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IMF STAFF DISCUSSION NOTE

Trade-offs in Bank Resolution

Giovanni Dell'Ariccia, Maria Soledad Martinez Peria, Deniz Igan, Elsie Addo Awadzi, Marc Dobler, and Damiano Sandri

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Trade-offs in Bank Resolution

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CONTENTS

EXECUTIVE SUMMARY 4

INTRODUCTION 5

I. KEY INSIGHTS FROM A SIMPLE MODEL 7

II. EMPIRICAL EVIDENCE 11

III. RESOLUTION FRAMEWORKS IN PRACTICE 24

IV. CONCLUSION 26

Figures

1. Optimal Resolution Framework as a Function of Spillover Intensity 9
2. Bank Size and Reaction to Events Altering Bail-out Expectations 14
3. Holdings of Bank Equity, Contingent Capital, and Bail-in-able Debt 23

Tables

1. Market Reaction to Bail-out Events 13
2. Borrowing Costs and Risk Metrics for Large versus Small Banks 15
3. Size and Risk Taking 16
4. Market Reaction to EU Bail-in Events 18
5. Market Reaction to US Bail-in Events 19
6. Reducing the Cost of Resolutions 25

Boxes

1. Fiscal Implications of Bail-outs 28
2. What Is Bail-in? 29
3. Resolution Regimes in Key Large Home Jurisdictions 30
4. Making Bail-in a Credible Policy Option for Systemic Banks 31
5. Good International Practice in Public Solvency Support 32

Appendix I. A Simple Model of Bail-ins and Bail-outs 33
Appendix II. Sample Coverage and Empirical Specifications 35
Appendix Table 1. Bail-in Events in Europe 38
Appendix Table 2. Bail-in Events in the United States 39

References 40

EXECUTIVE SUMMARY

During the global financial crisis, national authorities faced a steep policy trade-off in dealing with systemic bank failures. On the one hand, they knew bail-outs would reinforce expectations of future public support for distressed financial institutions. This could then undermine market discipline and lead to excessive risk taking—potentially seeding the ground for the next crisis. On the other hand, partly due to the absence of legal powers to resolve systemic failures through bail-ins, the use of public resources seemed necessary to prevent distress in one bank from spreading to others and becoming system-wide and to contain the economic and social costs of the crisis. Thus, in most cases, failing banks were bailed out. Most of the costs and risks were borne by taxpayers, sometimes to such a degree that the financial standing of the sovereign was threatened.

Since then, reforms have aimed to reduce the likelihood of crises and minimize costs should a crisis occur, including by shifting the burden to private investors and improving the trade-off between bail-outs and bail-ins. First, given the fiscal and moral hazard risks associated with government-funded resolution, the consensus is that bail-outs need to be the exception rather than the rule. With this objective in mind, reforms have aimed at formally delimiting the role of fiscal resources in the context of crisis resolution. Several countries have imposed strict conditions on the use of public funds in support of ailing banks and have introduced measures aimed at minimizing moral hazard. Second, new frameworks provide comprehensive powers to resolve a financial institution, including by bailing in private stakeholders (equity holders and unsecured and uninsured creditors). These include statutory bail-in powers, which enable resolution authorities to terminate or write down unsecured liabilities of failing banks and to convert claims of unsecured creditors into equity. The reforms have also sought to contain potential financial stability risks stemming from bail-ins by ensuring that banks (especially, large and complex ones) are subject to adequate loss-absorbing capacity requirements, and have aimed to make these banks more resolvable via effective resolution planning.

This note revisits the trade-off entailed in a policymaker's decision on the relative role of bail-ins of private stakeholders and public bail-outs. It does this by presenting an illustrative welfare-based and micro-founded model that juxtaposes the spillover effects from bail-ins and the moral hazard consequences of bail-outs. It also provides empirical evidence consistent with the existence of moral hazard effects associated with bail-outs and of spillovers associated with bail-ins. Finally, it discusses progress in shifting the burden of a crisis to private investors, strengthening resolution frameworks, and improving the bail-in/out trade-offs by enhancing resolvability and increasing loss absorbency.

The note supports the ongoing reform agenda to provide resolution authorities with effective bail-in powers and stresses that frameworks should aim at minimizing moral hazard associated with bail-outs. Nonetheless, it also emphasizes the need to allow for sufficient, albeit constrained, flexibility to be able to use public resources in the context of systemic banking crises—when spillovers are significant and deemed likely to severely jeopardize financial stability. Furthermore, the analysis calls for continued efforts to enhance loss-absorbing capacity, ensure that holders of bail-in-able debt are those best situated to absorb losses, and improve arrangements for cross-border resolution. This is essential to further boost the effectiveness of bail-in powers and contain the risk of spillovers.

INTRODUCTION

During the global financial crisis, governments in the United States and Europe resorted extensively to public bail-outs to prevent bank failures from destabilizing the financial sector and the economy. This strategy fueled strong public resentment against using scarce fiscal resources to rescue banks, especially given the fiscal consolidation efforts that followed. Furthermore, the use of bail-outs reignited the well-known debate about their moral hazard impact on the behavior of financial institutions. The perception that there would be few consequences for those responsible for the banks' losses reinforced this concern and public frustration about the handling of the crisis.

The academic literature and policy debate have long recognized that bail-outs entail a policy trade-off between ex ante and ex post efficiency. On the one hand, expectations of public financial support for distressed financial institutions may undermine market discipline and lead to excessive risk taking—essentially seeding financial vulnerabilities that may precipitate a crisis. Expectations of a bail-out may also trigger a leverage cycle, where lending standards are relaxed and leverage becomes too high in boom times and too low in crisis times (Geanakoplos 2010). On the other hand, in a crisis, the use of public resources to support the financial sector may sometimes be necessary to contain the effects of system-wide financial distress. A key question for policymakers is how to balance these two effects—where to position the system along the trade-off (how much to bail in and how much to bail out)—and how to improve the trade-off itself.

Against this backdrop, recent regulatory reforms and international standards on resolution have placed significant emphasis on reducing the need for and mitigating the risk of future bail-outs, including by improving the viability of bail-ins. Put differently, bail-outs need to become the exception rather than the rule. To this end, a new international standard—the Financial Stability Board's Key Attributes (KA) of Effective Resolution Regimes, issued in 2011—advocates for stronger resolution powers, available at early stages of distress, combined with better planning, resolvability assessments, and cross-border cooperation. The KA aim to make systemic financial institutions resolvable "without severe systemic disruption and without exposing taxpayers to loss. . ." while making "it possible for shareholders and unsecured and uninsured creditors to absorb losses." Bail-in powers, which enable resolution authorities to recapitalize financial firms by reducing the nominal value (that is, a "haircut") of bank liabilities or converting them into equity, are a key feature of the KA.

Resolution regimes that can allocate losses effectively among bank stakeholders through bail-ins are beneficial for several reasons. First, stakeholders that could be exposed to loss in the event of failure are likely to impose greater discipline on managers, thus reducing leverage and excessive risk taking. This should in turn reduce the likelihood that banks fail. Second, by recognizing the potential for loss and by calling for adequate loss-absorbing capacity, these frameworks may reduce the risk of systemic spillovers. Third, by clarifying ex ante how losses would accrue to private creditors in resolution, these frameworks may help address cross-border burden-sharing issues. Not least, they reduce the direct fiscal cost of the crisis and may weaken the feedback effects between sovereign and bank vulnerabilities (the "sovereign-bank nexus").

Reform efforts since the crisis have improved the trade-off between bail-ins and bail-outs by seeking to make bail-ins a credible option and bail-outs less likely. In some countries (especially in Europe), the default approach to handling distressed banks before the crisis was bail-outs, and this had fiscal and moral hazard costs. The reforms aimed to change this faulty approach and establish frameworks that allow for orderly bail-ins, while maintaining some flexibility to provide public funding to preserve financial stability and contain the macroeconomic consequences of a systemic crisis. Yet some fear that resolution reforms may have gone too far and overly restrict a government's ability to use fiscal resources when necessary (see, for instance, Geithner 2014). For example, a bail-in could create expectations for further bail-ins in other banks. This could undermine investor confidence even in healthy banks. Spillovers could also arise if those experiencing losses are forced to rebalance their portfolio and sell their claims on the initially nondistressed banks, threatening the stability of these other banks. The key feature of these spillovers is that they involve externalities that may not be fully priced by banks and private investors and therefore provide a rationale for policy intervention.

In this note, we examine the economic forces that determine the relative costs and benefits of bail-ins and bail-outs. We use the term "bail-in" in a generic sense, as the ability of resolution authorities to impose losses on private stakeholders in order to recapitalize a failing bank. Bail-in-able claims comprise equity and unsecured and uninsured liabilities with certain features. We use "bail-out" to refer to the ability of governments to provide public funds to restore the solvency of banks. We consider a model that provides a framework to assess under what circumstances losses may need to be borne by the public sector rather than private investors. The answer crucially hinges on the trade-off between the moral hazard costs associated with bail-outs and the potential spillovers arising from bail-ins. We then examine the pre-reform trade-off by presenting empirical evidence on these costs and spillovers. By reviewing the literature and performing some new analysis, we confirm that the expectation of bail-outs lowers funding costs and, in some instances, generates greater risk taking. We assess the extent of spillovers by looking at pre-reform events during which bank stakeholders suffered losses and find evidence consistent with financial spillovers, though we recognize that the evidence lends itself to alternative interpretations. Finally, we discuss the progress made under the reformed frameworks to improve the bail-in/out trade-offs.

The key takeaways from the note are as follows:

- Recent regulatory reforms have improved the trade-off between bail-ins and bail-outs. Effective resolution frameworks (as contemplated by the KA) are likely to reduce the potential spillovers from bail-ins. Better-defined constraints on the use of public funds have likely reduced the expectation of future bail-outs and the associated potential for moral hazard. Greater loss-absorbing capacity has reduced the probability of financial distress.
- Bail-outs should be the exception not the rule—their use justified as a last resort, exclusively when financial stability is gravely threatened, and structured to mitigate the associated costs. They should occur only alongside loss sharing with private stakeholders of the troubled bank and time-bound restructuring plans that address the underlying weaknesses and help restore the bank's long-term viability.

- Yet the framework should allow for the use of some public funds, with appropriate safeguards, during systemic crises if and when this is necessary to protect financial stability. Public funds may be needed if imposing extensive losses on private stakeholders would unleash large spillovers. In these exceptional cases, the moral hazard and fiscal costs of bail-outs would be preferable to the disruptive effects that spillovers associated with bail-ins could have on financial stability and the economy at large.
- To further reduce the recourse to bail-outs, policymakers should continue ongoing efforts to enhance resolvability and minimize the risk that bail-ins may result in large spillovers. Further clarifying which financial instruments can be subject to bail-in and increasing the loss-absorbing capacity of major financial institutions is key. Regulation should ensure that holders of loss-absorbing capacity in banks are those most capable of understanding and absorbing losses with a low risk of transmitting further shocks to the financial system and the economy. Furthermore, more progress is needed to improve cross-border resolution aspects.

The rest of this note is structured as follows. Section I presents the theoretical model. Section II discusses the empirical evidence. Section III provides a brief discussion of the recent reforms to enhance resolution frameworks. Section IV concludes.

I. KEY INSIGHTS FROM A SIMPLE MODEL

To gain clear insights into the optimal use of bail-ins and bail-outs, we develop a simple banking model that builds on Sandri 2015 and Cordella, Dell'Ariccia, and Marquez 2016. This section provides an overview of the model and presents its key implications; we refer the reader to Appendix I for the formal details.

The model features a continuum of banks that are heterogeneous in size. Banks raise deposits and issue debt to finance loans. Loan repayments are subject to both idiosyncratic and aggregate shocks. Banks can increase the likelihood that loans are repaid by exercising a costly monitoring effort that can be interpreted as an inverse measure of risk taking. They choose the level of monitoring to maximize expected profits. Thanks to limited liability, banks are not responsible for losses beyond their capital buffer. Losses exceeding capital are covered with a bail-in of private creditors, a public bail-out, or a combination of the two.[1]

The key feature of the model is that bail-ins may entail systemic spillovers; that is, they may impose negative externalities on society at large in addition to the losses borne by the bank's stakeholders. These externalities are modeled in reduced form, possibly proportional to the total size of bail-ins in the banking sector. They can involve bankruptcy costs, heightened macro-financial uncertainty, and a deterioration of the economic outlook. In practice, spillovers can spread through several channels. They can operate mechanically through balance sheet transmission, whereby a bail-in can jeopardize the solvency of exposed stakeholders and trigger bankruptcy chains. Or a bail-in

[1] The combination or mix of bail-ins and bail-outs can be interpreted as corresponding in practice to burden sharing, where part of the losses is borne by private stakeholders and the remaining part is assumed by the government and, ultimately, taxpayers.

can act as a wake-up call and lead to a sudden reassessment of bank risk. This can in turn undermine banks' market access and have negative repercussions for credit supply and GDP. The strength of spillovers varies across time and depends on broader economic and financial conditions, including the amount and structure of loss-absorbing capacity. For example, bail-in of a midsize bank may entail no spillovers if it happens during an economic upswing, but may become destabilizing if it occurs at a time of severe distress in the banking sector. The strength of spillovers may also vary across countries, reflecting different macro-financial and institutional characteristics. For instance, countries with more developed or larger financial sectors may be prone to spillovers due to greater interconnectedness across institutions and stronger macro-financial linkages.

Whereas bail-ins can be socially costly due to spillovers, bail-outs entail costs as well. The model recognizes that bail-outs may have administrative fixed costs (for example, operating a program of government investment and divestment). Bail-outs also involve fiscal costs and may threaten sovereign debt sustainability. The model leaves aside this aspect since bail-ins can also have fiscal consequences when spillovers endanger output and fiscal revenues. Box 1 shows that assessing net fiscal costs of bail-outs based on up-front outlays may be misleading because mitigating the output effects of a financial crisis can prevent even bigger tax revenue losses.

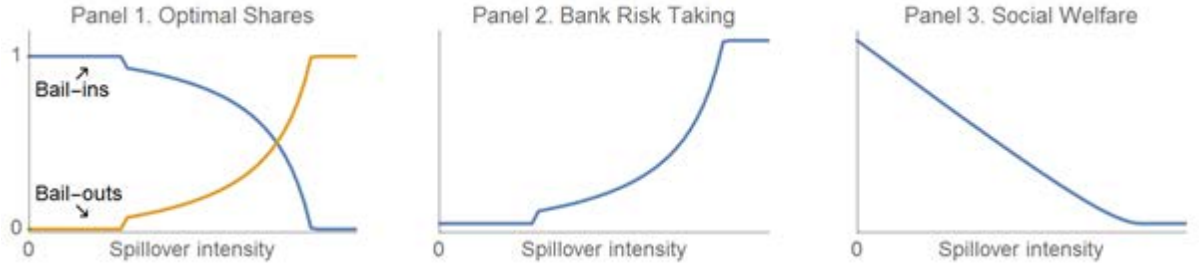
Crucially, the model emphasizes that bail-outs generate moral hazard by leading to insufficient monitoring by banks; that is, to excessive risk taking. This can occur through two main channels. First, bail-outs can undermine market discipline. When bank stakeholders expect to be bailed out, they do not penalize banks for taking on excessive risk by charging higher interest rates on their liabilities.[2] By weakening market discipline, the expectation of bail-outs can also lead to higher leverage, possibly magnifying dangerous leverage cycles (Geanakoplos 2010; Adrian and Shin 2014). This can further increase risk taking because of a stronger risk-shifting motive: due to limited liability, the bank neglects the losses associated with its default, so that it finds it optimal to exercise less monitoring the more leveraged it is. Second, bail-outs can generate moral hazard by providing transfers to bank shareholders and managers. For example, this can happen if bail-outs prevent the ousting of bank management or preserve equity values. Then, by providing some compensation even in the case of large losses, bail-outs promote risk taking.[3]

In designing a framework to address bank losses through bail-ins or bail-outs, policymakers need to carefully consider the relative costs of these two instruments. Specifically, the model highlights the key trade-off between the possible spillover effects associated with bail-ins and the moral hazard consequences and fixed costs of bail-outs. Figure 1 illustrates the model implications about how an optimal resolution approach should depend on the intensity of spillovers. The figure shows how losses exceeding bank capital should be covered through bail-ins and bail-outs (panel 1), the implications for bank risk taking (panel 2), and the consequences for social welfare (panel 3).

[2] This argument hinges on the assumption that bank stakeholders can observe how much risk the bank is taking. If they cannot, say, because of the complexity of a bank's operations, they cannot penalize additional risk taking by proportionally raising funding costs. So, market discipline is absent. Bail-outs then merely reduce funding costs by lowering or eliminating the risk of bail-ins. In turn, this increases the bank's franchise/charter value, thus strengthening incentives for prudent risk management. See Section II for more on this counterargument.

[3] Careful bail-out design could mitigate this effect. See Box 5.

Figure 1. Optimal Resolution Framework as a Function of Spillover Intensity



Consider first the optimal resolution approach in the absence of spillovers. In this case, bail-ins entail no social welfare costs since they simply reallocate losses from the bank to its creditors without imposing externalities. By contrast, bail-outs are costly not only due to fixed costs but also because they generate moral hazard and increase risk taking. So when spillovers are not a concern, it is best to avoid bail-outs and absorb losses entirely through bail-ins.

When instead spillovers are present, bail-ins are socially costly since they not only involve a transfer of losses from the bank to its creditors but also impose negative externalities on society at large. In choosing whether to absorb bank losses with bail-ins or bail-outs, it is crucial to trade off these externalities with the moral hazard consequences of bail-outs. When spillovers are relatively small, it is preferable to suffer their consequences than generate moral hazard by providing bail-outs.

If spillovers are instead severe, bail-outs become more justified, possibly entirely replacing bail-ins in exceptional cases. Panel 2 shows that such a large use of bail-outs has the potential to generate serious moral hazard by increasing risk taking. Nonetheless, when spillovers are particularly severe; for example, when an aggregate shock triggers a systemic banking crisis, it is preferable to tolerate the consequences of moral hazard than suffer the destabilizing effects associated with bail-ins.

These insights call for a resolution framework that allows use of public funds if and when the risks to macro-financial stability from bail-ins are exceptionally severe. Embedding the option to use public funds in such exceptional cases completes the framework and also makes it more resilient to the issues that may arise in practice (see below and Section III for more on this point).

The model provides three additional insights. First, even if bail-ins and bail-outs are used optimally in line with the model prescriptions, social welfare is declining as spillovers become more severe (panel 3). It is therefore crucial for policymakers not only to tailor bank resolution to the extent of spillovers, but also to design resolution regimes that can reduce the potential for spillovers in the first place.[4] This agrees with recent reform efforts to enhance the resolvability of large and complex financial institutions via effective resolution powers and planning and adequate loss-absorbing capacity. Furthermore, spillovers can be contained by restraining cross holding of bank debt within the financial sector and applying enhanced prudential standards to financial institutions that are too systemic to fail. Ample liquidity provision is also essential to contain the risk of spillovers, even though at times of severe financial distress it is often difficult to ascertain whether a financial institution is confronting a liquidity or solvency crisis. Finally, authorities should be mindful of

[4] Measures to reduce spillovers should be designed in a way that does not impair risk sharing. For example, blunt restrictions on interbank linkages may backfire by undermining risk and funding diversification.

financial institutions' perverse incentives to become more systemic to benefit from future bail-outs. This can occur both at the level of individual banks that may try to become more systemic—for example, by increasing their balance sheets despite weak lending opportunities—or at the level of the whole banking sector, for example, as banks correlate their exposures to increase systemic risk (Schneider and Tornell 2004; Farhi and Tirole 2012).

Second, the model shows that when spillovers are relatively weak, the use of bail-outs should be restrained. This raises a time-consistency problem. Policymakers may pledge ex ante to limit bail-outs and use them only when spillovers are high. But, once bank failures occur, they may be tempted to use them if spillovers exceed the fixed costs of bail-outs, neglecting the moral hazard effects. To contain this time-consistency problem, it is imperative to put in place a resolution framework that induces policymakers to rely on bail-ins when systemic concerns are absent or moderate, and have a transparent approach for determining "systemic-ness." [5] Importantly, frameworks that induce the use of bail-ins should be credible. Otherwise investors and banks may still expect to be bailed out, while being in fact bailed in during a crisis. This is a very dangerous scenario since it entails both moral hazard costs and spillover effects.

Third, the model can also be used to analyze the role of leverage limits. By boosting capital ratios, these limits reduce the likelihood that banks will face capital shortfalls and thus require socially costly bail-ins or bail-outs. This benefit should be traded off, however, against the possible negative effect of leverage limits on credit supply. Also noteworthy is that leverage limits reduce the moral hazard effects of bail-outs since they lower the likelihood that a bank will benefit from them. This improves the trade-off policymakers face and may provide more room to use bail-outs if needed.

Four additional considerations may be relevant when it comes to deciding between bail-ins and bail-outs, but they are not explicitly captured in the model. First, the case for bail-outs may seem weaker if the sovereign faces debt sustainability problems because of the fiscal costs involved. But, this concern must be weighed against the risk that the spillovers from bail-ins could themselves endanger the fiscal position by lowering GDP and tax revenues. Therefore, whether fiscal concerns should tilt the balance against bail-outs or bail-ins depends again on the strength of the spillovers.

Second, since banks most likely to receive bail-outs benefit from lower funding costs, they enjoy a competitive advantage relative to others. This can generate significant distortions within the banking sector, possibly leading to inefficient credit allocation and positions of market power. To level the playing field, policymakers may thus consider imposing capital surcharges on those institutions that are more likely to benefit from bail-outs. Further, levies could be imposed on a resolution fund (where one exists) to mitigate bail-out benefits for large banks.

[5] We use the term "systemic-ness" not necessarily in the context of individual financial institutions but also to encompass situations that may raise systemic concerns (for example, clustered failures of many small banks). A sound financial stability assessment framework is critical in making this determination. Such determination could be made based on the growing toolkit to assess systemic risk (see, for instance, IMF-BIS-FSB 2009 and Blancher and others 2013).

Third, the model neglects potential implementation costs and challenges associated with bail-ins (Avgouleas and Goodhart 2015). For example, the bail-in process may be time demanding and subject to legal challenges, especially in the context of cross-border resolution. Moreover, bail-ins may face political opposition if they entail the transfer of bank ownership to foreign investors. Last but not least, the extent of state ownership of the banking sector, depth of financial markets, and availability of sophisticated private investors that can absorb the losses could affect the trade-off a country may find itself facing.

Finally, the model considers the trade-offs from the point of view of a single policymaker. In some cases, multiple policymakers from different jurisdictions or a college of policymakers would be involved. For instance, in a currency union, one member state's bail-out could affect its public debt and may raise the perception that banks in other member states would also be bailed out in the event of trouble. Then, what may seem optimal based on purely domestic considerations may end up shifting risks and vulnerabilities to other countries. This points to the importance of cross-border aspects of resolution frameworks, which are discussed in Section III.

II. EMPIRICAL EVIDENCE

The discussion so far has highlighted the theoretical pros and cons of bail-ins and bail-outs. These are based on assumptions—moral hazard effects of bail-outs and spillover risks of bail-ins—that we seek to verify in this section. We rely largely on the existing literature but present new evidence where needed. Appendix II provides information on the details.

A critical caveat to consider is the fact that resolution frameworks explicitly featuring statutory bail-in powers are new and have not yet been fully tested. Furthermore, adequate loss-absorbing capacity in sufficient quality and quantity is not yet in place. This hinders the feasibility of direct comparisons of costs and benefits of bail-ins and bail-outs in today's regulatory environment. Rather, this section focuses on the trade-offs policymakers faced at the time of the crisis. Consistent with this, we use a broad definition of bail-in encompassing potentially any resolution that imposed losses on private stakeholders. Despite these limitations, we believe the empirical analysis presented can be useful in considering the trade-offs entailed. As reforms since the crisis have likely reduced the spillovers stemming from bank resolution, the estimates could be considered an upper bound for the spillover effect associated with bail-ins in the current environment.

Do bail-outs entail moral hazard?

From a theory perspective, it is ambiguous whether bail-outs motivate banks to behave less or more responsibly. On the one hand, bail-outs encourage risk taking in a classic moral hazard interpretation. If bank managers and shareholders know that they will not have to bear the full consequences of the risk they are taking when negative outcomes are realized, they have stronger incentives to take on more risk. Moral hazard also weakens the incentives of shareholders, creditors, and depositors to discipline banks. Less monitoring and underpricing of risk may, in turn, result in riskier portfolios and higher leverage. On the other hand, there is also an argument in the literature that bail-outs may result in higher franchise/charter values because they reduce funding

costs and, hence, discourage risk taking (Sarin and Summers 2016).[6] The lower rates promised to creditors/depositors increase payoffs, conditional on success, to managers/shareholders (as residual claimants). This enhances their incentives to choose safer portfolios.

It is an empirical question whether the former effect—banks take on more risk because they don't have to bear all the losses—or the latter—banks take less risk because bail-outs help them boost their charter values—dominates.[7] The evidence is far from clear-cut: the expectation of bail-outs does seem to reduce funding costs, but it is unclear if this results in higher or lower risk taking.

Indirect evidence on the effects of bail-outs is provided by cross-country studies that analyze the system-wide association between government guarantees and risk taking—and, ultimately, financial system fragility. Using deposit insurance, government ownership, and bank concentration as proxies for the scope of the public financial safety net,[8] some report destabilizing effects (Caprio and Martinez Peria 2002; Demirguc-Kunt and Detragiache 2002), while others find no significant impact or even a stabilizing effect (Barth, Caprio, and Levine, 2004; Beck, Demirguc-Kunt, and Levine 2006). The mixed findings can in part be attributed to differences in controlling for factors such as charter values and institutional quality. If banks earn rents through limits on competition, relationship lending, or reputation building, the effects of the public financial safety net on risk taking may be mitigated because these rents increase charter value and lower moral hazard (Gropp and Vesala 2004). If there is strong contract protection/regulation/supervision and low corruption, incentives and opportunities for excessive risk taking may be reduced (Hovakimian, Kane, and Laeven 2003). The macro-financial backdrop also plays a role: guarantees induce risk taking in tranquil times but dissuade it during crises (Anginer, Demirguc-Kunt, and Zhu 2014). One interpretation is that, by shielding banks from macroeconomic and contagion risks, guarantees increase charter values and reduce risk taking.

With the recognition that cross-country studies may suffer from endogeneity problems, we turn to studies that exploit banks' varying likelihood of benefiting from bail-outs. Moral hazard effects, if present, should be particularly visible for larger financial institutions—which expect or are perceived as more likely to be bailed out. The literature shows that large banks indeed benefit from lower borrowing costs and credit default swap (CDS) spreads.[9] Since the crisis, the funding advantage of large banks—the too-big-to-fail subsidy—has been reduced but not eliminated (IMF

[6] Franchise value is defined as the present value of the stream of profits that a firm is expected to earn as a going concern. In banking, given the important role of regulation, charter value—the present value of being able to continue to do business in the future and earn rents in a highly regulated environment with high barriers to entry—is often used synonymously with franchise value (Demsetz, Saidenberg, and Strahan 1996; Furlong and Kwan 2006).

[7] The model in Section I assumes that the former effect dominates to illustrate the trade-off between moral hazard costs of bail-outs and spillover effects of bail-ins. Also note that the literature is mostly based on guarantees (in many cases for depositors), which are distinct from bailing out equity holders or managers.

[8] The reasoning for the last proxy is that an individual bank is more likely to be systemically important in a concentrated than in a dispersed sector and, thus, more likely to benefit from public support measures.

[9] See Acharya, Anginer, and Warburton 2014; Ueda and Weder di Mauro 2013; GAO 2014; and Santos 2014 for evidence of the funding advantage enjoyed by large banks. Kroszner 2016 provides a thorough and critical review of the literature.

(continued)

2014a; GAO 2014). But many studies focus on the gross subsidy. It is plausible that the subsidy net of the higher regulatory costs now faced by larger banks—including enhanced capital and liquidity requirements and closer supervision—is lower today.[10]

To provide stronger evidence that the lower funding costs enjoyed by large banks are linked to the expectations of bail-outs, we look at how funding costs change around episodes that affect the likelihood of bail-outs. Concretely, we look at the change in CDS spreads and equity prices following the failure of Lehman Brothers and the passage of the Emergency Economic Stabilization Act of 2008—which established the Troubled Asset Relief Program (TARP)—as well as the beginning of the European bail-outs, distinguishing large banks from small banks.[11] We assume that the first of these events—the Lehman bankruptcy—sent a signal that policymakers' appetite for bail-outs was low. The latter two would signal the opposite. Figure 2 presents the raw data of daily changes in spreads and prices. As anticipated, large banks suffered more than small banks with the Lehman failure—consistent with a decline in their funding cost advantage—and enjoyed better outcomes when TARP was approved as well as when Dexia was recapitalized. Importantly, these relationships survive in an event-study setup (Table 1). In fact, when changes are calculated controlling for market benchmarks, the relationship between size and equity returns is statistically significant and positive in the European event as well, while the reaction in CDS spreads is still insignificant.[12]

Table 1. Market Reaction to Bail-out Events

Panel 1. Cumulative Abnormal Changes in the Cross Section of CDS spreads

	(1)	(2)	(3)	(4)	(5)	(6)
	Lehman	Lehman	TARP	TARP	Dexia	Dexia
Size	4.147*	2.816	-8.641***	-5.723*	-1.394	0.086
	(2.405)	(3.650)	(2.588)	(3.061)	(2.007)	(2.233)
Constant	-36.62	-28.82	94.21***	133.8***	20.00	5.016
	(29.12)	(48.92)	(30.93)	(41.03)	(26.03)	(29.93)
Observations	79	79	79	79	79	79
R squared	0.331	0.295	0.478	0.621	0.454	0.500
Country FE	NO	YES	NO	YES	NO	YES

Panel 2. Cumulative Abnormal Changes in the Cross Section of Equity Prices

	(1)	(2)	(3)	(4)	(5)	(6)
	Lehman	Lehman	TARP	TARP	Dexia	Dexia
Size	-1.565**	-0.536**	2.033***	2.412**	1.651***	2.014***
	(0.678)	(0.233)	(0.549)	(0.916)	(0.426)	(0.499)
Constant	18.68*	-28.52***	-14.63*	-43.96***	-10.47*	-28.30***
	(9.934)	(2.728)	(7.359)	(10.72)	(5.695)	(5.844)
Observations	461	461	461	461	461	461
R squared	0.586	0.581	0.464	0.494	0.454	0.511
Country FE	NO	YES	NO	YES	NO	YES

Sources: Bloomberg Finance L.P.; SNL Financial; Thomson Reuters Datastream; and IMF staff calculations.

Note: Cumulative abnormal CDS spread and equity price changes are computed over a seven-day (t−3 to t+3) event window for TARP and Dexia and a four-day (t to t+3) event window for Lehman, defined relative to the bail-out event date (t), over 2008:Q1–2016:Q3. Bail-out event dates are recorded on September 15, 2008 (Lehman bankruptcy), October 30, 2008 (TARP passage), and September 30, 2008 (Dexia capital injection). Size is the log of total assets. Standard errors clustered at the country level are displayed in parentheses; statistical significance at the 10 percent, 5 percent, and 1 percent levels is denoted by *, **, and ***, respectively. For sample coverage and further details on the empirical analysis, see Appendix II.

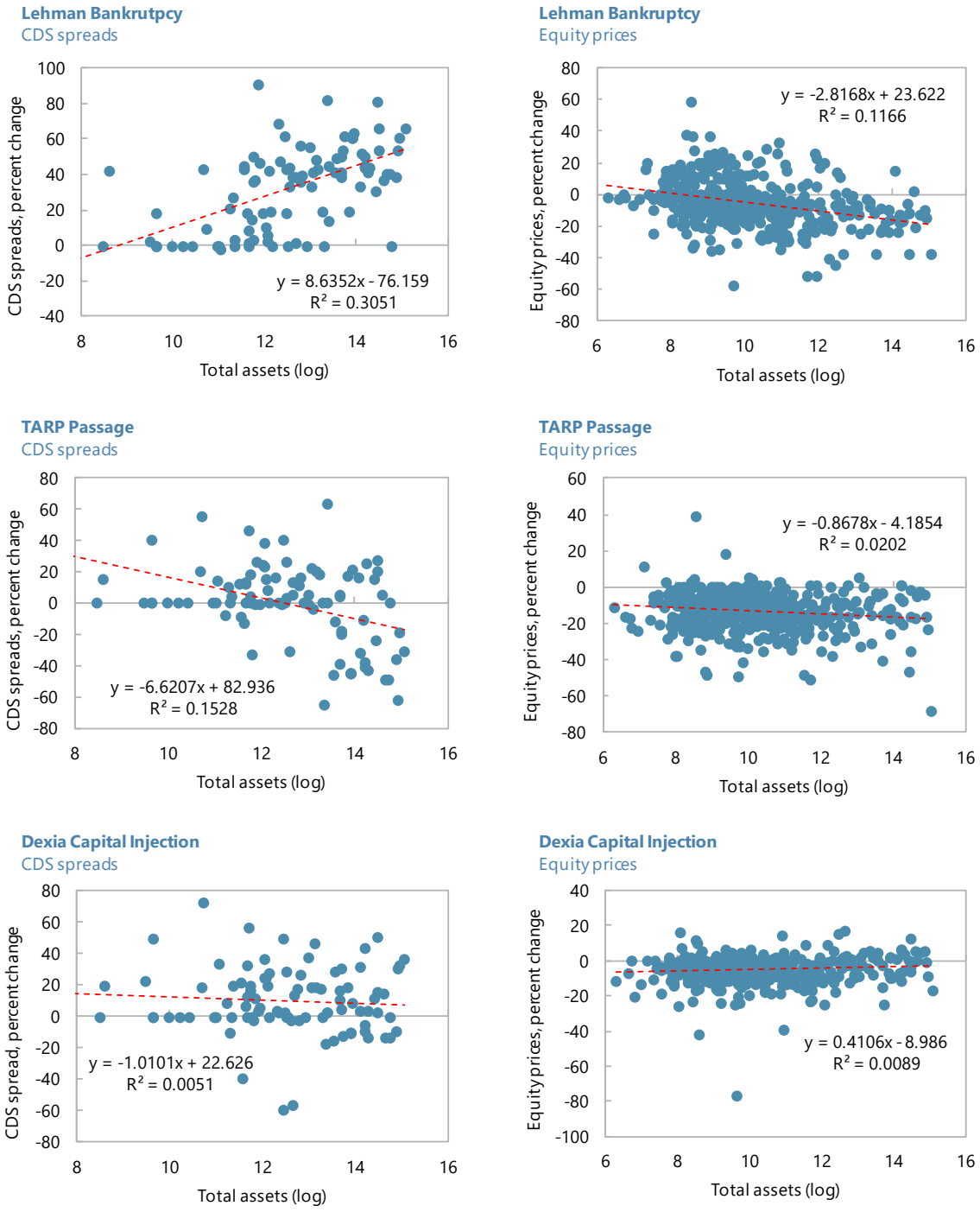
Whether lower funding costs due to bail-outs translate into more risk taking is not clear-cut. Using mainly precrisis data, some studies

[10] A net subsidy may still exist if market perceptions of bail-out probability have not changed yet. See Elliott 2014 for further discussion.

[11] The event we use for Europe is the capital injection to Dexia in September 2008. There were other events between October and December of the same year involving government interventions (capital injections and asset/debt guarantees) in other European banks (see Fratianni and Marchionne 2013 for a list). The key insights from examining these are similar. Note that comparing the failure of Lehman Brothers to the recapitalization of Dexia (and others) is difficult, given the systemic nature and shock value of the former.

[12] This insignificance may be due to pooling the banks located in the country where the event took place with those in other countries. To explore this, we split the sample and execute the event studies separately for US and non-US banks in the Lehman and TARP events and for EU and non-EU banks in the Dexia event. The findings are comparable to those obtained in the pooled sample: even though they are smaller in magnitude, the coefficient on bank size has the same sign and is statistically significant in the subsamples of non-US and non-EU banks.

Figure 2. Bank Size and Reaction to Events Altering Bail-out Expectations



Sources: Bloomberg Finance L.P.; Thomson Reuters Datastream; and IMF staff calculations.
Notes: Daily changes in spreads and prices around the events affecting bail-out expectations are shown. The event dates are recorded as September 15, 2008 (Lehman bankruptcy), October 30, 2008 (TARP passage), and September 30, 2008 (Dexia capital injection). For sample coverage and further details on the empirical analysis, see Appendix II.

show that larger banks take on larger positions on riskier loan segments, greater reliance on riskier funding, lower buffers against potential loan losses, and greater loan losses after a shock).[13]

Examination of our sample covering a set of global banks since 2008 gives some indication that large and small banks respond differently to a bail-out event: large banks increase risk taking while small ones decrease it (see Black and Hazelwood 2012 for a similar finding). This is, however, not robust across specifications. The evidence on whether large banks take on more risk in general is similarly mixed: large banks tend to have less core capital to total assets relative to risk-weighted assets—pointing to riskier portfolios—but also higher distance-to-default and lower nonperforming loan ratios (Table 2).[14] Of course, plotting various indicators against a proxy for bail-out probability does not account for other factors that may be at play. Yet regressions controlling for bank characteristics and fixed effects paint a similar picture: not all risk-taking measures point in the same direction (Table 3).[15] A possible explanation is that tighter postcrisis supervision has prevented large banks from taking excessive risk.[16]

Table 2. Funding Costs, Risk, and Profitability in Large versus Small Banks

	Obs.	Mean	Std. Dev.	Min.	Max.
Large Banks					
CDS spread	2,361	157.7	144.0	5.9	1623.0
Senior unsecured spread	101	169.0	150.5	13.1	901.8
Subordinated spread	108	350.6	164.8	45.4	860.9
CoCo spread	411	581.2	248.9	159.4	1837.8
Z-score	1,044	3.9	0.9	1.6	7.9
Tier 1 ratio	1,426	11.7	2.8	6.7	26.4
Leverage ratio	936	9.1	13.1	2.8	71.7
NPL ratio	959	3.2	3.1	0.0	21.4
ROA	1,209	0.5	0.6	-2.8	2.4
ROE	1,223	9.1	8.4	-36.7	30.0
Small Banks					
CDS spread	1,240	183.0	166.3	1.2	1698.7
Senior unsecured spread	41	181.9	165.0	20.1	641.7
Subordinated spread	18	322.5	122.7	215.6	667.6
CoCo spread	137	667.3	290.8	146.1	2050.6
Z-score	10,741	3.6	1.0	-2.4	6.0
Tier 1 ratio	11,699	12.4	3.2	6.7	27.9
Leverage ratio	10,856	12.8	16.6	2.7	82.0
NPL ratio	11,010	3.5	4.9	0.0	85.4
ROA	12,609	0.9	0.8	-2.8	3.6
ROE	12,540	9.2	7.5	-35.9	34.9

Sources: Bloomberg Finance L.P.; SNL Financial; Thomson Reuters Datastream; and IMF staff calculations.

Note: Large banks are defined as those with assets in the top percentile. CoCo refers to contingent convertible bonds. *Z*-score is computed as equity capital ratio plus return on assets divided by the standard deviation of return on assets (calculated over a rolling window of 10 quarters). Tier 1 ratio is defined as the ratio of Tier 1 capital to risk-weighted assets, and leverage ratio is defined as the ratio of Tier 1 capital to total tangible assets. NPL ratio is the ratio of nonperforming loans to total loans. ROA is return on average assets and ROE is return on average equity. For sample coverage and further details on the empirical analysis, see Appendix II.

The impact of bail-outs on funding costs and risk taking is analyzed also in a series of recent studies using German data that allow for better identification. Some find a positive link between bail-out expectations—predicted using regional political factors—and probability of distress (Dam and Koetter 2012). Furthermore, in a natural experiment

[13] See, among others, Boyd and Gertler 1994; Hovakimian and Kane 2000; and Schnabel 2009 for evidence of excessive risk taking by large banks. In addition to having higher stand-alone risks, large banks contribute more to systemic risk. See Laeven, Ratnovski, and Tong 2016 and the references therein.

[14] Large banks may extend riskier loans on an individual basis, but this may not be reflected in a riskier loan portfolio or balance sheet because of greater diversification. Empirical support for such an effect of diversification on bank risk, however, is limited: better diversification resulting from larger size can generate both scale economies and risk-taking incentives (Hughes and Mester 2013), and large banks may use their diversification advantage to operate with lower capital ratios and pursue riskier activities (Demsetz and Strahan 1997).

[15] Based on a comparison of return on assets and return on equity between large and small banks, there is no obvious sign of potential charter-value effects (Table 2). Controlling for bank and time fixed effects (and a measure of bank risk) reveals a positive, albeit not robust, relationship between bank profitability and size (Table 3). This is in line with findings reported elsewhere (see, for instance, Goddard, Molyneux, and Wilson 2004).

[16] Recent research argues that the relationship between bank size and risk taking changed in the aftermath of the crisis—as did the relationship between bank size and funding cost advantage. See, for instance, Bhagat, Bolton, and Lu 2015, who report that the positive correlation between total assets and *z*-scores breaks down in 2010–12.

Table 3. Size and Risk Taking

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Z-score	*Z*-score	Tier 1 ratio	Tier 1 ratio	Leverage ratio	Leverage ratio	NPL ratio	NPL ratio	ROA	ROA	ROE	ROE
Size	-0.1481***	-0.1348***	-3.1073***	-1.7066***	-0.9142***	-0.6241***	-1.6868***	-0.5621***	0.6799***	0.0275	7.9816***	0.2720
	(0.0238)	(0.0220)	(0.3982)	(0.2557)	(0.3459)	(0.1424)	(0.5101)	(0.1991)	(0.1099)	(0.0370)	(1.4334)	(0.3393)
Loan ratio	-0.0059***	-0.0061***	-0.1233***	-0.1344***	0.0312**	0.0194**	-0.0139	-0.0089	0.0164***	0.0004	0.2060***	-0.0098
	(0.0012)	(0.0011)	(0.0250)	(0.0223)	(0.0134)	(0.0097)	(0.0201)	(0.0143)	(0.0044)	(0.0031)	(0.0559)	(0.0321)
Deposit ratio	-0.0001	0.0000	-0.0245	-0.0275*	-0.0161	-0.0180**	-0.0024	0.0059	0.0201***	0.0119***	0.2111***	0.1401***
	(0.0011)	(0.0011)	(0.0189)	(0.0165)	(0.0104)	(0.0082)	(0.0229)	(0.0175)	(0.0044)	(0.0037)	(0.0567)	(0.0384)
Z-score									3.6889***	1.1025***	43.9870***	9.8422***
									(0.2904)	(0.1382)	(3.8339)	(1.2880)
Observations	11,259	11,259	12,317	12,317	1,762	1,762	12,145	12,145	11,242	11,242	11,183	11,183
R squared	0.160		0.172		0.263		0.070		0.365		0.310	
Number of banks	583	583	634	634	312	312	634	634	584	584	581	581
Bank FE	YES		YES		YES		YES		YES		YES	
Quarter FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE		YES		YES		YES		YES		YES		YES

Sources: Bloomberg Finance L.P.; SNL Financial; Thomson Reuters Datastream; and IMF staff calculations.

Note: Size is the log of total assets. Loan ratio refers to gross loans in percent of total assets. Deposit ratio refers to total deposits in percent of total assets. *Z*-score is computed as equity capital ratio plus return on assets divided by the standard deviation of return on assets (calculated over a rolling window of ten quarters). Tier 1 ratio is defined as the ratio of Tier 1 capital to risk-weighted assets, and leverage ratio is defined as the ratio of Tier 1 capital to total tangible assets. NPL ratio is the ratio of nonperforming loans to total loans. ROA is return on average assets and ROE is return on average equity. Standard errors are displayed in parentheses; statistical significance at the 10 percent, 5 percent, and 1 percent levels is denoted by *, **, and ***, respectively. For sample coverage and further details on the empirical analysis, see Appendix II.

where government guarantees for savings banks were removed due to litigation, banks that lost their guarantees are shown to cut off the riskiest borrowers, adjust their liabilities away from risk-sensitive debt instruments, and see their bond yield spreads increase (Gropp, Gruendl, and Guettler 2014). However, others report that capital support—instrumented by exploiting geographically driven differences in insurance and acquisition frameworks across Germany—reduces bank risk taking as well as lending (Berger and others 2016).[17]

A growing body of literature on the US experience with TARP arrives at mixed conclusions. Some argue that banks receiving government funds shifted to riskier segments within the same asset class, resulting in increased volatility and default risk, despite improved capital ratios (Duchin and Sosyura 2014). Others deliver a more nuanced message that weak banks—those with low charter values and high leverage—increased risk taking, but strong banks—those with high charter values and low leverage—decreased it (Schenk and Thornton 2016) and that TARP reduced systemic risk, especially in larger, safer banks located in economically stronger areas (Berger, Roman, and Sedunov 2016).

Analysis using changes in bank ratings to gauge the perceived likelihood of government support suggests that nuances exist through time in addition to across banks: higher bail-out probabilities result in higher risk taking in tranquil periods but in less risk taking when there is a crisis (Damar, Gropp, and Mordel 2012).[18] This is consistent with the argument that the charter value effect may dominate when the economy is hit by a systemic shock and contagion risk is high.

[17] They interpret this as support for the theory showing that capital reduces moral hazard (Morrison and White 2005) and strengthens banks' monitoring incentives (Allen, Carletti, and Marquez 2011; Mehran and Thakor 2011).

[18] In October 2006, Dominion Bond Rating Service introduced a change to its rating system to explicitly account for the potential of government support. This led to rating changes that were not a result of changes in the respective banks' credit fundamentals. Damar, Gropp, and Mordel (2012) exploit this natural experiment.

When interpreting the mixed evidence, it is also important to consider that the moral hazard effects of bail-outs might be attenuated by the fact that banks that are more likely to receive government support might be subject to tighter scrutiny by supervisors and regulators. In this respect, the postcrisis regulatory changes (for example, leverage ratios) may have helped limit risk taking by systemically important financial institutions in the presence of implicit and explicit government guarantees. While it is too early to judge, existing evidence on the role played by regulation and governance in determining risk taking (Laeven and Levine 2009) supports cautious optimism.

Do bail-ins entail systemic spillovers?

We now turn to the spillovers associated with bail-ins before the regulatory reforms. Since these reforms have likely reduced the magnitude and scope of these spillovers, the evidence should be read as a rationale for the reforms, rather than as an estimate of potential spillovers under the new resolution frameworks (see Section III and Box 3). We consider whether, during the crisis and in its aftermath, bail-in of a financial institution led to a repricing of (bail-in-able) unsecured debt and equity of other banks. Providing an accurate measure of the extent of spillovers is, however, an arduous task for several reasons.

On the one hand, the analysis may underestimate the extent of spillovers because the decision to impose losses on unsecured creditors is endogenous: aware of the possible spillovers, policymakers may use bail-outs rather than bail-ins in the context of a systemic crisis or failure of a large, complex, interconnected institution. Further, there have been very few events during which bail-in of private stakeholders has not been combined with (or has not been a precondition for) injection of public funds, thus containing the potential for spillovers.

On the other hand, comovement in bank equity and bond prices may not accurately reflect the kinds of spillovers highlighted in the model that are relevant for the bail-in/out trade-off (for example, those due to fire sales or a sudden shift to a worse equilibrium driven by heightened risk aversion). Comovement may instead arise because a bail-in reveals genuine information about a deterioration of the macro-financial outlook or because it leads investors to update their beliefs about the credibility of a bail-in regime. Distinguishing between spillovers and aggregate shocks is particularly challenging because the potential for spillovers is much greater in the context of a deteriorating outlook. So what in normal times would be an idiosyncratic bail-in may turn into an event that leads to panic among holders of claims on unaffected banks.

With these significant caveats, we start our analysis by looking at some European resolution cases where losses were imposed on private stakeholders (see list in Appendix Table 1). Given the heterogeneity of the surrounding circumstances (applicable resolution framework, extent of losses imposed and of public support, type of instrument or investor bailed in, macro-financial backdrop, etc.), we analyze each event separately. It is important to note that these cannot be regarded as examples of good resolution practice. Most occurred before the adoption of the new regulatory standards and resolution frameworks compliant with the KA. As such, the new frameworks are likely to deliver better outcomes, especially once they become fully operational. That said, these examples provide insights into the challenges the new frameworks are meant to tackle.

Table 4. Market Reaction to EU Bail-in Events

Panel 1. Cumulative Abnormal Changes in the Cross Section of Equity Prices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Austria	Cyprus	Denmark (1)	Denmark (2)	Greece (1)	Greece (2)	Greece (3)	Italy (1)	Italy (2)	Netherlands	Portugal (1)	Portugal (2)	Slovenia	Spain (1)	Spain (2)	United Kingdom
Country	-1.059***	-	-7.590***	-3.618**	-16.76***	-5.239***	11.09	0.390	-0.827	-6.236***	-13.18***	-5.369***	-	-5.739**	-5.032***	1.963
	(0.209)		(0.969)	(1.455)	(2.995)	(1.620)	(9.602)	(0.913)	(1.334)	(0.961)	(1.709)	(0.133)		(2.254)	(1.446)	(1.653)
EU less country	-0.915***	-2.971***	-1.097***	2.083**	-2.498**	-3.515***	0.626	-0.339	-2.393	1.744	-1.098**	-0.519**	-1.808**	-1.338*	-2.613***	-2.359***
	(0.337)	(0.914)	(0.367)	(0.851)	(1.099)	(0.845)	(0.542)	(0.493)	(1.522)	(1.184)	(0.557)	(0.256)	(0.705)	(0.686)	(0.938)	(0.856)
Russia		-2.802**														
		(1.277)														
Constant	1.008***	-0.906***	0.441**	-1.590***	0.217	0.938***	0.146	-0.858***	-1.292***	-0.407	-0.252	0.361***	0.475**	-1.020***	-0.978***	2.345***
	(0.0853)	(0.257)	(0.214)	(0.260)	(0.325)	(0.267)	(0.193)	(0.213)	(0.186)	(0.961)	(0.241)	(0.0896)	(0.229)	(0.220)	(0.219)	(0.309)
Observations	582	553	538	578	545	551	580	577	579	552	562	580	557	550	553	554

Panel 2. Cumulative Abnormal Changes in the Cross Section of CDS Spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Austria	Cyprus	Denmark (1)	Denmark (2)	Greece (1)	Greece (2)	Greece (3)	Italy (1)	Italy (2)	Netherlands	Portugal (1)	Portugal (2)	Slovenia	Spain (1)	Spain (2)	United Kingdom
Country	3.459**	-	-9.034***	-7.411***	-	-	-	6.986***	0.153	8.874**	7.840*	-1.161	-	-3.640	4.328**	1.848***
	(1.476)		(1.713)	(1.300)				(1.460)	(1.506)	(3.628)	(4.333)	(1.478)		(3.937)	(1.797)	(0.360)
EU less country	0.845	1.356*	-5.785***	-1.956	4.457**	4.898***	0.976	4.146***	-0.762	-0.245	2.667*	3.593***	4.156**	1.280	2.488***	1.325***
	(1.816)	(0.740)	(1.925)	(1.602)	(2.232)	(1.427)	(0.973)	(1.177)	(1.053)	(1.558)	(1.497)	(0.779)	(1.796)	(1.127)	(0.900)	(0.420)
Russia		0.244														
		(1.103)														
Constant	-4.608***	3.136***	0.876	-0.579	-9.867***	1.094	-2.301***	-1.600**	-0.193	-1.433	0.800	0.270	-0.282	-1.150**	3.685***	-0.411
	(1.476)	(0.394)	(1.713)	(1.300)	(1.372)	(0.963)	(0.695)	(0.667)	(0.790)	(1.254)	(0.723)	(0.380)	(1.649)	(0.539)	(0.467)	(0.360)
Observations	97	98	92	97	98	99	97	97	97	99	97	97	70	97	98	99

Sources: Bloomberg Finance L.P.; SNL Financial; Thomson Reuters Datastream; and IMF staff calculations.

Note: Cumulative abnormal changes in equity prices and in CDS spreads are computed over a ten-day (t+1 to t+10) event window, defined relative to the event date (t), over the period between 2008:Q1 and 2016:Q3. Event window for Denmark (1) and Portugal (1) in Panel 1 and for Spain (2) and Cyprus in Panel 2 is (t+1 to t+5) while that for the United Kingdom in Panel 2 and Portugal (2) in both panels is (t to t+1). Standard errors are displayed in parentheses; statistical significance at the 10 percent, 5 percent, and 1 percent levels is denoted by *, **, and ***, respectively. For sample coverage and further details on the empirical analysis, see Appendix II. For a list and description of the events, see Appendix Table 1.

Table 5. Market Reaction to US Bail-in Events

Panel 1. Cumulative Abnormal Changes in the Cross Section of Equity Prices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Wamu	Silverton	Independent	Waterfield	Midwest	Tierone	Enterprise	Community	Bankeast	Easternshore	Dupage	Union	Syringa	Multiple1	Allendale	Aztec
In-state	36.03***	10.30**	2.574**	4.382***	-4.671***	-3.415***	-1.362***	-0.572	-2.545	-0.470*	-0.483	-4.623**	-1.733*	2.372***	-2.327***	-2.078***
	(0.000)	(0.012)	(0.015)	(0.000)	(6.89-e05)	(0.002)	(3.06-e6)	(0.599)	(0.139)	(0.057)	(0.448)	(0.022)	(0.055)	(0.000)	(0.003)	(1.88-e06)
Out-of-state	21.67***	3.111**	3.422***	2.805***	-7.971***	-1.329*	-0.934***	-1.332***	-5.160***	-0.654***	-0.821	-5.841***	-2.499***	2.459***	-0.923*	-1.511***
	(0.000)	(0.047)	(6.81-e08)	(0.002)	(1.44-e06)	(0.093)	(1.13-e05)	(0.007)	(0.000)	(1.82-e05)	(0.156)	(0.000)	(3.51-e09)	(9.2-e07)	(0.051)	(0.000)
Constant	3.463***	1.503***	-0.525***	0.534**	-1.238***	-0.386	0.003	0.699**	2.934***	-0.132*	-1.105***	-0.230	-1.038***	0.762**	-0.667***	1.408***
	(1.83-e05)	(0.002)	(0.007)	(0.031)	(4.32-e05)	(0.104)	(0.977)	(0.021)	(0.000)	(0.090)	(1.59-e05)	(0.323)	(1.67-e05)	(0.022)	(0.009)	(7.10-e06)
Observations	517	518	522	530	533	533	538	538	547	548	557	557	557	557	559	561

Panel 2. Cumulative Abnormal Changes in the Cross Section of CDS Spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Wamu	Silverton	Independent	Waterfield	Midwest	Tierone	Enterprise	Community	Bankeast	Easternshore	Dupage	Union	Syringa	Multiple1	Allendale	Aztec
In-state	2.978**	19.00***	-9.390***	1.725**	4.333***	-5.046	2.604**	1.380	1.018	3.736**	0.273	-12.32***	1.167	2.978**	3.078*	1.097
	(0.017)	(3.67-e07)	(1.49-e05)	(0.429)	(4.94-e05)	(0.448)	(0.017)	(0.584)	(0.550)	(0.036)	(0.956)	(0.000)	(0.776)	(0.017)	(0.087)	(0.525)
Out-of-state	2.775	21.41***	-5.117**	1.823**	3.121***	1.698	0.613	4.656**	7.735***	4.256***	-5.686**	0.293	5.094	2.775	0.385	-1.717
	(0.411)	(7.08-e06)	(0.041)	(0.028)	(0.007)	(0.417)	(0.741)	(0.014)	(0.006)	(2.4-e05)	(0.012)	(0.948)	(0.178)	(0.411)	(0.749)	(0.222)
Constant	1.767**	-16.60***	2.236***	-2.738***	-1.891***	-3.171***	-0.858	-3.398***	-2.308	-2.272***	9.287***	2.932***	-1.387	1.767**	-3.676***	-1.076
	(0.033)	(0.000)	(0.001)	(0.000)	(0.000)	(0.002)	(0.164)	(0.006)	(0.124)	(8.99-e06)	(0.000)	(0.000)	(0.112)	(0.033)	(6.64-e07)	(0.106)
Observations	97	72	100	73	101	101	91	91	99	99	70	70	70	97	97	97

Sources: Bloomberg Finance L.P.; SNL Financial; Thomson Reuters Datastream; and IMF staff calculations.

Note: Cumulative abnormal changes in equity prices and in CDS spreads are computed over a ten-day (t+1 to t+10) event window, defined relative to the event date (t), over the period between 2008:Q1 and 2016:Q3. Event window for Easternshore, Enterprise, and Silverton in Panel 1 is (t+1 to t+5) while that for Midwest and Waterfield in Panel 1 and Easternshore and Enterprise in Panel 2 is (t to t+1). Event labeled "Multiple1" represents two bail-in events which occurred on the same day (Millennium Bank NA and Vantage Point Bank). Standard errors are displayed in parentheses; statistical significance at the 10 percent, 5 percent, and 1 percent levels is denoted by *, **, and ***, respectively. For sample coverage and further details on the empirical analysis, see Appendix II. For a list of the events, see Appendix Table 2.

Table 5. Market Reaction to US Bail-in Events (continued)

Panel 1. Cumulative Abnormal Changes in the Cross Section of Equity Prices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Columbia	Slavie	Freedom	Eastside	Greenchoice	NBRS	Chicago	Frontier	Northernstar	Crestview	Highland	Capitol	Doral	Edgebrook	Premier	Multiple2
In-state	-0.388	2.146**	-0.978	1.109*	1.493***	-1.107**	2.811***	-2.579***	-0.574	2.042***	4.496***	-1.924***	3.141***	1.193***	-1.114*	-1.120**
	(0.158)	(0.039)	(0.256)	(0.577)	(0.015)	(0.035)	(3.13-e05)	(1.53-e07)	(0.364)	(0.001)	(0.000)	(3.95-e05)	(0.000)	(0.002)	(0.078)	(0.034)
Out-of-state	-1.223***	2.044***	-0.608	-0.068	0.511	-1.987***	2.637***	-2.679***	-0.708**	0.884	5.686***	-2.359***	5.113***	1.247***	-1.613***	-0.395
	(2.09-e05)	(0.000)	(0.211)	(0.954)	(0.780)	(1.05-e08)	(8.83-e08)	(0.000)	(0.028)	(0.132)	(0.000)	(6.5-e07)	(0.000)	(6.57-e05)	(5.61-e08)	(0.455)
Constant	0.141	0.381**	-0.875***	0.872***	-0.526*	0.878***	0.777**	-0.594**	0.599***	-1.063***	-1.238***	0.764***	1.117***	0.112	0.868***	-1.179***
	(0.450)	(0.044)	(0.000)	(0.001)	(0.058)	(1.15-e08)	(0.019)	(0.015)	(0.005)	(0.001)	(0.000)	(0.007)	(0.001)	(0.620)	(5.70-e07)	(0.002)
Observations	561	561	562	562	562	568	568	568	570	570	570	572	573	576	576	578

Panel 2. Cumulative Abnormal Changes in the Cross Section of CDS Spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	Columbia	Slavie	Freedom	Eastside	Greenchoice	NBRS	Chicago	Frontier	Northernstar	Crestview	Highland	Capitol	Doral	Edgebrook	Premier	Multiple2
In-state	5.528*	10.11***	1.232***	0.754	-7.502***	4.185***	-0.232	-6.486***	0.808	0.478	-2.367	5.431**	-8.613***	1.303**	1.629	2.197*
	(0.069)	(0.002)	(0.820-e09)	(0.584)	(1.19-e05)	(2.52-e10)	(0.725)	(4.28-e05)	(0.331)	(0.588)	(0.429)	(0.021)	(0.000)	(0.044)	(0.599)	(0.067)
Out-of-state	4.821***	-1.020	-0.007	4.040	-3.358	2.613***	2.088*	-5.442***	0.327	1.329	-2.571***	8.308**	-2.057	1.962***	1.314	2.615
	(0.000)	(0.862)	(0.995)	(0.179)	(0.146)	(0.008)	(0.057)	(4.50-e07)	(0.769)	(0.298)	(0.005)	(0.043)	(0.330)	(0.000)	(0.588)	(0.127)
Constant	-6.580***	-6.353***	0.841***	1.340*	4.417***	-1.014**	-1.214***	5.544***	2.508***	-2.820***	2.259**	-5.988***	-0.268	-1.386***	-3.630***	-1.232***
	(0.000)	(0.000)	(2.96-e07)	(0.062)	(1.68-e07)	(0.013)	(0.008)	(0.000)	(8.72-e09)	(7.41-e05)	(0.010)	(4.81-e06)	(0.790)	(0.000)	(6.49-e07)	(3.36-e08)
Observations	97	97	97	97	97	97	97	97	97	96	96	97	87	97	97	97

Sources: Bloomberg Finance L.P.; SNL Financial; Thomson Reuters Datastream; and IMF staff calculations.

Note: Cumulative abnormal changes in equity prices and in CDS spreads are computed over a ten-day (t+1 to t+10) event window, defined relative to the event date (t), over the period between 2008:Q1 and 2016:Q3. Event window for Chicago, Edgebrook, Freedom, Multiple2, and NBRS in Panel 1 is (t to t+1) while that for Columbia, NBRS, and Premier in Panel 2 is (t+1 to t+5). Event labeled "Multiple2" represents two bail-in events which occurred on the same day (the Bank of Georgia and Hometown National Bank). Standard errors are displayed in parentheses; statistical significance at the 10 percent, 5 percent, and 1 percent levels is denoted by *, **, and ***, respectively. For sample coverage and further details on the empirical analysis, see Appendix II. For a list of the events, see Appendix Table 2.

The empirical analysis suggests that imposing losses on unsecured creditors may have implications not only for the bailed-in bank but also for other banks, especially when there is a considerable degree of uncertainty and when macro-financial risks are high (Table 4). In 11 out of 16 cases, equity prices for banks in EU countries other than the country in which the event took place show negative and significant changes. This is notable because equity holders would suffer losses or be wiped out one way or another independently of which debt securities are bailed in. In eight of these cases, CDS spreads show significant increases.[20] Almost all of these cases (the asset transfer and bail-in in Cyprus; two resolutions in Greece where shareholders and subordinated debtholders were significantly diluted; Portuguese and Spanish bridge bank operations; and resolutions and recapitalizations in Slovenia affecting five banks) took place in environments of heightened systemic risk.

Noteworthy in the European cases was a lack of significant prior experience with bank resolutions that would impose losses on private stakeholders, insufficient clarity ex ante on how losses would be allocated, and lack of explicit loss-absorbing capacity—as enshrined in the recent reforms. In particular, which funding instruments get bailed in and by how much likely has a bearing on the extent of spillovers.[21] An interesting case in point is Cyprus, where bail-in of unsecured bondholders and depositors had negative effects in other EU and non-EU countries (primarily Russian banks). These effects were mostly transitory, with CDS spreads and equity stabilizing about a week or so after the shock. That said, there may be other costs associated with bailing in unsecured creditors, particularly depositors, under an ad hoc regime (for example, bail-in of depositors in Cyprus led to claims for compensation and may have also encouraged strategic defaults on bank loans, exacerbating the nonperforming loan problem).

We also look at the resolutions executed by the Federal Deposit Insurance Corporation (FDIC) in the United States. It is worth noting that many of these were handled through a purchase and assumption, and the FDIC has a track record of imposing losses on bank creditors. We examine the cases that involved relatively large banks—those ranked in the top 30 by total assets among the more than 500 bank failures the FDIC handled since 2000 (Appendix Table 2)—and find mixed results on the equity prices and CDS spreads of other banks (Table 5). In half of the cases we find negative coefficients for equity prices of banks located in a state other than that of the failed bank, while in roughly 30 percent of the cases the coefficients are positive (the rest are insignificant). For CDS spreads, a third have positive coefficients, and for about 10 percent they are negative. These are smaller percentages than in the European case (of which two-thirds have negative significant coefficients for equity prices and more than half have positive significant coefficients for CDS spreads). The lack of firm evidence is not surprising given that the US cases involve relatively small, local banks.

With the caveat that the analysis does not control for any other factors that might have affected these groups of banks differently around the event dates, the dynamics examined are consistent with the

[20] We also examine senior bond spreads and observe that they rose as well, but these increases are not statistically significant. One reason could be that the sample size is much smaller for bonds. Other data limitations could also be an explanation—for example, the 10-year bonds we are looking at may or may not be subject to bail-in under the rules of a particular jurisdiction. Yet another reason could be that bondholders believed that they would ultimately be wholly compensated through litigation (in many cases, investors that were subject to losses took their case to courts).

[21] Spillovers may also be affected by a bank's liability structure and creditor hierarchy. See IMF 2013.

possibility that bailing in some banks may have had spillovers for creditors and equity holders in other banks that were not yet subject to bail-ins. That said, the evidence is also consistent with markets revising their beliefs about the macro-financial outlook or on the credibility of a bail-in regime. For instance, negative effects in the European cases could reflect increased market discipline resulting from the imposition of bail-ins or from signaling to investors that policymakers have become less inclined to bail them out (Schafer, Schnabel, and Weder di Mauro 2016). There is no easy way to tell the two interpretations apart. It is worth noting that the latter interpretation is less likely to apply in the US case, given the commonality in macro-financial factors across states and the existence of a federal resolution authority applying the same standards across state lines for FDIC-insured banks.[22,23]

The new resolution frameworks in key jurisdictions explicitly aim at preventing spillovers by ensuring that holders of bail-in-able securities can withstand and understand the risks involved (see Section III). In practice, this may require more time.[24] Taking a closer look at who holds bank securities could inform the debate: if securities that are hit first are held by unsophisticated or leveraged investors, distress in one bank can quickly translate into instability across a system or across borders. A stock-taking exercise on who holds bank equity, contingent capital (in the form of contingent convertible bonds), and bail-in-able debt (which, for illustrative purposes only, is assumed to be composed of senior unsecured and subordinated debt securities) shows cross-country variation. But a considerable share of bail-in-able debt is held by credit institutions, while the public sector and nonfinancial institutions are major holders of equities (Figure 3). The extent of cross holdings among banks and within the financial sector suggests that shocks to one or a group of banks may spread to others through losses on bail-in-able debt holdings.[25] In some countries, the extent of holdings by retail investors may render resolution through bail-in politically more difficult.

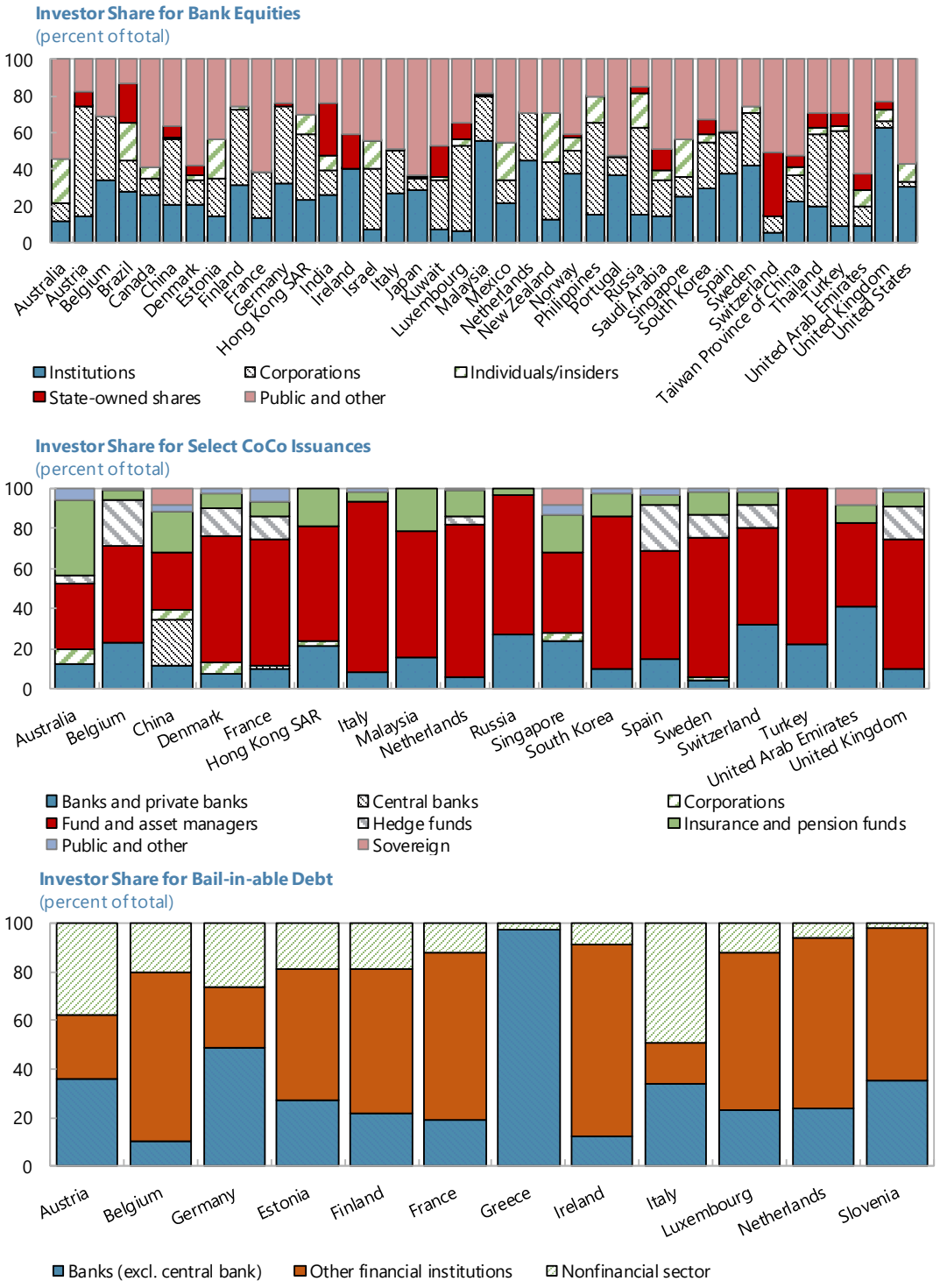
[22] Additional analyses produce results that seem to be more consistent with the spillover explanation than the belief-updating explanation. In regressions that are not reported for the sake of brevity but available on request, we examine whether there is a differential response by large banks. If the market reaction is due to an updating of beliefs on the likelihood of bail-outs, it would be expected to vary by bank size reflecting too-big-to-fail considerations. We do not find any robust evidence of such a differential for large banks. We also look at the time windows over which the effects are present. Markets would be quick to update their beliefs and, once they reassess their expectations of bail-outs, they would have no reason to go back—suggesting a very short-lived market reaction. We, however, observe the reaction to last for up to two weeks. Finally, we include the size of bilateral cross-border banking flows between the country where a bail-in event takes place and the country where a bank is headquartered as an additional variable in the empirical specification. If spillovers are present, we would expect them to be stronger for banks located in countries with more connections to the event country. The coefficient on this variable indicates, in half of the studied cases, a significant negative equity price reaction where bilateral flows are larger. Interestingly, the number of cases with significant negative coefficients increases from a third in the one-day window to a half in the ten-day window.

[23] Note that indirect evidence on spillovers comes from the examination of fiscal costs of systemic banking crises (Box 1). If larger losses are imposed on the private stakeholders when the size of the bail-out is small, larger output losses in these cases (when up-front fiscal cost is less than 1 percent of GDP) could be interpreted as an indication that these losses generate spillovers to other parts of the economy.

[24] The new EU resolution regime was recently applied for the first time in the context of a Spanish bank.

[25] Simulations using confidential supervisory data show that contagion from bailing in a large euro-area bank is limited under plausible scenarios, but in rare cases where the financial system is already weak, bail-in of a bank may lead to failure at a counterparty (Huser and others 2017). This underlines the importance of continuing to implement measures that limit interbank holdings of bail-in-able securities.

Figure 3. Holdings of Bank Equity, Contingent Capital, and Bail-in-able Debt



Sources: CapitalIQ; Dealogic Loan Analytics; ECB Securities Holdings database; and IMF staff calculations.

Note: Information on holders is available only for a subset of the contingent convertible bonds (CoCos) issued. Bail-in-able debt refers to senior unsecured and subordinated debt securities.

III. RESOLUTION FRAMEWORKS IN PRACTICE

So far we have used the term "bail-in" in a generic sense, to refer to the ability of resolution authorities to impose losses on private stakeholders to recapitalize a failing bank. In practice, bailing in a bank involves restructuring its liabilities in resolution on a going-concern basis to allow its recapitalization from the capital freed up from the exercise. Bail-ins (and other resolution powers) are supposed to be implemented in a manner that ensures continuity of systemically important financial services and payment, clearing, and settlement functions, and in a manner that avoids unnecessary destruction of value. Therefore, they seek to minimize the overall costs of resolution in home and host jurisdictions.

A bail-in can be achieved through various resolution tools, including statutory bail-in powers as a specific legal tool (Box 2).[26] Several jurisdictions have introduced bail-in powers as an integral part of bank resolution regimes (Box 3). Given the intrusive nature of bail-in and possible legal risks from potential interference with property rights, these are typically applied only when liquidation is not viable, as authorities seek to preserve the systemically important functions of a financial institution.

Significant attention has been given to ensuring that bail-in is an effective and credible policy option (Box 4). First, reforms seek to enhance the total loss-absorbing capacity (TLAC) of systemic banks, with clarity on the types of claims that qualify for loss absorption and the amounts and location within a financial group's structure of such claims. Second, it is crucial that unsecured and uninsured bank creditors understand the risks and can absorb the losses. Global systemically important banks (G-SIBs) have been issuing significant TLAC, which, to mitigate potential liquidity risk and spillovers, excludes short-term debt claims. Third, national authorities are expected to ensure that banks are subject to periodic "resolvability" assessments and that the supervisor or resolution authority has powers to require banks to remove legal and operational impediments to effective resolution. For cross-border banks, resolution planning should also encompass ex ante agreement between home and key host jurisdictions on the resolution strategy and the amount and location of loss-absorbing capacity.

The reforms have improved the trade-off between bail-outs and bail-ins, in addition to aiming to make the need for recapitalization less likely. These reforms, along with the use of emergency liquidity assistance,[27] potentially help reduce spillovers and lend credibility to measures aimed at constraining public solvency support in a crisis, thus reducing moral hazard.

Yet there may still be extreme circumstances under which the social costs of a bail-in exceed those of a bail-out. In other words, there remains a residual risk that public solvency support will be needed to preserve financial stability. Emergency liquidity assistance may end up being offered to potentially

[26] Statutory bail-in powers (Zhou and others 2012) are distinct from debt issued with contractual terms, which allow for their conversion at a predetermined trigger (for example, contingent capital) and, unlike a negotiated restructuring, do not require shareholder or creditor consent. Private contractual contingent capital instruments with write-off or conversion features could complement the statutory power of the resolution authority.

[27] Emergency liquidity can help mitigate spillovers—for example, across banks and from banks to markets (Dobler and others 2016).

(continued)

insolvent banks on terms or against collateral that leave the central bank with some risk of loss.[28] In some cases, state guarantees of bank liabilities (or loss protection on asset portfolios) may be needed to ensure continued market access. Or it may become apparent that loss-absorbing capacity is insufficient to cover potential losses or that imposing losses on certain claim holders could cause contagion. Public funding may also be needed to capitalize bridge banks that acquire systemically important liabilities and assets of a bank in resolution, to acquire temporary ownership of failed banks, and to resort to other mechanisms to help restore the solvency of banks.

Given these challenges, building flexibility into resolution regimes would seem prudent. Even if policymakers believe the risk of exceptional circumstances that would justify a bail-out is very low, there is value in having the flexibility embedded in the resolution framework: such a framework would allow authorities to cogently respond if and when necessary (that is, when spillovers are particularly severe) and transparently set the appropriate safeguards to mitigate the moral hazard costs.[29] But there is no international consensus on the optimal degree of flexibility. In addition, determining in advance the conditions under which a bail-out is justified is a challenge, given their extraordinary and difficult-to-anticipate nature. Spillovers will likely depend on observable variables, such as a bank's size and leverage. But they will also change with less-well-defined and less-readily-observable factors, such as a bank's degree of interconnectedness, the phase of the economic cycle, and the overall conditions of a financial sector. Regimes that are too constrained may not afford sufficient flexibility to preserve financial stability—for example, when they do not envisage circumstances under which exemptions from bail-in are warranted and prove time-inconsistent (if subsequently the legislation ends up having to be rewritten to deal with a crisis). At the other end of the spectrum, regimes that are too flexible may perpetuate too-big-to-fail premiums, increase contingent fiscal risks, and undermine the credibility of the regime. At a minimum, jurisdictions should ensure that the actual use of such flexibility provided in legislation is subject to adequate transparency and accountability mechanisms in order to help avoid potential abuse.

The recent reforms to bank resolution regimes have also included measures that aim to minimize the burden of resolution on taxpayers, even in cases where public funding is deemed desirable. Legislation has imposed conditions so that public funding may be provided only (1) on a temporary basis and only in systemic cases; (2) after bail-in of shareholders and some creditors; (3) after the use of ex ante resolution funds; and/or (4)

Table 6. Reducing the Cost of Resolutions

Minimizing Spillovers in Bail-ins	*Minimizing Moral Hazard in Bail-outs*
Enhance loss-absorbing capacity	*Bail-outs to be provided:*
Clarity on:	Only in systemic cases
which claims qualify	On a temporary basis
how much of these claims are needed	After bail-in of shareholders and some creditors
where these claims are located within a financial group's structure	After the use of ex ante resolution funds
Limit who can hold these claims	Subject to ex post recovery through levies
Unsecured/uninsured creditors that understand the risks and can absorb the losses	*… and accompanied with:*
	Good governance
Improve resolvability	Strict oversight
Periodic assessments and living wills	Exit planning
Powers to remove legal/operational impediments to resolution	Review and transparency
Cross-border planning	

[28] In a crisis it can be difficult to distinguish between illiquid and insolvent banks, and it is possible that liquidity assistance ends up becoming solvency support and, hence, a bail-out.

[29] As such, flexibility should not be confused with discretion to provide bail-outs at will. Also, note that KA 6.2 discourages but does not altogether prohibit public funding in resolution. Where necessary, the KA recommends that losses from such funding be recovered from the private sector. For further information, see Box 3 (with examples from recent resolution regimes) and Box 5.

subject to ex post recovery of any potential use of public funds through levies imposed on the banking sector. International experience and good practices offer further guidance on how best to structure public solvency support in such cases (Box 5). Effective resolution regimes would combine these principles with those aiming to make bail-ins a credible option (Table 6).

All these measures go in the direction of providing resolution authorities with effective bail-in powers and improving the trade-off between bail-ins and bail-outs. It will take some time to complete implementation and reach these goals, including ensuring that adequate loss-absorbing capacity is in place for all banks that could prove systemic. Restrictions on who can hold securities that count as loss-absorbing capacity would over time change the picture depicted in Figure 3, and limits on retail investors' exposure to complex securities would seem appropriate. In principle there are no nationality restrictions as to who can hold TLAC instruments, but political economy considerations might come into play, if those holding these securities are foreign investors. Potentially, home authorities might resist the idea of a systemic bank becoming foreign owned through the conversion of their debt claims into equity as part of a bail-in.[30] In addition, more remains to be done to ensure effective resolution planning and orderly resolution across borders (see IMF 2014b). The Financial Stability Board noted (FSB 2016c) that only a subset of its members has bank resolution regimes with comprehensive powers in line with the KA. Furthermore, much of bank debt is issued in foreign jurisdictions where the effect of national resolution powers remains uncertain, and cross-border resolution planning for individual banks is untested in practice. Finally, only time will tell whether the reforms have established credibility and struck the right balance in terms of constraints versus flexibility.

IV. CONCLUSION

After the global financial crisis, public bail-outs came to be viewed as too expensive, too inequitable, and too harmful to market discipline. Consequently, a defining feature of financial reform efforts has been limiting recourse to bail-outs. The new frameworks allow authorities to recapitalize a failed bank through the bail-in of private stakeholders. Hence, reforms after the crisis have likely reduced the potential for spillovers from bail-ins and made bail-outs less likely.

This note laid out some key considerations about the relative costs of bail-ins and bail-outs from a theoretical and empirical viewpoint. The theoretical section focused on the trade-off between spillovers associated with bail-ins and moral hazard effects of bail-outs. The model delivered several insights. First, when spillovers are small, bail-outs should not be used. To avoid time-consistency problems, this requires that policymakers operate under a constrained resolution framework that relies on bail-ins whenever systemic concerns are not severe. Second, when the spillover risks from bail-ins are very high, there may be some role for bail-outs. In such circumstances, the disruptive effects of bail-ins may outweigh the moral hazard consequences of bail-outs. Third, social welfare diminishes with the severity of spillovers. Therefore, it is crucial that policymakers continue to adopt measures to reduce the potential for spillovers—for example, by providing ample liquidity during

[30] Note, however, that KA 7.4 recommends national authorities not to discriminate against creditors based on their nationality or the location of their claim, among other things. The treatment of creditors should be transparent and properly disclosed to depositors, insurance policyholders, and other creditors.

periods of banking stress, restraining cross holding of bail-in-able debt within the financial sector, applying enhanced prudential standards on systemically important financial institutions, and enhancing the resolvability of large and complex financial institutions via effective resolution planning and adequate loss-absorbing capacity. Further research aimed at measuring spillovers and moral hazard is warranted, especially in the context of new resolution frameworks.

Pre-reform empirical evidence provided support for the key features of the model—namely, that bail-outs could give rise to moral hazard and that in some cases bail-ins might entail financial spillovers. Specifically, the empirical analysis first showed that public guarantees generated a funding advantage for large banks. Whether this translates into more risk taking and moral hazard seems to depend on the institutional environment and the macro-financial backdrop. The empirical analysis then provided suggestive evidence that imposing losses on the private stakeholders of a bank has negatively affected the market price of equity or debt securities of other banks in some cases. This may be interpreted as evidence of adverse financial spillovers. The risk of spillovers is likely to be more contained under the new resolution frameworks, particularly because authorities have stronger resolution powers, institutions are increasing their loss-absorbing capacity, and there is greater clarity about which instruments can be subject to bail-in. Nonetheless, it is important to remain alert to the possibility that severe spillovers may materialize in the context of systemic crises or cross-border resolution.

There are some essential features that recent reforms have introduced to improve the trade-off between bail-ins and bail-outs. Continued enhancement of these features can help strike an appropriate balance between bail-ins and bail-outs and ensure that bail-ins operate as intended:

- Credibility and flexibility in resolution frameworks: Regimes that are too constraining may have adverse consequences on financial stability—for example, if they preclude exempting creditors from bail-in under any circumstance. But regimes that are too flexible may perpetuate too-big-to-fail premiums while potentially increasing fiscal risk. Resolution frameworks should provide the latitude—subject to strict conditions—for the authorities to provide financial support in the event of bank failures only in exceptional cases where imposing excessive losses on private stakeholders may give rise to large spillovers. More attention needs to be paid to good practices in the provision of public funding as a last resort, to safeguard taxpayers' interests.

- Enhanced prudential standards and resolution planning: To reduce the scope for bail-outs, increasing the loss-absorbing capacity of major financial institutions and making them more resolvable—for instance, through resolution planning—is critical. Progress should continue on this front, including by linking prudential requirements on loss-absorbing capacity to resolution plans and by improving cross-border resolution aspects.

- Consumer/investor protection regulations: Clarity regarding which financial instruments may be subject to bail-in and restrictions on which investors can hold them directly are critical in limiting potential spillovers and in containing backlash to bail-ins. Retail investors' exposure to complex bail-in-able instruments should be limited—for example, only marketed to professional, institutional, or high-net-worth investors and diversified funds—and cross holding among banks should be restricted. Enforcing such regulations requires reporting and database upgrades to make effective real-time monitoring possible.

Box 1. Fiscal Implications of Bail-outs

Bail-outs may involve large fiscal costs. Gross fiscal outlays related to the restructuring of the financial sector can indeed amount to several percentage points of GDP (Laeven and Valencia 2010) and may, in some cases, jeopardize the sustainability of public finances. In assessing the fiscal costs of bail-outs, it is, however, important to consider also the fiscal implications without bail-outs. In the context of a systemic financial crisis, abstaining from bail-outs may result in a cascade of bank failures and widespread financial spillovers. This can result in a sharp contraction of GDP and tax revenues, possibly leading to a larger increase in public debt than in the case of up-front and sufficiently large public support to the banking system.

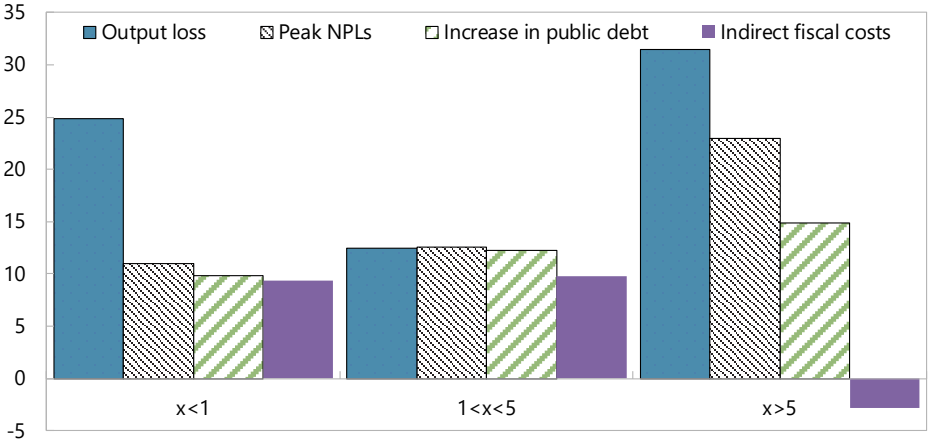
Testing these implications is unfortunately quite difficult due to endogeneity concerns. This is because the authorities provide larger bail-outs exactly when crises are more severe. Furthermore, when bail-outs are expected, the associated moral hazard effects lead to more severe crises. Therefore, we would expect to see a positive correlation between the size of bail-outs, drop in GDP, and increase in public debt.

Yet the relationship may not be as monotonic as expected: a too-timid response that aims to keep up-front fiscal costs down may backfire and end up associated with larger fiscal costs. In a sample of 87 systemic banking crises, there is such an irregularity (Figure 1.1). When up-front fiscal costs are limited to less than 1 percent of GDP, output losses reach 25 percent of trend GDP. When fiscal costs are between 1 and 5 percent of GDP, the typical output loss is only 13 percent of trend GDP. Interestingly, this happens as peak nonperforming loan (NPL) ratios reach levels comparable to cases where up-front fiscal costs are less than 1 percent of GDP. As up-front fiscal costs exceed 5 percent of GDP, output losses become larger and peak NPL ratios rise. Yet the increase in public debt is not commensurate with the increase in up-front fiscal costs and, hence, the indirect fiscal costs—calculated as the increase in public debt minus up-front fiscal cost—are lower. In simple ordinary least squares regressions, these insights are corroborated: controlling for the size of the output loss, the correlation between up-front fiscal costs and indirect fiscal costs is negative.

These observations show the danger of assessing the fiscal implications of bail-outs based only on their up-front cost. They suggest that in the case of systemic banking crises, up-front bail-outs may do much to contain the severity of the crisis and may ultimately also reduce the indirect fiscal costs.

Figure 1.1. Crisis Severity and Fiscal Costs

(percent)



Sources: Laeven and Valencia 2010; and IMF staff calculations.
Note: x refers to the up-front fiscal cost of a systemic banking crisis, expressed in percent of GDP and defined as the component of gross fiscal outlays related to the restructuring of the financial sector. It includes costs associated with bank recapitalizations but excludes asset purchases and direct liquidity assistance from the treasury. Output loss is computed as the cumulative sum of the differences between actual and trend real GDP over the period (t, t+3) with t the starting years of the crisis and expressed in percent of trend real GDP. Peak NPLs are in percent of total loans. Increase in public debt is in percent of GDP and measured over (t-1, t+3). Indirect fiscal costs are calculated as increase in public debt minus up-front fiscal cost.

Box 2. What Is Bail-in?

Statutory bail-in is a resolution tool that enables the recapitalization of a failed financial firm through cancellation, conversion, transfer, or write-down of claims of equity holders and unsecured and uninsured creditors, to the extent necessary to absorb losses on its balance sheet.[1] Following a bail-in, the firm (or a successor firm) can meet regulatory capital requirements, and its critical functions are preserved. In the analytical sections of this note, we use the term more broadly to refer to the ability of the authorities to impose losses on private stakeholders of a failing bank.

Contractual bail-in is another way to impose losses on private stakeholders to recapitalize a bank in resolution. Not all jurisdictions have adopted mandatory bail-in requirements. In such jurisdictions, implementing a bail-in may not be legally feasible absent provisions in banks' debt contracts that allow a resolution authority to bail in claims under such contracts.[2]

Contingent convertible bonds (CoCos) are hybrid capital securities that absorb losses when the capital of the issuer falls below a certain threshold. They carry two defining features: (1) a mechanism that specifies how losses will be absorbed (conversion into common equity or principal write-down) and (2) a trigger that activates this mechanism (often a given level of the common equity Tier 1 (CET1) ratio and sometimes a "point of nonviability trigger" (PONV) left at the discretion of the supervisor). An important benefit of CoCos—especially relative to equity—is their lower after-tax cost. Regulatory capital eligibility considerations determine the other CoCo features, including maturity. CoCos are supposed to be a first line of defense and to be triggered/depleted by the time a resolution authority decides to use its bail-in powers.

The scope of bail-in: Bail-in-able claims must be clearly specified in legislation or contract. While some jurisdictions specify claims that cannot be bailed in, others provide general discretion to exclude on a case-by-case basis claims that will not be bailed in.[3] Bail-in must respect the order of priorities of claims established in a given jurisdiction for bank liquidation, meaning that typically, equity must bear losses first, followed by subordinated debt, with deposits being the last to absorb losses in jurisdictions that provide for depositor preference.[4] Ensuring depositor preference can mitigate the likelihood of contagion by providing depositors with a higher probability of recovering their claims in a bank failure.[5]

Cross-border context: For cross-border banks, recognition and enforcement of bail-in is achieved through statutory mechanisms (such as automatic mutual recognition within the European Union or specific powers to recognize and to give effect to bail-in by foreign resolution authorities) or through contractual approaches to recognition of resolution actions. With respect to the latter, a number of G20 jurisdictions require their banks to provide for contractual bail-in recognition clauses in certain debt contracts governed by foreign law.[6]

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[1] The Financial Stability Board's Key Attributes (KA) of Effective Resolution Regimes include a "no creditor worse off" rule, designed to ensure that creditors of a failed bank are not left worse off in resolution than they would have been in liquidation proceedings against the bank. Mandatory compensation is required for claimants who are made worse off, as determined by an independent valuation.

[2] For example signatories to the International Swaps and Derivatives Association Resolution Protocol agree to incorporate bail-in provisions in their financial contracts.

[3] The KA require that this be done on a transparent basis, for limited reasons such as to contain systemic risk or to maximize the value of the remaining assets for all creditors.

[4] 4. There may be instances where the legal framework may permit the resolution authority to depart from the established order of priorities by exempting certain claims from the imposition of losses in resolution in the interest of financial stability.

[5] Many jurisdictions (including Argentina, Australia, China, India, Hong Kong SAR, Indonesia, Mexico, Russia, Singapore, Switzerland, Turkey, the United States, and EU member states) give preference to depositors.

[6] For example, EU jurisdictions impose this requirement pursuant to Article 55 of the EU Bank Recovery and Resolution Directive.

Box 3. Resolution Regimes in Key Large Home Jurisdictions[1]

China: The China Banking Regulatory Commission, as banking supervisor, can place a failing bank into receivership, under which the deposit insurer (currently the People's Bank of China) acts as receiver and may restructure a failing bank. The receiver may use the deposit insurance fund to provide financial support for a transfer of assets and liabilities; for example, through financial assistance, guarantees, and loss sharing. The regime lacks bridge bank, bail-in, and other powers laid out in the Financial Stability Board's Key Attributes (KA), which may be needed to resolve a systemic entity.

European Union: Most EU members had adopted the Bank Restructuring and Resolution Directive (BRRD) by January 2015 (the deadline for adopting the bail-in powers was a year later). The BRRD established administrative resolution regimes, with broadly harmonized resolution powers closely aligned with the KA across the European Union. The mandatory bail-in provisions of the BRRD require that any public funding for a bank in resolution can be provided only after the bank's shareholders and creditors have absorbed losses of at least 8 percent of the total liabilities of the failed bank. Under certain conditions (for example, if a bank is solvent but cannot generate enough profits to sustain itself during a serious economic disturbance—for instance, the bank has enough capital in the baseline scenario but falls short in a stress scenario), public support can be provided outside of resolution, subject to the applicable rules on state aid. These require that capital and subordinated debt holders (at least) absorb losses, along with other "compensatory" measures to restructure the bank's operations.

Japan: In 2013 a new regime was introduced, under which the Deposit Insurance Corporation of Japan (DICJ) can take over control of a bank, under the direction of the bank supervisor, and transfer assets and liabilities to a third-party purchaser or a bridge bank owned and administered by the DICJ. Resolution actions taken by the DICJ require court approval in lieu of shareholder approval. Wider powers to provide financial assistance or temporary nationalization, can be deployed after a systemic risk determination by the prime minister. The Japanese regime lacks statutory bail-in power.

United States: There are two separate resolution regimes—one for systemically important nonbanks—for example, bank holding companies (Title II of the Dodd-Frank Act, introduced in 2010) and another for banks. The Federal Deposit Insurance Corporation (FDIC) is appointed receiver[2] under both with resolution powers closely aligned with those in the KA, which can be exercised administratively and do not require shareholder or creditor consent. Those under Title II first require that the Treasury secretary determine that the firm represents a systemic risk; and potentially an expedited court approval process may be triggered. Bankruptcy is the first resolution option in the event of a failure of a systemic financial company and, to make this prospect achievable, Title I of the Dodd-Frank Act requires that all large, systemic financial companies submit living wills to demonstrate how they would be resolved under the bankruptcy code. The Title II regime prohibits taxpayers from bearing the losses of a nonbank placed into receivership. However, public funds can be lent to the Orderly Liquidation Fund, which in turn can provide funding to a firm in (but not outside of) resolution, subject to certain conditions. The US regimes lack a statutory power for bail-in, but may be able to achieve the same economic effect using bridge bank and other powers. Flexibility in the bank resolution regime was tightened after the global financial crisis—for example, the systemic risk exception authority of the FDIC can now be used only for banks placed into receivership and wound down.

[1] Sources: FSB 2016a, 2016b: and IMF Financial Sector Assessment Program reports.

[2] The terms "receivership" and "receiver" used in the US regime are analogous to "resolution" and "resolution authority."

Box 4. Making Bail-in a Credible Policy Option for Systemic Banks

Several measures have been agreed to at the international level to mitigate the potential spillover risks from the use of the bail-in tool in resolution. The Financial Stability Board has provided guidance on measures that seek to improve the outcomes of bail-in for individual countries and in the cross-border context. These include the following:

Recovery and resolution planning (RRP): National authorities are expected to ensure that banks are subject to periodic resolvability assessments as part of resolution planning exercises. Recovery plans are required to be prepared by the governing boards of banks to help their recovery from financial distress, with a minimum disruption of critical services. In addition, resolution authorities are required to prepare resolution plans for each bank reflecting concrete strategies for resolving them while safeguarding financial stability. Supervisory and resolution authorities are also required to undertake annual resolvability assessments for banks, and to require changes in the legal and operational structures of a firm if that is necessary to ensure continuity of critical functions in resolution. RRPs must reflect cross-border issues, including ex ante agreement on operational resolution strategies to be used for resolving such firms (see below).

Loss-absorbing capacity (LAC): In a systemic crisis, failure of any bank (regardless of size) may pose risks to financial stability, and without sufficient LAC (both quality and quantity), resolvability will not be achieved. Adequate levels of quality LAC in banks helps support their orderly resolution without recourse to public funds and with little or no potential systemic risk. The Financial Stability Board has called for global systemically important banks (G-SIBs) to maintain total loss-absorbing capacity (TLAC) in accord with their risk-weighted assets and leverage ratios. TLAC implementation by various national authorities is ongoing; banks in key jurisdictions (for example, the European Union, Japan, and others) are working toward complying with these requirements by 2019. The EU version, known as "minimum requirement of own funds and eligible liabilities (MREL)" applies to all EU banks, regardless of size, at both the individual and group consolidated levels.

Cross-border context: The Financial Stability Board's Key Attributes call for cooperative arrangements among national resolution authorities for the resolution of global systemically important financial institutions (G-SIFIs). Home and key host authorities are expected to maintain crisis management groups (CMGs, made of members of financial safety nets in each relevant jurisdiction) to prepare for and facilitate resolution of cross-border banks. They are also expected to enter into institution-specific cooperation agreements (CoAgs) for each G-SIFI. These agreements enable execution of an agreed resolution strategy. National authorities have adopted one of two operational strategies for resolving cross-border banks—namely, the single point of entry (SPE) and multiple points of entry (MPE). Under the SPE approach, the home resolution authority of the apex holding company of the cross-border financial group resolves the holding company—typically using the bail-in power under its legal framework. Shareholders and eligible creditors of the holding company absorb losses of the entire group through a write-down or restructuring of their equity and/or debt claims against the apex entity. Capital freed up from this exercise is passed down to subsidiaries operating at a loss and used for their recapitalization and liquidity provision. Host jurisdictions should be able to recognize and enforce resolution measures taken by the home authorities under an SPE strategy, using statutory powers of recognition and enforcement or through contractual provisions recognizing bail-in by foreign resolution actions. The SPE strategy requires an effective ex ante cooperation arrangement among the authorities of relevant jurisdictions. This strategy must be underpinned by aligned incentives that create confidence that their respective national interest for promoting financial stability will be protected. In the absence of such mutual trust, host authorities tend to undertake parallel resolution actions or ring-fence branches or subsidiaries in their jurisdictions, with suboptimal outcomes for all creditors of the institution/group. Under the MPE approach, home and relevant host authorities resolve nonviable parts of the financial group in separate proceedings using a range of resolution tools available to them in their respective jurisdictions. In the case of cross-border banks, resolution planning is expected to include ex ante agreement among home and key host jurisdictions on resolution strategies and the amount and location of LAC, in the context of CMGs and CoAgs. These measures (if well implemented) will help to promote trust and effective cooperation among relevant jurisdictions to give meaning to orderly resolution strategies.

Box 5. Good International Practice in Public Solvency Support

Public solvency support for problem banks typically involves significant cost, risk, and moral hazard. Private solutions and, if unattainable, orderly resolution without recourse to public funds, are distinctly preferable. The limits of public support should be recognized. Debt sustainability concerns may cast doubt on the feasibility of recapitalization strategies and contribute to further negative market reaction (the so-called sovereign-bank nexus). However, public solvency support may be unavoidable in exceptional circumstances—for example, if spillovers are high and/or an effective resolution regime is not in place. In such circumstances, it should be provided only under strict conditions that maximize burden sharing, minimize moral hazard, and protect taxpayers.

- **Systemic stability:** Public support should be reserved for institutions whose failure would destabilize the financial system and/or jeopardize the continuity of essential payment, clearing, and settlement functions.
- **Burden sharing:** Unrecognized losses must be identified, ideally via a comprehensive asset quality review if time allows, and the bank's equity must be written down for the losses before provision of public funds. To the extent that it is compatible with financial stability and permissible under the legal framework, loss allocation should continue in accordance with the creditor hierarchy, ultimately affecting claims of uninsured senior unsecured creditors.
- **Restructuring:** Solvency support must be paired with a comprehensive restructuring plan that addresses structural weaknesses and helps restore long-term viability, including via cost cutting and a stronger risk management framework, capital and liquidity planning, and so forth. Public solvency support should be remunerated to help mitigate moral hazard. Plans should provide for recovery of public support within a reasonable time frame, if necessary via divestiture of selected assets and business lines.
- **Governance:** Managers responsible for the failure of the bank should be replaced, executive compensation capped, and any bonuses paid to senior management before the failure clawed back (if possible). To fuel internal capital generation, dividend payments (if any original shareholders remain) need to be suspended until solvency support is repaid. The authorities should establish a high-level intra-agency committee to coordinate the nationalization, ensure timely and consistent information is released publicly, and manage the public sector's interest on an arm's length basis. Central banks and supervisors ideally should not contribute to recapitalization to avoid potential conflicts of interest. The central bank, however, may need to provide liquidity to viable banks that have been recapitalized in or outside of the resolution regime.
- **Strict oversight:** Recipients of public support must be subjected to strict supervision and enhanced reporting to prevent excessive risk taking, foster robust governance and safe and sound practices, and ensure consistent implementation of the restructuring plan. Supervisors should establish measures to prevent asset stripping, monitor, and—if needed—block intragroup and insider transactions.
- **Exit planning:** Solvency support should be structured to incentivize timely repayment—for example, via interest step-ups. Divestment strategies should be carefully analyzed and initiated as soon as market conditions allow. While exit scenarios should aim to ensure a reasonable return on the financial aid—for example, via market-based remuneration and/or the issuance of equity warrants to the government, the overarching objective should be to return the bank to private ownership within a reasonable amount of time—even if that entails losses on the original investment.
- **Review:** A review, conducted with independent expertise, should focus on the events that led up to the bank's failure and identify the structural weaknesses in its business model, governance, and risk controls—with the aim of learning how to prevent recurrence and determining the culpability of senior management. The supervisor should also closely evaluate its own role in order to identify potential improvements to supervisory procedures, the reporting framework, and instruments for early intervention.
- **Transparency:** Ongoing disclosure on the actual and estimated cost of the public solvency support and any recovery realized (updated periodically) is crucial for accountability to taxpayers.

Appendix I. A Simple Model of Bail-ins and Bail-outs

Consider a continuum of banks, each endowed with an exogenous level of capital K. Capital can include common equity as well as state-contingent debt that is automatically converted into equity or written off in case of financial distress. Banks are heterogeneous in size, with capital K being distributed over the support $[0, \bar{K}]$. Banks leverage up to the regulatory limit by issuing debt D, which carries the interest rate R_D.[31] On the asset side, banks provide loans equal to $L = K + D$, with a lending rate equal to R_L. κ denotes the proportion of lending financed with bank capital, so that $\kappa = K/L$.

Bank loans are used by competitive firms to produce output according to a simple linear production function $Y = \eta\, A\, L$. The level of productivity A is subject to the shock η, which is distributed as follows:

$$\eta = \begin{cases} 1 & \text{with probability } p \\ 0 \le \varepsilon \le 1 & \text{with probability } 1-p \end{cases}$$

The random variable ε is uniformly distributed over the $[0,1]$ interval and is given by the sum of an idiosyncratic and aggregate shock $\varepsilon = \varepsilon_i + \varepsilon_a$. Note that ε is thus bank specific. We refer to the case in which $\eta = 1$ as the "good state" and the case in which $\eta = \varepsilon$ as the "distress state." Each bank can control the probability p by exercising a monitoring effort m that entails a pecuniary cost equal to $cm^2L/2$, where $c > 0$. Specifically, we assume that $p = m$.

Without loss of generality, we assume that banks fully appropriate output production, setting $R_L = A$. In the good state, bank loans are fully repaid, while in the distress case banks recover only $\varepsilon R_L L$. Banks operate under limited liability so that they fully repay creditors only in the good state or in the distress state if loan repayments are high enough:

$$\varepsilon > \frac{DR_D}{LR_L} = \bar{\varepsilon}. \qquad (1)$$

If instead $\varepsilon < \bar{\varepsilon}$, the funding gap between the bank assets and liabilities must be absorbed through a combination of public bail-outs or the bail-in of private creditors. Bail-outs involve a government transfer of size o and entail a fixed cost F_o. We assume that a fraction δ of bail-outs is appropriated by bank owners, while the remaining part $1-\delta$ is used to repay bank creditors.[32] Bail-ins involve instead the write-down of bank creditors' claims that see repayments reduced to $DR_D - i$, where i denotes the size of the bail-in. The sum of bail-ins and bail-outs must fully cover the bank's unfunded liabilities, so that when $\varepsilon < \bar{\varepsilon}$:

[31] In the context of the model, debt includes both deposits and bonds. For the sake of simplicity, we assume that all deposits can in principle be bailed-in. We could easily extend the model to incorporate insured deposits, which carry a bail-out guarantee by the government. In this case, the questions of whether to use bail-ins or bail-outs would be relevant only for the portion of deposits that is uninsured.

[32] This assumption is quite standard in the literature and often corresponds to the observation that banks are likely to exploit their informational advantage to maximize the transfer they receive. In addition to being politically and socially costly, the fact that the bank can seize part of the bail-out transfers generates moral hazard since it reduces the bank's incentives to monitor borrowers.

$$(1-\delta)o + i = DR_D - \varepsilon R_L L. \tag{2}$$

The expected net return for an individual bank is thus given by

$$U_B = -\frac{c\,m^2}{2}L + p\frac{LR_L - DR_D}{R} + (1-p)\left(\int_{\bar{\varepsilon}}^{1}\frac{\varepsilon LR_L - DR_D}{R}d\varepsilon + \int_0^{\bar{\varepsilon}}\frac{\delta o}{R}d\varepsilon\right),$$

where R is the gross risk-free rate.

Regarding bank funding costs, we assume that bank creditors are risk-neutral, act competitively, and can observe the monitoring level chosen by the bank.[33] Creditors require an interest rate that allows them to break even in expectation by providing compensation against the risk of bail-ins:

$$R_D = R + (1-p)\int_0^{\bar{\varepsilon}}\frac{i}{D}d\varepsilon.$$

By substituting out R_D, the bank's expected returns can be rewritten as

$$U_B = -\mathrm{D} - \frac{c\,m^2}{2}L + \frac{LR_L\left(p + (1-p)\int_0^1 \varepsilon\,d\varepsilon\right)}{R} + (1-p)\int_0^{\bar{\varepsilon}}\frac{o}{R}d\varepsilon. \tag{3}$$

Note that banks appropriate in expectation all benefits from public bail-outs, not only the share δ that is directly seized by bank owners. This is because banks also benefit from the bail-out share $1-\delta$ that is used to repay creditors, since, by reducing the expectation of bail-ins, bail-outs lower bank funding costs R_D. Nonetheless, the higher the share δ, the greater the risk of moral hazard, since a larger bail-out is needed to achieve a given reduction in bail-ins, as shown in equation (2).

We now turn to the costs imposed on the rest of society when a bank becomes insolvent; that is, $\varepsilon < \bar{\varepsilon}$. The model incorporates two sources of losses. First, in the case of bail-outs, the government faces the associated fiscal cost o and the fixed costs F_o. Second, following Sandri 2015, we allow for the possibility that bail-ins may involve spillovers. Besides imposing losses on bank creditors equal to i, we assume that bail-ins involve negative externalities for the rest of society equal to ξi, where the parameter $\xi \geq 0$ controls the severity of spillovers. The cost for the rest of society C from resolving an individual bank is then

$$C = (1-p)\left(1_o F_o + \int_0^{\bar{\varepsilon}}\frac{\xi i + o}{R}d\varepsilon\right),$$

where 1_o is an indicator function taking the value of 1 if bail-outs are positive and zero otherwise. The model takes the intensity of spillovers ξ as an exogenous parameter and can thus encompass different mechanisms through which spillovers can emerge. One plausible assumption is that spillovers are proportional to the overall capital shortfall in the banking sector so that

[33] If bank monitoring is not observable, the provision of bail-outs could actually increase monitoring as explained in note 2.

$$\xi \propto \int_0^{\bar{K}} 1_{\varepsilon \le \bar{\varepsilon}} K\big((\kappa-1)R_D - \kappa\varepsilon R_L\big)\phi(K)\,dK,$$

where $\phi(K)$ is the probability density function of K and $1_{\varepsilon \le \bar{\varepsilon}}$ is an indicator taking a value of 1 if the bank is insolvent; that is, $\varepsilon \le \bar{\varepsilon}$. In this case, spillovers become severe if a large financial institution fails or if an aggregate shock pushes many banks into insolvency.

By subtracting from the bank's returns the costs faced by the rest of the society in case of insolvency, we can then define aggregate social welfare as [34]

$$U_S = U_B - C = -\mathrm{D} - \frac{c\,m^2}{2}L + \frac{LR_L\left(p+(1-p)\int_0^1 \varepsilon\,d\varepsilon\right)}{R} - (1-p)\left(1_o F_o + \int_0^{\bar{\varepsilon}} \frac{\xi i}{R} d\varepsilon\right).$$

Consider now the problem of a social planner that aims to maximize social welfare U_S by choosing which portion χ of a bank's unfunded liabilities $DR_D - \varepsilon R_L L$ should be subject to a bail-in in case $\varepsilon < \bar{\varepsilon}$. The remaining share $1-\chi$ is then covered with public bail-outs. Importantly, the planner cannot control the level of monitoring that is chosen by the bank to maximize its own profit. Formally, the planner chooses the bail-in's share χ by solving $\max_{\chi} U_S$ subject to $m = \arg\max_{m} U_B$.

From an ex post perspective; that is, once the bank faces a capital shortfall, bail-outs are preferable to bail-ins whenever the spillover costs associated with bail-ins exceed the fixed cost of bail-outs.

However, the choice between bail-outs and bail-ins should consider not only the ex post costs, but also the ex ante implications for bank monitoring. In this regard, note that equation (3) shows that the provision of bail-outs reduces monitoring incentives for the bank since it provides compensation even if the bank faces a capital shortfall; that is, $\varepsilon < \bar{\varepsilon}$. This is how bail-outs generate moral hazard.

The optimal choice between bail-ins and bail-outs should thus be based on a careful trade-off between the ex post costs associated with bail-ins and the ex ante moral hazard effects arising from bail-outs. The solution is illustrated in Figure 1, showing that bail-outs should play an important role in bank resolution only if spillovers are particularly large.

Appendix II. Sample Coverage and Empirical Specifications

The empirical analysis is conducted for a global sample of banks. These banks are selected in two steps. The first step criterion is bond issuance activity and size (total assets): a set of active issuers is identified based on available information from Bloomberg Finance L.P. and Thomson Reuters Datastream on issuances of senior unsecured, subordinated, and contingent convertible bonds. In the second step, a set of banks that are not selected based on this criterion but rank in the top 500 banks globally are added to the sample. Daily data on equity prices, credit default swap spreads, and bond prices are merged with quarterly data on balance sheet components (the source in this case is SNL Financial). The process delivers a global sample that consists of 841 banks across 75 countries encompassing both advanced and emerging market economies with coverage from 2008 to 2016. The countries covered are Argentina, Australia, Austria, Bahrain, Bangladesh, Barbados, Belgium,

[34] Note that we can neglect bank creditors since they always break even in expectation.

Bermuda, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Faroe Islands, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Kuwait, Lebanon, Liechtenstein, Luxembourg, Malaysia, Malta, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Singapore, Slovak Republic, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Taiwan Province of China, Thailand, Togo, Trinidad and Tobago, Turkey, United Arab Emirates, United Kingdom, United States, Venezuela, and Vietnam.

For Figure 2, daily changes in CDS spreads and equity prices around three events—September 15, 2008 (Lehman bankruptcy), October 30, 2008 (TARP passage), and September 30, 2008 (Dexia capital injection)—are plotted against bank size.

For Tables 1, 4, and 5, cumulative abnormal changes in CDS spreads and equity prices are computed in three steps. First, we estimate the relationship between the bank-level variable and its market equivalent over 60 trading days prior to relevant event. Market equivalents are benchmark regional indices collected from Thomson Reuters Datastream and Bloomberg Finance L.P. In the second step, abnormal changes are calculated as the difference between the actual change and the change predicted based on the regression estimated in the first step. Finally, these abnormal changes are summed over an event window to arrive at the cumulative abnormal changes. We use several event windows ranging from 1 to 10 days in length (that is, from *t* to *t* + 1, …, *t* + 10).

The regression specification in Table 1 is

$$CAR_i = \alpha + \beta Size_i + \theta_c + \varepsilon_i,$$

where i denotes the bank and c denotes the country of residence of the bank. The regressions are run separately for each of the three bail-out events featured in Figure 2, with and without country fixed effects, θ_c. Standard errors are clustered at the country level. A positive (negative) beta for CDS spreads (equity prices) can be interpreted as larger banks being affected adversely by the event in question.

The regression specification in Table 4 is

$$CAR_i = \alpha + \beta C\_bailin_i + \gamma C\_EUless_i + \varepsilon_i,$$

where C_bailin is a dummy that takes the value of 1 if the bank's residence is in the country where the bail-in event happened and C_EUless is a dummy that takes the value of 1 if the bank's residence is in a country that is an EU member but is not the country where the bail-in event happened. The regressions are run separately for each of the 16 bail-in events. The list of events is in Appendix Table 1. For the Cyprus event, an additional dummy for banks whose residence is Russia is included. Results are robust to clustering standard errors at the country level.

A similar specification is used in Table 5:

$$CAR_i = \alpha + \beta S\_bailin_i + \gamma S\_USless_i + \varepsilon_i,$$

where S_bailin is a dummy that takes the value of 1 if a bank is headquartered in the same state as the bank resolved by the Federal Deposit Insurance Corporation ("in-state"), and S_USless is a dummy that takes the value of 1 if a bank is headquartered in a different US state ("out-of-state"). The regressions are run separately for each of the 32 bail-in events. The list of events is in Appendix Table 2. The results are robust to clustering at the state level.

The coefficients obtained on the dummy variables in Tables 4 and 5 can be interpreted as the marginal impact of being "closer" to a bail-in event, conditional on a bail-in event. Given that non-bail-in events are not included in the estimation sample, the coefficients do not represent the average overall impact of the bail-in event. Note that there is no restriction on the samples used for these tables; that is, the samples include not only European/US banks but also banks from the other regions.

For Table 2, summary statistics on funding costs (CDS spread, senior unsecured bond spread, subordinated bond spread, contingent convertible bond (CoCo) spread), risk measures (*Z*-score, Tier 1 ratio, leverage ratio, NPL ratio), and profitability metrics (ROA, ROE) are displayed separately for large and small banks in the sample. Large banks are defined as those with assets in the top percentile of the full sample distribution. *Z*-score is computed as equity capital ratio plus return on assets divided by the standard deviation of return on assets (calculated over a rolling window of 10 quarters). Tier 1 ratio is defined as the ratio of Tier 1 capital to risk-weighted assets, and leverage ratio is defined as the ratio of Tier 1 capital to total tangible assets. NPL ratio is the ratio of nonperforming loans to total loans. ROA is return on average assets and ROE is return on average equity.

For Table 3, the risk measures and profitability metrics displayed in Table 2 are treated as the dependent variable in the following regression specifications:

$$Risk_{it} = \alpha + \beta Size_{it} + \gamma_1 Loan_{it} + \gamma_2 Deposit_{it} + \vartheta_i + \tau_t + \theta_c + \varepsilon_{it},$$

$$Profitability_{it} = \alpha + \beta Size_{it} + \gamma_1 Loan_{it} + \gamma_2 Deposit_{it} + \gamma_3 Zscore_{it} + \vartheta_i + \tau_t + \theta_c + \varepsilon_{it},$$

where $Loan$ refers to gross loans in percent of total assets and $Deposit$ refers to total deposits in percent of total assets. *Z*-score is omitted in the specification where the dependent variable is a risk measure given that it is also a risk measure, but it is included in the profitability regression to assess returns controlling for risk. Of course, the set of fixed effects included in each specification is either bank and time (ϑ_i, τ_t) or country and time (θ_c, τ_t). Results are robust to clustering standard errors at the country or bank level.

Note that the number of banks in the regression tables is fewer than 841 because of missing data over the estimation and/or event windows.

Appendix Table 1. Bail-in Events in Europe

Event	*Date*	*Description*
Austria	11-Apr-16	Resolution of HETA; first test of covered bonds under resolution; BRRD regime
Cyprus	25-Mar-13	Resolution and restructuring of Laiki and Bank of Cyprus, with Laiki's insured deposits, emergency liquidity assistance, and enough assets to meet regulatory requirements transferred to the Bank of Cyprus and uninsured deposits and other assets left in a run-off unit, and Bank of Cyprus recapitalized with participation of creditors including uninsured depositors to attain regulatory limits; an unexpected bail-in following ad hoc adoption of a resolution law inspired by the BRRD (which was then still under negotiation so a pre-BRRD experience)
Denmark (1)	7-Feb-11	Bankruptcy of Amagerbanken; first time haircut imposed on senior debt in Europe; first test of the Danish bail-in law passed six months prior to the event; pre-BRRD
Denmark (2)	5-Oct-15	Resolution of Andelskassen; hybrid application of the bridge bank and bail-in tools; BRRD regime
Greece (1)	10-Oct-11	Resolution of Proton Bank via a bridge bank; pre-BRRD
Greece (2)	18-Jan-13	Resolution of Hellenic Post Bank via a bridge bank; pre-BRRD
Greece (3)	11-Dec-15	Precautionary recapitalization of National Bank of Greece and Piraeus Bank; resolution not triggered but subordinated debt and senior bonds converted to equity; BRRD regime
Italy (1)	17-Jul-15	Liquidation of Banca Romagna Coop; burden sharing of equity and subordinated debt (later paid in full by cooperative bank's voluntary fund); under national insolvency law; pre-BRRD
Italy (2)	23-Nov-15	Resolution of Banca Marche, Cassa di risparmio di Ferrara, Popolare Eturia, Carichieti; equity and subordinated debt bailed in; BRRD regime
Netherlands	1-Feb-13	Nationalization of SNS Reaal; junior debt wiped out; pre-BRRD regime and in the run-up to the Cypriot bail-in
Portugal (1)	4-Aug-14	Resolution of Banco Espirito Santo (BES) via a bridge bank (Novo Banco); equity and subordinated debt become shares and bonds of the bad bank; BRRD regime (directive adopted in 15 May and entered into force on 2 July, although compliance and implementation deadline at the end of the year)
Portugal (2)	29-Dec-15	Transfer of some non-subordinated bonds back from Novo Banco to BES; BRRD regime (and eve of BRRD bail-in rule kick-in on 1 January 2016)
Slovenia	12-Dec-13	Public recapitalization of NLB, NKBM, Abanka, Probanka, and Factor Banka; bail-out accompanied by private loss absorption where shares and subordinated bonds are wiped out; pre-BRRD
Spain (1)	10-Jul-12	Spanish bank rescue plan involving subordinated liability exercises in addition to public recapitalization; preference shares and subordinated debt affected by haircuts and conversion; pre-BRRD
Spain (2)	22-Mar-13	Resolution of Bankia; haircuts on subordinated bonds; pre-BRRD
United Kingdom	17-Jun-13	Recapitalization of Co-operative Bank; negotiated/consensual bail-in or "liability management exercise"; outside the BRRD regime

Sources: European Parliament reports and news articles; Philippon and Salord 2017; Schafer, Schnabel, and Weder di Mauro 2016; World Bank 2016.
Note: The term bail-in is used in a generic sense to capture any resolution that imposed losses on private stakeholders. Bank Recovery and Resolution Directive (BRRD) 2014/59/EU of the European Parliament and of the Council of 15 May 2014 established a framework for the recovery and resolution of credit institutions and investment firms. The BRRD entered into force on 2 July 2014. EU member states were required under Article 130 of the BRRD to adopt and publish the laws, regulations, and administrative provisions necessary to comply with the BRRD by 31 December 2014 and to apply those with effect from 1 January 2015, except in relation to the bail-in provisions, which were to apply from 1 January 2016 at the latest.

Appendix Table 2. Bail-in Events in the United States

Event	*Date*	*Headquarter Location*
Washington Mutual (WaMu)	25-Sep-08	Nevada
Silverton Bank	1-May-09	Georgia
Independent Bankers Bank	18-Dec-09	Illinois
Waterfield Bank	5-Mar-10	Maryland
Midwest Bank and Trust Company	12-May-10	Illinois
TierOne Bank	4-Jun-10	Nebraska
Enterprise Banking Company	21-Jan-11	Georgia
First Community Bank	28-Jan-11	New Mexico
BankEast	27-Jan-12	Tennessee
Bank of the Eastern Shore	27-Apr-12	Maryland
DuPage National Bank	17-Jan-14	Illinois
The Bank of Union	24-Jan-14	Oklahoma
Syringa Bank	31-Jan-14	Idaho
Millennium Bank NA	28-Feb-14	Virginia
Vantage Point Bank	28-Feb-14	Pennsylvania
Allendale County Bank	25-Apr-14	South Carolina
AztecAmerica Bank	16-May-14	Illinois
Columbia Savings Bank	23-May-14	Ohio
Slavie Federal Savings Bank	30-May-14	Maryland
The Freedom State Bank	27-Jun-14	Oklahoma
Eastside Commercial Bank	18-Jul-14	Georgia
GreenChoice Bank, fsb	25-Jul-14	Illinois
NBRS Financial	17-Oct-14	Maryland
The National Republic Bank of Chicago	24-Oct-14	Illinois
Frontier Bank, FSB D/B/A El Paseo Bank	7-Nov-14	California
Northern Star Bank	19-Dec-14	Minnesota
First National Bank of Crestview	16-Jan-15	Florida
Highland Community Bank	23-Jan-15	Illinois
Capitol City Bank & Trust Company	13-Feb-15	Georgia
Doral Bank	27-Feb-15	Puerto Rico
Edgebrook Bank	8-May-15	Illinois
Premier Bank	10-Jul-15	Colorado
The Bank of Georgia	2-Oct-15	Georgia
Hometown National Bank	2-Oct-15	Washington

Source: Federal Deposit Insurance Corporation (FDIC).

Note: Compiled based on FDIC-executed resolution of failed banks as reported on the agency's website. The cases were selected from more than 500 bank failures the agency handled since 2000, subject to the condition that the approach used was a purchase & assumption (P&A) and the failed bank's total assets ranked among the top 30. The term bail-in is used in a generic sense to capture any resolution that imposed losses on private stakeholders.

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