigated. 89 O-SIIs remain in the SRM sample considering the highest level of consolidation, of which 57 enjoyed implicit bailout guarantees before the SRM has been introduced.

Table 4.10: SRM effects on risk-taking | O-SIIs

This table presents DD regression results of O-SIIs' risk-taking (H-1a). The interaction term *post15 * O-SII* is the DD estimator taking the value of one for O-SIIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. Models (1) to (3) include bank and time fixed effects, models (4) to (6) include country and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Z-score	RWA density	Loan impairments	Z-score	RWA density	Loan impairments
Post15 * O-SII	0.596***	-0.710	-0.274***	0.547***	-0.755	-0.331***
	(0.130)	(1.255)	(0.106)	(0.130)	(1.322)	(0.112)
Constant	3.810	189.538***	4.919*	3.416***	63.873***	2.631***
	(2.431)	(35.764)	(2.529)	(0.979)	(17.134)	(0.910)
Observations	4,887	3,239	4,801	4,887	3,239	4,801
Number of banks	643	572	633	643	572	633
Adjusted R^2	0.263	0.219	0.205	0.0875	0.391	0.103

Difference-in-differences regressions are estimated to analyze the SRM effects on banks' risk-taking behavior for O-SIIs.[333] The results for the main risk measures are displayed in Table 4.10. All three coefficients have the expected sign, but the RWA density lacks statistical significance. The results are stable to country fixed effects, depicted in columns (4) to (6). In Table 4.11, the results for an alternative set of risk measures are presented. O-SIIs significantly reduced their ratio of total impairments and their ratio of trading securities with reference to non-OSIIs. Among the listed banks, O-SIIs show a reduction in the volatility of annual stock returns of about 1.1 standard deviations compared to the control group. Overall, the results are interpreted as a reduction in the risk-taking of O-SIIs. Even though not all risk measures are significant, most have the expected sign and rather support ***Hypothesis 1a*** for a risk-decreasing effect of the SRM on O-SIIs.

[333] The 2018 list of O-SIIs is used to identify treated banks in the sample for two reasons. First, because the author is interested in the effects of the SRM on risk-taking and not in the effects of being declared as O-SII on risk-taking. This is considered as an appropriate approach as fundamental bank characteristics hardly change between 2015 and 2018. Second, the 2018 list is published with bank's LEI, which perfectly matches the institutions in the sample and therefore avoids identification errors.

The effects of additional O-SII capital buffers are interesting to analyze from a regulatory point of view. O-SII capital buffers are charged on the magnitude of systemic importance determined by the approach outlined in the EBA guideline. Theory suggests that banks with higher capital ratios have incentives for prudent action, although some suggest that capital increases incentives to offset lower prospect equity profitability by higher risk-taking.[334]

Table 4.11: SRM effects on risk-taking | O-SIIs (alternative risk measures)

This table presents DD regression results of O-SIIs' risk-taking using alternative risk-measures (H-1a). The interaction term *post15 * O-SII* is the DD estimator taking the value of one for O-SIIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Total impairments	(2) NPL-ratio	(3) LLR-ratio	(4) Trading Securities	(5) σStock	(6) Stock returns
Post15 * O-SII	-0.160***	-0.567	-0.128	-1.443***	-1.096**	-8.788
	(0.054)	(0.578)	(0.329)	(0.487)	(0.522)	(5.382)
Constant	2.373*	16.281	2.192	-26.945*	4.086	427.199
	(1.242)	(16.128)	(7.643)	(15.458)	(20.590)	(324.133)
Observations	4,833	3,607	3,895	4,015	527	527
Number of banks	636	606	618	582	75	75
Adjusted R^2	0.299	0.272	0.226	0.131	0.338	0.322

To gain more insights from the effects of additional capital buffers on risk-taking, the O-SIIs are split into two groups. The group with high buffer requirements are those whose additional O-SII-buffer is set above the median capital buffer, which is 1 percent CET1 capital, accounting for 19 banks in the sample indicated by the dummy *O-SII_highbuffer*.[335] In the SRM sample, all O-SIIs are obliged to hold additional capital buffers of at least 0,25 percent.[336] Table 4.12 presents the results of the difference-in-differences regression with two interaction terms.[337] The first term (*post15 * O-SII*) estimates the treatment effect for O-SIIs with capital buffers below the median level, and the second term (*post15 * O-SII_highbuffer*) the effects for all O-SIIs with buffers above 1 percent CET1. The reference group for both O-SII buffer classifications covers the remaining banks not categorized as O-SII.

This refinement provides some valuable insights. First, all coefficients for the O-SII subgroup with capital buffers below the median show a risk decreasing effect that is statistically significant at least at the 10%-level. Second, banks with higher capital buffers (and therefore more systemic importance) show an increase in magnitude or significance for all models except the loan impairments and the stock returns. For the accounting-based risk-measure (1) - (3), the results confirm that higher capital buffers seem to amplify incentives for O-SIIs to decrease their risk compared to other banks. Banks with high buffers immensely improved their z-scores, which could directly result from increased buffer requirements, as capital enters the z-score in the numerator. However, high capital buffers also seem to be accompanied by a higher trading

[334] See *Acharya/Mehran/Thakor* (2016); *Delis/Kouretas* (2011); *Repullo* (2004); *Hellmann/Murdock/Stiglitz* (2000); *Furlong/Keeley* (1989).

[335] The DD estimation framework is similar to that depicted in Equation (4.3).

[336] Not all banks identified as O-SII need to hold capital buffers according to their systemic importance. Those banks drop out of the sample as they are subsidiaries of other banks or insufficient observations.

[337] Presented are all models that yield statistical significance.

activity (4) and higher equity volatility (5), rather supporting the presumption that banks are keen to offset higher buffer requirements with higher rewarding business activities. Higher buffer requirements may thus produce more extreme responses, promoting or reducing bank risk.

Table 4.12: Effects of O-SII-buffers on risk-taking

This table presents DD regression results of O-SIIs' risk-taking, depending on their additional capital buffer requirements. The interaction term *post15 * O-SII_highbuffer* is the DD estimator taking the value of one for O-SIIs with buffer requirements above the median in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	Loan impairments	Total impairments	Trading Securities	σStock	Stock returns
Post15 * O-SII	0.553***	-0.264**	-0.157**	-1.034*	-1.025*	-11.964*
	(0.143)	(0.124)	(0.065)	(0.527)	(0.597)	(6.110)
Post15 * O-SII_highbuffer	0.762***	-0.314*	-0.171**	-2.971***	-1.242**	-2.258
	(0.254)	(0.190)	(0.085)	(0.838)	(0.577)	(6.539)
Constant	3.810	4.920*	2.373*	-26.933*	4.102	426.486
	(2.430)	(2.532)	(1.243)	(15.402)	(20.411)	(322.053)
Observations	4,887	4,801	4,833	4,015	527	527
Number of banks	643	633	636	582	75	75
Adjusted R^2	0.263	0.205	0.299	0.135	0.337	0.323

A continuous interaction term is applied to overcome the disadvantage of splitting the sample by a capital requirements cutoff. The capital buffers are employed as a continuous treatment variable for a more profound investigation of the relation between capital requirements and risk-taking incentives presented in Table 4.13. The capital buffer for O-SIIs in the sample range from 0,25% to 2%.[338] The interaction term *post15 * buffer* displays the effects of additional capital requirements on risk-taking against non-OSIIs. The results seem to support the idea that capital increases investors' skin in the game, encouraging banks to act more prudently. All displayed accounting-based risk measures indicate a risk-diminishing effect of increasing capital buffers, exceeding the reference group's changes in risk-taking. Additional capital buffers subsequently appear to amplify the risk-reducing impact of the SRM. The average marginal effects of capital buffers on risk-taking are presented for the z-score (Figure E.2) and total impairments (Figure E.3) in the appendix.[339] Each incremental rise in buffer requirements is significantly associated with an increase in z-scores and a decrease in total impairments, as both figures respectively demonstrate.

An alternative explanation for the observed effects could be that banks with higher capital buffers had higher incentives for moral hazard ex-ante as additional capital buffers are collinear

[338] The variable *buffer* is zero for banks not denoted as O-SII.

[339] The unreported coefficients for the NPL-ratio and the LLR-ratio are negative but statistically insignificant. The unreported coefficient for the RWA density is even positive, but also lacking statistical significance. However, marginal effects for a pre-post comparison revealed that capital buffers of up to 1.25 % are associated with a RWA reduction after the treatment (5% significance). But the RWA reduction does not exceed that of the reference group (non-OSIIs), which is why the unreported coefficient for RWA density is positive and insignificant.

with systemic importance and, consequently, implicit guarantees. The findings are in line with *Cappelletti et al.* (2019), who also find disciplining effects of O-SII capital buffers. Contrary, *Dautovic* (2020) finds that higher capital requirements led to increased asset risk among O-SIIs.[340]

Table 4.13: Effects of O-SII-buffers on risk-taking | continuous interaction

This table presents DD regression results of the effects of O-SII capital buffers on risk-taking. The variable post15 is one for all periods after the SRM has been established. The variable buffer denotes additional capital requirements for O-SIIs and ranges between 0-2%. The interaction term *post15 * buffer* is the DD estimator approximating the effects of additional capital buffers on risk-taking for O-SIIs. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	Loan impairments	Total impairments	Trading Securities	σStock	Stock returns
Post15 * buffer	38.891***	-14.399*	-9.045**	-194.808***	-42.054	195.726
	(12.792)	(8.404)	(3.627)	(43.578)	(27.872)	(366.101)
Constant	4.497*	4.449*	2.122*	-27.157*	-1.803	362.968
	(2.427)	(2.645)	(1.246)	(15.052)	(18.714)	(333.721)
Observations	4,887	4,801	4,833	4,015	527	527
Number of banks	643	633	636	582	75	75
Adjusted R^2	0.250	0.203	0.297	0.142	0.325	0.320

4.1.6 Risk-Taking for ECB Supervised Banks

Another group of banks worth investigating comprises the so-called *significant institutions* (SI), directly supervised by the ECB. This group is particularly interesting to study as they are, per definition, banks under the SRB guidance in cases of failure. The ECB directly supervises all banks with total assets above either EUR 30 billion or above EUR 5 billion and amounting to 20 percent of their home country's GDP.[341] After applying the standard data clearing process, 82 SIs at the highest level of consolidation remain in the SRM sample.[342]

The DD regressions are estimated with significant institutions identified by the treatment dummy *SI*. The results are presented in Table 4.14. The coefficient for the z-score and the loan impairments are statistically significant, showing the expected positive (negative) signs, indicating a decrease in risk-taking. Country fixed effects in models (4) to (6) support the effects on SIs.

[340] *Gropp et al.* (2019) find that higher capital requirements caused banks to meet the demanded capital ratios by reducing their risk-weighted assets through reduced lending.

[341] Art. 6(4) SSM Regulation.

[342] Some of the significant institutions in the sample are excluded as they are foreign-owned subsidiaries from banking groups outside the SRM region.

Table 4.14: SRM effects on risk-taking | significant institutions

This table presents DD regression results of significant institutions' risk-taking (H-1a). The interaction term *post15 * SI* is the DD estimator taking the value of one for SIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. Models (1) to (3) include bank and time fixed effects, models (4) to (6) include country and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Z-score	RWA density	Loan impairments	Z-score	RWA density	Loan impairments
Post15 * SI	0.554***	-0.856	-0.180*	0.491***	-0.771	-0.208**
	(0.142)	(1.258)	(0.093)	(0.144)	(1.344)	(0.105)
Constant	3.936	189.836***	4.640*	3.056***	60.195***	2.485***
	(2.421)	(35.969)	(2.690)	(0.945)	(17.005)	(0.939)
Observations	4,887	3,239	4,801	4,887	3,239	4,801
Number of banks	643	572	633	643	572	633
Adjusted R^2	0.257	0.219	0.204	0.0863	0.390	0.101

For a more comprehensive view, an alternative set of risk measures is used as dependent variables. Table 4.15 shows the regression results, which provide four significant coefficients indicating a more substantial risk decrease in comparison with less significant institutions (LSI). The results are in line with previous literature, showing that ECB supervised banks act more prudently, taking on less risk after being supervised by the ECB [*Avignone et al.* (2021); *Fiordelisi/Ricci/Stentella Lopes* (2017); *Altavilla et al.* (2013)]. However, as most significant institutions enjoy implicit guarantees, it is hard to evaluate the extent to which the results are driven by tighter supervision or by removing implicit guarantees. An additional robustness check is thus presented in section 4.3.3.

Table 4.15: SRM effects on risk-taking | significant institutions (alt. risk-measures)

This table presents DD regression results of significant institutions' risk-taking (H-1a). The interaction term *post15 * SI* is the DD estimator taking the value of one for SIs in all periods after the SRM has been established and zero otherwise. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Total impairments	NPL-ratio	LLR-ratio	Trading Securities	σStock	Stock returns
Post15 * SI	-0.127**	-0.313	-0.000	-1.471***	-1.232**	-10.801**
	(0.058)	(0.625)	(0.366)	(0.527)	(0.500)	(5.150)
Constant	2.277*	15.333	1.756	-26.801*	7.372	461.381
	(1.250)	(16.146)	(7.617)	(15.517)	(20.348)	(325.238)
Observations	4,833	3,607	3,895	4,015	527	527
Number of banks	636	606	618	582	75	75
Adjusted R^2	0.298	0.271	0.226	0.130	0.342	0.324

4.2 Effects of the BRRD on Risk-Taking

4.2.1 Univariate Difference in Means Analysis

A separate examination of the non-eurozone EU member states that adopted only the BRRD is needed to test whether the BRRD also affects treated banks' risk-taking. For that reason, a univariate difference in means analysis is conducted first to investigate the banks' response to the BRRD. The sample is reduced to countries that contain treated banks.[343]

Table 4.16 shows the univariate results. Compared to the SRM jurisdiction, the treated banks differ hardly from the untreated banks. Looking at the pre-treatment levels in columns (1) and (4), treated banks are more leveraged, have lower levels of RWA, and higher z-scores, with the other risk measures being comparable. Furthermore, the risk measures of the treated banks change only little from the pre to the post-treatment period, as column (3) shows. Only the change in the standard deviation of weekly stock returns is significantly smaller in the post-treatment periods. The differences for untreated banks depicted in column (6) show statistically significant risk reductions for most primary risk measures. The comparison of both groups using a univariate DD estimator depicted in column (7) yields only a significant result for stock returns.

Table 4.16: Univariate difference in means for risk-taking | BRRD

This table presents univariate difference in means results for the BRRD region. The treatment variable (*IGG*) separates the sample into two groups, where the treated group consists of banks with a minimum bailout probability of ≥ 50%. The pre-treatment period reaches from 2010 to 2013 and the post-treatment period from 2015 to 2018. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	Treated			Non-treated			
	(1)	(2)	(3) = (2) - (1)	(4)	(5)	(6) = (4) - (3)	(7) = (3) - (6)
Dependent variables	Pre	Post	Diff	Pre	Post	Diff	DD
z-score	3.31	3.70	0.38	3.15	3.80	0.65***	-0.27
RWA density	40.85	35.58	-5.27*	57.16	52.88	-4.27***	-0.99
Loan impairment	0.92	0.45	-0.46***	1.05	0.533	-0.51***	0.046
Total impairments	0.67	0.33	-0.33***	0.54	0.29	-0.25**	0.82
NPL-ratio	6.62	4.70	-1.55	6.06	5.54	-0.52	-1.033
LLR-ratio	3.27	2.40	-0.86*	3.16	3.04	-0.12	-0.74
Trading Securities	13.91	11.18	-2.75	8.86	8.71	-0.02	-2.76
CAR	6.02	6.60	0.59	12.46	12.78	0.31	-0.28
RoA	0.38	0.50	0.12	0.64	0.99	0.34***	-0.23
σRoA	0.29	0.28	-0.00	0.88	0.59	-0.28***	0.281
σStock	4.54	3.98	-0.48	4.43	3.70	-0.74	0.262
Stock returns	7.95	-8.90	-16.84**	-1.28	-0.79	0.49	-17.33*

Interestingly, treated banks seem to have reduced their distance to default against untreated banks. That is remarkable since higher capital requirements from the single rulebook should affect guaranteed banks even more given their pre-treatment leverage. From a univariate perspective, implicit guarantees are not associated with substantially higher pre-treatment risk-

[343] For the baseline identification, the sample contains observations from Bulgaria, Denmark, Poland, Romania, Sweden, and the United Kingdom as these countries accommodate entities with a pre-treatment bailout probability of at least 50%.

taking, and guaranteed banks do not significantly respond differently to the BRRD than untreated banks.

The results hardly point in any direction regarding guaranteed banks' risk-taking within the BRRD jurisdiction. That may as well be the case because the level of support is substantially lower compared to the SRM countries. Only 13 treated entities at the highest level of consolidation remain in the sample. Perhaps treated banks detected by a different identification strategy react more vital to the BRRD. Therefore, the differences in means for Other Systemically Important Institutions (O-SII) accommodated in BRRD countries are additionally analyzed.

Table 4.17: Univariate difference in means for risk-taking | BRRD (O-SIIs)

This table presents univariate difference in means results for the BRRD region. The treatment variable (O-SII) is one for banks declared as Other Systemically Important and zero otherwise. The pre-treatment period reaches from 2010-2013, the post-treatment period from 2015-2018. Standard errors are reported in parentheses, Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	Treated			Non-treated			
	(1)	(2)	(3) = (2) - (1)	(4)	(5)	(6) = (4) - (3)	(7) = (3) - (6)
Dependent variables	pre	post	Diff	pre	post	Diff	DD
z-score	3.12	3.44	0.32***	3.07	3.70	0.62***	-0.30*
RWA density	50.65	46.21	-4.44	54.78	52.62	-2.16	-2.30
Loan impairment	1.38	0.91	-0.47***	1.03	0.56	0.47***	0.001
Total impairments	0.86	0.52	-0.34***	0.67	0.37	-0.31***	-0.038
NPL-ratio	9.33	8.13	-1.20	6.71	6.29	-0.42	-0.78
LLR-ratio	4.93	4.53	0.40	3.75	3.57	-0.17	-0.21
Trading Securities	10.92	8.75	-2.17	9.15	9.15	-1.17	-1.00
CAR	7.26	7.72	-0.46	12.58	13.26	0.69	-0.22
RoA	0.33	0.54	0.22*	0.61	1.04	0.42***	-0.21
σRoA	0.48	0.42	-0.07	0.98	0.61	0.37***	0.30*
σStock	4.50	3.71	-0.79***	4.71	4.00	-0.78***	-0.00
Stock returns	5.48	-2.78	-8.26	-5.05	-2.08	2.97	-11.23

The BRRD sample for the analysis of O-SIIs is compiled by deleting all observations from Gibraltar, as this country does not accommodate O-SIIs, resulting in 29 banks declared as O-SIIs.[344] Table 4.17 shows the differences in means for the O-SIIs. Column (3) and Column (6) show that both the treated banks and the untreated banks significantly reduced their risk levels. As the coefficients for the differences-in-differences estimator in column (7) are insignificant and, except for the RWA density, very low, this suggests O-SIIs not to react strongly to the BRRD compared to remaining banks.

The parallel trends are plotted for the z-scores in Figure E.1 in the Appendix. Treated banks do not show a drastic increase in their distance to default in reaction to the resolution framework, as opposed to treated banks in the SRM region.

4.2.2 Multivariate Difference-in-Differences Analysis

For reasons of clarity and comprehensibility, the results for the BRRD effects on risk-taking are presented jointly in Table 4.18. The DD regressions are estimated with *IGG* as treatment

[344] All countries that accommodate O-SII at the highest level of consolidation are included. These are Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom.

variable (panel A), the identification as Other Systemically Important Institutions (panel B), and the designation as Global Systemically Important Institution (Panel C). In each panel, countries that do not accommodate any treated entities are excluded.[345] The number of treated entities shrinks drastically as most banks from non-Eurozone EU member states are subsidiaries of banks domiciled in the eurozone that are removed from the samples to avoid double counting. Panel A includes 13 treated banks with bailout probabilities above 50 percent at the end of the pre-treatment period. Panel B contains 29 banks belonging to the O-SIIs identified by national supervisors. Panel C includes 11 banks identified as G-SIIs by the EBA.

Table 4.18: Combined results for BRRD effects on risk-taking

This table presents combined results from DD regressions of BRRD effects on risk-taking (H-1a). Panel A includes estimations with government support (IGG) as treatment variable, Panel C includes estimations for O-SIIs, and Panel C includes estimations for G-SIIs. Countries without treated entities are excluded from each panel. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σStock
Panel A						
Post15 * IGG	-0.507**	-2.616	0.287	0.577	-0.374	-0.015
	(0.227)	(1.813)	(0.270)	(1.592)	(0.956)	(0.456)
Constant	5.918	-24.047	-11.569**	-37.067	-10.963	5.055
	(4.281)	(54.634)	(4.546)	(27.576)	(12.717)	(24.060)
Observations	1,274	915	1,204	1,090	1,190	312
Number of banks	170	153	162	157	163	42
Adjusted R^2	0.340	0.222	0.236	0.107	0.102	0.158
Panel B						
post15 * O-SII	-0.298	-4.184**	0.078	-1.177	-0.678	-0.453
	(0.191)	(1.687)	(0.200)	(1.380)	(0.738)	(0.475)
Constant	1.824	-28.144	-11.130***	22.351	-3.567	7.125
	(3.716)	(53.282)	(3.668)	(28.160)	(11.964)	(21.775)
Observations	1,487	1,030	1,382	1,255	1,378	363
Number of banks	200	174	186	182	191	49
Adjusted R^2	0.305	0.270	0.232	0.079	0.090	0.155
Panel C						
post15 * G-SII	-0.769***	-0.572	0.429***	-1.393	-1.068**	-0.146
	(0.215)	(1.790)	(0.159)	(0.910)	(0.517)	(0.640)
Constant	11.364**	-72.115	-12.494***	-33.705	1.745	12.991
	(5.350)	(65.659)	(4.016)	(23.719)	(10.191)	(32.229)
Observations	1,121	822	1,050	945	1,047	240
Number of banks	150	138	142	137	144	32
Adjusted R^2	0.403	0.267	0.328	0.168	0.141	0.278

The results in Table 4.18 show only a few statistically significant effects for moderated risk-taking of treated entities against their respective untreated counterparts. In panel A the

[345] Panel A includes Bulgaria, Denmark, Poland, Romania, Sweden, and the United Kingdom. Panel B includes Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom. Panel C includes Denmark, Sweden, and the United Kingdom.

coefficient for the z-score (1) is significant but points towards increased risk-taking. In panel B, O-SIIs show a highly significant decrease in RWA density that is also economically meaningful as treated entities decreased their RWA density (2) by 5.3 percentage points compared to the control group. Interestingly, that is the only coefficient that unambiguously shows a decrease in risk-taking for O-SIIs. The estimations in panel C deliver the highest number of precise results. G-SIIs significantly decreased their z-score and significantly increased their loan impairments, indicating higher risk against untreated banks.

By contrast, they simultaneously reduced their ratio of loan loss reserves on average, which complicates conclusions. Compared to the effects of SRM on risk-taking, the BRRD results are harder to grasp. Most models lack statistical significance, and only the RWA density shows a meaningful and significant reduction in panel B. Taken together, the BRRD has almost no effect on moral hazard, regardless of the identification strategy employed to identify treated banks. The lack of definite responses permits two possible conclusions: either the BRRD alone is not a credible resolution mechanism to banks, or the level of government support has never been high enough to incentivize banks to engage in excessive risk-taking. As the univariate analysis from the previous section reveals hardly any differences between treated and untreated banks, incentives for moral hazard must have been low in the BRRD area.[346] Nevertheless, the results might also be weak as the number of treated entities is smaller for all identification strategies in the BRRD compared to the SRM sample.

4.3 Robustness Tests

Various robustness tests are conducted to validate the presented results on the SRM effects on risk-taking (RT). The banking industry experienced multiple changes in regulations during the post-treatment period. Therefore, one has to be cautious with inference and cancel out that other regulatory changes bias the results.

4.3.1 Treatment Intensity

Defining the appropriate treatment and control units is essential for causal inference in DD analyses. Particularly in this research, as identifying treated banks involves additional techniques, mismeasurement is a potential threat to internal validity [*Meyer* (1995)]. Concerns on the identification strategy are first approached by using alternative definitions of treated entities. As the chosen cutoff for the estimated bailout probability of 50 percent is a relatively low level and not free of arbitrariness, higher cutoffs for 60 and 70 percent are used for robustness. The results are presented in Table 4.19, estimating the effects for the respective cutoffs on the full sample (panel A and B) and a reduced sample, excluding banks with bailout probabilities between 50 and 69 percent during the post-treatment period. The approach in panel C is performed since higher cutoffs increase the chance of wrongfully allocated banks entering the control group. As the number of treated banks is a bit smaller, the ratio of banks with ongoing support increases. Excluding banks with existing guarantees accordingly leads to more accurate results.

[346] See section 6.2.3 for additional results on the effects of implicit guarantees on moral hazard in the BRRD and SRM region.

Table 4.19: RT robustness I | alternative cutoff rates

This table presents robustness tests for alternative cutoff rates of banks' bailout probability. The cutoff is either 60% (panel A) or 70% (panel B and C). In panel C, the effects are estimated on a reduced sample, excluding all banks with bailout probabilities between 50 and 69% and all banks that still have a bailout probability above 50% during the post-treatment period. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σStock	Stock returns
			Panel A: 60%, full sample				
Post15 * IGG60	0.574***	-1.847*	-0.228**	-1.399**	-0.924***	-0.882*	-12.473**
	(0.152)	(1.081)	(0.092)	(0.620)	(0.350)	(0.448)	(6.083)
Constant	2.367	186.772***	4.650	10.839	5.280	11.188	482.079
	(2.536)	(36.405)	(2.956)	(16.483)	(7.778)	(21.959)	(370.089)
Observations	4,795	3,180	4,708	3,516	3,802	509	509
Number of banks	631	561	621	594	606	72	72
Adjusted R^2	0.256	0.217	0.199	0.290	0.244	0.343	0.324
			Panel B: 70%, full sample				
Post15 * IGG70	0.355**	0.605	-0.123	-1.395*	-0.727*	-0.778*	-10.020
	(0.169)	(1.004)	(0.096)	(0.715)	(0.413)	(0.451)	(7.200)
Constant	3.448	174.944***	4.072	8.635	3.300	9.617	451.534
	(2.524)	(35.382)	(2.880)	(16.318)	(7.745)	(21.627)	(410.541)
Observations	4,795	3,180	4,708	3,516	3,802	509	509
Number of banks	631	561	621	594	606	72	72
Adjusted R^2	0.242	0.215	0.198	0.287	0.239	0.339	0.321
			Panel C: 70%, reduced sample				
Post15 * IGG70	0.612***	-0.439	-0.229**	-1.955**	-1.034**	-0.801	-17.702***
	(0.188)	(1.054)	(0.115)	(0.903)	(0.505)	(0.527)	(6.159)
Constant	3.792	175.057***	3.820	4.060	2.461	-2.766	690.647*
	(2.669)	(46.732)	(3.068)	(16.153)	(7.752)	(26.283)	(380.966)
Observations	4,455	2,865	4,358	3,177	3,457	414	414
Number of banks	587	518	577	550	562	59	59
Adjusted R^2	0.229	0.259	0.161	0.285	0.234	0.332	0.339

The results hold for a bailout probability of 60 percent as a treatment threshold in the full sample, but the coefficient for the RWA density loses some significance. For a bailout probability of 70 percent in panel B, only the results for an increased z-score (1) and a slight decrease in credit risk (4)-(5) and stock return volatility (7) can be confirmed. The results are more potent for the reduced sample in panel C, even showing partly more potent effects than the 60 percent cutoff in panel A. In general, the results hold for different bailout probabilities. However, the effects are less intense compared to the baseline version. The relatively weak results for the 70 percent cutoff in panel B can be explained by a higher level of support in the control group and an increased share of entities in the control group that still enjoy implicit guarantees after the SRM has been established. Therefore, it can be concluded that there is substantive variation in the extent of risk reduction among treated entities.

A continuous treatment variable is used to dispel further doubts about the suitability of the identification method addressing the problem of arbitrarily chosen cutoff rates. The variable

bailoutp captures the continuous bailout probability of banks at the end of the pre-treatment period in 2013. Thus the interaction term $post15 * bailoutp$ estimates the continuous treatment effect for the introduction of SRM. Table 4.20 presents the results for the continuous treatment, which are overall in line with the baseline model in Table 4.1 and Table 4.3. This also indicates that the incentives for risk-taking seem to rise with increasing bailout probabilities.

Table 4.20: RT robustness II | continuous treatment

This table presents robustness tests for a continuous treatment variable. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σStock	Stock returns
Post15 * bailoutp	0.678***	-2.879**	-0.250**	-1.700**	-0.988**	-1.027*	-18.587**
	(0.188)	(1.292)	(0.115)	(0.758)	(0.428)	(0.565)	(8.282)
Constant	2.383	189.158***	4.575	10.464	4.642	9.797	489.132
	(2.527)	(36.649)	(2.976)	(16.544)	(7.857)	(21.666)	(379.491)
Observations	4,795	3,180	4,708	3,516	3,802	509	509
Number of banks	631	561	621	594	606	72	72
Adjusted R^2	0.253	0.218	0.199	0.289	0.241	0.339	0.325

4.3.2 Falsification Testing

This section presents several falsification tests challenging the identification strategy and underlying assumptions of the difference-in-differences regression framework. The timing of the treatment is crucial in the validation of treatment effects. Hence, the results are questioned by simulating a treatment before the EU resolution framework was about to be adopted. The placebo treatment starts in 2012, with the data set covering the years from 2010 to 2013. The adapted sample now includes two pre-treatment and two post-treatment periods. 2012 is the latest pseudo treatment possible given a two-year post-treatment period as later treatments would go over into the actual treatment period 2014. Another form of placebo treatment is conducted by defining all banks with a bailout probability of zero percent as the treatment group to validate the treatment identification procedure. The results are presented in Table 4.21.

Table 4.21: RT robustness III | placebo treatments

This table presents robustness tests for placebo treatments. A placebo treatment in 2012 [models (1) to (3)] and a pseudo treatment where treated entities are those with a bailout probability of 0% are conducted. The sample is restricted to the years from 2010 to 2013, with 2012 as the pseudo treatment period for placebo treatment of models (1) to (3). The σRoA, a z-score component, is calculated for the 2009-2013 time span. Bank and country controls are not reported for brevity. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	placebo treatment in 2012			pseudo treatment		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	RWA density	Loan impairments	z-score	RWA density	Loan impairments
Post12 * IGG	-0.096	-1.332	0.068	0.314	0.096	-0.089
	(0.106)	(0.847)	(0.101)	(0.224)	(2.399)	(0.161)
Constant	5.003	383.278***	9.221*	4.299*	177.116***	3.705
	(4.171)	(64.250)	(5.336)	(2.561)	(34.688)	(2.816)
Observations	2,429	1,281	2,391	4,952	3,285	4,867
Number of banks	629	510	614	631	561	621
Adjusted R^2	0.171	0.271	0.194	0.240	0.215	0.197

The treatment did not start before 2014, as all coefficients are insignificant for the placebo treatment in models (1) to (3). The coefficient for the z-score and the loan impairments even flip their signs. As all coefficients for the dependent variables in models (4) to (6) are insignificant, it can be concluded that the identification procedure applied in the baseline analysis is appropriate.

The results presented so far show the long-term effects on risk-taking after the new resolution regime has been introduced. Naturally, with an increasing length of the post-treatment phase, the risk that other factors influence the results increases. Therefore, the pre- and post-treatment periods are shortened to two years each to limit concerns that other factors influence bank risk-taking. The results are presented in Table 4.22, with similar effects on risk-taking. It is, therefore, unlikely that the results are driven by any changes that occurred after 2015. Moreover, this indicates that the SRM has not only long-term but also medium-term effects on risk-taking.

The falsification tests on treatment timing and period length are particularly valuable since certain banking sector reforms were implemented prior to the EU resolution framework, like the statutory burden-sharing requirements.[347] The results suggest that those regulations did not bias the results.

[347] See section 1.1.2 on statutory burden-sharing requirement implemented through the 2013 Banking Communication.

Table 4.22: RT robustness IV | shorter pre- and post-treatment periods

This table presents robustness tests for shorter pre (2012-2013) and post-treatment (2015-2016) periods. Models (1) to (3) include bank and time fixed effects, models (4) to (6) include country and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) z-Score	(2) RWA density	(3) Loan impairments	(4) z-score	(5) RWA density	(6) Loan impairments
Post15 * IGG	0.509***	-2.361**	-0.175*	0.410***	-2.045*	-0.271**
	(0.143)	(0.978)	(0.102)	(0.144)	(1.203)	(0.110)
Constant	-0.160	178.140***	-1.033	2.775***	60.337***	0.613
	(3.421)	(45.467)	(3.802)	(0.966)	(13.799)	(0.901)
Observations	2,514	1,898	2,458	2,514	1,898	2,458
Number of banks	636	536	622	636	536	622
Adjusted R^2	0.226	0.127	0.255	0.102	0.382	0.146

Another aspect worth considering is the evolution of risk-taking by banks that enjoy implicit guarantees throughout the entire sample period. The investigation of ongoing support is approached by re-estimating the difference-in-differences models using the dummy variable *persistent* to label quasi-treated banks. If they show no or only a slight reduction in risk-taking, this will support ***Hypothesis 1a.*** Table 4.23 shows the quasi-treatment results for banks persistently backed by their governments after the SRM has been introduced.[348] One can observe a significant reduction of the RWA density for pseudo-treated banks (2). All other risk measures are insignificant, with the z-score and the loan impairments showing opposite signs, slightly pointing to increased risk-taking. Overall, this confirms the identification strategy and the moral hazard channel as only the coefficient for the RWA density significantly suggests reduced risk-taking. The reduction in RWA density could result from deleveraging efforts of systemically important banks struggling to meet additional capital requirements.

[348] 17 treated entities with persistent implicit guarantees remain in the sample located in Austria, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, and Spain. Observations from other countries were removed to avoid bias.

Table 4.23: RT robustness V | persistent government support

This table presents robustness tests for ongoing government support. The variable *persistent* is one for banks with bailout probabilities of ≥ 50% throughout the entire sample period and zero otherwise. Bank observations from countries that do not have banks with persistent support are excluded. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Z-score	(2) RWA density	(3) Loan impairments	(4) NPL-ratio	(5) LLR-ratio	(6) σStock
Post15 * persistent	-0.262	-4.248**	0.161	-0.544	-0.140	-0.074
	(0.235)	(2.032)	(0.133)	(0.755)	(0.466)	(0.460)
Constant	3.547	182.310***	6.756***	10.247	3.065	58.294*
	(2.611)	(36.031)	(2.344)	(16.301)	(7.542)	(29.305)
Observations	4,601	3,028	4,514	3,351	3,637	406
Number of banks	604	539	596	571	584	58
Adjusted R^2	0.206	0.243	0.147	0.254	0.202	0.328

4.3.3 Alternative Explanations

As mentioned before, several changes in banking regulation and supervision could influence risk-taking. Considering the number of regulatory changes in European banking, it is decisive to identify those very changes affecting predominantly banks having enjoyed implicit guarantees (Table 4.25) and not others.[349] Some influences can be checked for by conducting robustness tests. For example, the 2014 stress test results conducted by the EBA and the ECB could influence the observed effects. Banks that performed poorly in the stress test were compelled to build additional capital buffers to pass the adverse stress test scenario. Those adaptions could, at least to some extent, influence the results.[350] To test this hypothesis, all banks performing poorly in the test were removed from the sample to see if the results still hold. Thirty-eight banks with a drop of their CET1 levels below the median in the adverse scenario are removed, leaving 53 treated entities in the sample.

An alternative explanation for the obtained results could arise from a change in the supervisory regime for significant institutions (SI) directly supervised by the ECB. At the end of 2014, the Single Supervisory Mechanism started with more comprehensive and closer supervision of the eurozone's SIs. A tightening of bank supervision could cause banks to adapt their risk levels. The potential influence of supranational oversight is examined by removing all SIs to see if there is still a risk-decreasing effect. Seventy-four banks under immediate ECB supervision since 2014 are removed, leaving 30 treated entities in the sample.

[349] Even if some regulations affect banks with implicit guarantees more intensively, e.g., because implicit guarantees provide incentives for high leverage or a risky funding strategy, this does not contradict the hypothesis of moral hazard. Instead, the observed effects would, to a certain extent, rather be attributable to other regulations and not only to the SRM.

[350] Some contributions provide evidence for negative CDS and stock market reactions to the publication of stress test results. See *Georgescu et al.* (2017); *Alves/Mendes/Da Pereira Silva* (2015).

Table 4.24: RT robustness VI | stress test & ECB supervision

This table presents robustness tests for alternative explanations. The initial versions of the DD regressions are re-estimated, excluding banks with poor stress test results (panel A) and banks directly supervised by the ECB (panel B). Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) z-score	(2) RWA density	(3) Loan imp.	(4) NPL-ratio	(5) LLR-ratio	(6) Total imp.	(7) σStock
			Panel A: poor stress test				
Post15 * IGG	0.587***	-2.603**	-0.256**	-1.567***	-0.790**	-0.177***	-0.729*
	(0.178)	(1.078)	(0.110)	(0.602)	(0.319)	(0.065)	(0.415)
Constant	2.052	189.205***	6.580***	8.374	0.177	2.445*	18.475
	(2.622)	(38.897)	(2.523)	(17.239)	(7.855)	(1.472)	(23.090)
Observations	4,507	2,892	4,408	3,223	3,505	4,440	351
Number of banks	593	523	583	556	568	586	50
Adjusted R^2	0.232	0.230	0.173	0.245	0.194	0.244	0.379
			Panel B: ECB supervision				
Post15 * IGG	0.452**	-2.576*	-0.195	-0.646	-0.523	-0.132**	-1.017**
	(0.219)	(1.486)	(0.136)	(0.788)	(0.429)	(0.062)	(0.482)
Constant	2.470	190.735***	4.492	6.454	2.154	1.849	64.932*
	(2.710)	(40.492)	(3.155)	(17.200)	(7.717)	(1.434)	(37.995)
Observations	4,226	2,626	4,132	2,956	3,235	4,157	246
Number of banks	557	487	547	520	532	550	36
Adjusted R^2	0.193	0.226	0.119	0.259	0.201	0.172	0.281

The results presented in Table 4.24 support the initial analysis. Removing banks that performed poorly in the 2014 EBA stress test does not alter the results' quality. Both the size and significance of the difference-in-differences coefficients are comparable. For the sample without the SIs, the results change. The remaining treated banks in panel B seem to have increased their distance to default (1) and reduced asset risk (2), total impairments (6), and equity volatility (7). However, the results are significantly weaker, as only 30 treated entities remain, and most SIs enjoyed implicit guarantees before the SRM.[351] The weakened results indicate that tighter supervision could explain some of the observed risk lowering. Nevertheless, at least four coefficients show a reduction in risk-taking unbiased by the potential effects of ECB supervision. Besides, the SRM effects on risk-taking for SI presented in section 4.1.6 are weaker than the results from the baseline identification strategy in section 4.1.2.

Table 4.25: Alternative explanations

Regulatory change	Expected effect on RT	Robustness test
Leverage ratio (LR)	(+) / (-)	Covariates, 1:1 matching, NN matching
Liquidity coverage ratio (LCR)	(+) / (-)	Covariates, 1:1 matching
Net stable funding ratio (NSFR)	(+) / (-)	Covariates, 1:1 matching, NN matching
Stress test results	(-)	exclusion of affected banks
ECB supervision	(-)	exclusion of affected banks
Additional capital buffers	(+) / (-)	Covariates, O-SII buffers

[351] Only 18 significant institutions have an estimated bailout probability of less than 50% at the end of 2013.

The post-crisis banking regulation, commonly referred to as Basel III, could also contribute to the obtained outcomes. The leverage ratio (LR),[352] the liquidity coverage ratio (LCR), [353] and the net stable funding ratio (NSFR)[354] were introduced in multiple phases but are, except for the LCR, not yet binding. All regulations could theoretically cause bias if banks with implicit guarantees are more affected by those regulations and thus respond more aggressively. In the applied DD setting, it cannot be directly tested for diverse reactions to banking regulations. However, covariates adapting for bank liquidity, capital ratios, and deposit ratios are added in most regressions to address this concern. The divergence in banks' responses to post-crisis regulations is furthermore attempted in various matching approaches in the following sections 4.3.4 and 5.3 for risk-taking and market discipline, respectively.

Some researchers have analyzed the effects of the Basel III regulations on bank behavior. *Dietrich/Hess/Wanzenried* (2014) provide evidence that large western European banks were indeed more affected by the NSRF since their stable funding ratio was lower than that of smaller banks. Nevertheless, the authors find that the increase in stable funding does not alter bank profitability. *Smith/Grill/Lang* (2017) investigate the LR requirements and find evidence against the concept of 'skin in the game,' supposing higher risk-taking incentives for weakly capitalized banks. Banks also need to fulfill additional capital buffers[355] depending on their systemic importance, which might cause bias. *Cappelletti et al.* (2019) find risk-decreasing effects of O-SII buffers, and *Gropp et al.* (2019) find that additional capital requirements from the EBA capital exercise were met by reducing RWA density. *Dautovic* (2020), on the other hand, shows that O-SII and G-SII buffers increased banks' asset risk. Those buffer requirements are not available in detail for each bank in the sample so that their potential bias cannot be ruled out. However, the results presented in Table 4.12 and Table 4.13 suggest an amplifying effect of O-SII capital buffers on risk-reduction, rather supporting the view that parts of the outcome might be due to additional capital requirements. Nevertheless, as capital requirements and implicit guarantees are partly collinear, the results cannot unambiguously be attributed to one explanation.

4.3.4 Sample Selection Bias

The comparability of the treatment and the control group is crucial for the explanatory power of difference-in-differences regressions. The treatment is not randomly assigned to banks but instead depends to some extent on bank characteristics. Banks with high bailout probabilities are, on average, larger, have lower capital ratios, and higher levels of risk, as Table 4.1 shows. Although the parallel trend assumption has been tested and found to be valid, bank heterogeneity might hamper causal inference. The author addresses potential bias from the selection problem by conducting further tests with different sample compositions and propensity score matching techniques, as suggested by Meyer (1995).

[352] The LR needs to be published by banks since 2015. The CRR II package [Regulation (EU) 2019/876] applying from 2021 onwards will turn the LR into a binding minimum requirement.

[353] The LCR became a binding standard from 1 January 2015 onwards by Commission Delegated Regulation (EU) 2015/61 from 10 October 2014.

[354] The NSRF was introduced in phases and will become a binding minimum requirement in 2021 by the CRR II package, Regulation (EU) 2019/876).

[355] These are buffers for O-SIIs, G-SIIs, and buffers resulting from SREP decisions.

Table 4.26: RT robustness VII | sample selection bias

This table presents robustness tests for sample selection. The initial versions of the DD regressions are re-estimated, excluding savings banks and co-operative banks [models (1) to (3)] and non-rated banks [models (4) to (6)]. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	Savings and co-operative banks excluded			Non-rated banks excluded		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	RWA density	Loan impairments	z-score	RWA density	Loan impairments
post15 * IGG	0.476***	-3.702**	-0.076	0.273*	-3.468***	-0.264***
	(0.179)	(1.499)	(0.135)	(0.145)	(1.320)	(0.094)
Constant	4.109	170.628***	1.211	1.783	156.545***	7.890***
	(3.097)	(40.235)	(4.052)	(4.036)	(48.854)	(2.777)
Observations	1,796	1,284	1,729	2,918	2,104	2,933
Number of banks	242	197	233	396	383	397
Adjusted R^2	0.293	0.188	0.231	0.356	0.152	0.299

First, all savings banks and cooperative banks are excluded from the sample as these banks follow partly different business models and probably vary in terms of their unobservable willingness to take on risk. Since it cannot be controlled for those disparities in the sample, both groups are excluded. Second, all non-rated banking groups are excluded. Rated entities may distinguish from unrated entities in several ways, which also could affect their risk-taking. Since rated banks are more capital market-orientated, short-term profitability and profit maximization may be more pronounced compared to unrated banks. As those attributes are unobservable, all unrated banks are excluded from the sample.[356]

The results are reported in Table 4.26 and confirm the effects on risk-taking. Excluding savings banks and cooperative banks yields a lower reduction in the z-score but a higher reduction in RWA density in models (1) – (3). Both coefficients are significant at the 5 percent level, whereas the coefficient for the loan impairments is statistically insignificant. Turning to the reduced sample containing solely rated banks, the coefficient for the z-score loses clearly in magnitude and is now significant at the 10%-level (model (4)). The coefficients for the RWA density and the loan impairments are both significant at the 1%-level, with an even increased magnitude for the RWA density. Although the exclusion of savings banks and cooperative banks yields results with less statistical significance, the overall effect of reduced risk-taking remains. Changing the composition of control groups does not reasonably impair the results, suggesting that the sample composition is not a concern for inference.

The results might also be biased due to missing observations or changes in accounting standards. Therefore, the model is re-estimated with an adjusted sample in which observations with missing data on key variables are deleted. Also, all banks from the sample switching their accounting standards are excluded. The results are displayed in Table 4.27, indicating that risk-reduction is not due to either change in accounting standards or inconsistencies in the sample.

[356] All banks not rated by either Fitch, Moody's, or Standard & Poor's are excluded from the subsample. This is done by considering the highest consolidation level available, excluding unrated parents to avoid double counting.

Table 4.27: RT robustness IX | removal of missing observations

This table presents robustness tests for missing observations. All observations with missing variables are deleted. All banks that change their accounting standard are dropped from the sample. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) z-score	(2) RWA density	(3) Loan impairments	(4) NPL-ratio	(5) LLR-ratio	(6) σStock	(7) Stock returns
Post15 * IGG	0.565***	-2.610**	-0.194**	-1.670**	-0.811**	-0.764*	-13.991**
	(0.153)	(1.131)	(0.093)	(0.651)	(0.390)	(0.450)	(6.188)
Constant	-0.695	207.738***	-2.722	30.325*	6.562	8.985	475.799
	(4.187)	(46.823)	(3.627)	(17.642)	(11.548)	(21.653)	(370.199)
Observations	2,595	2,595	2,595	2,595	2,595	509	509
Number of banks	510	510	510	510	510	72	72
Adjusted R^2	0.293	0.239	0.268	0.340	0.293	0.340	0.326

Some further robustness checks are conducted to resolve remaining doubts about the validity of the estimated effects arising from sample selection. As implicit bailout guarantees are not randomly assigned to banks but depend next to sovereign characteristics on bank attributes, a more sophisticated technique is used to compare the treatment and control group and deduce causal inference.[357] This challenge is addressed using a matched sample analysis that combines matching procedures with a difference-in-differences research design.[358] The propensity score matching technique is used to match treated with untreated bank observations that are otherwise similar [*Rosenbaum/Rubin* (1983)]. The propensity score is calculated for each bank using matching variables that describe bank characteristics reflecting each banks' probability of receiving sovereign support. Each observation from treated banks is then matched to observations from untreated banks by their propensity scores. The difference-in-differences regressions are re-estimated in their initial form on the matched sample. The advantage of this approach is that a more homogenous bank sample can be examined while maintaining the panel model features, estimating the within bank variation of risk-taking. Reducing sample heterogeneity is not free of contradictions as implicit guarantees also formed bank characteristics. However, performing a matched sample investigation is assumed to increase the analysis's validity [*Ignatowski/Korte* (2014)].

The matching technique is applied to a reduced sample where all observations with missing data are removed. The propensity score is calculated without replacement to match each treated observation with an untreated one. The matching covariates are total assets, capital ratio, and customer deposit ratio using the SRM sample's 2013 pre-treatment values. The matching variables are chosen in this way since bank size, leverage, and funding approach characterize implicitly supported banks. Besides, this selection achieves propensity scores for treated and untreated banks that are statistically equal. The matched sample contains 465 observations of the

[357] Although the implicit bailout guarantee is not assigned by following a defined selection rule, bank attributes such as size, interconnectedness, and the performance of critical banking system functions determine implicit guarantees, see section 2.1.2.

[358] See, e.g., *Fiordelisi/Ricci/Stentella Lopes* (2017); *Ignatowski/Korte* (2014).

treated and 465 observations of the control group. The unbalanced structure of the set amounts to 61 treated and 65 untreated banks in 2013.[359]

Table 4.28: RT robustness VIII | 1:1 matched sample

This table presents robustness tests for sample selection. The matched sample is compiled by calculating propensity scores based on pre-treatment covariates total assets, capital ratio, and customer deposit ratio. The matching process is 1:1 NN matching based on the propensity score. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) z-score	(2) RWA density	(3) Loan impairments	(4) NPL-ratio	(5) LLR-ratio
Post15 * IGG	0.399**	-3.948**	-0.041	-1.501**	-0.868*
	(0.184)	(1.546)	(0.112)	(0.736)	(0.494)
Constant	9.716	242.514***	1.727	20.111	15.324
	(6.882)	(75.125)	(4.712)	(33.843)	(18.866)
Observations	930	930	930	930	930
Number of banks	126	126	126	126	126
Adjusted R^2	0.378	0.204	0.411	0.358	0.295

The results are presented in Table 4.28. All five risk measures have the expected sign and are, except for the loan impairments (2), at least significant at the 5 percent level. The results are economically weaker for the z-score and the loan impairments but otherwise comparable to the baseline version. The results prove that bank characteristics like size, leverage, and funding strategy do not bias the results. Hence, it seems unlikely that the baseline results are affected by an asymmetric adaption of capital levels induced by the CRR and CRD IV as treated and untreated banks in this analysis have comparable pre-treatment capital levels. The resulting sample homogeneity may as well reduce potential bias from unequal responses to other post-crisis regulations by treated and untreated banks.

As an additional robustness check addressing the sample selection bias, the author combines the bias-adjusted nearest neighbor (NN) estimator from *Abadie/Imbens* (2011) with a difference-in-differences research framework. Observations from treated banks are matched with observations from non-treated banks. The matching process involves the estimation of a propensity score based on bank covariates. The analysis is performed on a cross-sectional basis, disregarding the panel data structure but involving the pre versus post and the treated versus non-treated perspectives with dummy variables.[360] The estimated effect is the average treatment effect on the treated (ATT), comparable to the difference-in-differences estimator. The matching process uses variables that capture differences in business models, funding strategies, and risk appetite. The bias-adjusted matching estimator is employed as all matching variables are continuous, which likely causes bias even in large samples as the probability of finding enough matches shrinks.

[359] Balance is achieved when matching the treated banks with untreated counterparts, hence reducing the heterogeneity between both groups.

[360] Please note that the author uses the full SRM sample for the nearest neighbor matching approach to increase the number of suitable matches. However, using the sample containing only observations from countries with implicitly guaranteed banks yields very similar results.

Table 4.29: NN matching approaches for risk-taking

Approach	Basic	Country	GIIPS Region
Sample	Full sample	Full sample	Full sample
Number of matches	1:4	1:3	1:3
Country		✓	
GIIPS region			✓

Table 4.29 shows the applied matching techniques performed to receive detailed and robust results regarding the implemented matching algorithm. First, a 1:4 matching is applied to the full sample.[361] Second, a 1:3 matching with an exact match on the respective country of treated banks is performed. Exact matches on each treated bank's country lead to the exclusion of some observations as several treated banks have less than two matched controls.[362] Third, a 1:3 GIIPS region matching method is used, which discerns between banks operating in Greece, Ireland, Iceland, Portugal, or Spain or the remaining euro area.[363] Table 4.29 provides an overview of the different matching approaches applied.[364] The matching variables for each risk measure vary conditionally on the dependent variables but are constant across the matching approaches and are depicted in Table 4.30. They were selected to identify the banks' observable characteristics related to their risk-taking, like size, leverage, profitability, and business model.

Table 4.30: Matching variables for risk measures

Risk measures	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σRoA	σStock
Matching variables							
Total assets	✓	✓	✓	✓	✓	✓	✓
Capital asset Ratio	✓	✓	✓	✓	✓	✓	✓
Return on Assets		✓	✓				
Deposit Ratio	✓	✓	✓	✓	✓	✓	✓
Non-int. inc. ratio	✓	✓	✓			✓	
Cost income ratio	✓	✓		✓	✓		✓

The results for the different matching approaches are presented in Table 4.31.[365] The coefficients for all seven risk measures are significant for the basic matching and have the expected sign. The coefficients for the z-score, RWA density, loan impairments, and σstock are even highly significant and economically meaningful. Implicitly supported banks significantly decreased their risk-taking to a higher degree compared to their matched counterparts after the treatment, regardless of the risk measures employed. This shows that the baseline results

[361] The basic matching approach with four exact matches is inspired by *Abadie/Imbens* (2011), who find that four matches are a good compromise between an increasing bias resulting from higher numbers of matches and increased variance of the matching estimator due to a lower number of matches.

[362] All observations from Cyprus, Estonia, Latvia, Lithuania, and Slovakia are dropped from the SRM sample as they do not contain sufficient observations for a 1:3 matching.

[363] Matching on the GIIPS region is motivated by the fact that these countries were severely affected by the GFC and the eurozone crisis, perhaps resulting in a unique response to the SRM regulation.

[364] See *Gropp et al.* (2019); *Gropp/Gründl/Güttler* (2014) for similar matching approaches.

[365] The achieved matching quality is satisfactory. The differences in matching covariates between treated and untreated banks are considerably reduced. The matching quality of the basic approach is exemplarily demonstrated through kernel density plots for total assets, the CAR, and the deposit ratio in the Appendix from Figure E.4 on p. 184 onwards.

discussed earlier are not driven by differences in the treatment and control group that would prohibit causal inference. Hence, banks' response to the SRM is likely determined by the removal of implicit guarantees instead of other impeding factors.

The results for the within-country matching estimation in panel B even increase concerning statistical significance and magnitude. Nearly all coefficients are highly significant, and the magnitude of the coefficients for the z-score, the RWA-density, and σRoA also increases. Similarly, most coefficients for the within-region matching estimation in panel C increase in size and significance compared to the basic approach without exact matches depicted in panel A of Table 4.31.

Overall, the results are robust to all three matching approaches, providing hard evidence that the effects are unbiased by bank or country heterogeneity, thereby strongly supporting ***Hypothesis 1a*** proclaiming reduced risk-taking due to the SRM. The convincing within-country and region matching estimation results, which the author assumes to be even more suitable to reduce control group heterogeneity than the basic approach, mitigates concerns that SRM region disparities drive the results. Specifically, differences in size, leverage, profitability, funding, and business models are not found to cause the SRM impact on risk-taking. Accordingly, the results seem to be unaffected by capital, liquidity, and funding regulations as the matching estimation adapts for bank characteristics potentially responsible for differing responses of treated and untreated banks to those regulations.

Table 4.31: RT robustness X | NN matching

This table presents robustness tests for sample selection. The average treatment effect of the treated (ATT) is estimated by combining a bias-adjusted matching estimator with a DD setting. Panel A shows the result for the basic matching approach with four matches. Panel B shows the results with exact matches on country, and panel C with exact matches on the GIIPS region. σRoA (6) is calculated over 2010-2014 for the pre- and over 2015-2018 for the post-treatment period. Robust standard errors are reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σRoA	σStock
Panel A: Basic							
ATET	0.347***	-3.259***	-0.304***	-1.624**	-0.752**	-0.202**	-0.969***
	(0.082)	(0.830)	(0.062)	(0.685)	(0.352)	(0.094)	(0.336)
Observations	3,013	3,013	3,013	3,013	3,013	3,013	397
Matches	4	4	4	4	4	4	4
Panel B: Country							
ATET	0.672***	-7.334***	-0.340***	-1.130**	-0.793***	-0.433***	-0.801***
	(0.087)	(1.080)	(0.078)	(0.447)	(0.247)	(0.103)	(0.284)
Observations	2,947	2,947	2,947	2,947	2,947	2,947	376
Matches	3	3	3	3	3	3	3
Panel C: Region							
ATET	0.323***	-4.163***	-0.337***	-1.717***	-0.851**	-0.274***	-0.969***
	(0.082)	(0.829)	(0.064)	(0.645)	(0.334)	(0.092)	(0.314)
Observations	3,013	3,013	3,013	3,013	3,013	3,013	397
Matches	3	3	3	3	3	3	3

5 Results on Market Discipline

5.1 Effects of the SRM on Market Discipline

5.1.1 Univariate Difference in Means Analysis

As expressed by ***Hypothesis 2a***, the removal of implicit guarantees through the introduction of the EU resolution framework may have reinforced market discipline. Moreover, ***Hypothesis 2b*** postulates that banks respond to increased market discipline and reduce their share of risk-sensitive debt. Both hypotheses are tested with a similar difference-in-differences regression setup as employed in section 4.2 but with funding measures as dependent variables and a different set of covariates. This section begins with a univariate difference in means analysis to gather an understanding of the funding structure and funding costs differentials in the sample.

From the univariate difference in means analysis depicted in Table 5.1, one can see a general trend of decreasing funding expenses.[366] Both groups face lower funding costs for risk-sensitive debt after the treatment. However, untreated banks reduce their costs for risk-sensitive funding by 2.8 percentage points (6), whereas treated banks only show a reduction by 0.63 percentage points (3). The declining interest rate level could explain the general trend in recent years, which was passed on to bank funding costs.[367] Interestingly, the univariate DD estimator (7) is negative and highly significant, confirming that treated banks experienced a less drastic reduction in funding costs than the control group, which could be explained by increased market discipline. The fact that treated banks have lower expenditures on risk-sensitive funding before and after the treatment suggests other circumstances affecting funding costs. Banks with bailout guarantees tend to be larger and therefore profit from diversification and economies of scale.

The sensitive funding ratio reveals a similar pattern. The overall trend shows a reduction as well, perhaps because of the recently implemented Net Stable Funding Ratio (NSFR)[368] or because of a general trend towards more stable funding sources. Treated banks show an 11.39 percentage point decrease in risk-sensitive funding (3), which is 6.7 percentage points higher than the reduction of untreated banks (7). The same accounts for the wholesale funding ratio, which was considerably more decreased by treated banks. Moreover, one can observe that treated banks exchanged risk-sensitive funding sources to a large fraction with customer deposits.

[366] All variable definitions can be found in Table C.1 in the Appendix.
[367] See *Arnould/Pancaro/Żochowski* (2020); *Szczerbowicz* (2015).
[368] The NSFR is fully applicable from 2021 onwards. *Dietrich/Hess/Wanzenried* (2014) find that a few banks already started to increase their ratio of stable funding during the GFC.

Table 5.1: Univariate difference in means for market discipline | SRM

This table presents univariate difference in means results for the SRM region. The treatment variable (*IGG*) separates the sample into two groups, of which the treated group only consists of banks with a minimum bailout probability of ≥ 50%. The pre-treatment period reaches from 2010 to 2013 and the post-treatment period from 2015 to 2018. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	Treated			Non-treated			
	(1)	(2)	(3) = (2) - (1)	(4)	(5)	(6) = (4) - (3)	(7) = (3) - (6)
Dependent variables	Pre	Post	Diff	Pre	Post	Diff	DD
Funding expenses	2.70	2.06	-0.633***	6.33	3.48	-2.84***	2.22***
Borrowing costs	2.26	1.30	-0.95***	1.97	1.04	-0.93***	-0.02
Sensitive funding	53.57	42.18	-11.39***	31.94	27.26	-4.68***	-6.70***
Wholesale funding	30.85	22.17	-8.68***	10.11	8.34	-1.70***	-6.91***
Customer deposits	46.50	57.55	11.05***	66.87	71.85	4.97***	6.08***

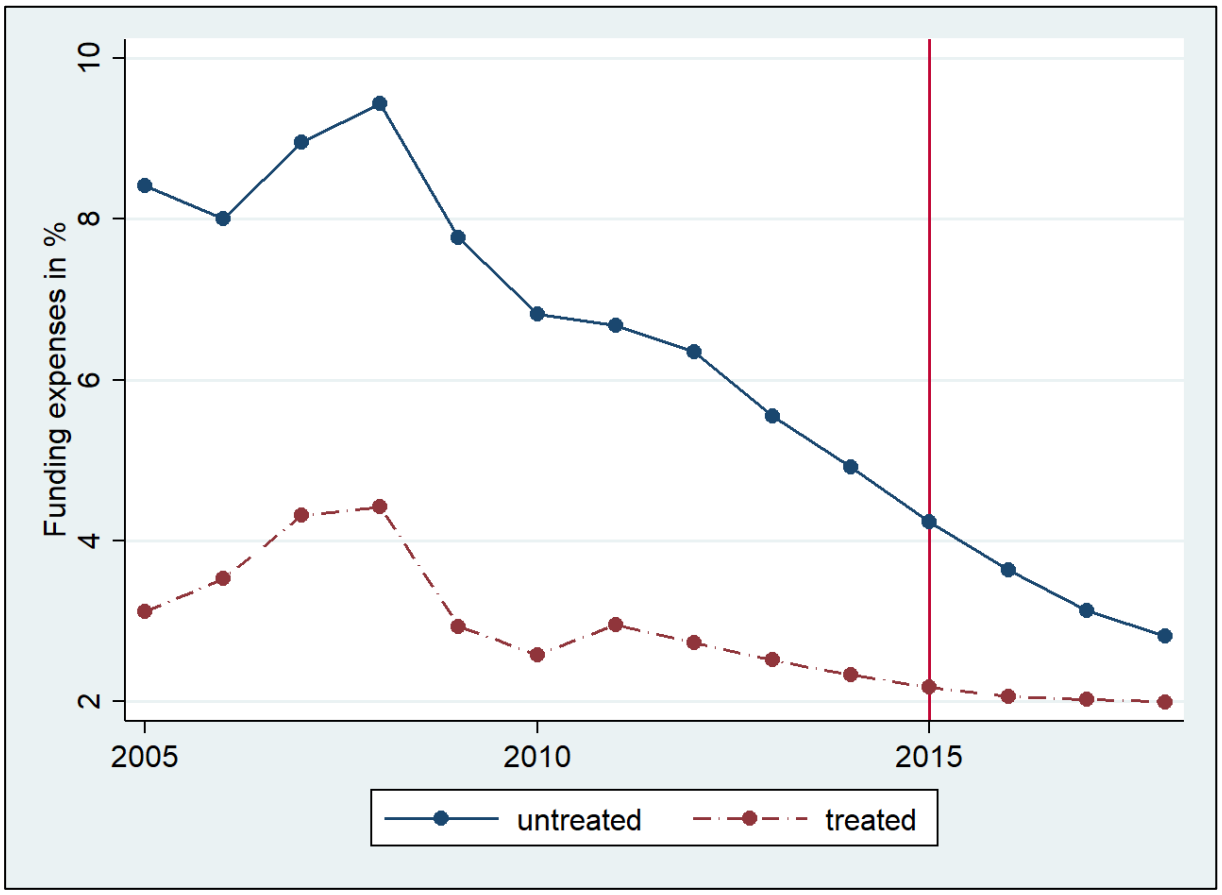
Ruling out that the adaptions of funding structures are not merely due to regulatory requirements or a reaction to the ECB's monetary policy is difficult. The fact that treated banks' funding expenditures slightly decreased might give some reason to interpret this decline against the hypothesis of increased market discipline. Anyhow, the difference to the control group is positive and with 2.22 percentage points economically and statistically significant. Furthermore, considering the declining trend of the average interest rate level during the post-treatment period, one would rather expect that treated banks profited more from lower rates after shifting their funding towards more stable sources.[369] One can obtain a more detailed understanding by looking parallelly at the expenditures for average interest-bearing liabilities (*borrowing costs*), depicted in line two of Table 5.1. Both groups experienced an almost equal reduction of their total interest expense, the difference between the two groups being insignificant. Thus, it can be concluded that the differences in risk-sensitive funding in column (7) are probably due to increased market monitoring by creditors and investors after the introduction of the resolution framework.

Changes in the funding structure are more difficult to interpret. As pointed out above, they might be due to changes in regulatory standards. The treatment group shows a stronger alignment, suggesting a higher risk aversion in favor of the moral hazard channel discussed in section 4.1. Nevertheless, banks still could have decided to restructure their funding after market discipline was enforced or before that effect came into place to take the chance of saving some debt expenditure.[370]

[369] Of course, the final effect depends on the cost difference between customer deposits and alternative funding sources. But average rates for customer deposits declined strongly as well.

[370] One should notice that only because funding costs are not rising in absolute terms, the declining interest rate level affects banks' interest margin. Banks may, therefore, avoid risk-sensitive funding in order to adapt to the new market environment.

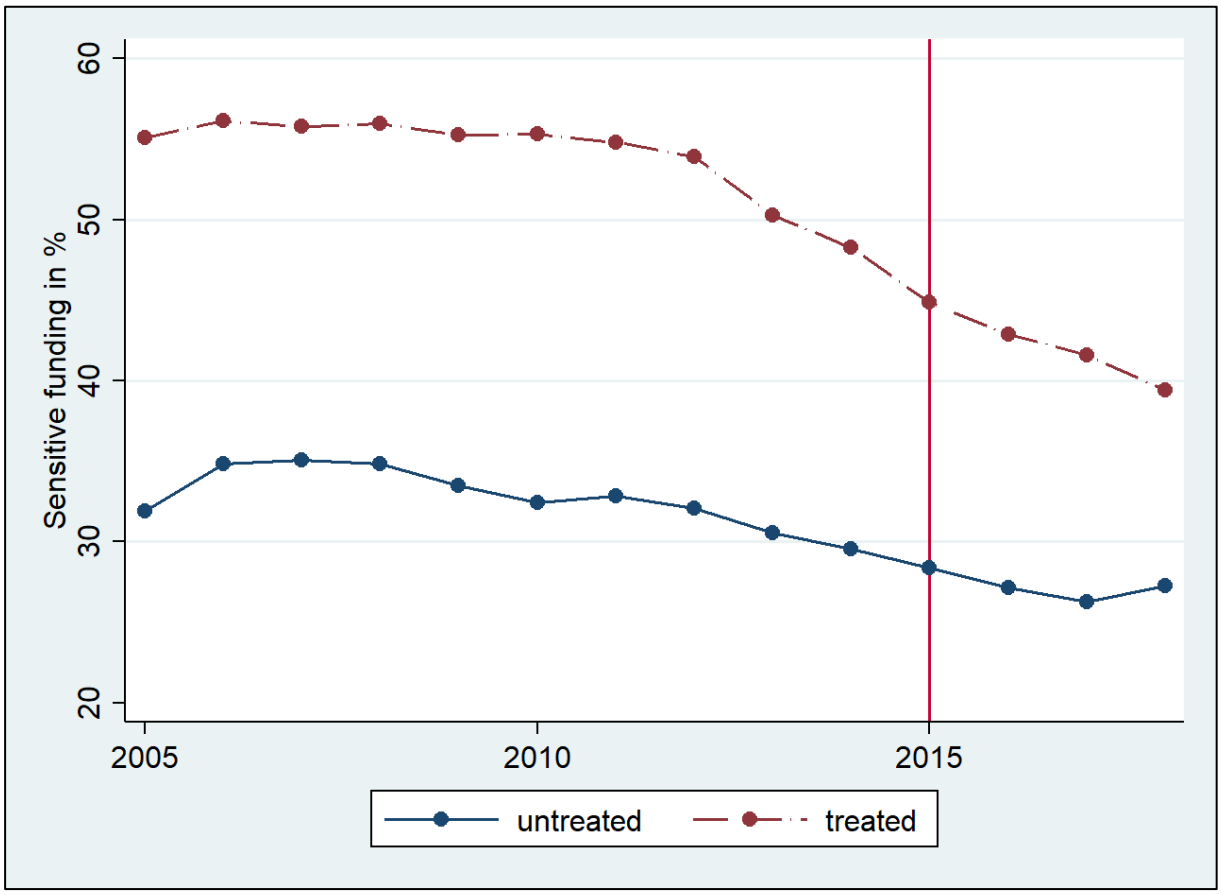
Figure 5.1: Parallel trends of funding expenses | SRM



This figure presents the development of the mean risk-sensitive funding expenses (defined as expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities in %). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥ 50% in 2013 and zero otherwise. The treatment period 2014 is included.

The visual inspection of funding expenses in Figure 5.1 shows that both groups follow a similar trend, although treated banks have lower expenditures for risk-sensitive debt. The different levels of funding expenditures are most likely due to implicit guarantees, resulting in a funding costs advantage for treated banks. Moreover, treated banks are on average larger and have diversification benefits and economies of scale, also lowering their cost of debt. The average funding expenses for untreated banks show a substantial decline, especially after the interest rate level dropped in 2012. Divergent to untreated banks, funding expenditures for guaranteed banks declined less and remained relatively stable from the beginning of the treatment period onwards. Formerly supported banks do not seem to have benefitted from falling interest rates to the same extent as the remaining banks did. Accordingly, the gap in risk-sensitive funding expenditures narrowed over time, showing that the funding cost advantage of treated banks considerably declined.

Figure 5.2: Parallel trends of sensitive funding | SRM



This figure presents the development of the mean ratio of risk-sensitive funding (defined as risk-sensitive funding divided by total funding in %). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥50% in 2013 and zero otherwise. The treatment period 2014 is included. Source: Fitch Connect and author's calculations.

The parallel trend analysis of risk-sensitive funding ratios in Figure 5.2 exhibits that treated banks decreased their share of risk-sensitive debt more than the control group. Both groups reduced risk-sensitive funding, but that the reduction itself is more remarkable for treated banks. This development is consistent with the hypothesis of increased market discipline but could also be interpreted with banks' desire to profit from declining interest rates. However, banks' adaption of funding structures seems to have begun before the legislative process of the resolution framework has progressed. For both, the funding expenditures and the ratio of risk-sensitive funding, it is hard to argue that the treatment happened in 2015, since both trends seem to start from 2013 onwards, at least from a univariate perspective. The premature decline coincides with the publication of the 2013 Banking Communication, which introduced the statutory burden-sharing requirement.[371]

5.1.2 Multivariate Difference-in-Differences Analysis

In this section, the dataset's panel structure is used to control for bank heterogeneity by adding fixed effects and control variables. The selection of covariates is basically in line with the

[371] See section 1.1.2.

literature on funding costs differentials.[372] Some of those variables controlling for the risk profile were already used for the analysis of moral hazard.[373]

Table 5.2 presents the regression results for the multivariate analysis with bank and country controls as well as different levels of fixed effects. The results confirm the univariate findings from Table 5.1 and prove that the impact on market discipline is still valid when controlling for other factors potentially biasing the results. The DD interaction term shows that treated banks experienced a 1.9 percentage point increase in expenses for risk-sensitive funding against the control group (1). Also, treated banks decreased the ratio of risk-sensitive financing by almost three percentage points compared to the control group (2). Both results indicate that treated banks experienced higher monitoring and acted accordingly by shifting the funding towards more stable and risk-insensitive sources. Models (3) and (4) confirm that affected banks shifted their liability structure by avoiding wholesale funding and relying more on customer deposits. The fit for the linear models is good, reaching R-squared values of nearly 40 percent.

Naturally, it would be interesting to control for banks' risk profiles more adequately to cancel out that the observed changes in risk-sensitive funding expenses are due to variations in banks' risk profiles. Therefore, in the following regressions, the models additionally control for bank ratings to gather insights into the funding costs differentials, independent of banks' riskiness. Fitch's Long-Term Issuer Default Rating (LTIDR) is chosen since it is available for most banks in the annual sample and because investors prefer long-term all-in credit ratings for assessing bank risk.[374] Using Fitch Long-Term Issuer Default Rating naturally shrinks the sample size to rated banks, probably leading to a more homogenous sample.

[372] See *Guillaume/Cosimo/*Dawid Zochowski (2020); *Gropp/Gründl/Güttler* (2014); *Körner/Schnabel* (2013).

[373] The baseline regressions for market discipline control for the capital ratio (CAR), the ratio of liquid assets to total assets (liquidity), the return on assets (RoA), banking competition (HHI), the short-term interest rate, GDP growth, inflation, and the private monitoring index.

[374] The long-term all-in credit rating is preferred to a stand-alone credit rating because most investors are more interested in the default probability of their investment than in banks' genuine risk profile. See, e.g., *Drago/Gallo* (2017); *Adelino/Ferreira* (2016); *Alsakka/ap Gwilym/Vu* (2014); *Bongini/Laeven/Majnoni* (2002).

Table 5.2: SRM effects on market discipline

This table presents baseline results from DD regressions of SRM effects on market discipline (H-2). The interaction term *post15 * IGG* is the DD estimator taking the value of one for banks with bailout probabilities ≥ 50% in all periods after the SRM has been established and zero otherwise. Funding expenses are expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities. Sensitive funding is risk-sensitive funding divided by total funding. Wholesale funding is wholesale funding divided by total funding. Customer deposits are the ratio of total customer deposits to total funding. HHI is the Herfindahl-Hirschman Index as a measure for competition per country. Short-term rate is the short-term interest rate level per country. Private monitoring captures the incentives and ability of private investors to monitor banks. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Sensitive funding	(3) Wholesale funding	(4) Customer deposits
Post15 * IGG	1.901***	-2.982***	-3.979***	2.745**
	(0.193)	(1.001)	(1.069)	(1.086)
RoA	-0.017	-0.718*	-0.077	0.008
	(0.130)	(0.419)	(0.373)	(0.515)
CAR	0.012	-0.763***	-0.204*	0.239
	(0.044)	(0.119)	(0.107)	(0.181)
Liquidity	-0.017	-0.015	0.003	-0.013
	(0.013)	(0.037)	(0.046)	(0.045)
HHI	-4.976***	-1.994	-7.753**	4.965
	(1.012)	(3.364)	(3.476)	(3.730)
Short-term rate	1.730***	-11.830	2.766	12.521
	(0.330)	(11.529)	(3.573)	(12.648)
GDP	0.219***	-0.675***	-0.590**	0.945***
	(0.057)	(0.183)	(0.283)	(0.212)
Inflation	-0.553***	0.301	1.435***	-0.152
	(0.108)	(0.371)	(0.468)	(0.425)
Private monitoring	0.254***	0.014	-0.048	-0.104
	(0.060)	(0.196)	(0.248)	(0.228)
Constant	4.467***	56.305***	15.987***	45.394***
	(0.852)	(11.812)	(4.401)	(13.038)
Observations	4,733	4,745	4,653	4,744
Number of banks	619	619	621	619
Adjusted R^2	0.397	0.386	0.193	0.281

The results for the rated subsample controlling for the long-term rating are presented in Table 5.3 and reveal comparable results to the unrated SRM sample in Table 5.2. The coefficients in models (1) and (2) increase in magnitude, while the coefficient in model (4) increases in significance. Thus, it seems unlikely that the comparable rise in funding expenses is due to deteriorating solvency. Moreover, a better rating is associated with lower funding costs and a higher ratio of risk-sensitive debt. That is reasonable since notably weaker rated banks have incentives to avoid risk-sensitive funding sources. The lack of significance for the covariates RoA, CAR, and liquidity in most models, which control for banks' risk profile, shows that the information contained in ratings outperforms balance sheet ratios when determining funding costs differentials. This surpassing of balance sheet indicators is supported by the risen R-squared, indicating that the models explain up to 60 percent of the changes in funding expenses when bank ratings (LTIDR) are included.

Table 5.3: SRM effects on market discipline | rated subsample

This table presents baseline results from DD regressions of SRM effects on market discipline using a subsample of rated banks (H2). The models depicted differ from those of the previous table only in the additional rating control variable, Fitch's Long-Term Issuer Default Rating (LTIDR). All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

	(1)	(2)	(3)	(4)
Dependent variables	Funding expenses	Sensitive funding	Wholesale funding	Customer deposits
Post15 * IGG	2.949***	-4.545***	-3.468***	3.547***
	(0.276)	(1.208)	(1.130)	(1.298)
RoA	-0.018	-1.461***	-0.139	1.773***
	(0.149)	(0.489)	(0.487)	(0.514)
CAR	0.070**	-0.723***	-0.077	-0.190
	(0.030)	(0.232)	(0.201)	(0.449)
Liquidity	0.013	0.036	-0.021	-0.079
	(0.015)	(0.052)	(0.023)	(0.065)
LTIDR	-0.224**	0.699*	0.709***	-0.996**
	(0.088)	(0.405)	(0.216)	(0.432)
HHI3	-4.718***	2.411	-15.798**	1.493
	(1.366)	(6.153)	(6.138)	(7.140)
Short-term rate	1.298***	5.246***	7.289***	-6.265***
	(0.187)	(0.766)	(0.850)	(0.946)
GDP	0.085	-0.244	-0.623*	0.336
	(0.054)	(0.185)	(0.345)	(0.221)
Inflation	0.008	-0.865*	0.395	1.500***
	(0.128)	(0.462)	(0.610)	(0.562)
Private monitoring	0.175*	-0.017	0.361	-0.095
	(0.094)	(0.421)	(0.298)	(0.463)
Constant	9.293***	17.429***	-3.832	93.892***
	(1.368)	(6.318)	(4.861)	(8.337)
Observations	2,594	2,603	2,605	2,510
Number of banks	350	350	352	349
Adjusted R^2	0.613	0.512	0.365	0.399

However, some questions remain: even after including LTIDR, in model (2) for the ratio of risk-sensitive funding, and in model (4) for the ratio of customer deposits, higher profitability and higher capital ratios are associated with a higher share of stable funding. This relation may be due to differences in business models and funding strategies. However, the DD estimator confirms that treated banks faced higher funding costs by 2.9 percentage points and decreased their ratio of risk-sensitive funding by 4.5 percentage points compared to non-treated banks.

The effects on market discipline are also estimated for SIs, O-SIIs, and G-SIIs and presented in the Appendix (Table F.4, Table F.5, and Table F.6). All three groups increased their expenses on risk-sensitive debt and reduced their wholesale funding ratio compared to the respective control groups by nearly the same magnitude, except for G-SIIs, who show no adaption of their funding structure. This proves that the effects on funding expenses are robust to different identification strategies. Since the impact is the strongest for the baseline identification, the relative increase in funding expenses and banks' adaption of funding structures likely result from the SRM's effect on implicit guarantees.

An alternative interpretation of the results could be made, considering the already low interest rates for risk-sensitive debt paid by treated banks. Possibly, treated banks could not benefit from falling interest rate levels to the same extent as untreated banks, as investors consider their funding expenses as the bottom line. This concern is encountered by some robustness tests, including borrowing costs as a covariate (see section 5.3).

5.2 Effects of the BRRD on Market Discipline

5.2.1 Univariate Difference in Means Analysis

Table 5.4 shows the differentials for funding expenditures for treated and untreated banks in the BRRD sample.[375] In contrast to the SRM region, the difference in means analysis hardly delivers any statistically significant results for the BRRD region. For the treated banks, funding expenses declined on average by 1.23 percentage points (3), exceeding the untreated banks' reduction only slightly by 0.02 percentage points (7). The ratio of sensitive funding to total funding was averagely reduced by 3.3 percentage points by treated banks (3), but the difference is not statistically significant. The control group's variation in sensitive funding is smaller and lacking significance as well. The pre-treatment funding cost advantage of treated banks is profound. On average, treated banks pay 1.38 percentage points less for risk-sensitive funding, as columns (1) and (4) show. On the other hand, the overall borrowing costs show lower pre-treatment levels for untreated banks. Formerly guaranteed banks managed to reduce their borrowing costs even more than their risk-sensitive funding expenses, reaching equal post-treatment levels as the peer group.

Table 5.4: Univariate difference in means for market discipline | BRRD

This table presents univariate difference in means results for BRRD effects on market discipline. The treatment variable (*IGG*) separates the sample into two groups, of which the treated group only consists of banks with a minimum bailout probability of ≥ 50%. The pre-treatment period reaches from 2010 to 2013 and the post-treatment period from 2015 to 2018. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	Treated			Non-treated			
	(1)	(2)	(3) = (2) - (1)	(4)	(5)	(6) = (4) - (3)	(7) = (3) - (6)
Dependent variables	Pre	Post	Diff	Pre	Post	Diff	DD
Funding expenses	2.71	1.48	-1.23**	4.09	2.84	-1.25***	0.02
Borrowing costs	2.64	1.03	-1.62***	2.00	1.04	-0.97***	-0.65**
Sensitive funding	36.81	33.43	-3.39	17.65	16.66	-0.99	-2.40
Wholesale funding	20.48	17.18	-3.3	18.14	18.27	0.14	-3.44
Customer deposits	63.78	68.32	4.55	84.39	85.54	1.15	3.40

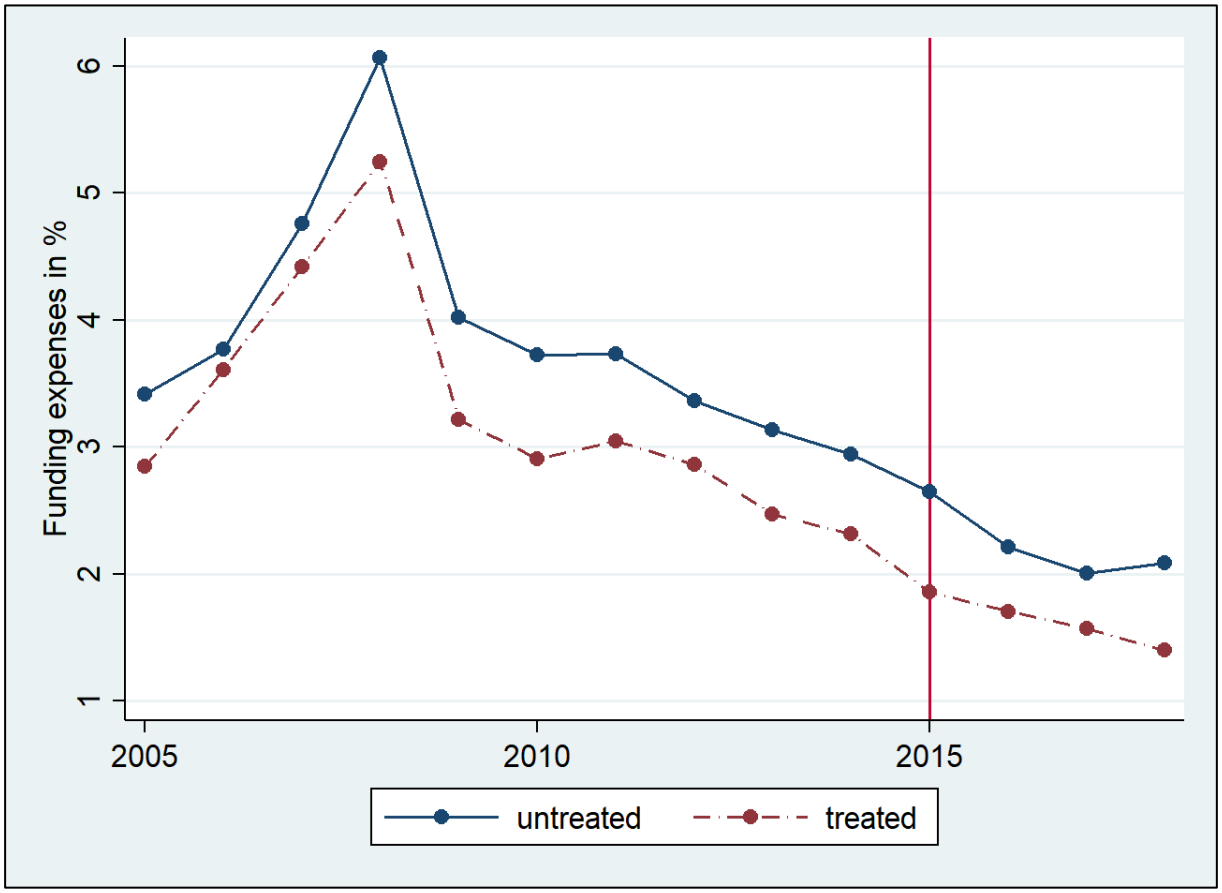
The differences between the SRM and BRRD samples are apparent when comparing Table 5.4 with Table 5.1 on page 106. At least from a univariate perspective, treated banks in the SRM sample are exposed to strengthened market discipline after the resolution rules have been implemented and reacted accordingly by reducing their risk-sensitive funding ratio. The differences found may explain why the BRRD effects on risk-taking are smaller in affected countries. The lack of evidence for increased market discipline is at least in line with previous results on

[375] The BRRD sample contains observations from Bulgaria, Denmark, Poland, Romania, Sweden, and the United Kingdom as these countries provided implicit guarantees to banks above the treatment threshold in 2013.

risk-taking and supports the hypothesis of the SRM being the tougher resolution scheme, which, opposed to the BRRD, incentivizes creditors and investors to monitor banks. Regarding the different funding structures, both treated and untreated banks in the BRRD region show a greater reliance on stable funding sources compared to SRM banks. Lower proportions of risk-sensitive funding could, consequently, result in fewer incentives for market discipline.

The parallel trend of risk-sensitive funding expenses plotted in Figure 5.3 reveals a relatively stable funding cost advantage for treated banks. The gap in funding expenses between treated and untreated banks is smaller compared to the SRM region and widens again in 2018. Remarkably, funding costs continue to decline for implicitly supported banks after the BRRD was implemented in 2015. For more reliable results, multivariate difference-in-differences regressions are estimated in the following section.

Figure 5.3: Parallel trends of funding expenses | BRRD



This figure presents the development of the mean risk-sensitive funding expenses (defined as expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities in %). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥ 50% in 2013 and zero otherwise. The treatment period 2014 is included.

5.2.2 Multivariate Difference-in-Differences Analysis

For the multivariate analysis, the model applied in section 5.1.2 is re-estimated for banks domiciled in the BRRD area. Table 5.5 presents the results for the BRRD sample incorporating treated entities with a bailout probability of at least 50 percent at the end of the pre-treatment

period, denoted by the dummy variable *IGG*.[376] Panel A includes bank and time fixed effects, panel B country and time fixed effects. Because the economic conditions and developments of the BRRD countries are more diverse as among SRM countries, adding country fixed effects seems appropriate to avoid unobserved heterogeneity biasing the results.

The DD estimator in panel A shows a reduced ratio of wholesale funding (3), which could be interpreted as a greater reliance on more stable and risk-insensitive funding sources for the treated banks. This can be confirmed by panel B, revealing an increased reliance on customer deposits. Panel C shows the results for a rated subsample, also controlling for banks' long-term rating.

Table 5.5: BRRD effects on market discipline

This table presents combined results from DD regressions of BRRD effects on market discipline (H-2). The treatment variable (IGG) is one for banks with a minimum bailout probability of 50% at the end of the pre-treatment period and zero otherwise. All countries without treated entities were removed. Panel A includes bank and time fixed effects; panel B includes country and time fixed effects; panel C includes bank and time fixed effects for a rated subsample. Bank and country controls are not reported for brevity. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Sensitive funding	(3) wholesale funding	(4) Customer deposits
Panel A: bank and time FE				
Post15 * IGG	0.019	-1.571	-3.352*	2.858
	(0.539)	(1.664)	(1.824)	(1.904)
Constant	5.063**	-0.951	12.651*	108.372***
	(2.040)	(8.627)	(6.481)	(11.207)
Observations	1,137	1,148	882	1,148
Number of banks	157	157	133	157
Adjusted R^2	0.063	0.104	0.061	0.107
Panel B: country and time FE				
Post15 * IGG	0.017	-2.047	-4.178*	3.780*
	(0.516)	(1.997)	(2.153)	(2.225)
Constant	5.835***	0.576	17.337	110.093***
	(2.084)	(13.660)	(11.837)	(15.738)
Observations	1,137	1,148	882	1,148
Number of banks	157	157	133	157
Adjusted R^2	0.0262	0.236	0.0470	0.168
Panel A: rated subsample				
Post15 * IGG	-0.523	-2.540	-4.518*	3.444
	(0.553)	(2.542)	(2.590)	(2.985)
Constant	1.391	43.636**	9.381	54.776**
	(4.977)	(19.402)	(12.655)	(22.201)
Observations	205	205	205	205
Number of banks	28	28	28	28
Adjusted R^2	0.136	0.196	0.181	0.226

[376] Panel A and B contain the exact covariates as the equivalent analysis for the SRM displayed in Table 5.2. Panel C additionally controls for the long-term rating.

The results remain unchanged, only showing significant effects on the reduction of wholesale funding (3). The fact that the results for both panels are only significant at the 10%-level underscores that there is hardly any variation in the funding behavior of treated banks after the BRRD implementation. There are no indications of increased market discipline, as there are in the SRM sample. The absence of any bank reactions again highlights the regional differences, crediting the SRM with stronger disciplinary effects in comparison to the BRRD. The regressions are re-estimated with O-SII and G-SII as treated entities, showing some significant effects regarding the funding behavior (see Table F.7 and Table F.8 in the Appendix). O-SIIs show moderate evidence of increased funding expenses by about one percentage point, but no evidence on changed funding structures. Interestingly, the most substantial impact for the estimation of BRRD effects on market discipline is obtained for G-SIIs, displayed in Table F.8. G-SIIs reveal a significant increase in the average cost for risk-sensitive funding by one percentage point higher than the control group (1), while their change in overall borrowing costs deviates not significantly from the control group (2). The results further show that, on average, the ratio of risk-sensitive funding has been reduced compared to the control group (3), and that G-SIIs instead relied more on customer deposits (4).

5.3 Robustness Tests

This section presents robustness tests for the SRM effects on market discipline. As section 4.3 already proves the validity of the identification strategy, the tests conducted in this section aim to show that model specifications do not drive the results. In the first test, a different set of control variables is used, presented in Table 5.6. All models control for banks' total assets, borrowing costs, subordinated debt, long-term rating, return on asset, and capital ratio. Since size may still be an essential determinant of banks' funding cost differentials, adding it may improve the model's explanatory power. The ratio of subordinated debt to total assets proxies the extent banks are exposed to market discipline, as investors' have higher monitoring incentives when their claims are senior.[377] The borrowing costs enter the regressions as a control variable and as a dependent variable in model (2), adapting for the general declining trend of bank funding costs that might bias the results. Those additional covariates were not implemented in the baseline version in the initial version as they are assumed to be relatively stable and thus play a minor role in the fixed effects regressions, which seeks to adapt for factors changing a lot.[378]

The adjusted R^2 of all models increases compared to the baseline version presented in the previous section, showing a higher explanatory power for the effects on banks' funding expenditures and funding structure of up to 80%. The results show that the observed rise in funding expenses and the reduction of risk-sensitive funding compared to the control group are not driven by banks' size, their ratio of subordinated debt, or their overall borrowing costs. The fact that the DD estimator for the borrowing costs (2) is insignificant suggests rising funding

[377] See *Gimber/Rajan* (2019).

[378] Also, the use of the subdebt ratio reduces the sample size drastically, which is why it is not included in the baseline version.

expenses for treated banks occur due to bail-in premia, reflecting the decreased bailout probability instead of the declining interest rate level.

Table 5.6: MD robustness I | different control variables

This table presents robustness tests for market discipline employing additional covariates. Different control variables are used to show that the results are not affected by banks' size, ratio of subordinated debt, and borrowing costs. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Post15 * IGG	2.440***	0.157	-3.908***	-4.364***	3.740***
	(0.261)	(0.134)	(1.022)	(0.909)	(1.059)
Borrowing costs	1.777***		-0.010	1.357***	0.542
	(0.217)		(0.719)	(0.462)	(0.785)
Subdebt	-0.150	-0.017	0.796**	0.810***	-0.973**
	(0.107)	(0.022)	(0.344)	(0.265)	(0.392)
Total assets	-2.422***	0.391***	5.271*	0.582	-5.624*
	(0.616)	(0.117)	(2.854)	(1.313)	(3.126)
LTIDR	-0.176*	0.000	0.554	0.543**	-0.690
	(0.092)	(0.020)	(0.448)	(0.213)	(0.485)
RoA	-0.109	0.006	-1.471***	-0.318	1.551***
	(0.122)	(0.032)	(0.468)	(0.508)	(0.474)
CAR	0.130*	-0.040***	-0.900***	-0.323	0.632**
	(0.069)	(0.010)	(0.258)	(0.207)	(0.269)
HHI	-0.550	-0.868	-0.193	-14.558**	3.876
	(1.458)	(0.708)	(6.794)	(6.117)	(7.201)
Short-term rate	2.019***	0.033	2.611*	5.823***	-2.913*
	(0.307)	(0.088)	(1.477)	(0.911)	(1.612)
GDP growth	0.094*	-0.018	-0.066	-0.367	0.096
	(0.056)	(0.018)	(0.185)	(0.252)	(0.208)
Inflation	0.121	-0.052	-1.040**	0.780	1.271**
	(0.133)	(0.049)	(0.459)	(0.605)	(0.498)
Private monitoring	-0.036	0.117***	-0.172	-0.108	0.347
	(0.092)	(0.032)	(0.378)	(0.230)	(0.434)
Constant	59.221***	-7.210**	-94.109	-12.792	202.082***
	(13.505)	(2.783)	(59.813)	(29.496)	(65.717)
Observations	2,340	2,355	2,344	2,355	2,344
Number of banks	339	340	339	340	339
Adjusted R^2	0.670	0.800	0.536	0.419	0.483

The author applies a continuous treatment variable reflecting the 2013 bailout probability to validate the robustness of the identification strategy regarding the effects on market discipline. Table 5.7 shows the results of difference-in-differences estimations involving a continuous treatment variable, representing the respective bailout probability at the end of the pre-treatment period. All models contain the exact covariates as in the previous analysis presented in Table 5.6. The interaction term *post15 * bailoutp* estimates the effects of higher bailout expectations on treated banks' funding behavior after the SRM. A high pre-treatment bailout probability is associated with rising expenditures for risk-sensitive debt (1) and a decline in risk-sensitive

funding (3). All models are highly significant and promote ***Hypotheses 2a*** and ***2b***. Consequently, the author finds the identification strategy to be valid.

Table 5.7: MD robustness II | treatment intensity

This table presents robustness using a continuous treatment variable. Bank and country controls are not reported for brevity. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Post 15 * bailoutp	3.097***	0.247	-4.755***	-5.332***	4.486***
	(0.362)	(0.215)	(1.383)	(1.158)	(1.415)
Constant	59.552***	-7.543***	-96.296	-15.022	204.687***
	(13.593)	(2.791)	(59.968)	(29.733)	(65.878)
Observations	2,340	2,355	2,344	2,355	2,344
Number of banks	339	340	339	340	339
Adjusted R^2	0.668	0.800	0.534	0.415	0.481

As the test for parallel trends in section 5.1.1 revealed a long-term inclination for lower funding costs and stable funding sources, the SRM effects on market discipline are estimated for shorter periods. The pre- and post-treatment periods are shortened to two years each to minimize the potential influence from other pre-or post-treatment factors. Table 5.8 shows the results using a total period reaching from 2012 to 2016. Although the results are less intense in terms of both significance and magnitude, the SRM has the expected impact on funding expenditures and structures in the two years following its introduction. The coefficient for funding expenditures (1) remains highly significant and still indicates a meaningful rise of 1.8 percentage points with regard to untreated banks.

Table 5.8: MD robustness III | shorter pre- and post-treatment periods

This table presents robustness tests for shorter pre (2012-2013) and post-treatment (2015-2016) periods. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Post15 * IGG	1.828***	0.113	-2.705**	-2.709***	2.357**
	(0.255)	(0.125)	(1.081)	(0.802)	(1.080)
Constant	59.822***	-6.959***	-50.080	40.669	153.492**
	(11.720)	(2.567)	(61.495)	(37.986)	(67.126)
Observations	1,236	1,243	1,238	1,243	1,238
Number of banks	333	335	334	335	334
Adjusted R^2	0.622	0.763	0.443	0.326	0.392

As Figure 5.1 and Figure 5.2 exhibit long-term trends in the treated banks' funding expenses and structures, a placebo treatment in 2012 is simulated to verify that the main adaption is due to the introduction of the SRM. This test is conducted on two samples, one of which does not control for the long-term rating of banks for the sake of a larger sample size.

As shown in Table 5.9, the rated subsample in panel A shows a reduction in sensitive funding (3) and wholesale funding (4) and a slight increase in their funding expenses (1). When it is not controlled for banks' long-term rating but other covariates used in this section (panel B), treated banks show an increase in their borrowing costs and a reduction in their wholesale funding, both highly significant. Banks may have started to adapt funding sources before the post-bailout era to benefit from falling interest rates and increase their funding stability.[379] The moderate increase in treated banks' funding expenses relative to untreated banks, although only significant at the 10% level, might be due to creditors' reaction to the burden-sharing requirements implemented with the 2013 Banking Communication. Moreover, investors could also have reacted to the discussion of SRM proposals, which started in 2012. However, the fact that the coefficient for funding expenses (1) shows only slight significance and the borrowing costs in panel B (2) even increases slightly by 0.23 percentage points reveals that the main adaption happened after the SRM implementation. It can be assumed that treated banks avoided risk-sensitive funding sources after 2012 and were exposed to slight increases in their funding expenses but that the SRM significantly amplified this trend.

Table 5.9: MD Robustness IV | placebo treatment in 2012

This table presents results for a simulated treatment in 2012. The pre (2010-2011) and post-treatment (2012-2013) period each cover two years. Panel A controls for the standard set of controls used in this section; Panel B does not control for banks' long-term rating. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Panel A: controlling for rating					
Post12 * IGG	0.283*	0.033	-1.384**	-3.194***	1.268*
	(0.169)	(0.074)	(0.568)	(0.898)	(0.646)
Constant	67.453***	-9.145***	-110.491**	-18.126	233.709***
	(17.054)	(3.424)	(47.240)	(53.657)	(52.114)
Observations	1,155	1,166	1,159	1,166	1,159
Number of banks	316	318	317	318	317
Adjusted R^2	0.381	0.606	0.517	0.330	0.432
Panel B: not controlling for rating					
Post12 * IGG	0.286*	0.227***	-0.363	-2.466***	0.186
	(0.173)	(0.075)	(0.529)	(0.829)	(0.583)
Constant	49.785***	-14.280**	-173.835***	34.595	275.400***
	(14.408)	(7.137)	(62.906)	(57.525)	(70.851)
Observations	1,862	1,880	1,866	1,877	1,866
Number of banks	503	508	504	508	504
Adjusted R^2	0.240	0.218	0.388	0.174	0.301

As pointed out in section 4.3.3, other banking regulations like the LCR or the NSFR could bias the results (see Table 4.25 on page 98). To assign the observed effects to the SRM, additional robustness tests are conducted. Similar to the matched sample analysis presented in Table 4.28 on page 102, a more comprehensive sample concerning banks' funding characteristics is compiled. Observations from treated banks are matched with untreated counterparts based on

[379] See European Central Bank (2016); *Van Rixtel/Gasperini* (2013).

propensity scores estimated using 2013 covariates values. The score is estimated using the matching covariates total assets, capital ratio, customer deposit, sensitive funding, and liquidity.[380]

The matched sample amounts to 53 treated and 53 untreated banks. The applied DD regressions on the matched sample are equal to those presented in Table 5.6 on page 116. Banks' size and pre-treatment funding characteristics do not seem to significantly influence the results on market discipline, as shown in Table 5.10. The increase in funding expenses and the subsequent reduction of risk-sensitive debt are probably unbiased by varying responses to regulations regarding funding (NSFR), liquidity (LCR), and leverage (LR).

Table 5.10: MD robustness | 1:1 matched sample

This table presents robustness tests for sample selection. The matched sample is compiled by calculating propensity scores based on pre-treatment covariates total assets, capital ratio, customer deposit ratio, sensitive funding, and liquidity. The matching process is 1:1 NN matching based on the propensity score. Bank and country controls are similar to previous models. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Post15 * IGG	1.792***	0.250	-3.432***	-4.479***	3.253**
	(0.346)	(0.152)	(1.238)	(1.086)	(1.303)
Constant	64.637***	-24.426**	-318.893***	-55.405	408.828***
	(18.197)	(9.932)	(83.130)	(74.013)	(84.271)
Observations	804	804	804	804	804
Number of banks	106	106	106	106	106
Adjusted R^2	0.579	0.679	0.723	0.495	0.683

Another robustness check is conducted to ease concerns regarding the selection issue as the treatment was not randomly assigned to banks. The average treatment effect on the treated (ATT) is estimated by combining the bias-adjusted nearest neighbor (NN) matching estimator of *Abadie/Imbens* (2011) with a difference-in-differences research design. By matching on selected variables describing bank funding differentials, an attempt is made to minimize potential differences between treated and untreated banks that could bias the result. Table 5.11 summarizes the different matching approaches used. The basic matching approach refers to the entire SRM sample with matches on four nearest neighbors. Furthermore, in the country approach, each treated bank is matched with three untreated banks operating in the same country of domicile. The country & rating approach also uses exact matches on the country and additionally uses the long-term rating (LTIDR) as a matching covariate. The same calibration variables are applied for all three matching strategies, varying according to the dependent variable capturing banks' funding expenditures and funding structure.

[380] It is verified that the matched sample is homogenous regarding the estimated propensity scores.

Table 5.11: NN Matching approaches for market discipline

Approach	Basic		Country	Country & rating	
Sample	Full sample		Full sample	Rated subsample	
Number of matches	1:4		1:3	1:3	
Country			✓	✓	
Funding measures	Funding expenses	Borrowing costs	Sensitive funding	Wholesale Funding	Customer Deposits
Matching variables					
Total assets	✓	✓	✓	✓	✓
Capital asset Ratio	✓	✓	✓		
Return on Assets	✓	✓	✓	✓	✓
Subdebt	✓	✓	✓		
Borrowing costs	✓				
Cost income ratio				✓	✓
Deposit ratio	✓	✓	✓		
(LTIDR)	✓	✓	✓	✓	✓

Table 5.12 presents the nearest neighbor matching results, which overall support hypotheses 2a and 2b of increased funding expenditures and a shift towards risk-insensitive funding sources. Treated banks managed to reduce their borrowing costs even after the introduction of the SRM. Still, they faced higher expenditures on risk-sensitive funding, as revealed in panels B and C. The coefficient for risk-sensitive funding (1) yields only positive and significant results when banks are exactly matched with untreated competitors from the same country. Treated banks may still enjoy funding cost advantages, e.g., because of their size or because removing guarantees needs time to be passed on to banks' liability sides. As the nearest neighbor matching approach uses a cross-sectional dimension disregarding the panel structure, differences in levels influence the results.

The results for the residual funding measures remain qualitatively unchanged to the baseline regressions in section 5.1.2, indicating that country and bank heterogeneity do not significantly distort the observed effects on funding. Hence, the overall results for market discipline are probably not caused by different reactions of both groups to regulatory or market changes.

Table 5.12: MD robustness V | NN matching

This table presents robustness tests for sample selection. The average treatment effect of the treated (ATT) is estimated by combining a bias-adjusted matching estimator with a difference-in-differences setting. Panel A displays results for the basic matching approach. Panel B displays results for the exact matching on country. Panel C displays results for the exact match on country, additionally controlling for the long-term rating. Robust standard errors are reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)
Dependent variables	Funding expenses	Borrowing costs	Sensitive funding	Wholesale Funding	Customer Deposits
Panel A: basic					
ATT	0.094	-0.539***	-3.618***	-1.448	3.227**
	(0.085)	(0.095)	(0.863)	(1.129)	(1.642)
Observations	3,691	3,691	3,691	3,691	3,691
Matches	4	4	4	4	4
Panel B: country					
ATT	0.289***	-0.322***	-1.815**	-3.728***	5.236***
	(0.080)	(0.104)	(0.758)	(1.109)	(1.340)
Observations	3,659	3,659	3,659	3,659	3,659
Matches	3	3	3	3	3
Panel C: country & rating					
ATT	0.511***	-0.613***	-1.602**	-2.568**	4.667***
	(0.099)	(0.082)	(0.752)	(0.999)	(1.100)
Observations	2,316	2,316	2,316	2,316	2,316
Matches	3	3	3	3	3

As the measure for risk-sensitive funding is rather simplistic and produces many outliers, an additional robustness test with a differently designed measure of risk-sensitive funding (*funding expenses 2*) is performed. The measure is computed by dividing expenses for non-customer deposit liabilities by the average interest-bearing liabilities (*IBL*). This procedure produces fewer outliers but is expected to underestimate the effects on funding expenses, as the denominator is higher (see Table D.2). The author also includes the ratio of average interest-bearing liabilities to total liabilities (*IBL-ratio*) as a covariate to verify that the denominator's changes do not drive the effects. The results are in line with those from the original measure, showing that the variable definition and outliers do not bias the results (see Table F.3). The parallel trends of the new funding measure for treated and untreated banks are presented in Figure E.10. With the alternative measure, treated banks even seem to be exposed to an absolute rise in funding expenses, as opposed to the initial measure.

6 Additional Results

This section offers some insightful supplementary results. The author investigates the short-term effects on risk-taking and market discipline, compares the treatment effects of the resolution mechanism and the impact of implicit guarantees between the SRM and BRRD areas, and explores the long-term trend between implicit guarantees and investors' perception of banks' default risk. These additional studies aim to validate and apprehend the initial findings on risk-taking and market discipline.

6.1 Short-Term Effects of the SRM

6.1.1 Risk-Taking

The short-term effects of the SRM on risk-taking are investigated more closely with a subsample of banks reporting quarterly. This study can conclude whether banks anticipate the new regulation and reduce risk-taking before the resolution framework applies or whether they react to it later. Bank ratings were collected on a quarterly basis for a subset of listed banks to examine the evolution of bailout probabilities during the implementation phase of the SRM in more detail.[381]

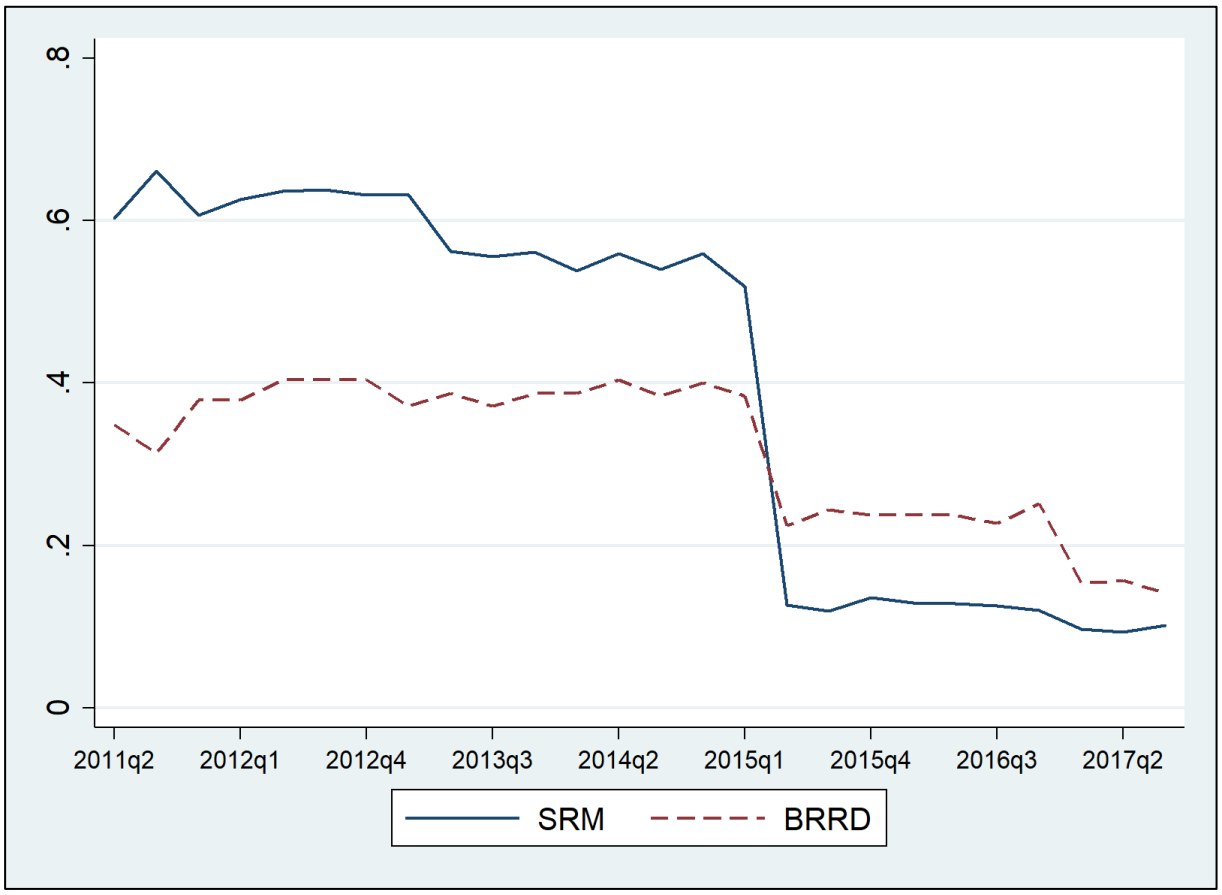
As Figure 6.1 shows, the average bailout probability drastically declined in the second quarter of 2015. The response was substantially more vital for the SRM region, dropping from over 50 percent in the fourth quarter of 2014 to around 20 percent in the second quarter of 2015. Bailout probabilities remained on that level and further declined during 2016. The incremental reduction can be attributed to the activation of the bail-in tool and the Single Resolution Fund. The average bailout probability in the BRRD region declined as well but remained just above 20 percent in 2015 and then continued to fall from the first quarter of 2017 onwards. Overall, the resolution framework leads to an inversion of support levels with higher bailout probabilities for the BRRD region since 2015. The inversion is probably due to the delayed implementation of the BRRD by some member states and the assumed greater discretionary confidence in resolution matters compared to the SRM jurisdiction.

Surprisingly, this is not the case for bailout probabilities estimated for the annual sample displayed in Figure 3.1, which is available for a larger number of banks. Looking closer at the evolution of quarterly bailout probabilities before the resolution framework has been in effect, the average bailout probabilities in the SRM region show a clear drop at the beginning of 2013, followed by a slight downward trend. The moderate decline might be attributable to the early discussion of the resolution mechanism or the Banking Communication published in August 2013, defining stricter burden-sharing requirements for staid aid purposes.[382] The evolution of quarterly bailout probabilities solely derived from Fitch ratings is also presented in Figure E.7 and Figure E.8.

[381] The quarterly rating sample comprises all banks that are listed according to Fitch Connect, with a total number of 109 banks in the EU. See Table A.1Table D.4 in the Appendix on the composition of the quarterly subsample.

[382] See section 1.1.2 on p. 6 for details on the EU Commission's 2013 Banking Communication.

Figure 6.1: Quarterly bailout probabilities by region | Fitch & Moody's



This figure presents the average bailout probability by region in quarterly frequency for a subset of listed banks. The probability is estimated for each bank by relying on rating information from Fitch's and Moody's. Depicted are the mean bailout probabilities for each region. SRM are all members of the eurozone. BRRD are all non-eurozone EU members.

The subsample containing quarterly accounting and market data is downloaded from Fitch Connect, including all banks from the primary sample with quarterly reports available between 2013 and 2016. Banks with less than four observations per year, foreign-owned banks, and subsidiaries are removed from the sample. Due to the limited sample size, observations from countries not offering implicit support to their banks remain in the sample.[383] Table D.5 in the appendix provides summary statistics for the quarterly sample. The regressions include four risk measures as dependent variables assumed to react faster to changes in banks' risk appetite. For the z-score, the standard deviation of return on assets is calculated using a rolling window approach incorporating the last eight quarters. All models control for total assets, return on assets, capital ratio, deposit ratio, liquid assets, revenue growth, GDP growth, and inflation. By shortening and shifting the pre-treatment period to the four quarters in 2014 and the post-treatment period to the four quarters in 2015, the chance that other factors bias the results is reduced. Moreover, considering only four quarters as the post-treatment period, it can be explored if treated banks immediately adapt their risk-levels after the SRM regulation applies.

[383] Nevertheless, the results remain qualitatively comparable if observations from countries without treated entities are removed.

Table 6.1: Short-term SRM effects on risk-taking | 8 quarter subsample

This table presents short-term SRM effects on risk-taking using a subsample with quarterly accounting and stock market data. The pre-treatment period stretches from 2014Q1 to 2014Q4, and the post-treatment period stretches from 2015Q1 to 2015Q4. Four risk measures are used as dependent variables: the z-score (defined as return on assets plus the capital ratio divided by the standard deviation of return on assets), RWA density (defined as the risk-weighted assets to total assets in %), LLR-ratio (defined as loan loss reserves to total loans), and σStock (defined as the quarterly standard deviation of stock returns). All models control for total assets, RoA, CAR, deposit ratio, liquidity, revenue growth, GDP growth, and inflation. Bank and country controls are not reported for brevity. All models include bank and quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) z-score	(2) RWA density	(3) LLR-ratio	(4) σStock
2015Q1 * IGG	0.428**	-2.379**	-0.717	-1.809*
	(0.208)	(0.976)	(0.482)	(0.899)
Constant	-20.085	666.496***	132.260*	-24.520
	(27.201)	(127.277)	(67.438)	(71.809)
Observations	433	355	379	311
Number of banks	58	54	56	41
Adjusted R^2	0.154	0.435	0.213	0.339

Table 6.1 shows the difference-in-differences results for the quarterly subsample, which are in line with previous findings, exhibiting risk-reducing effects of the SRM on treated banks compared to their untreated peers. Only the coefficient for the LLR-ratio is insignificant but has the expected sign. Table F.9 in the appendix presents the results for a shifted post-treatment period starting in the fourth quarter in 2014. The results are weaker compared to the eight quarter subsample, revealing significant coefficients at the 10 percent level except for the LLR-ratio, whose coefficient is significant at the 5 percent level. Overall, the results show that implicitly guaranteed banks reduce their risk-taking to a higher degree than non-guaranteed peers around the SRM implementation at the beginning of 2015. The short-term response is consistent with the sudden decrease in bailout probabilities in the second quarter of 2015, depicted in Figure 6.1. Since it can be assumed that even the quick-reacting risk measures show adaption of banks' risk appetite with some delay, banks probably decided to adapt their risk-taking before their ratings have been revised.

6.1.2 Market Discipline

Following the previous section's approach, the quarterly subsample is used to investigate short-term effects on market discipline for the SRM region. The period stretching from the third quarter of 2013 to the second quarter of 2015 is explored, relying on difference-in-differences regressions. In contrast to the effects on risk-taking, the author assumes that investors increased monitoring shortly after the EU parliament has passed the regulation since *Schäfer/Schnabel/Weder di Mauro* (2017) detect the most potent market response to that event.

The third quarter of 2014 is defined as the beginning of the treatment time. Market-based proxies for the monitoring activities are employed as market prices are assumed to respond immediately to investors' assessment of bank risk. All models control for total assets, RoA, CAR, liquidity, GDP growth, inflation, and the private monitoring index. Table 6.2 shows the result for the eight quarter period, revealing that treated banks were significantly exposed to a sharp

increase in CDS spreads and stock price volatility compared to their untreated peers. Treated banks[384] exhibit a substantial rise in CDS spreads by 126 basis points (1) and show an increase in stock return volatility by one standard deviation compared to the control group in the four quarters after the resolution framework has been adopted.[385] Those results are in line with *Fiordelisi et al.* (2020b); *Schäfer/Schnabel/Weder di Mauro* (2017), who provide evidence for increased market discipline in response to the adoption of the resolution framework via event study analyses.

Table 6.2: SRM effects on market discipline | 8 quarter subsample

This table presents short-term effects on market discipline using a subsample with quarterly accounting and market data. The pre-treatment period stretches from 2013Q3 to 2014Q2, and the post-treatment period stretches from 2014Q3 to 2015Q2. All models control for total assets, RoA, CAR, liquidity, GDP growth, inflation, and the private monitoring index. Bank and country controls are not reported for brevity. All models include bank and year-quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

Dependent variables	(1) CDS	(2) CDSmean	(3) Stock returns	(4) σStock
2014Q3 * IGG	126.002**	217.468**	-6.183	1.063***
	(52.949)	(84.804)	(4.203)	(0.335)
Constant	9,376.657	8,018.906	-142.866	113.749
	(8,051.794)	(7,127.355)	(547.439)	(79.424)
Observations	144	144	334	334
Number of banks	18	18	42	42
Adjusted R^2	0.493	0.611	0.285	0.203

Contrary to event study analyses, this research shows that increased market discipline persists in subsequent periods, indicating a high potential to influence banks' risk-taking behavior. Table F.10 in the appendix presents the same regressions estimated on a sample covering only six quarters, emphasizing short-term effects. The results are similar, with significant results for lower stock returns for treated banks in the three months after the EU Parliament had passed the regulations.

6.2 BRRD & SRM Comparison

6.2.1 Differences in Treatment Effects

The drastic divergence in the reaction to the resolution rules between the eurozone and non-eurozone countries is a motivation for further explorations. As predicted by ***Hypothesis 3***, banks in the euro area (SRM region) respond relatively intense to the policy change, while other EU member states (BRRD region) show no reduction in risk-taking. One naturally wonders if the different levels of support between banks in the SRM or BRRD area explain the results. For most non-eurozone countries, the level of government support is lower. Banks in countries

[384] From 25 banks with CDS spreads available in the quarterly sample, 19 are identified as treated, of which 14 are located in the SRM region. From 75 banks with stock market data available, 39 are identified as treated, of which 28 are located in the SRM region.

[385] Note that the European Parliament adopted the SRM-Regulation and the BRRD on 15 April 2014. The post-treatment period is defined to start in the third quarter of 2014, the first quarter after this event. Analysis for the second quarter delivers significant results for increased CDS spreads in unreported regressions.

where the level of sovereign support has been weak in the first place may face few incentives for moral hazard. Comparing both regions regarding banks' reaction to the resolution rules is also beneficial for the sample heterogeneity among treated banks. Other bank regulations of the single rulebook that might influence banks' risk-taking, except for the Single Supervisory Mechanism (SSM), were adopted in the entire EU (see Table 4.25 in section 4.3.3). Treated banks' regulatory environment is thus very similar.

The different treatment effects of the SRM and BRRD are investigated using a three-group comparison involving two DD estimators. The group comparison is achieved using different factor variables, *treated*, which identify treated entities and discriminate between banks' domicile.[386] The regression equations are otherwise similar to Equations (3.24) and (3.25), estimating the effects on risk-taking and market discipline.[387] In Equation (6.1), β_4 estimates the treatment effect of the BRRD, and β_5 the treatment effect of the SRM.

$$Y_{i,t} = \alpha + \beta_1 post_t + \beta_2 treated_i + \beta_3 treated\_SRM_i + \beta_4(post_t * treated_i) + \beta_5(post15_t * treated\_SRM_i) + X_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (6.1)$$

For the first region comparison, a new treatment variable is introduced. The factor variable *decline* identifies banks whose bailout probability dropped from above 50 percent in 2013 to below 40 percent in 2015, additionally indicating banks domicile. In doing so, divergent treatment responses in risk-taking between banks that lose sovereign support in different regions can directly be examined. 50 Banks in the SRM and 7 Banks in the BRRD region are identified, which experienced the described decline in bailout probabilities.

Table 6.3 shows the result for the decline in bailout probability for both areas. The DD estimator for BRRD banks losing support (*post15*decline*) delivers only one statistically significant result for σStock, showing a slightly reduced equity volatility compared to untreated banks inside the EU. Most of their risk measures even indicate increased risk-taking compared to the control group. The second DD estimator (*post15 * decline_SRM*) shows the results for the SRM banks and reveals substantial differences. All model coefficients point towards a reduced risk-taking with statistically significant effects for the main risk measures. Except for σStock, those effects are only observable for SRM domiciled banks, indicating a more robust treatment effect for the SRM region. This finding cancels out that the baseline results are driven by different levels of ongoing sovereign support in both areas.

A three-group comparison analysis is once again applied using Equation (6.1) to compare the risk-taking between global systemically important banks (G-SIIs), headquartered in the SRM or BRRD region. Comparing G-SIIs' risk-taking regarding their domicile is appealing as G-SIIs are assumed to form a relatively homogenous group of banks exposed to similar regulations, such as additional capital requirements.[388]

[386] Technically, the variablee *treated* takes the value of one for treated banks within the BRRD, two for treated banks within the SRM, and zero for untreated banks.

[387] In this section, all group comparison models use the same bank and country-level covariates as the baseline DD regressions, presented in Table 4.2.

[388] Observations from all EU countries with G-SIIs are included. These are Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom are included.

Table 6.3: SRM & BRRD effects on risk-taking | decline in bailout probability

This table presents DD regression results of the comparison of risk-taking in SRM and BRRD countries (H-3). The variable decline identifies banks whose bailout probability dropped from ≥ 50% in 2013 to below 40% in 2015 and discriminates between banks domiciled either in the BRRD or SRM area. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Z-score	(2) RWA density	(3) Loan impairments	(4) NPL-ratio	(5) LLR-ratio	(6) σStock
Post15 * decline	-0.382	-0.891	-0.169	-0.688	-1.207	-0.893*
	(0.246)	(1.649)	(0.437)	(2.440)	(1.573)	(0.507)
Post15 * decline_SRM	0.801***	-2.655**	-0.209*	-0.767	-0.433	-0.774*
	(0.181)	(1.326)	(0.117)	(0.782)	(0.425)	(0.446)
Constant	3.120	167.051***	-1.316	5.562	-0.269	4.538
	(2.143)	(34.323)	(2.408)	(15.504)	(7.093)	(14.354)
Observations	5,399	3,634	5,275	4,029	4,353	676
Number of banks	709	627	695	667	680	93
Adjusted R^2	0.254	0.204	0.181	0.143	0.110	0.265

Table 6.4 reveals the SRM and BRRD disparities. Panel A contains models with bank and time fixed effects and panel B country and time fixed effects as a robustness check, avoiding bias by unobserved country heterogeneity. The interaction term *post15 * G-SII_SRM* in panel A shows the SRM effects on G-SIIs' risk appetite and delivers, except for the RWA density, statistically significant results. G-SIIs' reduction in risk-taking in the SRM area significantly exceeds the reduction in risk-taking of non-G-SIIs inside the EU. The results change for the reaction of BRRD domiciled G-SIIs, estimated by the interaction term *post15*G-SII* in panel A. The coefficients or the z-score and the RWA density switch signs, indicating a lower response regarding the z-score but a higher response for the RWA density against non-GSIIs. The coefficients for the models (3) to (5) are negative, suggesting that the BRRD had a moderating effect on G-SII's credit risk. However, only the NPL-ratio reaches significance at the 5 percent level in panel A.

Table 6.4: SRM & BRRD effects on risk-taking | G-SIIs

This table presents DD regression results of the G-SIIs' risk-taking in the SRM vs. the BRRD jurisdiction (H-3). Panel A includes bank and time fixed effects, panel B country and time fixed effects. Both panels include only countries that accommodate G-SIIs. The interaction term post15 * G-SII DD estimator distinguishing between the BRRD and SRM area. Bank and country controls are not reported for brevity. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	z-score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σStock
Panel A: bank FE						
Post15 * G-SII	-0.468**	-3.493**	-0.205	-1.676**	-0.815*	-0.692
	(0.183)	(1.418)	(0.156)	(0.811)	(0.470)	(0.452)
Post15 * G-SII_SRM	0.379***	1.201	-0.197**	-1.840***	-1.070***	-1.551***
	(0.146)	(1.012)	(0.088)	(0.501)	(0.279)	(0.367)
Constant	4.647**	137.250***	2.735	9.877	3.926	17.120
	(2.187)	(33.173)	(2.200)	(11.982)	(5.141)	(15.474)
Observations	5,718	3,839	5,538	4,294	4,666	658
Number of banks	752	675	730	708	724	92
Adjusted R^2	0.252	0.208	0.142	0.195	0.160	0.308
Panel B: country FE						
Post15 * G-SII	-0.440**	-2.375*	-0.220	-1.548**	-0.859**	-0.790**
	(0.188)	(1.357)	(0.151)	(0.692)	(0.433)	(0.375)
Post15 * G-SII_SRM	0.313**	2.358**	-0.215**	-1.312***	-0.865***	-1.571***
	(0.143)	(1.152)	(0.088)	(0.471)	(0.261)	(0.331)
Constant	4.451***	56.465***	2.932***	11.237*	4.468	8.009
	(0.944)	(14.983)	(0.866)	(5.771)	(2.996)	(4.963)
Observations	5,718	3,839	5,583	4,294	4,666	658
Number of banks	752	675	730	708	724	92
Adjusted R^2	0.0763	0.392	0.0621	0.0650	0.0745	0.259

Besides, the coefficients decrease in size, showing a relatively smaller effect on G-SIIs located in the BRRD region. The opposite is true for the RWA density's coefficient, showing a reduction by 3.49 percentage points compared to the control group. The results in panel B are broadly in line with panel A but show stronger BRRD effects for models (4) to (6). In conclusion, G-SIIs in the SRM react to the resolution framework by reducing their risk more substantially than non-G-SIIs. G-SIIs headquartered in BRRD reacted less unambiguous, showing smaller credit risk reductions and even an increase in their insolvency risk with reference to non-G-SIIs. The results indicate a more substantial effect of the SRM regulation compared to the BRRD. This analysis further reveals that the group heterogeneity between the BRRD and SRM sample impacts the results as the above outcomes suggest some reaction of G-SIIs to the BRRD as opposed to the within-BRRD regressions in Table 4.18. However, the treatment effects may be harder to analyze since the BRRD countries are less homogenous than the SRM countries.

Table 6.5: SRM, BRRD & non-EU effects on risk-taking

This table presents DD regression results comparing risk-taking in SRM, BRRD, and non-EU countries (H-3). The variable IGG (region) identifies banks with bailout probabilities ≥ 50% in 2013 and discriminates between treated banks domiciled in the BRRD, SRM, or non-EU area. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1

Dependent var.	(1) z-score	(2) RWA density	(3) Loan impairments	(4) Trading securities	(5) Total impairments	(6) σStock
Post15 * IGG_nonEU	0.266	-1.602	0.165***	0.886	0.114***	0.776**
	(0.179)	(2.380)	(0.051)	(1.769)	(0.035)	(0.299)
Post15 * IGG_BRRD	-0.383*	-2.353	-0.060	-1.718**	-0.015	-0.357
	(0.216)	(1.859)	(0.243)	(0.745)	(0.152)	(0.361)
Post15 * IGG_SRM	0.477***	-3.278***	-0.125	-2.077***	-0.095	-0.790**
	(0.140)	(1.068)	(0.095)	(0.549)	(0.063)	(0.361)
Constant	3.729*	148.455***	-2.034	-11.207	-1.670	8.097
	(1.928)	(30.017)	(2.108)	(12.091)	(1.147)	(12.940)
Observations	7,247	5,038	6,982	5,633	7,032	1,078
Number of banks	951	855	927	828	934	155
Adjusted R^2	0.257	0.165	0.158	0.150	0.222	0.200

As the number of treated banks outside the SRM jurisdiction is relatively small, another comparative analysis is conducted, appending treated banks from non-EU countries. Involving more banks that satisfy the IGG identification requirement is assumed to increase the analysis' validity regarding the SRM effects since more banks with implicit guarantees serve as an additional comparison group. Observations from Switzerland and Norway are added, enlarging the sample with ten more treated banks. The author relies again on the DD regressions described in Equation (6.1) and utilizes a factor variable distinguishing between treated banks from the non-EU, BRRD, or SRM region, amounting to three DD estimators.[389]

The results are presented in Table 6.5, containing three DD estimators indicating the different responses to the regulation. As expected, implicitly supported banks outside the EU did not reduce their risk-taking against untreated banks (*post15*IGG_nonEU*).[390] Treated banks outside the EU seem to be entirely unaffected and even increase their loan impairments (3), total impairments (4), and their equity volatility (6) against untreated banks inside the EU. Except for the size of the trading portfolio, the BRRD also does not affect the treated bank's risk-taking compared to untreated banks located in non-BRRD countries. Their z-score even decreases. On the other hand, treated banks within the SRM significantly improved their z-scores (1), reduced their asset risk (2), their trading portfolio (4), and their equity volatility (6) against untreated European banks. This comparison underscores that the weak results for the BRRD region from the initial analysis are not due to the smaller number of treated banks in the BRRD. Nevertheless, this again emphasizes the control group's influence as treated SRM banks show a weaker

[389] Technically, the factor variable *treated* takes the value of one for guaranteed banks within non-EU countries, two for guaranteed banks within the BRRD, three for guaranteed banks within the SRM, and is zero for all untreated banks.

[390] Unreported coefficients for the NPL-ratio and the LLR-ratio are uniformly insignificant.

risk reduction compared to the within-SRM analysis presented in section 4.1.2. Overall, the results from group comparisons strongly support ***Hypothesis 3***.

6.2.2 Differences in Investors' Reactions

This section aims to explore the divergent short- and mid-term reactions of CDS and equity investors to the resolution framework for different treatment groups. Several event windows around the SRM and BRRD implementation are analyzed using Equation (6.1) on the quarterly subsample with accounting and market data described in section 6.1.1.

Table 6.6 shows the results of the re-estimation of regressions shown in Table 6.2, now discriminating between the BRRD and the SRM region. In both areas, treated[391] banks are exposed to rising CDS spreads compared to their untreated peers in the four months following the BRRD and SRM adoption. The impact is more intense for the BRRD than for the SRM region in terms of statistical significance and economic magnitude. The effects of the SRM Regulation are much more acute regarding stock returns, especially for stock return volatility. The discrepancy of higher monitoring activity of CDS investors for the BRRD on the one hand, and at the same time, a more negative reaction of equity investors to the SRM is challenging to interpret. It appears that fears of bail-ins are more pronounced in the BRRD region, while the loss of competitive advantages and, consequently, lower growth prospects led to a more severe stock market reaction in the SRM region. That would coincide with the results of section 5, suggesting smaller funding costs advantages for guaranteed banks within the BRRD as compared to those within the SRM region.

Table 6.6: SRM & BRRD effects on market discipline | 8 quarter subsample

This table presents short-term effects on market discipline using a subsample with quarterly accounting and market data for the SRM and BRRD region (H-3). The pre-treatment period stretches from 2013Q3 to 2014Q2, and the post-treatment period stretches from 2014Q3 to 2015Q2. All models control for total assets, RoA, CAR, liquidity, GDP growth, inflation, and the private monitoring index. Bank and country controls are not reported for brevity. All models include bank and year-quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

Dependent variables	(3) CDS	(4) CDSmean	(5) Stock returns	(6) σStock
2014Q3 * IGG	90.233**	146.185**	1.910	0.575**
	(39.966)	(67.429)	(3.132)	(0.261)
2014Q3 * IGG_SRM	73.406*	128.861*	-6.202*	1.050***
	(40.993)	(67.809)	(3.178)	(0.288)
Constant	10,257.680	8,449.081	-23.075	37.263
	(7,186.482)	(6,486.658)	(270.374)	(45.687)
Observations	200	200	577	577
Number of banks	25	25	75	75
Adjusted R^2	0.462	0.557	0.228	0.100

[391] From 25 banks with CDS spreads available in the quarterly sample, 19 are identified as treated, of which 14 are located in the SRM region. From 75 banks with stock market data available, 39 are identified as treated, of which 28 are located in the SRM region.

The effects on market discipline for G-SIIs are more balanced between jurisdictions compared to the baseline identification via IGG. Table 6.7 shows that the impact on CDS spreads is comparable for both regulations. G-SIIs seem to be only exposed to strengthened market discipline by the CDS market for both regions as the coefficients are positive for stock returns and insignificant for σStock. That is of particular interest, as many other researchers find that being denoted as G-SII involves value effects [*Bongini/Nieri/Pelagatti* (2015); *Moenninghoff/Ongena/Wieandt* (2015); *Abreu/Gulamhussen* (2013)]. Being a global systemically important bank seems to be rewarded by equity investors, assuming that resolution measures will not apply to them. That interpretation is consistent with an incomplete implementation of the SRM and BRRD without appropriate bail-in tools and resolution financing arrangements.

Table 6.7: SRM & BRRD effects on market discipline | G-SIIs

This table presents short-term effects on market discipline using a subsample with quarterly accounting and market data for the SRM and BRRD region. The pre-treatment period stretches from 2013Q3 to 2014Q2, and the post-treatment period stretches from 2014Q3 to 2015Q2. All models control for total assets, RoA, CAR, liquidity, GDP growth, inflation, and the private monitoring index. Bank and country controls are not reported for brevity. All models include bank and year-quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

Dependent variables	(1) CDS	(2) CDSmean	(3) Stock returns	(4) σStock
2014Q3 * G-SII	97.311***	139.849**	14.410***	0.273
	(30.577)	(51.163)	(2.506)	(0.240)
2014Q3 * G-SII_SRM	96.537**	134.405**	6.339***	0.396
	(35.243)	(55.036)	(2.165)	(0.266)
Observations	200	200	577	577
Number of banks	25	25	75	75
Adjusted R^2	0.470	0.564	0.236	0.088

Since the full implementation of the BRRD and SRM involved several steps and was not completed until the beginning of 2016, when the bail-in applied as a resolution tool and the Single Resolution Fund (SRF) became fully operative, market reactions to that event are separately analyzed. This consideration is limited to the investigation of stock returns, as they are available for a larger number of banks in the quarterly sample. The effects of the full implementation of the resolution framework in January 2016 are estimated for guaranteed banks (*IGG*) and Global Systemically Important Institutions (*G-SIIs*). The pre-treatment period is defined as the four quarters of 2015. In doing so, the investigation reveals if the full implementation led to a revaluation of bank risk by investors, exclusively examining four quarters after the resolution framework has been fully in effect.

The results are presented in Table 6.8, showing that G-SIIs and primarily supported banks are exposed to higher market discipline by stockholders during 2016 by contrast with their counterparts.[392] The effects are more potent for the SRM region, with σStock increasing by more than 2.5 standard deviations higher and stock returns decreasing by 12 percentage points more

[392] Between 2015 and 2016, the sample compromises 80 banks with quarterly reports and stock market data available, of which 40 banks were implicitly guaranteed before the treatment (29 in the SRM and 11 in the BRRD region).

for formerly guaranteed banks in relation to unsupported banks. Although equity investors also respond to the BRRD, as shown by the negative stock returns significant at the 10% level, the results again reveal more pronounced effects for the SRM. It can be concluded that equity investors fear bail-ins and the resulting decline in their market values due to the suspended funding costs advantage. Equity Investors did not anticipate this regulatory change but responded to the final implementation of the bail-in. The findings regarding the stock market's response are in line with *Leone/Porretta/Riccetti* (2019), who also find adverse stock market reactions after the bail-in applies. More specifically, the more potent response to the SRM confirms the finding of *Fiordelisi et al.* (2020b).

Table 6.8: SRM & BRRD effects on stock returns

This table presents short-term effects on market discipline using a subsample with quarterly accounting and market data for the SRM and BRRD region. The pre-treatment period stretches from 2015Q1 to 2015Q4, and the post-treatment period stretches from 2016Q1 to 2016Q4. All models control for total assets, RoA, CAR, liquidity, GDP growth, inflation, and the private monitoring index. Bank and country controls are not reported for brevity. All models include bank and year-quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

Dependent variables	(1) Stock returns	(2) σStock	(3) Stock returns	(4) σStock
Post16 * G-SII	-10.905*	1.640		
	(5.769)	(1.110)		
Post16 * G-SII_SRM	-5.189	1.878***		
	(3.256)	(0.458)		
Post16 * IGG			-3.060	0.471
			(5.310)	(0.864)
Post16 * IGG_SRM			-12.001***	2.569***
			(3.601)	(0.472)
Constant	870.706**	-59.784	1,015.187***	-90.125
	(340.580)	(64.016)	(324.875)	(56.422)
Observations	607	607	607	607
Number of banks	80	80	80	80
Adjusted R^2	0.388	0.249	0.400	0.295

6.2.3 Pre-Treatment Impact of Implicit Guarantees

The results presented so far exhibit the effects of abolishing implicit guarantees on moral hazard and market discipline. The SRM was interpreted as a game-changer, demonstrating that guaranteed banks reduced their risk more heavily than non-guaranteed banks did after the SRM implementation. As the findings revealed, treated banks outside the SRM jurisdiction reacted significantly weaker to the resolution framework. Naturally, the question arises whether the BRRD itself is not credible or whether implicit guarantees outside the eurozone provide fewer incentives for moral hazard.

The author aims to investigate the different effects of implicit guarantees on bank risk-taking and market discipline for banks inside and outside the SRM Regulation's reach by using pooled OLS regressions. The analysis is performed on the master sample for the entire pre-resolution period stretching from 2005 to 2013, including all EU member states and additionally Iceland, Liechtenstein, Norway, and Switzerland. The sample is extended to enlarge the number of

implicitly supported banks outside the SRM region, enabling a proper investigation of bank behavior depending on implicit guarantees and banks' domicile.[393] Therefore, interaction terms are engaged with a dummy for the *SRM* region and either the *IGG* treatment dummy or banks' continuous pre-treatment bailout probability (*bailoutp*), estimating the effect of implicit guarantees on banks' risk-taking and funding costs. Equation (6.2) includes time fixed effects (γ_i) and a vector of bank and country control variables. All models control for banks' size, business growth, GDP growth, and inflation. Standard errors are clustered at the bank level. The coefficient of interest is β_3, estimating the effect of high bailout probabilities for banks operating in the SRM region against the base group, which are unsupported banks outside the SRM.

$$y_{i,t} = \alpha + \beta_1 SRM_i + \beta_2 IGG_i + \beta_3 (SRM_i * IGG_i) + \gamma_i + X_{i,t} + \varepsilon_{i,t} \tag{6.2}$$

The marginal effects for increasing bailout probabilities are estimated with another pooled OLS model, which incorporates the continuous bailout probability, presented in equation (6.3). To avoid reverse causality issues, the author uses the 2013 values of each bank's bailout probability.

$$y_{i,t} = \alpha + \beta_1 SRM_i + \beta_2 bailoutp_i + \beta_3 (SRM_i * bailoutp_i) + \gamma_i + X_{i,t} + \varepsilon_{i,t} \tag{6.3}$$

The results for the pooled OLS regressions are presented in Table 6.9. Panel A displays the interaction between the *SRM* and the *IGG* dummy, revealing that banks with implicit bailout guarantees outside the SRM region (*IGG*) take on less risk and do not enjoy a significant funding costs advantage over the reference group, which are non-SRM unsupported banks. The reverse outcome for non-SRM banks is a remarkable finding, suggesting that implicit guarantees do not provide sufficient incentives for moral hazard and do not result in significantly lower refinancing costs for non-SRM banks.

[393] In prior analyses involving the IGG as treatment dummy, observations from all countries without banks with bailout probabilities above 50% are excluded. This approach is discarded for the analysis of marginal effects since these countries do have banks with bailout probabilities between 0 and 49%.

Table 6.9: Pooled OLS regressions

This table presents pooled OLS regression results (H-3). The sample includes bank observations from all EU member states and Iceland, Liechtenstein, Norway, and Switzerland. σRoA (5) is calculated over the periods 2005-2009 and 2010-2014, respectively. All models control for total assets, revenue growth, GDP growth, and inflation. Bank and country controls are not reported for brevity. All models include time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. The number of observations differs between different models depending on data availability. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) z-Score	(2) NPL-ratio	(3) Total im-pairments	(4) Loan im-pairments	(5) σRoA	(6) Funding expenses
Panel A: dummy interaction						
SRM	0.617***	-0.053	-0.078**	-0.160***	-0.475***	3.653***
	(0.066)	(0.397)	(0.035)	(0.059)	(0.076)	(0.266)
IGG	0.333**	-0.116	-0.070	-0.241*	-0.395***	0.054
	(0.140)	(0.716)	(0.086)	(0.128)	(0.137)	(0.402)
SRM * IGG	-1.073***	1.417*	0.200**	0.322**	0.670***	-2.702***
	(0.160)	(0.822)	(0.092)	(0.134)	(0.140)	(0.442)
Constant	3.982***	1.854	0.467*	0.096	3.012***	15.800***
	(0.539)	(2.335)	(0.247)	(0.379)	(0.815)	(2.426)
Observations	7,412	4,211	7,151	7,113	7,478	7,087
Adjusted R^2	0.171	0.125	0.113	0.094	0.102	0.099
Panel B: continuous interaction						
SRM	0.618***	-0.062	-0.082**	-0.168***	-0.482***	3.640***
	(0.067)	(0.405)	(0.035)	(0.060)	(0.078)	(0.271)
Bailoutp	0.461**	-0.469	-0.148	-0.414**	-0.622***	0.105
	(0.213)	(0.995)	(0.116)	(0.177)	(0.202)	(0.600)
SRM * bailoutp	-1.490***	2.000*	0.275**	0.460***	0.937***	-3.437***
	(0.232)	(1.087)	(0.118)	(0.176)	(0.190)	(0.634)
Constant	3.874***	1.633	0.402	-0.014	2.932***	15.792***
	(0.544)	(2.422)	(0.256)	(0.396)	(0.815)	(2.485)
Observations	7,412	4,211	7,151	7,113	7,478	7,087
Adjusted R^2	0.172	0.124	0.113	0.094	0.102	0.097

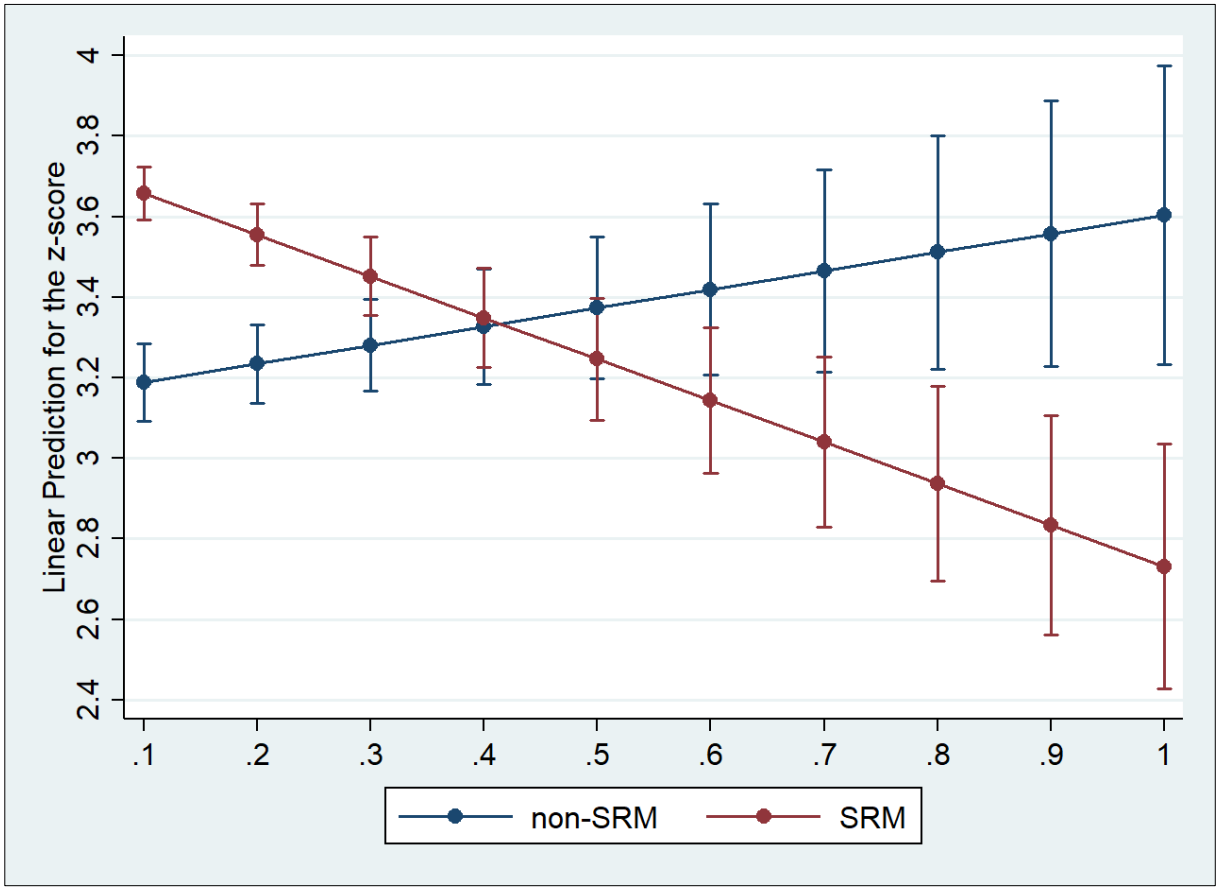
The interaction term *SRM * IGG in* panel A, by contrast, reveals that implicitly supported banks in the SRM region have, on average, 66% lower z-scores (1) compared to unsupported banks outside the SRM region.[394] Compared to guaranteed non-SRM banks, their average z-score is 52% lower, considering the covariates' adaption for size, revenue growth, GDP growth, and inflation.[395] The interaction term also displays a higher impact on non-performing loans by 1.4 percentage points for treated SRM banks compared to untreated non-SRM banks.[396] Compared to the remaining risk measures, the coefficients are all statistically significant and indicate higher effects on moral hazard for guaranteed banks within the SRM. Furthermore, implicitly guaranteed banks also have a higher funding cost advantage when located within the SRM (6).

[394] 100 * (exp(-1.073) -1) ≈ 66%. Note that this interpretation refers to the z-score prior to the log transformation.

[395] 100 * (exp(0.33-1.073) -1) ≈ 52%. This difference between implicitly guaranteed banks inside and outside the SRM is also highly significant, with 95% confidence intervals reaching from -0.97 to -0.51. The differences between guaranteed banks inside and outside the SRM region are all significant, at least at the 5% level, except for the loan impairments ratio in model (4) of Table 6.9.

[396] The difference between treated SRM banks to treated non-SRM banks [1.30=1.417-0.116] is significant at the 5% level, with 95% confidence intervals reaching from 0.17 to 2.43.

Figure 6.2: Linear predictions with 95% confidence intervals | z-score

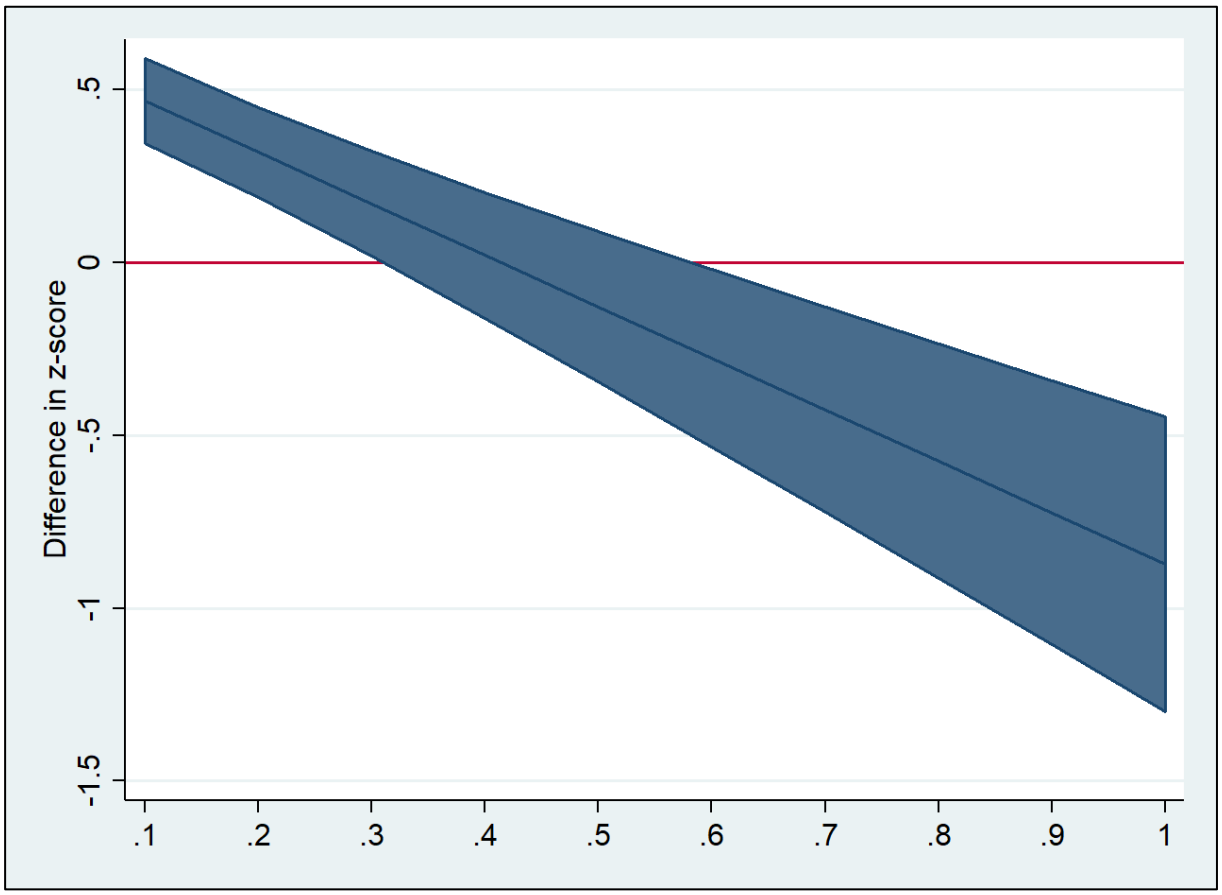


This figure presents the linear prediction for the z-score for increasing levels of the 2013 bailout probability (x-axis) for SRM and non-SRM banks. This illustration corresponds to estimates from model (1) in panel B of Table 6.9.

In panel B of Table 6.9, the 2013 bailout probability is used in a continuous interaction to estimate the marginal effects of implicit guarantees on moral hazard and market discipline. The interaction term *SRM * bailoutp* displays that increasing bailout probabilities are associated with higher risk-taking and lower market-discipline (6) in the SRM region. The coefficients for *bailoutp*, measuring the impact of rising bailout probabilities for non-SRM banks, shows no indications of moral hazard or weak market discipline. To better interpret the marginal effects of increased bailout probabilities for SRM and non-SRM banks, the linear predictions for the z-score are exemplary plotted in Figure 6.2. With increasing bailout probabilities, banks in the SRM (non-SRM) region tend to have lower (higher) z-scores and, therefore, higher (lower) distances to default. Figure 6.3 also shows the average marginal effect of the SRM on the z-score for different bailout probabilities compared to non-SRM banks. Lower levels of government support are related to higher banking stability, while bailout probabilities above 60 percent significantly decrease banks' distance to default for banks within the SRM jurisdiction.[397]

[397] Linear predictions and marginal effects of bailout probabilities for σRoA and the NPL-ratio are presented in the Appendix from Figure E.11 onwards.

Figure 6.3: SRM effects for different levels of bailout probabilities | z-score



This figure presents the average marginal effect of increasing bailout probabilities (x-axis) on the z-score of SRM-banks compared to non-SRM banks with 95% confidence intervals. This illustration corresponds to estimations from model (1) in panel B of Table 6.9.

The results of this section show that implicitly supported banks only reduce their risk-taking when they are domiciled in the euro area, where policymakers additionally adopted the SRM Regulation. Also, the results from pooled OLS regressions advocate that implicit guarantees did not provide equal incentives for moral hazard in the pre-treatment period. Increasing bailout probabilities are instead only associated with higher risk-taking in the SRM area. To the best of the author's knowledge, the differing impact of implicit guarantees on risk-taking between eurozone and non-eurozone banks has so far not been studied. A large body of literature investigates various aspects of euro area banks' risk-taking but does not compare the differing impact of implicit guarantees between eurozone and non-eurozone banks.[398] However, *Huizinga/Laeven* (2019) find that the procyclicality of loan loss provisions in the euro area is about twice as large as in other advanced economies. This section can further relate to other contributions finding increased risk-taking by banks due to implicit guarantees [(*Brandao-Marques/Correa/Sapriza* (2018); *Cabrera/Dwyer/Nieto* (2018); *Afonso/Santos/Traina* (2014); *Prabha/Wihlborg* (2014)].

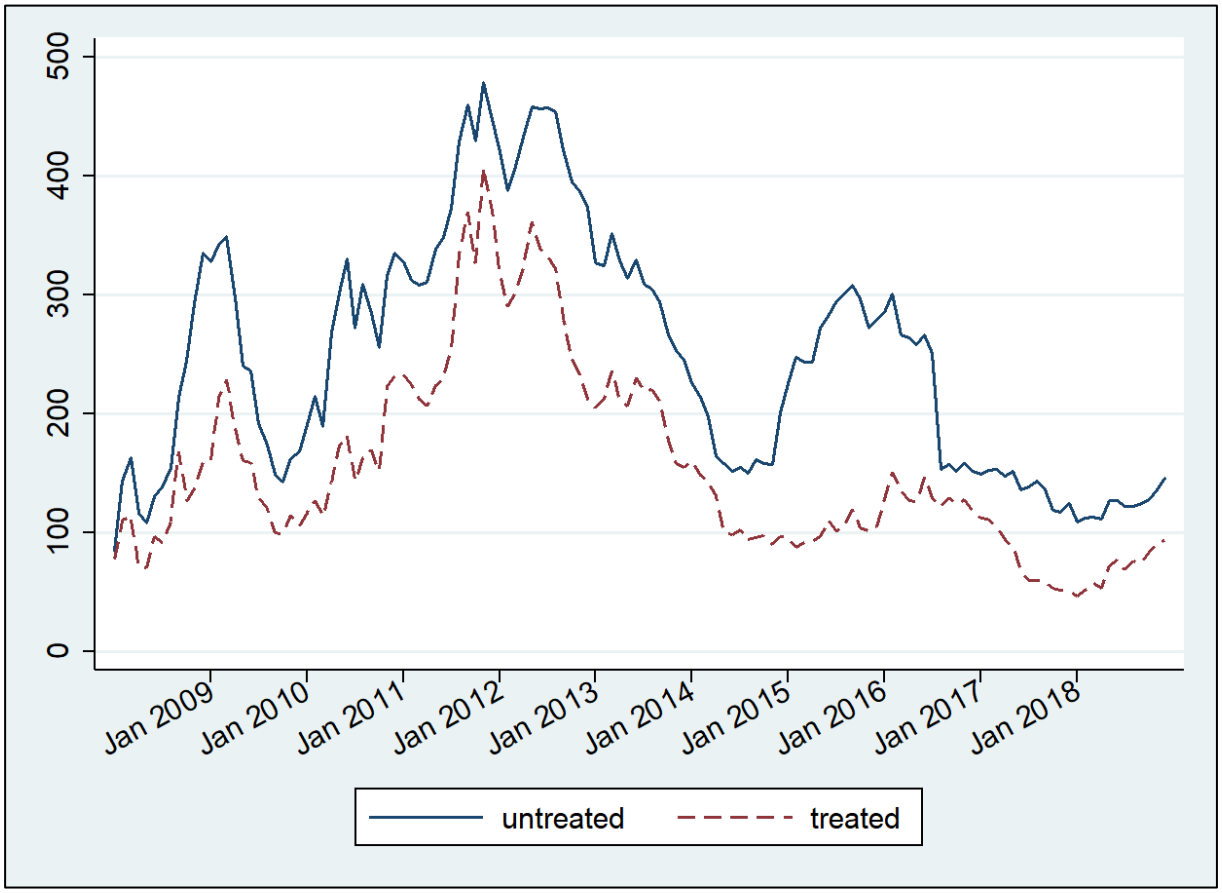
[398] See, e.g., *Bouheni/Hasnaoui* (2017); *Eichler/Sobański* (2016); *Baselga-Pascual/Trujillo-Ponce/Cardone-Riportella* (2015); *Makri/Tsagkanos/Bellas* (2014); *Reichlin* (2014); *Altavilla et al.* (2013); *Haq/Heaney* (2012).

6.3 Exploration of Monthly CDS Spreads

6.3.1 Long-Term Impact of Guarantees on Market discipline

This work's various findings indicate that implicit guarantees led to moral hazard and weakened market discipline, especially in the euro area. The main investigation also provides evidence for the SRM being the remedy for the negative consequences of implicit guarantees. With the following examination, the author attempts to shed light on the general relation between implicit guarantees and investors' perception of banks' default risk. CDS spreads are again employed as a proxy for investors' monitoring to analyze the impact of implicit guarantees on market discipline for banks in the entire European Union.[399] CDS spreads are preferred to stock market data since changes in CDS spreads can be directly linked to the market perception of default risk, taking any bailout guarantees into account.[400]

Figure 6.4: Monthly CDS spreads in the EU



This figure presents the development of the mean CDS spread in the EU for banks with an estimated bailout probability above 60 (treated) or below 60% (untreated) in 2013. Source: Thomson Reuters Datastream and author's calculations.

From the visual inspection of monthly CDS spreads (Figure 6.4), one can observe differences between banks having a bailout probability of 60 percent or higher in 2013 and those who do

[399] The investigation of monthly CDS spreads is done using CDS and rating observations from banks operating in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

[400] See *Longstaff/Mithal/Neis* (2005).

not.[401] Supported banks have lower CDS spreads during the entire period but have a varying distance to unsupported banks. The gap widens, especially at the beginning of 2009 and during the European debt crisis of 2011 and 2013. Interestingly, the gap widens the strongest at the end of 2014, when the resolution framework was about to become effective. During this time, banks with a high bailout guarantee do not display such an increase in CDS spreads. At the beginning of 2016, when the bail-in was in place, previously supported banks experience a sharp rise in CDS spreads. The gap then narrows in midyear 2016. The increase in CDS spreads for unsupported banks at the end of 2014 can be interpreted as a revaluation of their default probability. Supported banks were apparently assumed to receive support until the bail-in mechanism was established in 2016. This reading is consistent with the revision of support ratings to the updated bailout expectations that were mostly conducted during the second quarter of 2015. Until then, implicit guarantees seem to have protected banks from negative CDS market reactions.

For a more profound analysis, monthly CDS spreads are merged with rating information and then exploited similarly to *Barth/Schnabel* (2015). Each rating is recurringly matched with monthly CDS spreads until a new rating is assigned.[402] The CDS spreads are modeled as a function of bank-specific ratings using OLS panel regressions.

$$\begin{aligned} CDS_{i,t} = \alpha + \beta_1 Support_{i,t} + \beta_2 Stand - alone_{i,t} \\ + \ \beta_3 (Support_{i,t} * Stand - alone)_{\ i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \end{aligned} \tag{6.4}$$

CDS is either the last quote of banks' CDS spread per month or banks' mean CDS spread per month, calculated from daily CDS observations. Implicit Guarantees are proxied by Fitch's Support Rating Floor, and Stand-alone is proxied by Moody's Baseline Credit Assessment.[403] Due to the monthly frequency, the use of additional control variables is neglected.

[401] The cutoff for the bailout probability is chosen to be higher than the baseline version since the average level of support is higher for banks with CDS spreads and ratings available.

[402] Table D.6 in the Appendix shows the summary statistics of the monthly CDS and rating subsample.

[403] Moody's Baseline Credit Assessment (BCA) is preferred to Fitch's stand-alone rating, the Viability Rating, as Moody's BCA is available for a larger number of banks and for a longer time span in the monthly sample. In a robustness test, Fitch's Bank Support Rating (BSR) is used as a measure of support. The results are presented in the Appendix in Table F.12 on p. 204 and are broadly in line with the SRF as support measure.

Table 6.10: OLS regressions of market discipline

This table presents OLS panel regression results with CDS spreads as dependent variables, modeled as a function of different bank ratings using all EU bank observations. The sample includes observations from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Panel A captures the period from 2007-2013, and panel B the period from 2014 to 2017. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) CDS	(2) CDS	(3) CDSmean	(4) CDSmean
Panel A: 2007-2013				
SRF	-26.009**	-37.229***	-27.226**	-39.283***
	(11.990)	(8.794)	(12.156)	(8.605)
BCA	-40.075***	-60.999***	-40.133***	-62.616***
	(7.601)	(12.766)	(7.406)	(12.947)
SRF * BCA		1.879*		2.019**
		(0.972)		(0.963)
Constant	1,020.968***	1,119.405***	1,036.051***	1,141.820***
	(116.415)	(64.313)	(115.093)	(61.768)
Observations	2,914	2,914	2,914	2,914
Number of banks	43	43	43	43
R^2	0.567	0.574	0.580	0.589
Panel B: 2014-2017				
SRF	7.422**	-5.215	7.721**	-4.578
	(3.650)	(5.632)	(3.605)	(5.693)
BCA	-47.074**	-60.550***	-49.516**	-62.632***
	(19.025)	(20.272)	(19.650)	(20.400)
SRF * BCA		1.052**		1.024**
		(0.473)		(0.477)
Constant	579.944***	729.472***	597.498***	743.032***
	(164.829)	(173.362)	(175.721)	(177.775)
Observations	1,663	1,663	1,663	1,663
Number of banks	44	44	44	44
R^2	0.184	0.196	0.189	0.201

Table 6.10 provides the OLS regression results with CDS spreads as dependent variables. Panel A contains the observations between 2007 and 2013 and panel B between 2014 and 2017. The results from panel A show a significant reduction of CDS spreads for each notch increase in the support rating. Although stand-alone ratings (*BCA*) have a more considerable negative impact on CDS spreads, the mean CDS spread decreases on average by 27 basis points for a one-notch increase in the Support Rating Floor (3). The explanatory power for all models in panel A is relatively high, as indicated by the R-squared values being above 0.56. The high fit is remarkable, considering the absence of additional control variables. The relationship between government support and CDS spreads becomes inverse between 2014 and 2017, depicted in panel B. A one-notch increase in the Support Rating Floor is then associated with a rise in mean CDS spreads by nearly eight basis points (3). Moreover, the R-squared is reduced by almost a third, suggesting that guarantees are less crucial for investors when assessing banks' default risk after the SRM and BRRD have been established.

The interaction terms (*SRF * BCA*), estimating the combined effects of government support depending on banks' stand-alone ratings (model 4), can only be interpreted by computing

marginal effects. Table 6.11 shows the marginal impact of a one-notch increase in support rating for different levels of banks' stand-alone rating for the pre-resolution (2007-2013) and the post-resolution (2014-2017) periods. In the pre-resolution period, weaker rated banks show significant decreases in their mean CDS spreads when the Support Rating Floor increases by one notch. *Barth/Schnabel* (2015) and *Estrella/Schich* (2015), (2011) obtain comparable results, suggesting investors value implicit guarantees, particularly for financially weak banks. This relation changes in the post-resolution period after 2014. Government support to banks is now associated with higher mean CDS spreads, predominantly for banks with high stand-alone ratings. A one-notch increase in the SRF for banks with a BCA rating of *a1* (=16) is associated with an increase in the mean CDS spread by 11.8 basis points.[404] This structural break in CDS pricing highlights the prompt reaction of CDS markets to the BRRD introduction, anticipating rating changes and underscoring the abolishment of implicit guarantees. The above observations are generally in line with previous literature detecting increased market monitoring by CDS investors after the implementation of resolution rules [*Covi/Eydam* (2020); *Fiordelisi et al.* (2020a); *Pancotto/Gwilym/Williams* (2019); *Neuberg et al.* (2016)].

Table 6.11: Marginal effects of support ratings on mean CDS spreads

This table presents the marginal effects of the likelihood of government support (Support Rating Floor, SRF) on Banks' stand-alone rating (Moody's Baseline Credit Assessment, BCA) for the period from 2007 to 2013 and from 2014-2017, respectively.

	2007-2013		2014-2017	
Dependent variables	Coefficient (Support Rating Floor)	Standard Error	Coefficient (Support Rating Floor)	Standard Error
BCA rating =1	-37.264***	(8.779)	-3.553	(5.314)
BCA rating =2	-35.244***	(9.054)	-2.529	(4.952)
BCA rating =3	-33.225***	(9.419)	-1.505	(4.612)
BCA rating =4	-31.206***	(9.865)	-0.481	(4.298)
BCA rating =5	-29.187***	(10.382)	0.543	(4.016)
BCA rating =6	-27.167**	(10.959)	1.568	(3.773)
BCA rating =7	-25.148**	(11.587)	2.592	(3.578)
BCA rating =8	-23.129*	(12.259)	3.616	(3.439)
BCA rating =9	-21.110	(12.968)	4.640	(3.362)
BCA rating =10	-19.091	(13.707)	5.665*	(3.353)
BCA rating =11	-17.071	(14.473)	6.689**	(3.410)
BCA rating =12	-15.052	(15.261)	7.713**	(3.532)
BCA rating =13	-13.033	(16.069)	8.737**	(3.711)
BCA rating =14	-11.014	(16.892)	9.761**	(3.941)
BCA rating =15	-8.995	(17.730)	10.786**	(4.212)
BCA rating =16	-6.975	(18.580)	11.810***	(4.518)
BCA rating =17	-4.956	(19.440)	12.834***	(4.851)
BCA rating =18	-2.937	(20.309)	13.858***	(5.207)

[404] See Table B.3 for the BCA rating scale.

6.3.2 Mid-Term SRM and BRRD Effects

Some authors find that the introduction of the EU resolution framework leads to increased market discipline by using event study analyses [*Fiordelisi et al.* (2020b); *Schäfer/Schnabel/Weder di Mauro* (2017); *Moenninghoff/Ongena/Wieandt* (2015)]. By investigating short event windows, treatment effects can be accurately assigned to policy changes to draw causal inferences. However, as there is already evidence for short-term effects on market discipline, mid-term effects could indicate whether market discipline remains strengthened, unfolding enough potential to influence banks' risk-taking behavior.

Therefore, an event study design is combined with a difference-in-differences approach for three event windows, each covering two months before and after the specified event date. This close-up examination shall incorporate the advantage of an exact identification of cause and effect from event studies and the benefit of more extended examination periods from DD models to estimate the persistence of SRM and BRRD effects. The evolution of monthly CDS spreads is examined for three event windows covering the legislative process of the resolution framework's introduction:[405]

The author uses the monthly CDS & rating sample (Table D.6) and the DD regression framework below (6.5). Relying only on monthly bank ratings and CDS spreads is beneficial as the sample size increases compared to the quarterly sample.

$$CDS_{i,t} = \alpha + \beta_1 post_t + \beta_2 treated_i + \beta_3(post_t * treated_i) + BCA_{i,t} + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (6.5)$$

All models control for banks' financial soundness using their stand-alone rating (*BCA*) and additionally contain bank (γ_i) and time (δ_t) fixed effects. Treated entities are either Global Systemically Important Institutions, captured by the dummy *G-SII*, or banks with an estimated bailout-probability of 60 percent, captured by the variable *IGG60*. The cutoff for the bailout probability is chosen to be higher than the baseline version since the average level of support is higher for banks with CDS spreads and ratings available.

Table 6.12 shows the results for three treatment periods, each covering two months around the respective event. The EU parliament's adoption of the BRRD/SRM regulation (panel A) is followed by increased CDS spreads, particularly evident for G-SIIs. The more significant impact on G-SIIs may be due to their well-known systemic importance and the resulting pre-treatment bailout probability. When the framework was applicable in 2015 (panel B), banks with bailout probabilities of 60 percent even show reduced CDS spreads compared to the remaining banks. Although the effects are only significant at the 10 percent level, this could imply that investors assume some banks not to be resolved in the event of a failure. On the other hand, one would then expect a statistically significant fall in CDS spreads for G-SIIs as well. When the bail-in tool was applicable in January 2016, banks formerly enjoying implicit guarantees suffered a small rise in CDS spreads against their peers (panel C). Concluding this examination, the resolution framework seems to enforce market discipline around its adoption and the bail-in

[405] Although CDS spreads do not directly impose costs on banks, it is reasonable to assume that other security prices and funding expenditures follow CDS spread trends. See *Blanco/Brennan/Marsh* (2005). Thus, the author assumes CDS spreads to be a reliable indicator of short- and mid-term changes in market monitoring.

application. Nevertheless, the outcomes on increased CDS spreads remain relatively weak in the close-up examination sample covering both the SRM and the BRRD region.

Table 6.12: Monthly treatment effects for different treatment groups

This Table presents DD regression results analyzing various legislative events concerning the establishment of the EU resolution mechanism (H-2). The sample includes observations from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Panel A covers the event of the resolution framework's passage by the EU parliament, stretching from February to May 2014. Panel B covers the Commencement of the SRM/BRRD in January 2015, stretching from November 2014 to February 2015. Panel C covers the application of the bail-in mechanism as a resolution tool in 2016, stretching from November 2015 to February 2016. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) CDS	(2) CDSmean	(3) CDS	(4) CDSmean
Panel A: Parliament adoption				
Post14m4 * G-SII	37.240*	28.580**		
	(19.008)	(12.676)		
post14m4 * IGG60			42.605	60.133*
			(33.120)	(33.769)
BCA	10.966	7.401	11.691	-39.630*
	(12.374)	(9.068)	(11.772)	(22.422)
Constant	78.429	118.813	71.422	573.150**
	(114.965)	(85.248)	(108.844)	(230.287)
Observations	212	212	212	212
Number of banks	53	53	53	53
R^2	0.102	0.246	0.102	0.311
Panel A: Commencement				
Post15m1 * G-SII	-37.791	-39.536		
	(24.545)	(24.982)		
Post15m1 * IGG60			-128.320*	-131.501*
			(69.115)	(70.356)
BCA	-78.396***	-71.752***	-51.578***	-44.083***
	(23.872)	(21.122)	(7.703)	(4.744)
Constant	890.225***	827.696***	625.087***	554.142***
	(222.583)	(197.486)	(64.230)	(37.468)
Observations	212	212	212	212
Number of banks	53	53	53	53
R^2	0.067	0.081	0.190	0.228
Panel C: Bail-in taking effect				
Post16m1 * G-SII	-4.146	3.311		
	(11.397)	(10.434)		
Post16m1 * IGG60			18.760*	24.431*
			(10.832)	(13.023)
BCA	-18.729**	-28.759*	-16.983**	-25.708**
	(9.302)	(15.015)	(8.413)	(12.546)
Constant	364.038***	472.112***	346.278***	441.083***
	(92.103)	(153.513)	(82.817)	(127.844)
Observations	208	208	208	208
Number of banks	53	53	53	53
R^2	0.300	0.271	0.314	0.296

For a closer investigation of CDS markets' reaction to the resolution framework, several DD regressions are estimated to study the mid-term effects on market discipline separately for the SRM and BRRD, further exploring ***Hypothesis 3***. CDS markets' response is analyzed around the three events studied in the above examination but now covering nine months before and after the respective events.

The model from Equation (6.5) is slightly adapted to a three-group comparison regression framework. The factor variable *treated* again identifies G-SIIs and banks with high bailout probabilities (*IGG60*) but additionally discriminates between their domicile (*SRM* or *BRRD*). Moreover, the model additionally controls for banks' all-in rating, proxied by Moody's Long-Term Foreign Deposit Rating (LTFCDR). Both the stand-alone and the all-in ratings are included to explain as much CDS spread heterogeneity as possible, considering the extended period of 18 instead of four months from the last analysis and the unavailability of other controls.

Table 6.13: CDS differences in regions and treatment groups | SRM & BRRD adoption

This table presents DD regression results with monthly CDS spreads as dependent variables (H-3). The sample includes observations from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Models (1) and (2) contain G-SII as treatment variable, and models (3) and (4) contain IGG60 as treatment variable. The period stretches from July 2013 to December 2014, covering nine months before and after the EU parliament had passed the resolution framework. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) CDS	(2) CDSmean	(3) CDS	(4) CDSmean
Post14m4 * G-SII	96.140***	98.084***		
	(34.903)	(33.366)		
Post14m4 * G-SII_SRM	74.341**	75.547**		
	(35.912)	(35.269)		
Post14m4 * IGG60			120.762**	131.374**
			(47.203)	(51.919)
Post14m4 * IGG60_SRM			59.730	72.404
			(56.529)	(59.378)
BCA	55.724*	52.575*	50.516	46.741
	(32.475)	(29.382)	(33.951)	(31.223)
LTFCDR	-59.174**	-58.421**	-36.430	-33.888
	(27.245)	(27.672)	(22.957)	(23.671)
Constant	485.392*	513.532*	247.657	259.185
	(276.100)	(274.007)	(260.159)	(249.467)
Observations	954	954	954	954
Number of banks	53	53	53	53
R^2	0.288	0.304	0.288	0.308

Table 6.13 presents the results for the passage of the resolution framework, covering nine months around the parliament's adoption. The outcomes show significantly higher CDS spreads for G-SIIs and implicitly supported banks against their control groups of unsupported banks for nine months after the SRM and BRRD adoption. As presented by the interaction term *Post14m4 * IGG60*, implicitly supported banks in the BRRD are exposed to an increase in CDS spreads exceeding that of the control group by 131 basis points. Surprisingly, for both treatment groups, the CDS spreads are significantly higher if treated banks operate in the BRRD region. For implicitly supported banks in the eurozone, coefficients for the DD estimators are even statistically

insignificant. Investors' response to the BRRD and their reluctance regarding the SRM can probably be explained by higher government support levels in the euro area, leading to the perception of ongoing support until the regulations were in effect.

Table 6.14: CDS differences in regions and treatment groups | SRM & BRRD application

This table presents DD regression results with monthly CDS spreads as dependent variables (H-3). The sample includes observations from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Models (1) and (2) contain G-SII as treatment variable, and models (3) and (4) contain IGG60 as treatment variable. The period stretches from April 2014 to September 2015, covering nine months before and after the EU resolution framework applied in January 2015. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) CDS	(2) CDSmean	(3) CDS	(4) CDSmean
Post15m1 * G-SII	-23.037	-19.174		
	(26.045)	(26.675)		
Post15m1 * G-SII_SRM	-65.584	-62.721		
	(40.079)	(39.417)		
Post15m1 * IGG60			-187.680**	-184.204**
			(88.585)	(86.084)
Post15m1 * IGG60_SRM			-209.867**	-207.917**
			(93.721)	(91.147)
BCA	-45.047**	-45.861**	-30.109**	-31.133**
	(19.412)	(19.612)	(13.806)	(13.909)
LTFCDR	-71.073**	-71.644**	-74.606***	-75.092***
	(30.622)	(30.291)	(26.934)	(26.556)
Constant	1,484.588***	1,506.413***	1,384.244***	1,407.051***
	(527.393)	(526.974)	(407.113)	(407.737)
Observations	954	954	954	954
Number of banks	0.222	0.217	0.340	0.335
R^2	53	53	53	53

The models are re-estimated for the period after the resolution framework applied in January 2015, shown in Table 6.14. CDS spreads for implicitly supported banks decrease against the control groups in both regions, suggesting that they benefit from implicit guarantees. As all models control for banks' stand-alone and all-in credit ratings, the results reflect the market perception of implicit guarantees when the bail-in was not yet applicable. Lower CDS spreads for treated banks to untreated banks before the bail-in application coincides with the post-bailout evolution of CDS spreads, depicted in Figure 6.4.

Table 6.15 presents the results for the impact of the bail-in establishment in 2016, disclosing slightly larger treatment effects in terms of increased CDS spreads for treated SRM-domiciled banks. Investors might regard the SRM as incomplete without the full implementation of the Single Resolution Fund, which coincides with the observation of more potent initial effects to the BRRD, presented in Table 6.14. However, the outcomes for both regions remain small, indicating that the full implementation of the resolution framework is of minor importance to CDS investors, as already suggested by the results of Table 6.12.

Taken together, the results from the close-up examination using monthly CDS spreads confirms the findings from section 6.2.2. Indications of increased market discipline from CDS investors,

particularly after the EU parliament adopted the regulations, are robust to bank ratings and a monthly frequency.

Table 6.15: CDS differences in regions and treatment groups | bail-in application

This table presents DD regression results with CDS spreads as dependent variables. The sample includes observations from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Models (1) and (2) contain G-SII as treatment variable, and models (3) and (4) contain IGG60 as treatment variable. The period stretches from July 2015 to May 2015, covering 5 months before and after the bail-in applies January 2016. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) CDS	(2) CDSmean	(3) CDS	(4) CDSmean
Post16m1 * G-SII	5.062	2.739		
	(17.885)	(17.033)		
Post16m1 * G-SII_SRM	-0.672	0.563		
	(17.787)	(17.065)		
Post16m1 * IGG60			65.899*	59.518
			(38.291)	(36.404)
Post16m1 * IGG60_SRM			73.501*	66.740*
			(37.503)	(35.510)
BCA	-39.957*	-37.758**	-38.327*	-36.390**
	(22.598)	(18.536)	(20.278)	(16.045)
LTFCDR	29.265	26.206	26.076	23.611
	(19.443)	(18.075)	(16.387)	(15.132)
Constant	200.227	220.970*	225.903	241.441*
	(146.485)	(128.657)	(149.973)	(129.332)
Observations	573	573	573	573
Number of banks	53	53	53	53
R^2	0.081	0.082	0.156	0.155

Conclusion

This study analyzes the impact of the EU resolution framework, comprising the BRRD and SRM Regulation, on moral hazard and market discipline. As several theoretical contributions suggest and previous empirical papers on the relationship between implicit guarantees, moral hazard, and market discipline have shown, the introduction of credible bank resolution schemes can increase market discipline and mitigate moral hazard. The author provides evidence from difference-in-differences estimations that the SRM achieves both goals as opposed to the BRRD, which cannot be associated with a substantial regulating impact on banks and their creditors.

Specifically, the evidence inferred in this thesis affirms that the SRM implementation encourages investors to monitor banks more closely. Banks that would have profited from bailouts before the regulation are exposed to a relative rise in funding expenses after its implementation, which is not the case for unaffected banks without guarantees. Moreover, increased monitoring incentivizes affected banks to behave more prudently. Banks formerly enjoying bailout guarantees responded to the SRM by reducing their risk-taking more than their unaffected peers. The results provide valuable evidence for evaluating the resolution framework, showing that the SRM effectively leads to prudent bank behavior and restores market discipline.

Additionally, the results demonstrate that other bank-level characteristics influence the magnitude of risk reduction when implicit guarantees are removed. Previously supported banks with a high charter value reduced their risk-taking to a greater degree than supported banks with a low charter value. Furthermore, capital buffers for Other Systemically Important Institutions (O-SII) amplify the risk-reducing effect of the SRM. Very large and global systemically important institutions (G-SII) reduced their risk-taking less aggressively, indicating that the EU resolution framework did not diminish incentives for moral hazard for all banks equally. The results on moral hazard are robust to the application of several risk measures, falsification tests, sample compositions, and alternative identification strategies, providing hard evidence that the SRM encourages banks to act more prudent.

The SRM exposes formerly guaranteed banks to increased market discipline in the long term, as their funding expenses rise relatively compared to those of unaffected banks. Affected banks also adapt their funding mix, avoiding funding sources responsive to market discipline. These results are robust to the application of different funding measures, falsification tests, and alternative identification strategies, confirming that the SRM reduces implicit guarantees. However, the evidence hints towards a slight rise in funding expenses and a decline of risk-sensitive funding, even before the SRM adoption. The premature responses could imply that creditors reacted to the 2013 baking communication, which implemented statutory burden-sharing, and that the SRM amplifies a long-term trend towards more stable funding sources.

Indications of increased market discipline are supported by short- and medium-term effects on CDS spreads and stock returns in reaction to the resolution framework. Investors' responses to the adoption of the framework and the bail-in activation were remarkably distinct. The investigation of the general relation between government support and CDS spreads confirms previous findings on strengthened market discipline. Higher guarantees are associated with lower CDS spreads until the impact becomes inverse after the regulation has been announced. This

structural break in long-term CDS pricing marks the turning point for banks who no longer profit thereon after from implicit guarantees.

As medium- and long-term indications of improved market discipline persist, it is possible that creditors' and investors' response to the new resolution mechanism – especially to the bail-in application – contributed to the risk reduction of treated banks. Changes in funding structures support the hypothesis of market participants influencing bank behavior. Anyhow, changing funding structures and decreased risk cannot be understood as proof for market influence, since the evidence for moral hazard and market monitoring can be explained independently. Increased market monitoring and reduced risk-taking could still occur autonomously from one another, as opposed to increased market monitoring, causing banks to reduce their risk-taking.

The effects on market discipline and moral hazard are only evident for the SRM-Regulation in the euro area. For banks operating in the remaining EU countries, which solely adopted the BRRD, reduced risk-taking or increased funding costs are not observable. However, investors' reactions to the BRRD announcement were partly more distinctive than to the announcement of the SRM. The lack of significant results of changes in bank risk-taking and funding might be due to several reasons. First, implicit guarantees within the BRRD did not fuel moral hazard to the same extent as they did within the SRM jurisdiction. Estimates from pooled OLS regressions demonstrate that implicitly supported banks within the eurozone increased their risk-taking more drastically than those outside the eurozone during the years preceding the resolution framework. The difference is also apparent for marginal effects, revealing that increased bailout probabilities have a higher impact on risk-taking for banks within the SRM jurisdiction.

Additionally, some BRRD features may harm its credibility. First, the BRRD provides more arbitrariness among member states, as resolution decisions are made independently by national authorities. Second, some countries delayed the implementation of the BRRD, which could be interpreted as an indirect signal of a more relaxed attitude towards future bailouts. Third, the level of implicit guarantees and the level of support provided were significantly lower within the BRRD region, offering fewer incentives to engage in morally hazardous risk-taking.

Surprisingly, the analysis of short- and mid-term effects on market discipline revealed remarkable differences between the SRM and BRRD regions. The announcement effects on market discipline are more pronounced for the BRRD region, while investors in the SRM region also reacted to the introduction of the bail-in mechanism. Given the delayed implementation of the BRRD in some countries, its effects on market discipline being more profound than those of the SRM truly is remarkable. It seems that the announcement of implementing resolution tools is sufficient to increase market discipline by CDS investors significantly. In opposition to the euro area, the lower extent of implicit guarantees and their outcomes appear to have been solved in a single step through the BRRD. On the other hand, investors apparently regarded the SRM as incomplete without the bail-in tool and the Single Resolution Fund in effect. Therefore, they kept some of their powder dry until the SRM was fully operational. Nonetheless, the discrepancy in the BRRD area of strong short- and mid-term effects on market discipline, but no long-term effects at all, neither on risk-taking nor on market discipline, leaves room for discussion. Perhaps, CDS investors relied on implicit guarantees, while creditors and particularly banks, did not. A diverging reliance of investors and banks would underscore the different effects of implicit guarantees, explaining the non-uniform results concerning moral hazard.

As banks located outside the euro area do not appear to have been encouraged by implicit guarantees in the same way, other institutional circumstances must have helped shape incentives for moral hazard. The unique setting of monetary policy in the euro area and its vicious cycle of bank and sovereign debt pushed governments into a dilemma. Knowing about member states' dependence on bank soundness and financial stability probably motivated banks to take on more risk in the long term. Only the SRM has broken the sovereign-bank nexus, abolishing implicit guarantees, finally resulting in lower bank risk levels and increased market discipline. It appears reasonable for regulators to focus on improving the credibility of the EU resolution framework. Stopping the fiscal backstop by increasing institutional reliability for resolution funding and requiring banks to provide enough bail-inable liabilities would strengthen the enforceability of the resolution framework. Since those regulations have already been initiated with the MREL and TLAC requirements, moral hazard incentives should remain low.

Naturally, the research conducted also has its limitations. While it is not ambiguous to interpret banks' and investors' reactions subject to reduced moral hazard and increased market discipline, one could claim that parts of the observed impacts are also attributable to other regulatory changes. Most robustness tests were able to cancel out other bank regulations driving the results. Nevertheless, since many implicitly guaranteed banks are also subject to tighter supervision and capital regulation, identifying the extent to which the results could be biased is hard. As shown by some refinements, additional capital requirements increase banks' skin in the game, eventually reducing moral hazard. Since the information on detailed requirements for additional capital buffers is not available in the dataset, it is unclear whether those unobservables drive the results. However, since higher capital requirements, banks' systemic risk, and to some extent, implicit guarantees are collinear, it is impossible to evaluate which reduced bank risk-taking unambiguously. The same applies to tighter bank supervision by the ECB, insinuating that ECB supervision is stricter than national oversight.

Because the results are weaker for guaranteed banks not supervised by the ECB, it cannot be canceled out that ECB supervision partly drives the outcomes. However, since the identification of treated entities via their bailout probability outperforms the regulators' classification of treated entities regarding their impact on moral hazard and market discipline, the author is confident that the results are mainly attributable to the SRM.

Moreover, the results do not deliver an unambiguous explanation of the treatment effects' dispersion between the SRM and BRRD region. Although it has been undoubtedly shown that implicit guarantees have more severe effects within the SRM region, regarding both moral hazard and market discipline, it cannot be excluded that the BRRD alone is ineffective.

Further research is needed regarding the link between market discipline and moral hazard. It would be insightful to identify the extent to which investors and creditors help in reducing moral hazard. Moreover, the interaction of tight supervision and additional capital buffer requirements needs a thorough investigation to assess what causes prudent bank action. The varying effects of implicit guarantees on banks inside and outside the eurozone also need an additional inspection. Most existing research neglects the interaction between government guarantees and bank or region variables. Nevertheless, as this work has shown, these factors seem to be of importance.

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Appendix

A State Aid Measures

Table A.1: State aid measures in the EU

	Recapitali-zations	Impaired asset measures	Guarantees	Liquidity Measures	Total	
SRM	in bn EUR	in bn EUR	bn EUR	in bn EUR	in bn EUR	% of 2014 GDP
Austria	40.13	0.60	84.14	0.00	124.87	37%
Belgium	23.32	28.22	325.42	20.50	397.46	99%
Cyprus	3.30	0.00	9.00	0.00	12.30	70%
Estonia	0.00	0.00	0.00	0.00	0.00	0%
Finland	4.00	0.00	50.00	0.00	54.00	26%
France	29.24	4.70	382.68	8.65	425.26	20%
Germany	114.61	82.78	455.85	9.50	662.73	23%
Greece	48.97	0.00	85.00	15.84	149.81	84%
Ireland	90.86	57.24	386.00	40.73	574.83	294%
Italy	22.00	0.00	110.00	0.00	132.00	8%
Latvia	0.82	0.54	5.20	2.70	9.26	39%
Lithuania	0.85	0.58	0.29	0.04	1.75	5%
Luxembourg	2.50	0.00	7.05	0.32	9.87	20%
Malta	0.00	0.00	0.00	0.00	0.00	0%
Netherlands	39.84	30.61	200.00	54.00	324.45	48%
Portugal	32.25	4.00	44.27	6.06	86.58	50%
Slovakia	0.66	0.00	2.80	0.00	3.46	5%
Slovenia	4.46	3.75	13.76	0.00	21.96	58%
Spain	174.32	139.92	321.25	32.65	668.14	64%
BRRD						
Bulgaria	0.00	0.00	0.00	1.65	1.65	4%
Croatia	0.00	0.00	0.00	0.00	0.00	0%
Czech Republic	0.00	0.00	0.00	0.00	0.00	0%
Denmark	14.55	2.30	587.90	7.88	612.63	231%
Gibraltar					0.00	0%
Hungary	1.07	0.04	5.35	3.87	10.33	10%
Poland	34.66	0.00	119.21	0.00	153.88	37%
Romania	0.00	0.00	0.00	0.00	0.00	0%
Sweden	5.03	0.00	156.00	0.52	161.56	37%
United Kingdom	114.62	248.05	458.75	51.93	873.35	38%

This Table presents state aid measures to banks in eurozone (SRM) and non-eurozone countries (BRRD) approved by the European Commission. Source: State aid 2018 Scoreboard of the European Commission, IMF statistics, and author's calculations.

B Rating Scales

Table B.1: Bailout probability for Fitch's Support Rating Floor

The bailout probabilities for Fitch's Support Rating Floor (SRF) are derived from Fitch's statement that the No Floor Rating ('NF') corresponds to a bailout probability of less than 40%. Consequently, the NF rating is assumed to reflect a bailout probability of 0, and the remaining 60% are linearly added to the 18 outstanding rating scales.

Fitch's SRF	Assigned bailout probability
AAA	1
AA+	0.967
AA	0.933
AA-	0.900
A+	0.867
A	0.833
A-	0.800
BBB+	0.767
BBB	0.733
BBB-	0.700
BB+	0.667
BB	0.633
BB-	0.600
B+	0.567
B	0.533
B-	0.500
CCC	0.467
CCC	0.433
CCC	0.400
NF	0.000

Source: Fitch Ratings (2019).

Table B.2: Moody's rating scale and one year ahead default rates

The estimated default rates for Moody's long-term rating scale are assigned to the respective rating notch. The default rates are obtained from Moody's Annual Default Study: Corporate Default and Recovery Rates, 1920-2017. The default rates from 1998-2017 are preferred as they probably more accurately fit the current economic condition. Corporate default rates are chosen because various bailout actions bias bank default rates.

Moody's long-term rating scale	Numerical scale	Average one year ahead default rates 1998-2017 (in %)
Aaa	20	0
Aa1	19	0
Aa2	18	0
Aa3	17	0.05
A1	16	0.11
A2	15	0.07
A3	14	0.07
Baa1	13	0.15
Baa2	12	0.19
Baa3	11	0.25
Ba1	10	0.31
Ba2	9	0.68
Ba3	8	0.96
B1	7	1.33
B2	6	2.79
B3	5	3.84
Caa1	4	4.78
Caa2	3	9.46
Caa3	2	19.7
Ca	1	32.87
C	0	32.87

Source: Moody's Investor Service (2018a)

Table B.3: Moody's Baseline Credit Assessment (BCA) rating scale

Moody's BCA	Numerical scale
aaa	20
aa1	19
aa2	18
aa3	17
a1	16
a2	15
a3	14
baa1	13
baa2	12
baa3	11
ba1	10
ba2	9
ba3	8
b1	7
b2	6
b3	5
caa1	4
caa2	3
caa3	2
ca	1
c	0

C Variable Definitions

Table C.1: Variable definitions

Variables	Definition & source
Dependent variables	
z-Score	Bank's distance to default, computed as the sum of return on assets plus the capital asset ratio divided by the Standard deviation of return on assets. FC & author's calculations.
RWA density	Risk-weighted assets divided by total assets in %. FC, BF, & author's calculations.
Total impairments	Total impairment charges divided by total assets in %. FC & author's calculations.
Loan impairments	Loan impairment charges divided by total gross loans in %. FC.
σRoA	Standard deviation of the return on assets in %. FC & author's calculations
Return on Trade	Trading revenue divided by total assets in %. FC, BF, & author's calculations
Trading securities	Trading securities divided by total assets in %. FC & author's calculations
NPL-ratio	Non-performing loan ratio, computed as total non-performing divided by total gross loans in %. FC & BF.
LLR-ratio	Reserves for impaired loans divided by total gross loans in %. FC, BF, & author's calculations.
σStock	Annual standard deviation of weekly stock returns of the total return index. DS & author's calculations.
Stock returns	Annual stock returns derived from weekly observations of the total return index in %. DS & author's calculations.
Funding expenses	Expenses for risk-sensitive funding divided by risk-sensitive funding in %. FC & author's calculations.
Funding expenses 2	Expenses for risk-sensitive funding divided by interest-bearing liabilities (IBL) in %. FC & author's calculations.
Sensitive funding	Calculated as total assets minus non-financial customer deposits and equity, divided by total assets in%. FC & author's calculations.
Wholesale funding	Calculated as money market and other short-term funding divided by total funding in %. FC.
Customer deposit	Total customer deposits divided by total deposits in %. FC & author's calculations.
CDS	Last month or quarter quote of bank's daily senior unsecured mid CDS spread in basis points. DS.
CDSmean	Mean CDS senior unsecured mid CDS spread calculated for quarterly or monthly frequency from daily observations. DS & author's calculations.
Explanatory variables & controls	
IGG	IGG takes the value of 1 if the estimated bailout probability is at least 50% in 2013, and zero otherwise. FC & author's calculations.
O-SII	OSII takes the value of 1 for banks identified as Other Systemically Important Institutions (O-SII) and 0 otherwise. EBA.
G-SII	GSII takes the value of 1 for banks identified as Global Systemically Important Institutions (G-SII) and 0 otherwise. EBA.
SI	SI takes the value of 1 for banks identified as significant institutions and 0 otherwise. ECB.
Tobin's q	Calculated as market value of equity plus the book value of liabilities, divided by the book value of total assets. DS, FC & author's calculations.
NIM	Net interest margin, calculated as net interest income to total assets in %. FC.
LTIDR	Numerical rating scale of Fitch's Long-Term Issuer Default Rating. FC.

LTFCDR	Numerical rating scale of Moody's Long-Term Foreign Currency Deposit Rating. FC.
SRF	Numerical rating scale of Fitch's Support Rating Floor. FC.
BCA	Numerical rating scale of Moody's Baseline Credit Assessment. FC.
Total assets	Measure for bank size, the natural logarithm of total assets Euro. Foreign Currency are transformed using the 2010 exchange rate. FC & author's calculations.
Revenue growth	Annual growth rate of gross revenues. Gross revenue is calculated as interest income plus non-interest operating income. FC & author's calculations.
RoA	Return on assets, computed as pre-tax net earnings divided by total assets in %. FC & author's calculations.
CAR	Capital asset ratio, computed as total equity divided by total assets in %. FC & author's calculations.
Liquidity	Cash and Due from Depository Institutions plus tradable securities divided by total assets in %. FC & author's calculations.
Deposit ratio	Total deposits divided by total assets in %. FC & author's calculations.
Borrowing costs	Total interest expenses divided by total interest-bearing liabilities (IBL) in %. FC & author's calculations.
Subdebt	Subordinated borrowings divided by total assets in %. FC & author's calculations.
IBL ratio	Interest-bearing liabilities to total liabilities in %. FC & author's calculations.
Non-int. inc. ratio	Non-interest income to gross revenue in %. FC author's calculations.
Cost-income ratio	Operating Expenses divided by gross revenue in %. FC & author's calculations.
Country control variables	
GDP	Annual growth rate of real GDP. World bank.
Inflation	Annual growth rate of consumer prices. World Bank.
Short-term rate	Short-term interest rate per country in %. FC.
HHI	Herfindahl Hirschman Index as a measure of bank competition by country, computed as banks' total assets divided by the squared sum of total banking assets per country. FC & author's calculations.
Capital regulation	Index from the World Bank Regulation and Supervision Survey that measures the stringency of capital regulation. The Index ranging from 0-10 is based on survey questions to the institutions in charge of banking supervision and regulation where higher values indicate a stricter capital regulation. The index values covering the years 2003, 2006, and 2011 are used in the analysis. Barth/Caprio/Levine (2013).
Official supervisory power	Index from the World Bank Regulation and Supervision Survey that measures the power of supervisory institutions to enforce actions on banks. The Index ranging from 0-14 is based on survey questions to the institutions in charge of banking supervision and regulation where higher values indicate greater power of respective institutions. The index values covering the years 2003, 2006, and 2011 are used in the analysis. Barth/Caprio/Levine (2013).
Activity restrictions	Index from the World Bank Regulation and Supervision Survey that measures the extent to which Banking related activities (securities, insurance, and real estate) are forbidden. The Index ranging from 0-12 is based on survey questions to the institutions in charge of banking supervision and regulation where higher values indicate higher strictness. The index values covering the years 2003, 2006, and 2011 are used in the analysis. Barth/Caprio/Levine (2013).
Private monitoring	Index from the World Bank Regulation and Supervision Survey that measures the ability and the incentives for private investors to monitor bank behavior. The Index ranging from 0-12 is based on survey questions to the institutions in charge of banking supervision and regulation, where higher values indicate greater incentives for private monitoring. The index values covering the years 2003, 2006, and 2011 are used in the analysis. Barth/Caprio/Levine (2013).

Notes: FC: Fitch Connect database; BF: Bank Focus database; DS: Thomson Reuters Datastream.

D Summary Statistics

Table D.1: Master sample description by country

This table presents summary statistics for the annual master sample, containing the EU member states and additional European countries. State aid means total aid provided to banks between 2008 and 2014 to 2014 country's GDP. The dummy variable *IGG* identifies banks with implicit government guarantees. Source: Fitch Connect, State aid 2018 Scoreboard of the European Commission, World Bank statistics, and author's calculations.

Country	N	Banks	Banks with IGG	State aid to 2014 GDP (%)	Foreign-owned banking assets (%)
Austria	625	46	13	37.5	19.4
Belgium	177	13	2	99.3	57
Bulgaria	54	4	1	3.9	76.3
Croatia	108	8	0	0	90.1
Cyprus	82	7	0	69.8	33.6
Czech Republic	149	13	0	0	85
Denmark	527	39	1	230.5	14.2
Finland	153	14	2	26.3	50
France	1,129	89	6	19.8	8.4
Germany	4,511	334	17	22.6	8.2
Gibraltar	14	1	0	.	.
Greece	84	6	1	83.9	5
Hungary	127	10	0	9.8	64
Iceland	112	9	0	.	38.4
Ireland	48	4	2	294.3	61.3
Italy	928	71	10	8.1	10
Latvia	35	3	0	39.2	59.6
Liechtenstein	14	1	0	.	.
Lithuania	27	2	0	4.8	91
Luxembourg	85	8	1	19.8	90
Malta	40	4	1	0	75
Netherlands	189	15	4	48.3	6.8
Norway	1,435	108	8	.	26.7
Poland	151	13	4	37.4	60
Portugal	89	7	3	50	12
Romania	66	5	1	0	90
Slovakia	28	2	0	4.6	99
Slovenia	41	3	2	58.4	35
Spain	396	32	14	64.4	8.7
Sweden	908	71	3	37.3	10.2
Switzerland	605	46	2	.	11.6
United Kingdom	579	45	3	38.2	50
∑	13,516	1,033	101	48.45	44.88

Table D.2: Summary statistics | SRM sample

This table provides summary statistics for the main bank- and country-level variables in the annual SRM sample between 2010 and 2018. The SRM sample comprises all eurozone EU member states.

Variables	N	Mean	St.Dev	min	max	Median
z-Score	5672	4.03	1.24	.05	6.27	4.24
RWA density	3825	51.14	16.88	5.1	100	53.39
Loan impairments	4974	.45	1.17	-2.33	6.88	.24
NPL-ratio	4265	5.41	6.7	0	37.92	2.99
LLR-ratio	4614	2.94	3.56	0	21.67	1.78
Total impairments	5587	.29	.7	-1.12	4.23	.15
Trading securities	4644	2.89	6.89	0	61.31	.14
σStock	599	4.74	3.13	.4	15.58	3.87
Stock returns	599	-11.43	45	-167.73	74.65	0
Tobin's q	607	.97	.07	.83	1.5	.97
NIM	5581	1.75	.96	-.34	8.61	1.76
Funding expenses	5543	4.62	4.12	.24	16.78	3.16
Funding expenses 2	5591	1.27	1.22	0	9.07	1
Borrowing costs	5599	1.56	1.4	.05	11.68	1.32
Sensitive funding	5565	31.58	22.96	.78	96.09	24.14
Wholesale funding	5434	11.21	17.68	0	97.15	2.87
Customer deposits	5564	67.58	25.32	.14	100	75.85
Subdebt	4356	.92	1.12	0	7.98	.57
Bailoutp(2013)	1007	.5	.35	0	1	.63
Bailoutp	1007	.38	.37	0	1	.4
Total assets	5723	22.69	1.49	18.47	27.94	22.26
Revenue growth	5650	4.27	28.53	-96.87	218.65	1.03
RoA	5713	.35	.83	-3.44	7.07	.24
CAR	5723	9.24	8.07	.77	71.65	7.9
Liquidity	5718	14.64	15.48	.14	97.05	9.91
Deposit ratio	5723	75.28	21.07	0	95.59	84.83
IBL-ratio	5625	94.92	8.8	29	119.83	96.71
Non-int. inc. ratio	5698	33.36	22.29	-51.1	115.34	29.44
Cost-income ratio	5698	65.38	19.16	2.73	166.14	65.44
HHI	5719	.38	.19	.01	1.19	.35
Shor-term rate	5698	.45	.48	-.26	2	.1
GDP growth	5721	1.65	1.71	-9.1	25	1.5
Inflation	5721	1.4	.91	-1.6	4.7	1.5
Supervisory power	5725	10.68	1.57	5	14.5	11
Activity restrictions	5725	5.66	1.26	4	9	5
Capital stringency	5725	5.4	1.15	1	7	6
Private monitoring	5725	7.87	1.1	6	11	7

Table D.3: Summary statistics | BRRD sample

This table provides summary statistics for the main bank- and country-level variables in the annual BRRD sample between 2010 and 2018. The BRRD sample comprises all non-eurozone EU member states.

Variables	N	Mean	St.Dev	min	max	Median
z-Score	1770	3.37	1.17	.05	6.27	3.45
RWA density	1241	55.18	20.02	5.1	100	58.08
Loan impairments	1467	.9	1.35	-2.33	6.88	.36
NPL-ratio	1472	7.32	8.93	0	37.92	3.42
LLR-ratio	1620	3.96	4.85	0	21.67	1.64
Total impairments	1664	.56	.86	-1.12	4.23	.21
Trading securities	1447	8.42	13.21	0	61.31	1.69
σStock	414	4.22	2.25	.49	15.58	3.61
Stock returns	414	-1.52	33.9	-167.73	74.65	2.42
Tobin's q	405	1.01	.09	.88	1.96	.98
NIM	1589	3.5	3.94	.24	16.78	2.21
Funding expenses	1729	1.68	1.58	.05	11.68	1.27
Borrowing costs	1611	19.93	23.53	.78	96.09	11.48
Sensitive funding	1279	18.26	25.74	0	97.15	7.5
Wholesale funding	1611	81.53	25.06	.14	100	90.68
Customer deposits	851	1.49	1.33	0	7.98	1.23
Subdebt	1785	2.33	1.6	-.34	8.61	2.07
Bailoutp(2013)	345	.27	.34	0	.83	0
Bailoutp	345	.22	.32	0	.9	0
Total assets	1777	21.62	2.01	18.47	27.94	21.27
Revenue growth	1755	9.6	34.8	-96.87	218.65	4.63
RoA	1785	.77	1.42	-3.44	7.07	.68
CAR	1785	12.21	10.54	.77	71.65	10.36
Liquidity	1782	19.73	18.29	.14	97.05	13.78
Deposit ratio	1785	68.94	26.66	0	95.59	79.44
IBL-ratio	1730	91.33	13.88	29	119.83	94.62
Non-int. inc. ratio	1781	36.26	26.66	-51.1	115.34	33.94
Cost-income ratio	1780	64.11	25.29	2.73	166.14	62
HHI	1736	.14	.28	0	.9	0
Shor-term rate	1776	.79	1.26	-.5	7	.5
GDP growth	1770	2.21	1.55	-3.9	7	2.1
Inflation	1770	1.5	1.31	-1.6	6.1	1.4
Supervisory power	1785	9.45	1.75	8	14.5	8
Activity restrictions	1785	6.8	2	3	11	7
Capital stringency	1785	3.28	1.43	1	7	3
Private monitoring	1785	8.1	1.2	6	10	8

Table D.4: Summary statistics for quarterly subsample by country

Country	N	Banks	Banks with IGG
Austria	100	7	2
Belgium	24	2	1
Bulgaria	28	2	1
Croatia	44	4	0
Cyprus	44	3	0
Czech Republic	4	1	0
Denmark	252	17	1
Finland	48	3	2
France	64	4	4
Germany	96	7	3
Greece	92	6	1
Hungary	32	2	0
Italy	264	18	9
Lithuania	16	1	0
Netherlands	48	3	1
Poland	100	7	4
Portugal	16	1	1
Romania	28	2	1
Spain	120	8	6
Sweden	88	6	3
United Kingdom	68	5	2
∑	1576	109	42

Table D.5: Summary statistics for quarterly subsample | 2013-2016

This table provides summary statistics for the quarterly subsample between 2013 and 2016, comprising the main bank-level variables for the SRM and the BRRD area, respectively.

	N	Mean	St.Dev	min	max	Median
SRM region						
z-Score	925	3.9	1.15	1.13	6.8	4
RWA density	773	46.16	17.38	5.28	91.74	44
LLR-ratio	800	6.67	5.76	0.07	22.81	4.49
CDS	286	284.24	351.97	41.54	1574.42	126.94
CDSmean	286	284.57	369.38	45.55	1965.65	127.87
σStock	671	5.76	4.03	0.33	19.12	4.76
Stock return	671	-4.19	23.04	-77.09	42.17	-0.94
Total assets	956	24.67	2.08	20.7	28.44	24.83
RoA	932	0.07	0.56	-2.16	4.64	0.11
CAR	956	8.3	5.78	1.52	45.84	6.92
Revenue growth	866	2.19	52.03	-183.44	332.92	-0.47
Liquid assets	956	15	12.32	1.2	59.06	10.98
Deposit ratio	956	58.49	20.46	0	92.31	61.16
BRRD region						
z-Score	656	4.17	1.07	1.13	6.72	4.3
RWA density	471	54.64	22.53	5.28	87.66	61.15
LLR-ratio	562	6.59	5.32	0.07	22.81	5.53
CDS	112	90.59	50.11	41.13	202.36	71.77
CDSmean	112	88.88	49.77	39.79	202.36	69.32
σStock	518	3.93	2.21	0.59	18.33	3.5
Stock return	518	1.83	14.4	-64.55	42.17	1.82
Total assets	656	22.89	2.58	19.35	28.39	22.27
RoA	656	0.18	0.42	-2.16	4.64	0.18
CAR	668	9.4	4.14	1.52	21.56	8.54
Revenue growth	638	4.24	43.89	-183.44	332.92	0.52
Liquid assets	667	21.27	10.37	1.2	48.32	22.59
Deposit ratio	668	67.01	18.77	1.55	92.31	73.44

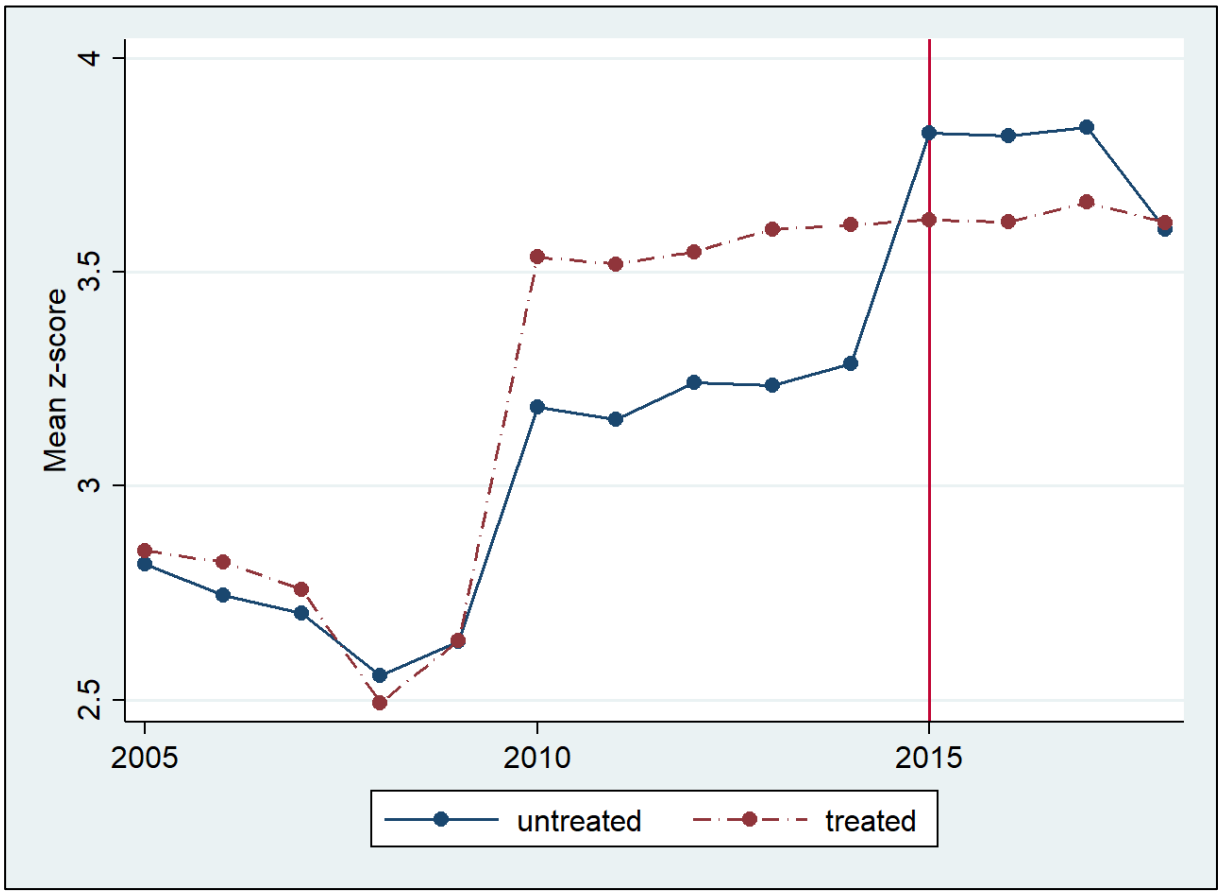
Table D.6: Summary statistics for monthly CDS & ratings

This table provides summary statistics for the monthly sample of CDS spreads and bank ratings from 2007 to 2013 and from 2014 to 2017, respectively. All bank ratings are transformed into a numerical scale, see appendix B. Fitch's BSR is inverted so that high values indicate strong support and vice versa. The sample comprises bank observations from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

	N	Mean	St.Dev	min	max	Median
			2007 - 20013			
CDS	2914	259.28	294.09	27	1427.01	154.41
CDSmean	2914	257.33	291.7	27.55	1416.54	154.13
SRF	2914	12.82	3.02	0	16	13
BSR	2914	4.53	0.96	1	5	5
BCA	2914	12.24	3.61	1	18	12
LTFCDR	2914	15.32	3.39	3	20	16
			2014 - 2017			
CDS	1663	170.79	239.27	24.2	1427.01	87.72
CDSmean	1663	171.99	239.19	24.38	1416.54	87.87
SRF	1663	6.26	6.41	0	15	5
BSR	1663	2.76	1.81	1	5	2
BCA	1663	10.19	3.9	1	16	11
LTFCDR	1662	12.93	4.04	2	18	14

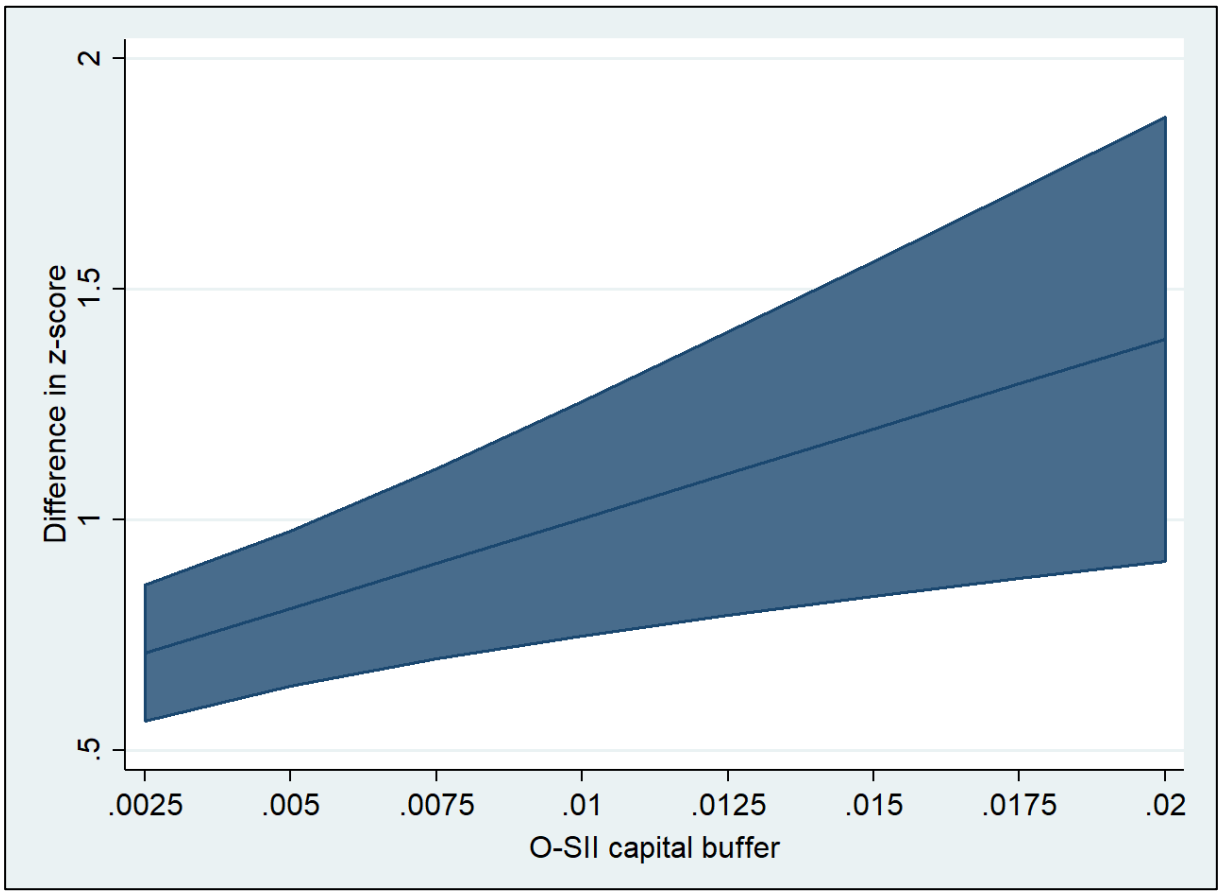
E Supplementary Figures

Figure E.1: Parallel trends of z-scores | BRRD



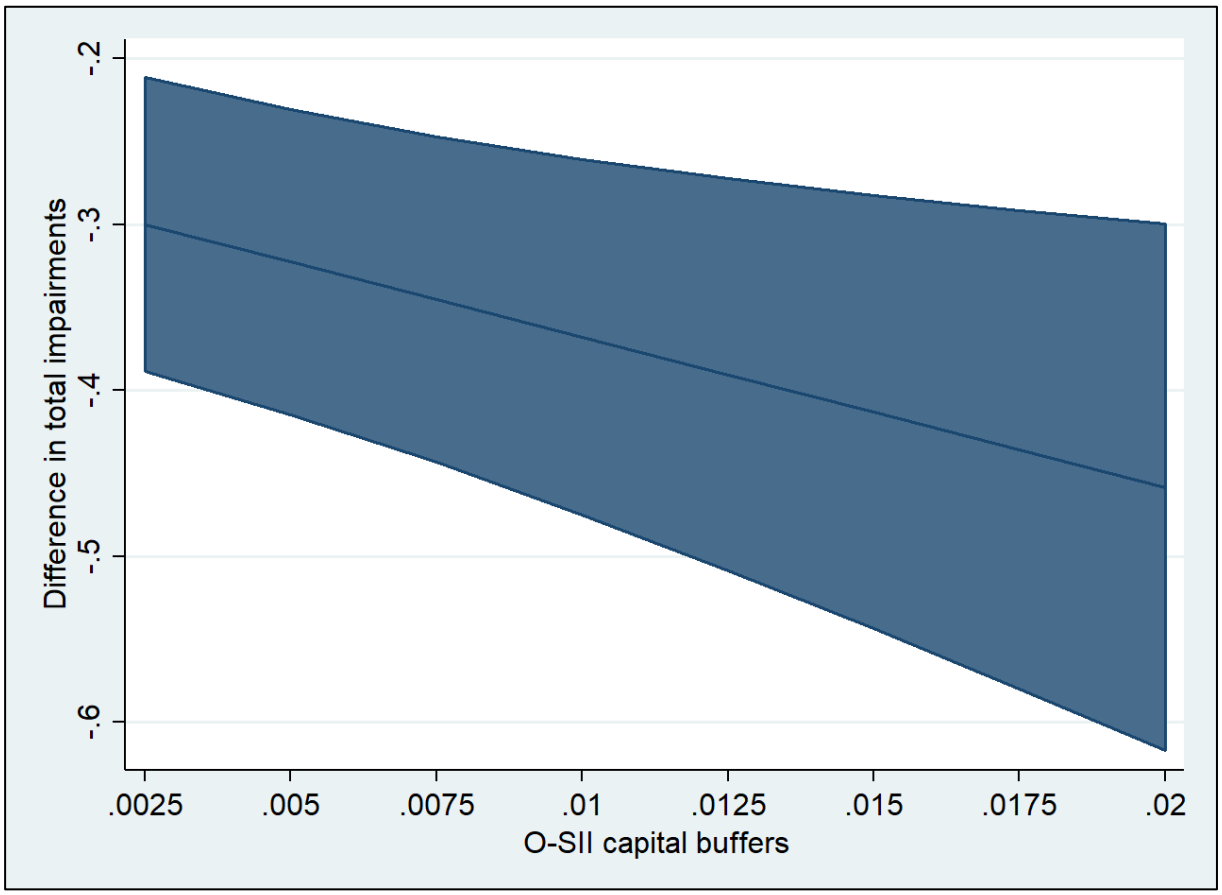
This figure presents parallel trends of mean z-scores (defined as return on assets plus the capital ratio divided by the standard deviation of return on assets). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥50% in 2013 and zero otherwise. The standard deviation of the return on assets which enters the z-score as the denominator is calculated for the following periods: 2005-2009, 2010-2014 and 2015-2018. The treatment period 2014 is included.

Figure E.2: Marginal effects of O-SII capital buffers | z-score



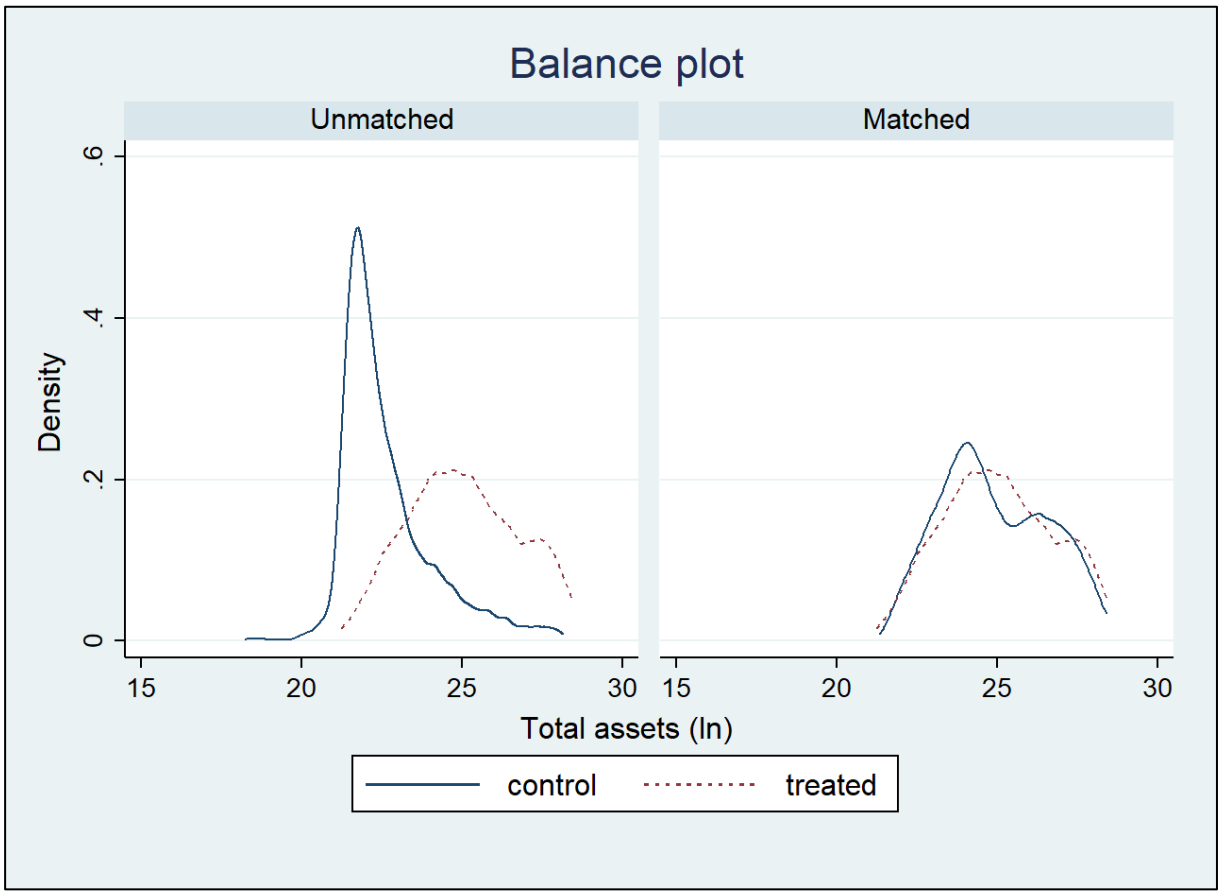
This figure presents the average marginal effects of O-SII capital buffers (x-axis) on the z-score (y-axis) after the SRM has been established in 2015 with 95% confidence intervals. This illustration corresponds to estimates from model (1) of Table 4.13.

Figure E.3: Marginal effects of O-SII capital buffers | total impairments



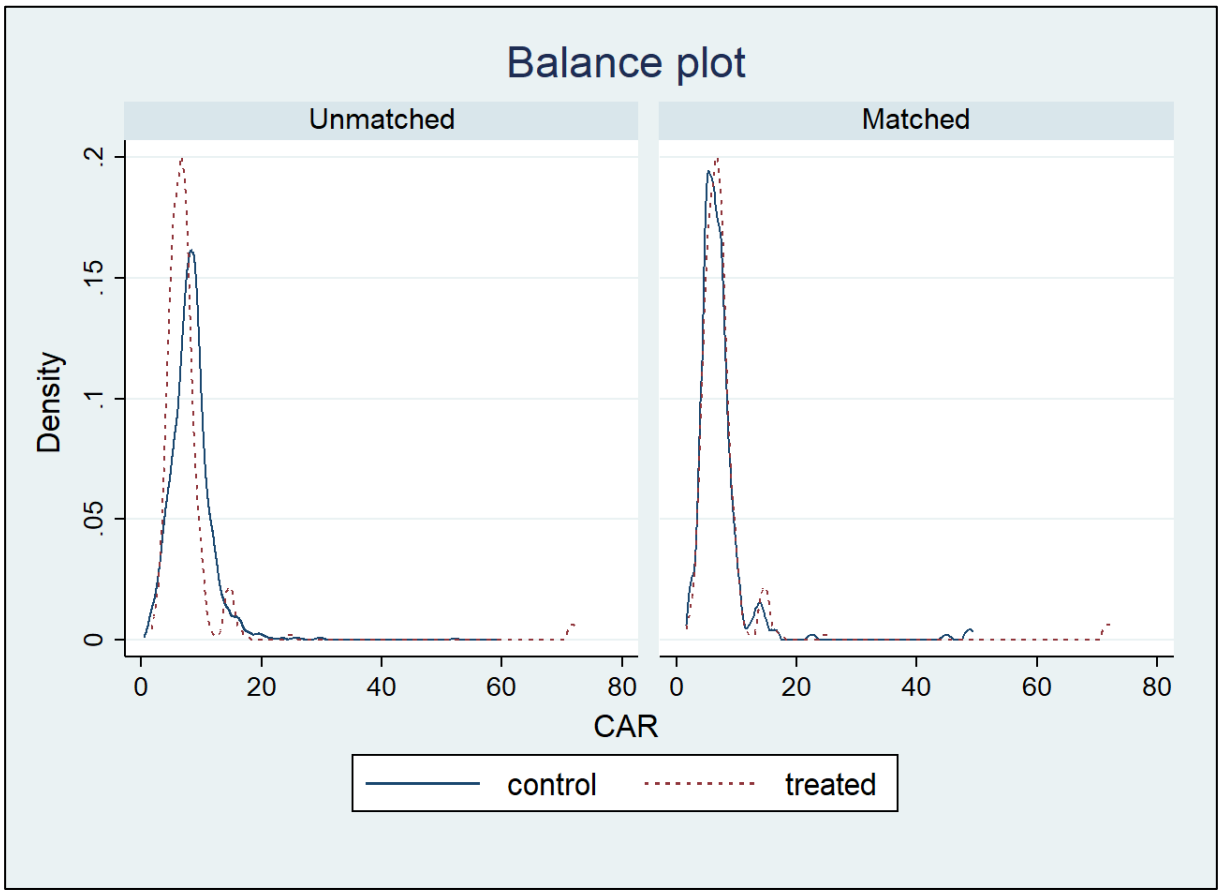
This figure presents the average marginal effects of O-SII capital buffers (x-axis) on total impairments (y-axis) after the SRM has been established in 2015 with 95% confidence intervals. This illustration corresponds to estimates from model (3) of Table 4.13.

Figure E.4: Kernel density plots | total assets (ln)



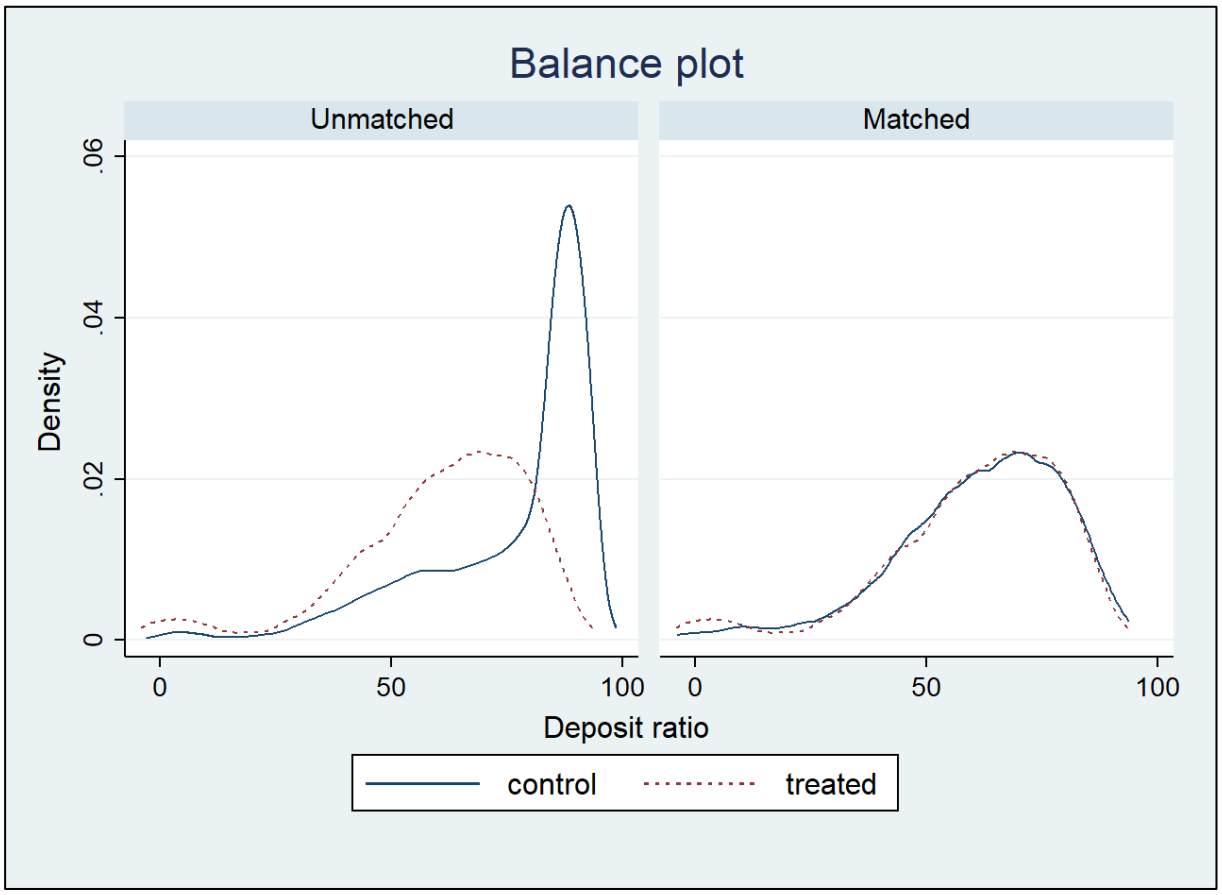
This figure presents the kernel density plots for banks' total assets (ln). The balance plots refer to the basic 1:4 NN matching approach depicted in panel A of Table 4.31.

Figure E.5: Kernel density plots | CAR



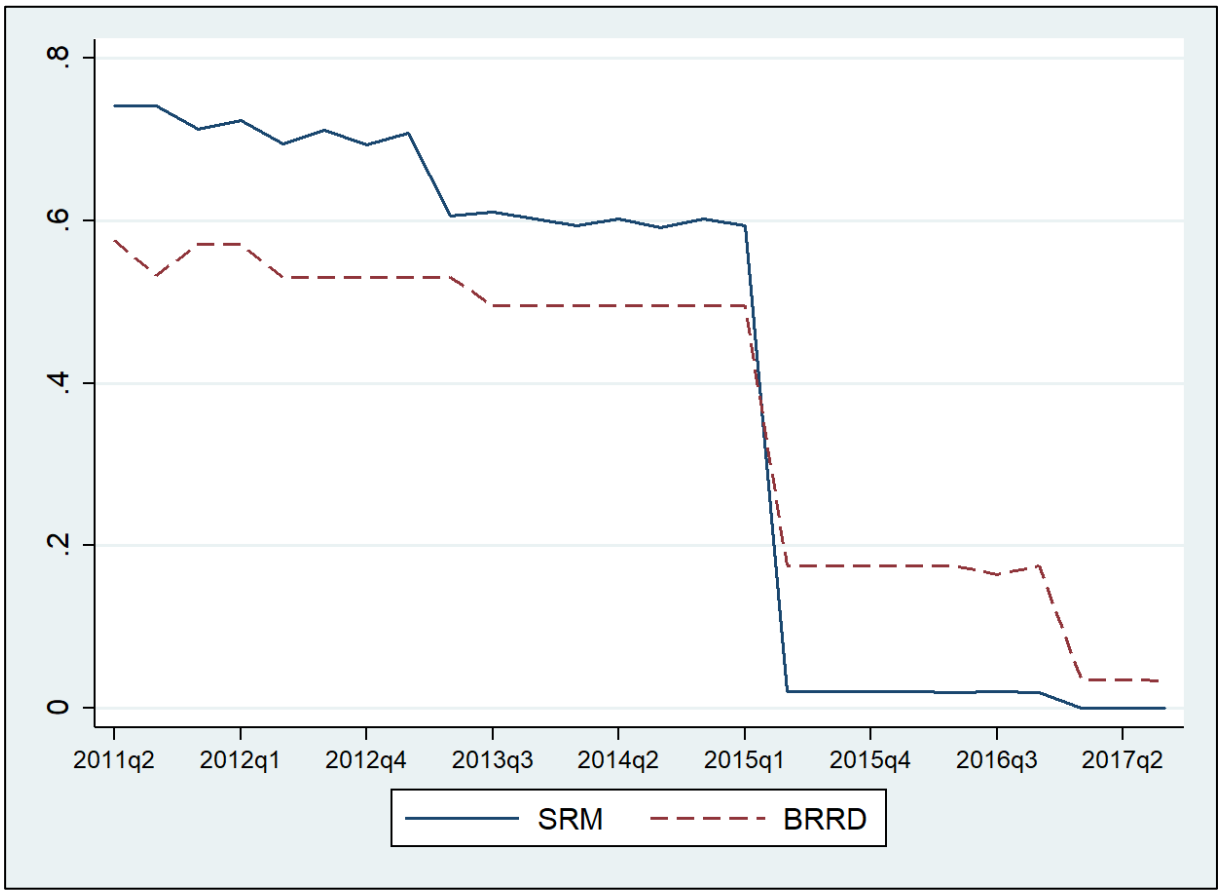
This figure presents the kernel density plots for banks' capital to asset ratio (CAR). The balance plots refer to the basic 1:4 NN matching approach depicted in panel A of Table 4.31.

Figure E.6: Kernel density plots | deposit ratio



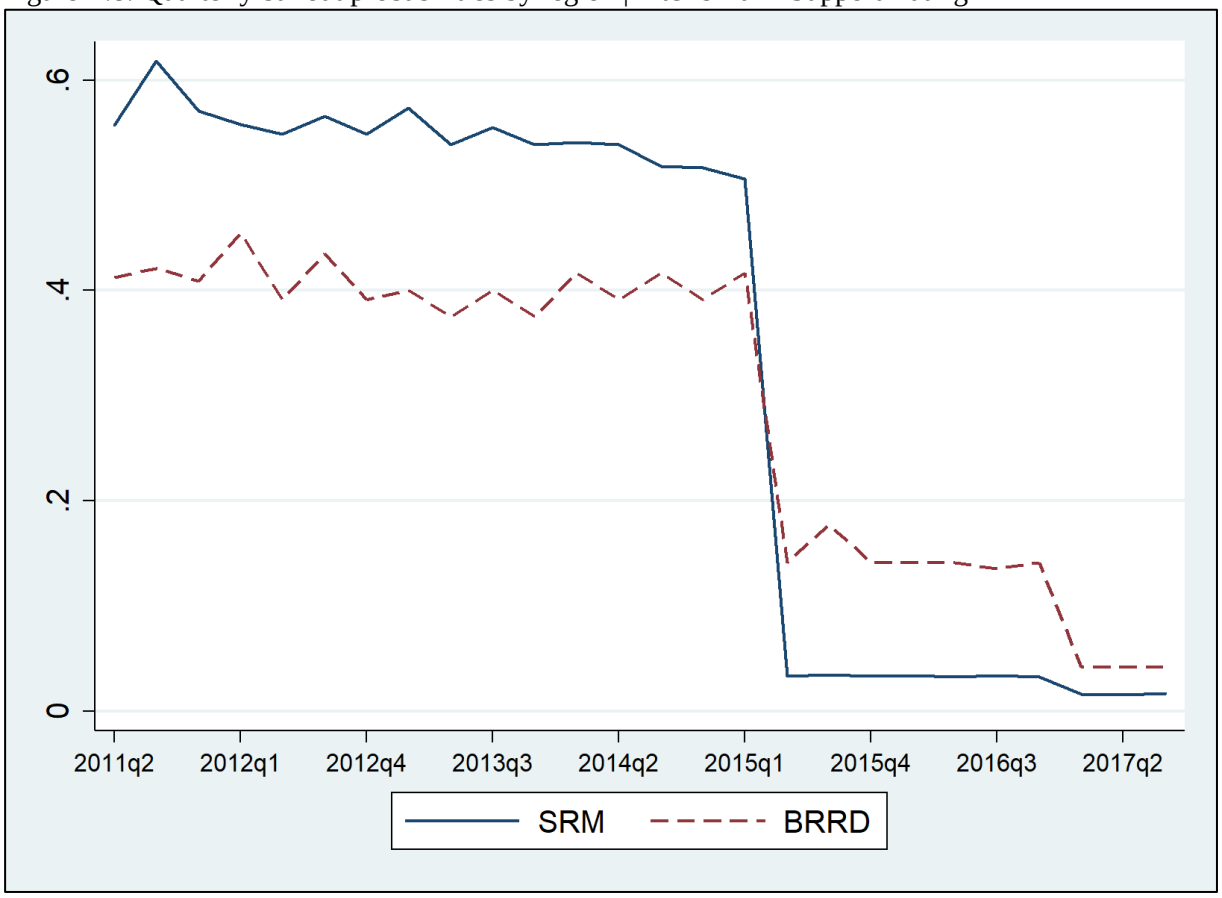
This figure presents the kernel density plots for banks' deposit ratio. The balance plots refer to the basic 1:4 NN matching approach depicted in panel A of Table 4.31.

Figure E.7: Quarterly bailout probabilities by region | Fitch's Support Rating Floor



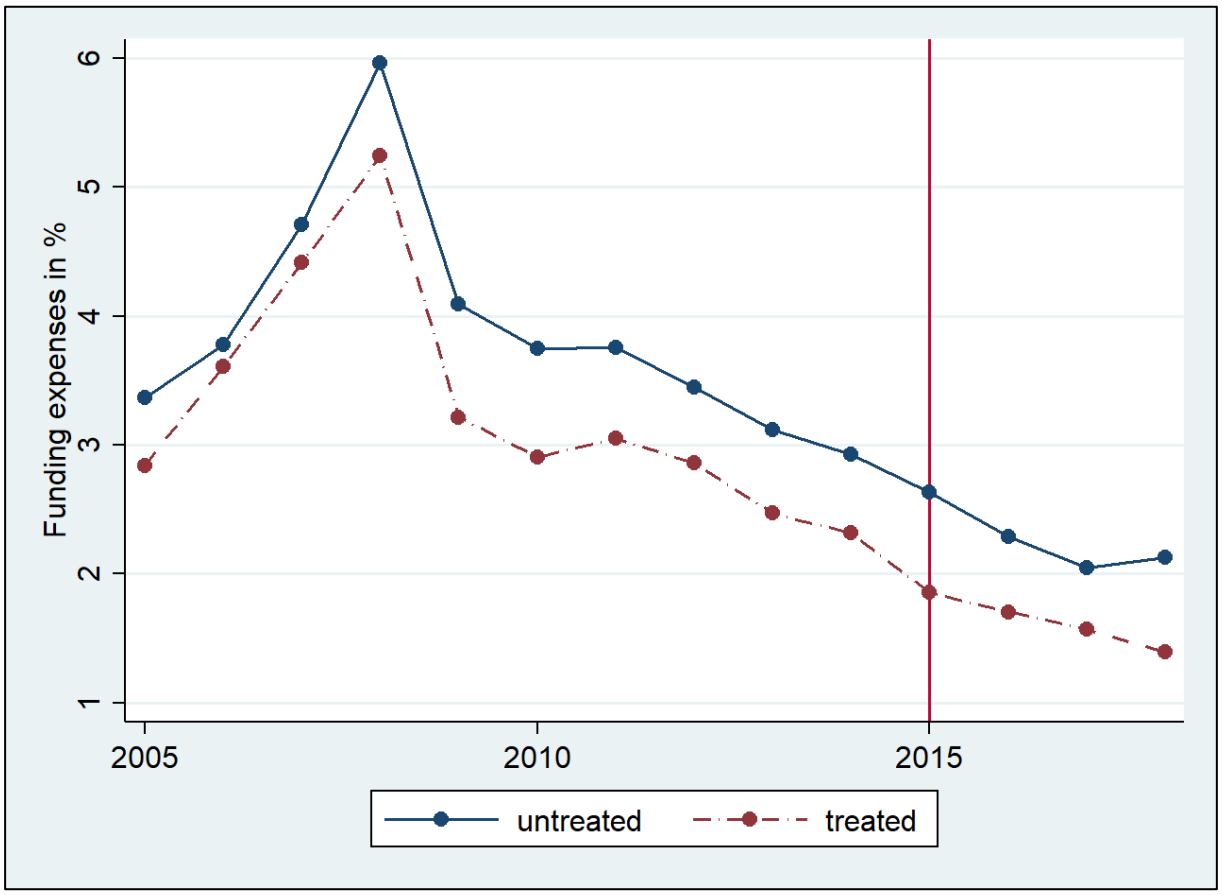
This figure presents the average bailout probabilities by region in quarterly frequency for a subset of listed banks. The probabilities are estimated for each bank by relying on rating information from Fitch's Support Rating Floor (SRF). Depicted are the mean bailout probabilities for each region. SRM are all members of the eurozone. BRRD are all non-eurozone EU members.

Figure E.8: Quarterly bailout probabilities by region | Fitch's Bank Support Rating



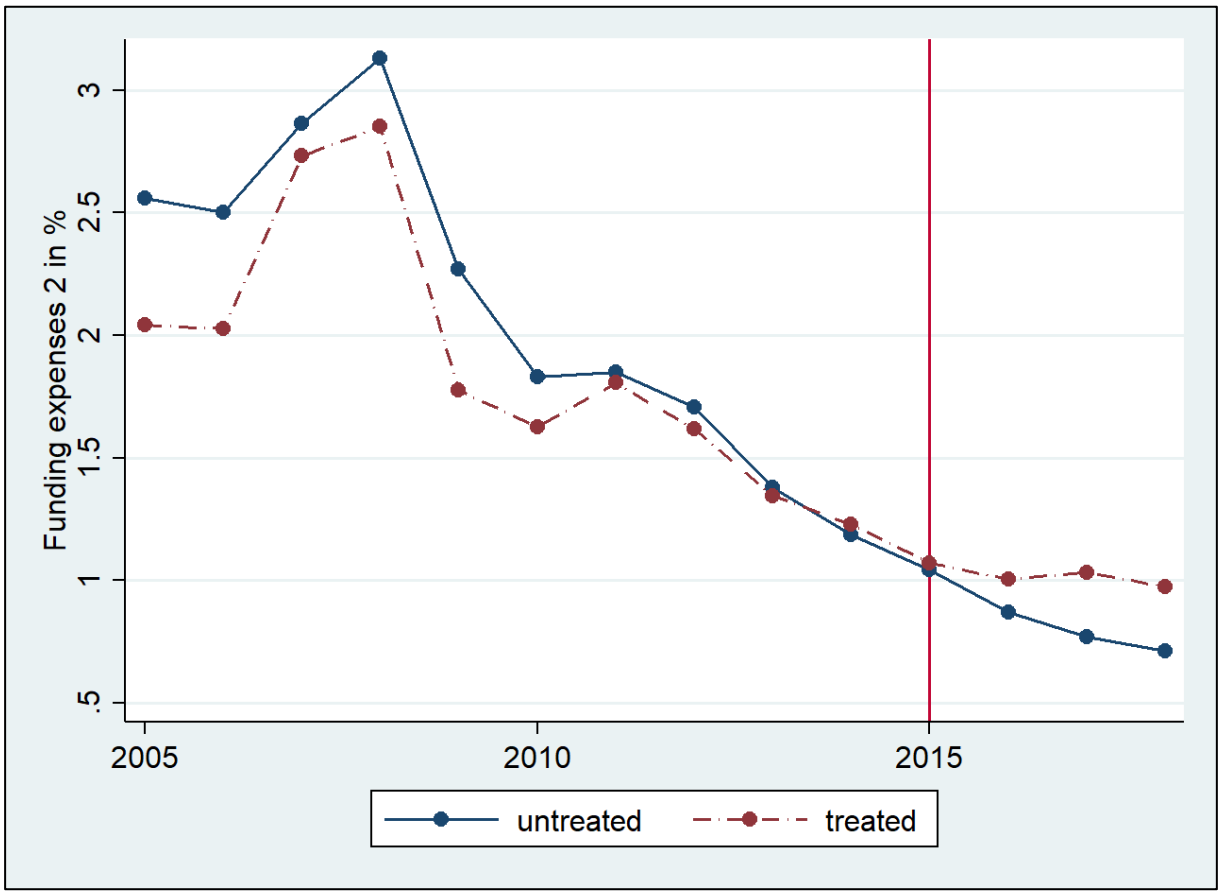
This figure presents the average bailout probabilities by region in quarterly frequency for a subset of listed banks. The probabilities are estimated for each bank by relying on rating information from Fitch's Bank Support Rating (BSR). Depicted are the mean bailout probabilities for each region. SRM are all members of the eurozone. BRRD are all non-eurozone EU members.

Figure E.9: Parallel trends of funding expenses | non-EU



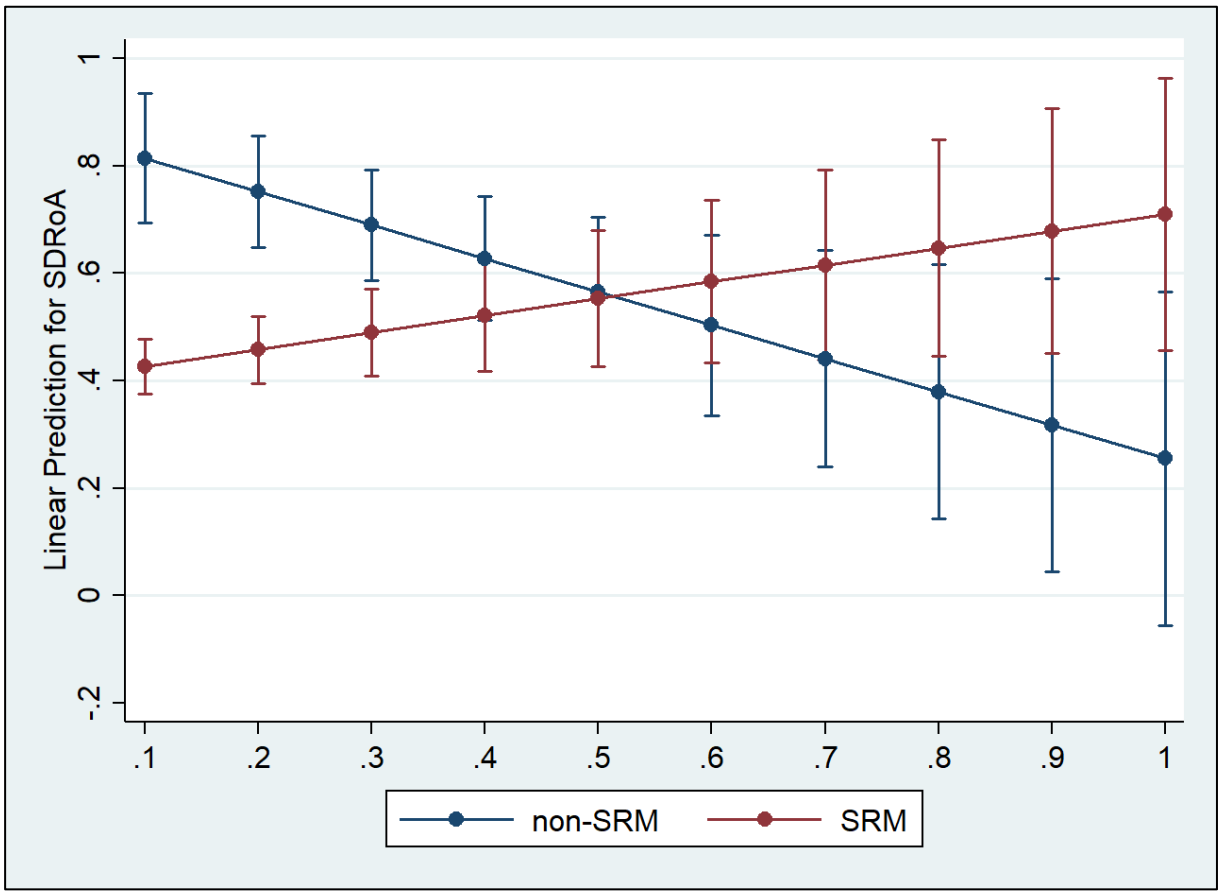
This figure presents the development of the mean funding expenses (defined as expenditures for risk-sensitive funding divided by risk-sensitive funding in %). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥ 50% in 2013 and zero otherwise. The treatment period 2014 is included. This sample includes observations from non-EU countries (Iceland, Liechtenstein, Norway, and Switzerland).

Figure E.10: Parallel trends of alternative funding expenses | SRM



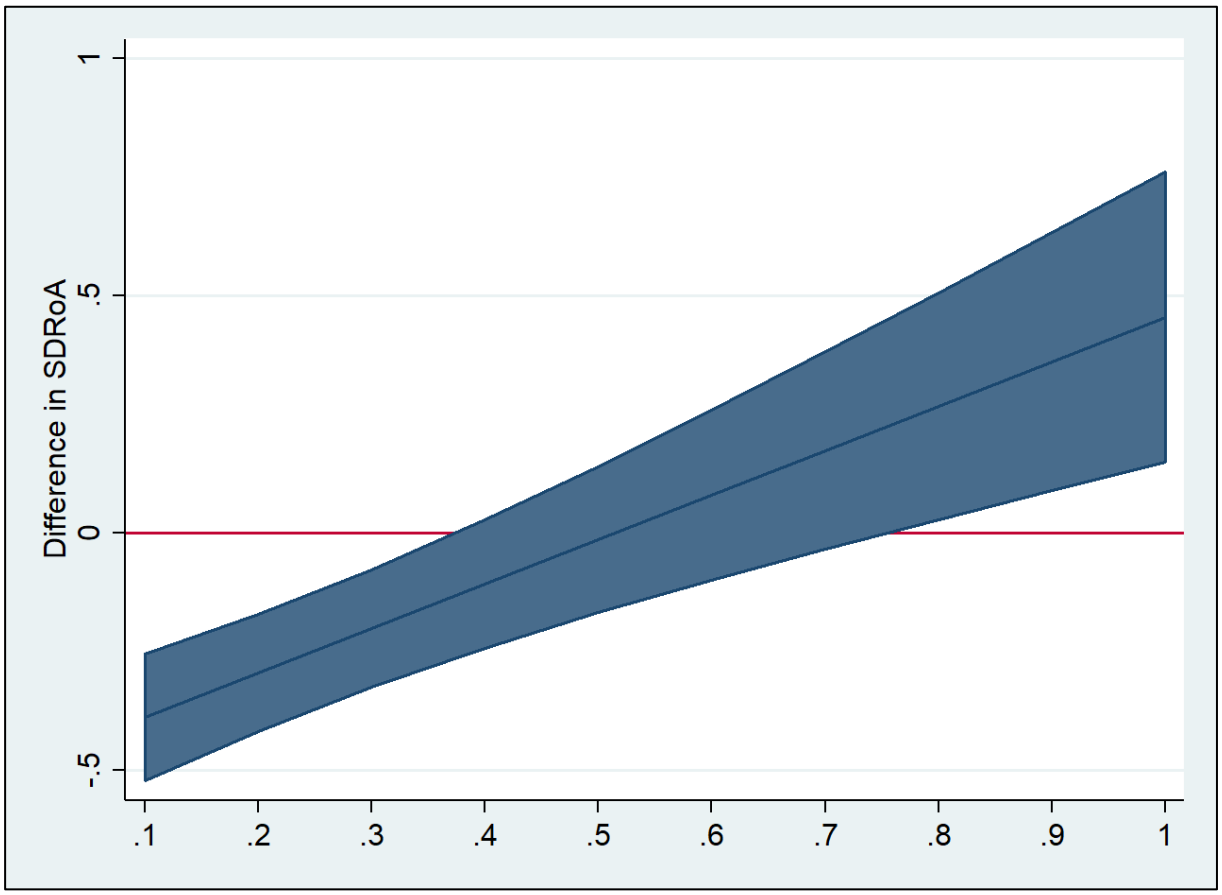
This figure presents the development of the mean alternative measure of funding expenses (defined as expenditures for risk-sensitive funding divided by interest-bearing liabilities in %). The treatment variable (IGG) is a dummy taking the value of one if the estimated bailout probability ≥ 50% in 2013 and zero otherwise. The treatment period 2014 is included.

Figure E.11: Linear predictions with 95% confidence intervals | σRoA



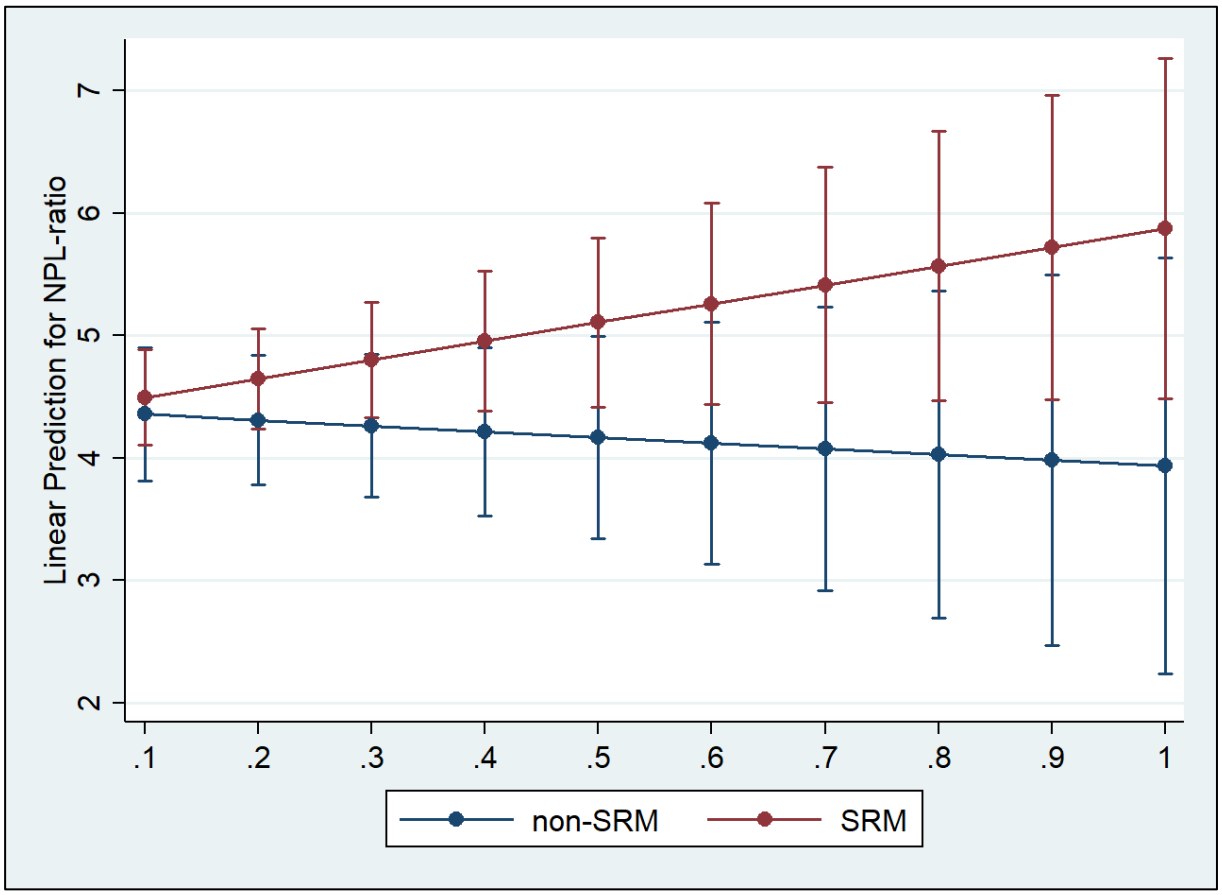
This figure presents the linear prediction for σRoA (defined as the standard deviation of the return on assets calculated over the periods from 2005 to 2009 and from 2010 to 2013) for increasing levels of the 2013 bailout probability (x-axis) for SRM and non-SRM banks. This illustration corresponds to estimates from model (5) in panel B of Table 6.9.

Figure E.12: SRM effects for different levels of bailout probabilities | σRoA



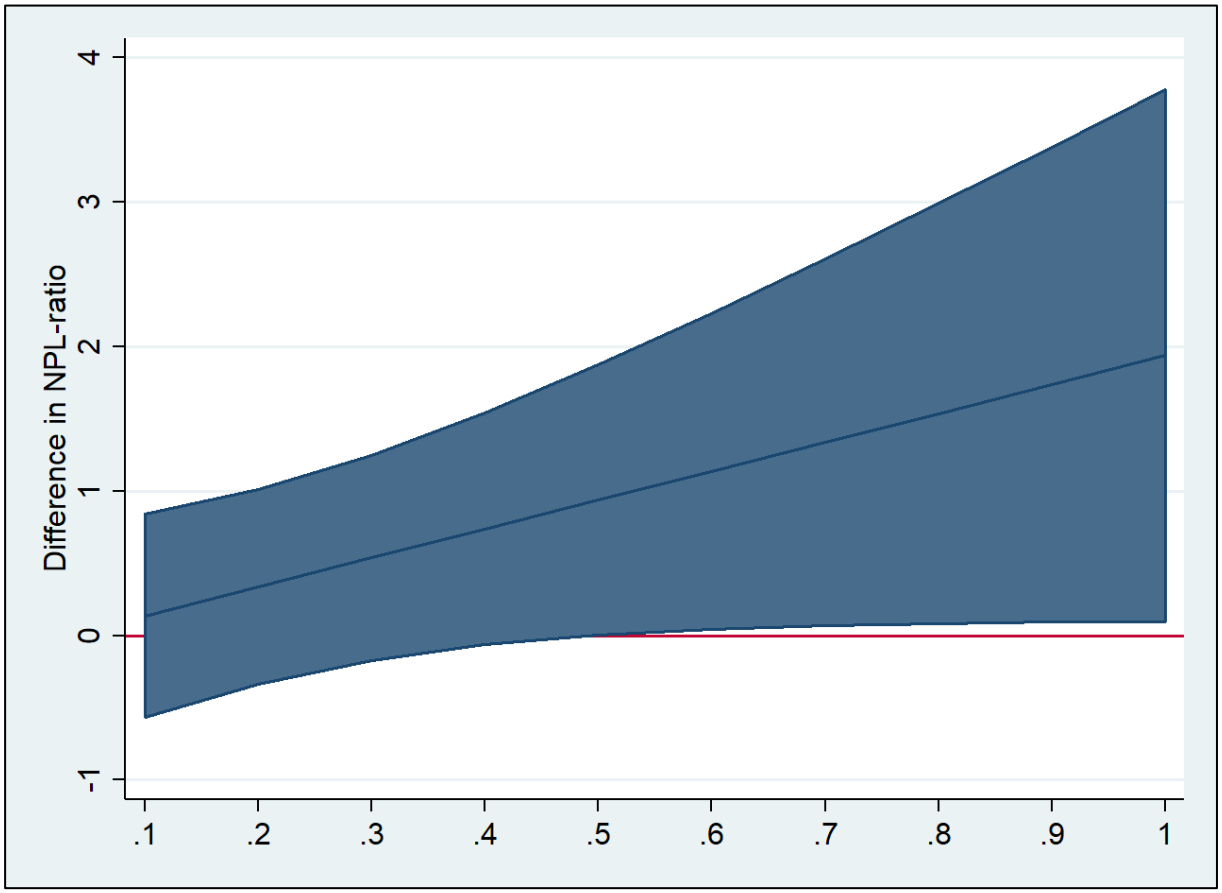
This figure presents the average marginal effect of increasing bailout probabilities (x-axis) on the σRoA (defined as the standard deviation of the return on assets calculated over the periods from 2005 to 2009 and from 2010 to 2013) of SRM-banks compared to non-SRM banks with 95% confidence intervals. This illustration corresponds to estimations from model (5) in panel B of Table 6.9.

Figure E.13: Linear predictions with 95% confidence intervals | NPL-ratio



This figure presents the linear prediction for the NPL-ratio (defined as non-performing loans to total loans in %) for increasing levels of the 2013 bailout probabilities (x-axis) for SRM and non-SRM banks. This illustration corresponds to estimates from model (2) in panel B of Table 6.9.

Figure E.14: SRM effects for different levels of bailout probabilities | NPL-ratio



This figure presents the average marginal effect of increasing bailout probabilities (x-axis) on the NPL-ratio (defined as non-performing loans to total loans in %) of SRM-banks compared to non-SRM banks with 95% confidence intervals. This illustration corresponds to estimates from model (5) in panel B of Table 6.9.

F Supplementary Tables

Table F.1: Robustness | bailout probability estimated with Fitch's ratings

This table presents robustness tests for a different definition of the treatment variable IGG. Bailout probabilities are estimated by relying on Fitch's rating only using either Fitch's Support Rating Floor (SRF) or Fitch's Bank Support Rating (BSR) if the former is unavailable. IGG takes the value of 1 if the bailout probability is ≥ 50% (panel A) or ≥ 60% (panel B). Bank and country controls are not reported for brevity. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variables	z-Score	RWA density	Loan impairments	NPL-ratio	LLR-ratio	σStock	Stock returns
Panel A: 50%							
Post15 * IGG	0.618***	-1.498	-0.274***	-1.637***	-0.860**	-0.897*	-11.498*
	(0.146)	(1.205)	(0.090)	(0.597)	(0.341)	(0.473)	(6.666)
Constant	2.693	182.479***	4.600	10.489	3.904	9.312	447.267
	(2.530)	(35.147)	(2.891)	(16.036)	(7.402)	(21.501)	(369.194)
Observations	4,795	3,180	4,708	3,516	3,802	509	509
Number of banks	631	561	621	594	606	72	72
Adjusted R^2	0.261	0.217	0.200	0.293	0.243	0.343	0.323
Panel B: 60%							
Post15 * IGG	0.554***	-1.214	-0.235**	-1.469**	-0.869**	-0.835*	-12.164*
	(0.164)	(1.188)	(0.100)	(0.658)	(0.387)	(0.452)	(6.224)
Constant	2.891	181.644***	4.466	10.136	4.046	10.159	470.561
	(2.541)	(35.113)	(2.893)	(16.021)	(7.395)	(21.804)	(367.645)
Observations	4,795	3,180	4,708	3,516	3,802	509	509
Number of banks	631	561	621	594	606	72	72
Adjusted R^2	0.254	0.216	0.199	0.290	0.242	0.341	0.324

Table F.2: Exclusion of ECB supervised entities | alternative risk measures

This table presents robustness tests for alternative explanations. The initial version of the DD regression is re-estimated, excluding significant institutions (SI) directly supervised by the ECB. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(4)	(5)	(12)	(13)	(14)
Dependent variables	NPL-ratio	LLR-ratio	Total Impairments	σStock	Stock returns
Post15 * IGG	-0.646	-0.523	-0.132**	-1.651**	5.411
	(0.788)	(0.429)	(0.062)	(0.732)	(14.905)
Constant	6.454	2.154	1.849	52.457	479.918
	(17.200)	(7.717)	(1.434)	(35.465)	(573.862)
Observations	2,956	3,235	4,157	265	266
Number of banks	520	532	550	39	39
Adjusted R^2	0.259	0.201	0.172	0.253	0.223

Table F.3: MD Robustness | alternative measure of funding expenses

This table presents robustness tests for market discipline using an alternative measure of risk-sensitive funding expenses. The dependent variable (funding expenses 2) is defined as expenditures for non-customer deposit liabilities divided by interest-bearing liabilities (IBL). Models (1) to (4) differ by implementing different co-variates. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Funding expenses 2	(1)	(2)	(3)	(4)
Post15 * IGG	0.292***	0.344***	0.308***	0.421***
	(0.099)	(0.091)	(0.093)	(0.119)
Total assets		0.230**	0.185**	0.218*
		(0.113)	(0.078)	(0.117)
RoA		-0.007	-0.002	-0.009
		(0.042)	(0.035)	(0.039)
CAR		0.024	0.031**	-0.021**
		(0.015)	(0.015)	(0.009)
Liquidity		-0.004	-0.004	-0.001
		(0.004)	(0.003)	(0.003)
IBL-ratio			-0.011**	-0.004
			(0.004)	(0.003)
Customer deposits			-0.006*	-0.000
			(0.004)	(0.003)
Subdebt				0.003
				(0.022)
LTIDR				-0.026
				(0.020)
HHI			-0.719**	-0.629
			(0.298)	(0.644)
Short-term rate			0.609**	0.362***
			(0.263)	(0.093)
GDP growth			0.034**	0.018
			(0.013)	(0.016)
Inflation			-0.147***	-0.016
			(0.034)	(0.046)
Private monitoring			0.035	0.085***
			(0.021)	(0.028)
Constant	1.842***	-3.470	-1.669	-3.038
	(0.027)	(2.591)	(1.863)	(2.852)
Observations	4,792	4,792	4,680	2,340
Number of banks	631	631	619	339
Adjusted R^2	0.438	0.448	0.525	0.790

Table F.4: SRM effects on market discipline | significant institutions

This table presents DD regression results of the effects on market discipline for significant institutions (SI) in the SRM sample. The treatment variable (SI) is one for all significant institutions directly supervised by the ECB and zero otherwise. All countries without treated entities were removed. Funding expenses are expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities. Borrowing costs are interest expenses divided by interest-bearing liabilities. Sensitive funding is risk-sensitive funding divided by total funding. Wholesale funding is wholesale funding divided by total funding. Customer deposits are the ratio of total customer deposits to total funding. RoA profit to total assets. CAR is equity divided by total assets. HHI is the Herfindahl-Hirschman Index as a measure for competition per country. Short-term rate e is the short-term interest rate level per country. GDP is the annual real GDP growth rate per country. Inflation is the annual change in consumer prices per country. Private monitoring captures the incentives and ability of private investors to monitor banks. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing costs	(3) sensitive funding	(4) wholesale funding	(5) customer deposits
Post15 * SI	1.379***	-0.006	-1.237	-2.907***	1.560
	(0.302)	(0.117)	(1.260)	(1.057)	(1.368)
RoA	0.013	-0.071	-0.748*	-0.077	0.069
	(0.131)	(0.048)	(0.402)	(0.365)	(0.491)
CAR	0.014	0.029*	-0.756***	-0.219**	0.236
	(0.045)	(0.016)	(0.118)	(0.110)	(0.175)
liquidity	-0.016	-0.002	-0.019	0.010	-0.010
	(0.013)	(0.004)	(0.037)	(0.045)	(0.044)
HHI	-3.647***	-0.493	-2.885	-8.223**	6.134*
	(0.938)	(0.315)	(3.225)	(3.514)	(3.649)
Short-term rate	1.394*	0.620*	-7.481	3.204	7.840
	(0.754)	(0.341)	(6.270)	(3.146)	(6.997)
GDP	0.212***	-0.029*	-0.706***	-0.559**	0.939***
	(0.057)	(0.017)	(0.214)	(0.251)	(0.238)
Inflation	-0.505***	-0.103***	0.447	1.520***	-0.341
	(0.114)	(0.035)	(0.379)	(0.436)	(0.428)
Private monitoring	0.256***	0.024	0.025	-0.125	-0.116
	(0.062)	(0.030)	(0.201)	(0.246)	(0.231)
Constant	4.181***	1.585***	51.941***	16.089***	50.167***
	(1.105)	(0.416)	(6.869)	(4.093)	(7.774)
Observations	4,791	4,848	4,803	4,709	4,802
Number of banks	629	641	629	631	629
Adjusted R^2	0.375	0.466	0.377	0.185	0.278

Table F.5: SRM effects on market discipline | O-SIIs

This table presents DD regression results of the effects on market discipline for O-SIIs in the SRM sample. The treatment variable (O-SII) is one for all Other Systemically Important Institutions and zero otherwise. All countries without treated entities were removed. Funding expenses are expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities. Borrowing costs are interest expenses divided by interest-bearing liabilities. Sensitive funding is risk-sensitive funding divided by total funding. Wholesale funding is wholesale funding divided by total funding. Customer deposits are the ratio of total customer deposits to total funding. RoA profit to total assets. CAR is equity divided by total assets. HHI is the Herfindahl-Hirschman Index as a measure for competition per country. Short-term rate e is the short-term interest rate level per country. GDP is the annual real GDP growth rate per country. Inflation is the annual change in consumer prices per country. Private monitoring captures the incentives and ability of private investors to monitor banks. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing Costs	(3) sensitive funding	(4) wholesale funding	(5) customer deposits
Post15 * O-SII	1.426***	-0.077	-1.273	-2.311**	1.713
	(0.307)	(0.113)	(1.163)	(1.134)	(1.258)
RoA	-0.000	-0.070	-0.747*	-0.085	0.068
	(0.130)	(0.048)	(0.403)	(0.367)	(0.490)
CAR	0.012	0.029*	-0.756***	-0.214*	0.236
	(0.045)	(0.016)	(0.118)	(0.112)	(0.176)
liquidity	-0.015	-0.002	-0.019	0.009	-0.011
	(0.013)	(0.004)	(0.037)	(0.046)	(0.044)
HHI	-3.632***	-0.500	-2.918	-8.208**	6.187*
	(0.936)	(0.317)	(3.210)	(3.496)	(3.628)
Short-term rate	1.279*	0.641*	-7.378	3.328	7.680
	(0.755)	(0.344)	(6.056)	(3.192)	(6.745)
GDP	0.206***	-0.025	-0.693***	-0.584**	0.917***
	(0.056)	(0.017)	(0.201)	(0.236)	(0.224)
Inflation	-0.496***	-0.103***	0.422	1.517***	-0.314
	(0.110)	(0.034)	(0.368)	(0.426)	(0.416)
Private monitoring	0.261***	0.024	-0.011	-0.117	-0.076
	(0.061)	(0.030)	(0.200)	(0.242)	(0.230)
Constant	4.255***	1.559***	52.093***	15.926***	50.061***
	(1.108)	(0.423)	(6.643)	(4.138)	(7.512)
Observations	4,807	4,863	4,819	4,720	4,818
Number of banks	631	643	631	633	631
Adjusted R^2	0.376	0.466	0.378	0.183	0.279

Table F.6: SRM effects on market discipline | G-SIIs

This table presents DD regression results of the effects on market discipline for Global Systemically Important Institutions (G-SIIs) in the SRM sample. The treatment variable (G-SII) is one for all Global Systemically Important Institutions and zero otherwise. All observations from countries without treated entities are removed. Funding expenses are expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities. Borrowing costs are interest expenses divided by interest-bearing liabilities. Sensitive funding is risk-sensitive funding divided by total funding. Wholesale funding is wholesale funding divided by total funding and equity. Customer deposits is the ratio of total customer deposits to total funding. RoA profit to total assets. CAR is equity divided by total assets. HHI is the Herfindahl-Hirschman Index as a measure for competition per country. Short-term rate e is the short-term interest rate level per country. GDP is the annual real GDP growth rate per country. Inflation is the annual change in consumer prices per country. Private monitoring captures the incentives and ability of private investors to monitor banks. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing Costs	(3) sensitive funding	(4) wholesale funding	(5) customer deposits
Post 15 * G-SII	1.677***	0.131	-0.871	-1.163	0.872
	(0.281)	(0.205)	(1.325)	(1.144)	(1.289)
RoA	0.051	-0.052	-0.222	-0.141	-0.787
	(0.156)	(0.069)	(0.468)	(0.484)	(0.581)
CAR	0.024	0.029*	-0.818***	-0.177*	0.328*
	(0.049)	(0.017)	(0.128)	(0.106)	(0.182)
liquidity	-0.021	-0.000	0.015	0.026	-0.043
	(0.013)	(0.003)	(0.036)	(0.033)	(0.045)
HHI	-5.172***	-0.404	-0.735	-6.331*	3.895
	(1.064)	(0.355)	(3.382)	(3.569)	(3.737)
Short-term rate	-25.978*	1.624	171.104***	249.243***	-160.342**
	(15.742)	(5.730)	(63.723)	(63.195)	(73.310)
GDP	0.536***	-0.020	-1.414***	-1.639***	1.699***
	(0.093)	(0.029)	(0.309)	(0.321)	(0.351)
Inflation	-0.440***	-0.121***	0.026	1.235**	0.124
	(0.131)	(0.042)	(0.537)	(0.527)	(0.610)
Private monitoring	0.186***	0.013	0.241	0.248	-0.384*
	(0.060)	(0.031)	(0.197)	(0.241)	(0.227)
Constant	31.837**	0.585	-127.117*	-231.106***	218.794***
	(15.913)	(5.827)	(65.167)	(64.382)	(75.138)
Observations	4,556	4,585	4,567	4,453	4,566
Number of banks	594	602	594	593	594
Adjusted R^2	0.399	0.485	0.374	0.208	0.270

Table F.7: BRRD effects on market discipline | O-SIIs

This table presents DD regression results of the effects on market discipline for Other Systemically important Institutions (O-SIIs) in the BRRD sample. The treatment variable (O-SII) is one for Other Systemically important financial institutions and zero otherwise. All countries without treated entities were removed. Funding expenses are expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities. Sensitive funding is risk-sensitive funding divided by total funding. Wholesale funding is wholesale funding divided by total funding and equity. Customer deposits are the ratio of total customer deposits to total funding. RoA profit to total assets. CAR is equity divided by total assets. HHI is the Herfindahl-Hirschman Index as a measure for competition per country. Short-term rate e is the short-term interest rate level per country. GDP is the annual real GDP growth rate per country. Inflation is the annual change in consumer prices per country. Private monitoring captures the incentives and ability of private investors to monitor banks. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p <

Dependent variables	(1) Funding expenses	(2) Borrowing Costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Post15 * O-SII	1.151**	-0.245	-2.003	2.531	2.636
	(0.541)	(0.189)	(2.434)	(2.400)	(2.728)
RoA	-0.082	-0.004	-0.213	-0.945	0.306
	(0.130)	(0.061)	(0.408)	(0.624)	(0.467)
CAR	0.116*	0.048	-0.574***	-0.490**	0.465**
	(0.062)	(0.043)	(0.183)	(0.221)	(0.183)
Liquidity	-0.011	0.007	0.043	0.014	-0.043
	(0.020)	(0.006)	(0.071)	(0.089)	(0.085)
HHI	2.154*	-0.686**	0.615	6.000	-0.314
	(1.182)	(0.342)	(3.319)	(4.705)	(3.669)
Short-term rate	-0.040	0.343***	1.446	1.290	-1.499
	(0.258)	(0.068)	(0.922)	(0.850)	(1.032)
GDP	-0.162*	-0.144***	-0.260	-0.082	0.221
	(0.097)	(0.019)	(0.196)	(0.227)	(0.231)
Inflation	0.328***	0.037	0.819*	-0.020	-1.118**
	(0.117)	(0.044)	(0.438)	(0.423)	(0.498)
Private monitoring	-0.551**	0.094	3.574***	0.571	-4.255***
	(0.229)	(0.101)	(0.990)	(0.612)	(1.253)
Constant	7.332***	0.686	-4.685	17.124***	113.317***
	(2.341)	(1.157)	(9.064)	(6.047)	(11.231)
Observations	1,335	1,443	1,354	1,063	1,354
Number of banks	185	201	185	161	185
Adjusted R^2	0.112	0.487	0.157	0.059	0.140

Table F.8: BRRD effects on market discipline | G-SIIs

This table presents DD regression results of the effects on market discipline for Global Systemically Important Institutions (G-SIIs) in the BRRD sample (H-2). The treatment variable (G-SII) is one for all Global Systemically Important Institutions and zero otherwise. All countries without treated entities were removed. Funding expenses are expenditures for non-customer deposit liabilities divided by total non-customer deposit liabilities. Borrowing costs are interest expenses divided by interest-bearing liabilities. Sensitive funding is risk-sensitive funding divided by total funding. Wholesale funding is wholesale funding divided by total funding and equity. Customer deposits are the ratio of total customer deposits to total funding. RoA profit to total assets. CAR is equity divided by total assets. HHI is the Herfindahl-Hirschman Index as a measure for competition per country. Short-term rate e is the short-term interest rate level per country. GDP is the annual real GDP growth rate per country. Inflation is the annual change in consumer prices per country. Private monitoring captures the incentives and ability of private investors to monitor banks. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

Dependent variables	(1) Funding expenses	(2) Borrowing Costs	(3) Sensitive funding	(4) Wholesale funding	(5) Customer deposits
Post 15 * G-SII	1.151**	0.156	-3.254*	-3.376	4.555**
	(0.481)	(0.135)	(1.724)	(2.286)	(2.037)
RoA	-0.281*	-0.073	-0.618	-1.479*	0.971
	(0.158)	(0.069)	(0.535)	(0.854)	(0.612)
CAR	0.181*	0.069	-0.337**	-0.439*	0.218
	(0.104)	(0.062)	(0.154)	(0.264)	(0.169)
liquidity	0.019	0.013*	-0.057	0.034	0.075
	(0.019)	(0.007)	(0.055)	(0.114)	(0.062)
HHI	1.908	-0.484	-1.085	9.356	2.617
	(1.774)	(0.473)	(5.036)	(8.452)	(5.474)
Short-term rate	-0.965	0.163	0.635	1.877	-0.013
	(0.604)	(0.157)	(1.623)	(2.479)	(1.808)
GDP	-0.117	-0.115***	0.170	0.227	-0.246
	(0.150)	(0.023)	(0.262)	(0.379)	(0.298)
Inflation	-0.111	-0.080	0.749	0.771	-0.650
	(0.369)	(0.124)	(1.095)	(1.698)	(1.179)
Private monitoring	-0.241	0.259*	3.611***	0.238	-4.514**
	(0.292)	(0.153)	(1.373)	(1.272)	(1.742)
Constant	4.895*	-1.038	-7.893	18.810**	117.728***
	(2.665)	(1.562)	(11.160)	(8.512)	(14.532)
Observations	982	1,086	993	741	993
Number of banks	137	151	137	113	137
Adjusted R^2	0.100	0.362	0.114	0.063	0.118

Table F.9: SRM effects on risk-taking | 7 quarter subsample

This table presents DD regression results of the short-term SRM effects on risk-taking using a subsample with quarterly accounting and stock market data. The pre-treatment period stretches from 2014q1 to 2014q3, and the post-treatment period stretches from 2014q4 to 2015q3. All models control for total assets, RoA, CAR, deposit ratio, liquidity, revenue growth, GDP growth, and inflation. Bank and country controls are not reported for brevity. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(6)
Dependent variables	z-score	RWA density	LLR-ratio	σStock
Post15 * IGG	0.355*	-1.942*	-0.869**	-1.490*
	(0.200)	(1.085)	(0.424)	(0.804)
Constant	-31.226	640.308***	198.049**	42.104
	(28.028)	(129.029)	(84.393)	(81.663)
Observations	378	306	326	273
Number of banks	57	52	54	41
Adjusted R^2	0.162	0.426	0.250	0.341

Table F.10: SRM effects on market discipline | 6 quarter subsample

This table presents robustness tests on short-term effects on market discipline using a subsample with quarterly accounting and market data. The pre-treatment period stretches from 2013Q4 to 2014Q2, and the post-treatment period stretches from 2014Q3 to 2015Q1. All models control for total assets, RoA, CAR, liquidity, GDP growth, inflation, and the private monitoring index. Bank and country controls are not reported for brevity. All models include bank and year-quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

	(1)	(2)	(3)	(4)
Dependent variables	CDS	CDSmean	Stock returns	σStock
2014Q3 * IGG	64.786*	160.289**	-10.335**	0.824*
	(30.713)	(56.699)	(5.092)	(0.447)
Constant	12,146.468	12,015.532	-883.889	54.826
	(10,104.112)	(7,188.966)	(783.224)	(98.361)
Observations	108	108	251	251
Number of banks	18	18	42	42
Adjusted R^2	0.314	0.595	0.383	0.163

Table F.11: SRM & BRRD effects on market discipline | 6 quarter subsample

This table presents DD regression results of the short-term SRM & BRRD effects on market discipline using a subsample with quarterly accounting and market data. The interaction term *2014Q3 * IGG* estimated the treatment effect for implicitly guaranteed banks inside the BRRD region. The interaction term *2014Q3 * IGG_SRM* estimated the treatment effect for implicitly supported banks inside the SRM region. The pre-treatment period stretches from 2013Q4 to 2014Q2, and the post-treatment period stretches from 2014Q3 to 2015Q1. CDS is the latest CDS spread quote for the respective quarter. CDSmean is the quarterly mean CDS spread calculated from daily CDS spread, Stock returns is as quarterly return from weekly total return index, and σStock is the quarterly standard deviation of the weekly total return index. All models include bank and year-quarter fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1, respectively.

	(1)	(2)	(4)	(5)
Dependent variables	CDS	CDSmean	Stock returns	σStock
2014Q3 * IGG	35.720	99.160**	-0.040	0.575*
	(22.491)	(42.996)	(3.712)	(0.290)
2014Q3 * IGG_SRM	42.424**	99.243**	-9.520**	0.811**
	(20.503)	(44.012)	(3.605)	(0.337)
Total assets	-433.283	-397.407	14.396	-2.316
	(334.293)	(236.676)	(14.842)	(2.075)
RoA	10.368	50.629**	4.573	-0.286
	(23.858)	(24.523)	(3.703)	(0.330)
CAR	-40.402***	-47.710***	1.065	-0.178
	(10.515)	(12.151)	(1.918)	(0.288)
Liquidity	0.695	-0.774	-0.338	-0.022
	(2.040)	(1.443)	(0.315)	(0.035)
GDP growth	-63.179**	-57.093**	-2.972*	-0.332
	(28.808)	(20.429)	(1.558)	(0.304)
Inflation	61.657	54.890*	-2.561	0.216
	(44.409)	(29.699)	(2.451)	(0.315)
Constant	11,954.495	11,099.705*	-341.261	61.497
	(8,941.708)	(6,356.837)	(370.464)	(51.933)
Observations	150	150	435	435
Number of banks	25	25	74	74
Adjusted R^2	0.304	0.546	0.284	0.091

Table F.12: OLS regressions with Fitch's Bank Support Rating (BSR)

This table presents OLS regression results with CDS spreads as dependent variables, modeled as a function of different bank ratings. Panel A captures the period from 2007-2013, and panel B the period from 2015 to 2017. All models include bank and time fixed effects. Standard errors are clustered at the bank level and reported in parenthesis. Significance levels are indicated by ***p < 0.01, **p < 0.05, *p < 0.1.

	(1)	(2)	(3)	(4)
Dependent variables	CDS	CDS	CDSmean	CDSmean
Panel A: 2007-2013				
BSR	-109.729***	-139.931***	-115.171***	-146.182***
	(36.140)	(25.720)	(36.438)	(25.326)
BCA	-34.714***	-57.118***	-34.524***	-57.528***
	(6.832)	(16.243)	(6.588)	(16.441)
BSR * BCA		5.571		5.720
		(3.457)		(3.488)
Constant	1,107.441***	1,191.225***	1,128.819***	1,214.847***
	(120.213)	(69.570)	(119.623)	(67.938)
Observations	3,279	3,279	3,279	3,279
Number of banks	49	49	49	49
R^2	0.577	0.585	0.593	0.601
Panel B: 2015-2017				
BSR	16.064*	-30.718*	16.766*	-28.813
	(8.548)	(18.008)	(8.550)	(18.186)
BCA	-39.975**	-58.304***	-42.058**	-59.916***
	(16.952)	(19.836)	(17.623)	(19.926)
BSR * BCA		3.848**		3.749**
		(1.619)		(1.624)
Constant	516.313***	725.967***	531.090***	735.354***
	(148.500)	(175.346)	(158.582)	(177.794)
Observations	1,973	1,973	1,973	1,973
Number of banks	49	49	49	49
R^2	0.158	0.171	0.162	0.174

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