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New bank resolution mechanisms: Is it the end of the bailout era?

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Abstract

We study the effectiveness of three common bank resolution mechanisms: bailouts, bank sales, and 'bad banks'. We first apply the financial fragility model of Goodhart et al. (2005, 2006a) to analyze the impact of these resolution mechanisms on bank behavior. We then use a novel bank-level database on 39 countries that used these resolution mechanisms during 1992-2017 and analyze the relationship between the mechanisms applied and subsequent bank performance. We find that the effectiveness of resolution mechanisms depends crucially on the timing and severity of crises. While mergers can deliver good results at the beginning of a crisis, this is less likely at later stages of a crisis. In the event of severe crises, mechanisms aimed at restructuring bank balance sheets are most likely to deliver positive results. We find no support for bank bailouts as an optimal strategy. A calibration exercise shows that the effectiveness of resolution mechanisms to mitigate systemic risk declines with the severity of crises.

Keywords: Government intervention; Resolution mechanism; Financial crisis; Bailout; Financial contagion; Bank default; Financial stability; Systemic risk

JEL Classification Number: C68, G21, G28

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1. Introduction

In the nineteenth and early twentieth century governments either largely stood aside or adopted minimalistic policy responses to systemic banking crises (Calomiris, 1997). This has changed during the last decade, particularly after the 2007-08 crisis. Recent years have witnessed governments adopting increasingly extensive and costly bailouts. These interventions have become highly unpopular with the general public because of the fiscal burden they impose on taxpayers. They also contribute towards the moral hazard through the perception that they create rents for bankers (e.g., Gropp et al., 2004; Dam and Koetter, 2012). These arguments have contributed to the increase in demand for new resolution frameworks. Most of the new resolution mechanisms introduced by G20 countries aim to secure operational continuity and banking sector stability while redirecting the potential losses to private investors. Despite significant evidence on the effectiveness of the objectives of these new resolution mechanisms, concerns remain as to whether they are able to restore banks' health and work effectively in the event of a systemic banking crisis. Our main goal in this paper is to test the effectiveness of these recent regulatory initiatives in restoring financial health of the distressed banks in the economy.

Many countries around the world have recently enacted their own bank resolution regimes. For instance, the Bank Recovery and Resolution Directive (BRRD) introduced by the European Parliament and the European Council in 2014 plays this role in the EU while the Dodd-Frank Act defines the rules for bank resolutions in the United States. These bodies uniformly aim to facilitate an orderly restructuring of their banking sector in order to mitigate moral hazard as well as to restore banking sector stability without a high cost to the taxpayer. They are in agreement on several recommended methods to restore banks' health before the use of any bankruptcy procedures. These include: (i) the sale of the business or shares of the institution under the resolution; (ii) the setting up of a "bad-bank" (that is, Asset Management Company) to separate the performing assets or underperforming asset from the impaired bank; and (iii) the bail in of the shareholders and creditors of a distressed bank. While the first two interventions aim to decrease the likelihood of bank bankruptcy, the latter is to be initiated in the case of banks' severe distress or failure. In our study we assess the effectiveness of two resolution methods: a sale of bank assets through a merger and a "bad-bank" mechanism and compare them with a bailout, i.e., nationalization of the troubled bank. We analyze the effectiveness of these resolution mechanisms in resolving banks' distress by looking at their ex-post bank capital, reserves and non-performing loans (NPLs) as well as their lending

activities. Finding an effective resolution is extremely important for maintaining financial stability as well as for economic activity in general. Distressed and undercapitalized banks are likely to be subject to the debt overhang problem as they tend to engage in "zombie lending" (e.g., Myers and Majluf 1984; Giannetti and Simonov, 2013). In turn, healthy banks tend to increase their lending and, thus, allow for economic recovery (Homar, 2016). However, whether and which resolution mechanism could turn out to be an effective tool in restructuring bank distressed asset is still an open question.

Additionally, the G20 countries requested their systemically important financial institutions (SIFIs) to make contingency plans for times of stress, called "Living Wills". Such bank resolution plans should incorporate scenarios under which certain (less important) parts of a bank could be sold, or put into liquidation to limit their systemic effect during a crisis. In our paper we analyze the impact of possible resolution mechanisms on the reduction of the contagious effects of a crisis. The existing literature does not provide a clear answer to this. First, bank resolution mechanisms have been designed at the micro-level (see Avgouleas and Goodhart, 2019; Schwarcz, 2019). Second, most of the regimes lack clarity about the sources of funding for banks during the resolution process (Avgouleas and Goodhart, 2019).

The current research evaluating the impact of the new regulatory framework on banking sector recovery has so far concentrated on assessment of the bail-in arrangements, as opposed to bailouts (see Galliani and Zedda, 2014; Conlon and Cotter, 2014, Benczur et al., 2017). Bail ins should only be initiated when recovery mechanisms do not succeed and, in such cases, the new regulations allow banks to redirect losses to other stakeholders. Beck et al. (2017), for instance, analyze the effect of bail in of a major Portuguese bank on the credit supply. They find some evidence of a contraction in distressed bank lending, though no effect on the credit supply in the banking sector. Similarly, De Souza et al. (2019) simulate stress scenarios for the Brazilian banking sector in the context of bank bail ins in comparison to their liquidation. They find that bail ins cause lower credit contraction to the economy than bank liquidations. Contrary to the above studies, we analyze the effectiveness of different resolution strategies on banking sector performance and its recovery. Our reasoning is similar to Brei et al. (2020). They test the effect of asset segregation mechanisms and bank recapitalizations on bank lending and restructuring of non-performing loans (NPLs). They find that distressed banks use the recapitalization funds first to clean up their balance sheet by reducing their NPLs without increasing credit extension. They show that banks use additional capital from credit extension whenever their capitalization exceeds a certain critical threshold. We go further than Brei et al.

(2020) as we test and contrast a range of resolutions. In addition, we test their effectiveness under different crisis environments.

There is very little literature on the effectiveness of resolution mechanisms on mitigating the systemic effects of a financial crisis. Few studies look at how creditors perceive bail ins. For example, Hüser et al. (2017) analyze how the distress of one bank and its potential bail in would affect other interlinked banks. The authors assess the bail-in mechanism positively, suggesting that the bail in would not precipitate significant contagious effects on other interlinked banks. A study by Beck and and Gambacorta (2019) is similar to the approach applied in this paper. The authors analyze how different resolution frameworks adopted by individual countries are able to limit the contagious effects of crises. Their evidence suggests that those countries' resolution rules are effective in dealing with bank-specific shocks, while they may exacerbate the effect of system-wide shocks. Similarly, we investigate the effectiveness of such resolutions and their contagious effects on banking sector, using bank resolution data instead of country resolution data.

Our paper contributes to the debate on bank resolution mechanisms. For many years policy makers have searched for optimal resolution schemes to rescue failing banks. Until the global financial crisis (GFC) of 2007-08 most of countries developed resolution plans at the national level based on their own past experience with financial crises. However, the GFC demonstrated that a well-designed resolution mechanism at the bank level is warranted in order to counteract financial shock, help troubled institutions, and decrease the cost of interventions as well as limit potential moral hazard effects in the banking sector. Important questions arise about what such resolution mechanisms should look like. Which measures are effective in the context of a systemic banking crisis? We endeavor to provide answers to these questions through our analysis.

Our paper starts with the application of the Goodhart et al. (2005, 2006a) model of financial fragility in order to illustrate how effective bank resolution mechanisms could be in the context of a systemic banking crisis. This model has been widely used by policy makers to study the tradeoffs between bank performance and financial stability. We incorporate three resolution mechanisms into this model, i.e., bailout (nationalization), sale of a distressed bank (merger) and a "bad-bank" approach. We assess the impact of these mechanisms on banks via a calibration exercise. Next, we use a novel bank-level database to empirically assess the impact of different resolution mechanisms across 39 countries on almost 1,000 banks, of which 215 were subject to government resolution mechanisms. We analyze the effectiveness of those

resolution mechanisms in regards to banks' lending, their capital and reserves-to-NPL positions in comparison to their peers that were not subject to intervention.

We find no clear winner among the resolution mechanisms studied. Our findings suggest that mergers can be effective in resolving banking distress at the beginning of a crisis, or with banks that are not severely impacted by it. Our results indicate that the merger route could have a positive impact on bank capital and future profit of the acquirer. However, this method does not seem to yield positive results in the event of a severe crisis, whereby capital injection by the government is required. This is because the financial condition of the acquirer is likely to be severely impacted by the losses of the acquired bank. Consequently, such banks tend to engage in "zombie lending" at the ex-post stage. This result seems to suggest that merger, as a resolution mechanism, does not solve the real problem in the banking sector; which is mainly related to banks' losses from toxic assets. Instead it shifts the problem into the future, which negatively impacts banking sector stability in the longer term.

We find that in the event of a severe financial crisis, bank recapitalization coupled with deep asset restructuring delivers the best results. A bank under this scenario is likely to improve its financial performance and carry out healthy lending. NPLs are removed from the portfolio and so is the uncertainty surrounding the bank's future losses. This further restores bank capital and, at the same time, encourages credit extension. In turn, pure restructuring under a "bad-bank" mechanism is not sufficient to restore the bank's health. The lack of sufficient capital to cover any losses might discourage the bank from undertaking deep restructuring and disclosure of its true losses. Therefore, such a bank remains weak (see also Corbett and Mitchell, 2000). Our empirical results support the above conclusions and are consistent with our theoretical calibration exercise. In summary, we find under both empirical and theoretical analyses that a "bad-bank" mechanism coupled with capitalization is the most effective way to resolve bank distress and restore credit activity in the banking sector.

Finally, we find the least positive results from bailouts. Both our theoretical and empirical results indicate that bailout in the form of bank nationalization is unlikely to be effective in restoring a bank's financial strength and its credit activities. We argue that pure capital injection aimed at helping banks to survive might not restore banks from their distress in the absence of any balance sheet restructuring. Our results seem to be consistent with Brei et al. (2020) who assert that only capital injections coupled with balance sheet restructuring allow troubled banks to restore their financial strength and carry out healthy lending. They also find that pure capital

injections mainly concentrate on fulfilling banks' capital requirements, which may not be sufficient to restore banking sector activities.

In addition, our theoretical results indicate that the resolution mechanisms discussed are less likely to be effective in mitigating the systemic effects of troubled banks during a severe crisis. They are most effective under less severe crises. We find that when the banking sector is severely impacted by high levels of NPLs the risk in the interbank market is still present, as captured by higher lending rates.

Our results contribute to the debate on the reasoning behind the sustained weak performance of the European banking sector after the crisis of 2008-10 despite the record level of government financial support. The average profitability of the European banking sector stood at 6.5% after the crisis in comparison to 10-12% prior. We argue that despite significant financial support injected into the sector during the crisis, there was a lack of deep bank restructuring that should have been aimed at resolving the bad asset problem. Consequently, European banks were holding toxic assets on their balance sheets, which weaken their financial position and credit activity over time (Landier and Ueda, 2009). Our findings strongly encourage policy makers to undertake more comprehensive resolution actions in order to aid the banking sector. We argue that the recent reforms aimed at shifting the crisis containment policy away from bailouts and towards new resolution mechanisms are on the right trajectory. Our results also call for more regulatory actions and tools to tackle the systemic risk in the banking sector.

Our paper is organized as follows. Section 2 describes the related literature. Section 3 presents the applied model of financial fragility. In Section 4 we carry out the empirical analysis and present the combined results. Section 5 concludes our paper. Figures and Tables are displayed at the end of the paper. An appendix is available online.

2. Review of the related literature

2.1. Theoretical rationale for government interventions and types of resolution mechanisms

Systemic banking crises and the need for government intervention to save troubled banks are often explained in the context of systemic risk shocks. Shoenmaker and Siegmann (2014) define systemic risk as an event that triggers loss of confidence in a substantial portion of the financial system and whose effects are transmitted to the real economy. The impact might also

result from the interconnection of financial institutions through bilateral contracts, such as loans and derivatives. If one institution is insolvent and defaults on its agreements, its counterparties may become insolvent as well – this is known as financial contagion (Bernard et al., 2017). Consequently, "*too big to fail*" and "*too interconnected to fail*" arguments have often been used as a justification for costly bank bailouts (IMF/BIS/FSB, 2009). Governments intervened in distressed banks with public money to limit negative spillovers from the crisis into real economic activity.

The use of taxpayer money for bank bailouts has been heavily criticized. First, bailouts bear significant fiscal costs which could have been utilized for public investments rather than on rectifying the profligate behavior of banks. Second, the presence of implicit bailout protection for banks that are "too big to fail" can give them the wrong incentive to engage in excessive risk taking through, for instance, over-investing in highly risky assets (see Demirgüç-Kunt and Kane, 2002; Demirgüç-Kunt et al., 2008). In order to remove implicit government guarantees from bank risk taking, recent regulations require banks to prepare resolution procedures for potential distress. In addition, SIFIs are required to calculate such costs on their balance sheets (FSB, 2013). Although severe restrictions are now placed on government actions by requiring banks to have their own restructuring plans in place for a potential distress event, government intervention in the case of an extreme systemic crisis cannot be ruled out. Some crises may be managed better by newer resolution mechanisms, while others could be more difficult to resolve without any government action (Avgouleas and Goodhart, 2019). For example, the collapse of Bear Stearns in 2008 could not have been resolved without the government intervention as its consequences were so severe that creditors lost confidence that they could recoup their loans by selling the collateral (Bernanke, 2008).

A distressed bank has several options to restructure its activities before any legal bankruptcy measures can be applied. One option is to separate its distressed operation and sell it to another healthy bank(s). This mechanism might also involve the withdrawal or cancellation of the troubled bank's licence. Most importantly, the liabilities of the troubled bank are taken over proportionally under this mechanism (Klimek et al., 2015). A very important characteristic of this merger resolution is that, in comparison to a bank liquidation where creditors are repaid over time – or under specific circumstances not repaid at all – this resolution assumes that assets and liabilities are transferred to other healthy institutions. Thus, the potential contagion, as a result of a bank's distress or liquidation, could potentially be limited. Sheng (1996) claims

that this form of merger resolution can be effective if the markets have sufficient funds to absorb the new institution.

Another possibility to restore the distressed institution is a "bad-bank" mechanism, sometimes referred to as an Asset Management Company (AMC). It often takes the form of a transfer of NPLs from the distressed institution's balance sheet into a fund created for the purpose. The role of the fund is to clean up the bank's balance sheet in order to restore its profitability. The fund then tries to maximize loan recovery through its active restructuring. An important advantage of this resolution is that it removes the uncertainty with regards to the bank's asset valuation and, thus, improves bank asset quality. Moreover, separating the bad asset from a good bank improves bank solvency and profitability ratios. As a result, the good bank might be more willing to lend to the real sector. In addition, this strategy allows for handling larger institutions (those deemed "*too big to fail*"), when market transactions are not possible and, at the same time, limits bail in costs. This requires, however, market discipline mechanisms to work effectively (see Dell'Ariccia and Ratnovski, 2012).

Although recent banking legislation tries to avoid banking bailouts, it cannot be ruled out that in extreme cases governments would have to step in to save troubled banks using public funds. The EU's Single Resolution Mechanism (SRM) regulation envisages the use of national funds to bail out troubled banks if their losses, not less than 8 per cent of total liabilities including own funds, have already been absorbed by the creditors of the failing bank through a bail in mechanism (European Commission, 2014). Some researchers found that in extreme cases the fund money might be not sufficient to restore the distressed banks and, thus, government help would be necessary (see Avgouleas and Goodhart, 2019). In our analysis, we contrast the effect of new resolution mechanisms with a potential bailout. Cross-country experience with different depths of systemic crises will allow us to assess under which crisis scenarios bailouts might be more effective than the new resolution mechanisms.

2.2. Literature Contribution

Our study contributes to three strands of the literature. First, we add to the recent literature on the new resolution mechanisms. The scale of government interventions between 2008 and 2010 lead to many economic and social disruptions across the globe. Consequently, the regulatory authorities, including international agencies, began to work on a regulatory environment focused on bank resolution plans in the event of new financial shocks. In Europe, the EU's

BRRD and the SRM regulation came into force at the start of 2015. An important element of this framework is a new bank resolution mechanism, i.e., bail in, which envisages that bank resolution takes place without the use of public funds. In addition, G20 leaders called for the development of resolution plans for SIFIs as mentioned earlier. Banks are now required to have their own contingency plans. Under these plans, SIFIs should develop scenarios in which they consider the restructuring process of a defaulted bank along with rescuing the systemic parts of a bank (Huertas, 2010). The Financial Stability Board (FSB) issued a set of twelve key attributes which refer to the scope of resolution, the powers of the resolution authorities, and recovery and resolution planning (FSB, 2011). This document also requires each institution to prepare emergency plans aimed at restructuring risky parts of the business, with a particular focus on the cross-border part of the bank. There are also national documents that have modified the regulatory environment to give higher power to the supervisory institutions to react in case of a systemic crisis. For instance, separate national bank resolution frameworks have been established in the UK (the Banking Act) and in Germany (the Bank Restructuring Act). In a nutshell, all recent recovery and resolution frameworks suggest a set of different resolution mechanisms that give the best chance of avoiding massive losses for the financial system as a whole (Beck and Gambacorta, 2019).

We, thus, add to this field by testing the effectiveness of various resolution mechanisms in the context of the new regulatory framework. One strand of relevant literature tries to assess the effectiveness of bank bails in by looking at their cost (e.g., Galliani and Zedda, 2014; Faja and di Mauro, 2015, Benczur et al., 2017), or at moral hazard behavior (e.g., Ignatowski and Korte, 2014; Martynova and Perotti, 2018). Beck et al. (2019) and Klimek at al. (2015) try to analyze the effect of bail ins on economic recovery. The overall conclusions from these studies are quite optimistic, indicating that bank bail ins – as opposed to bailouts – render lower crisis costs, reduce public spending and, under certain scenarios, might restore economic activity.

Another strand of literature tries to assess the cost of the safety net. Breuss et al. (2015) and Benczur et al. (2017) calculate the costs of the whole resolution procedures which are split into creditors, government and/or a single resolution fund. Both authors find that the new resolution mechanisms would curtail the cost of the crisis. The bail in mechanism seems to mostly contribute to this reduction. In our study we contribute to the literature by assessing the resolution mechanisms before any bankruptcy procedures are initiated. We are especially interested in the effect of bank resolutions, instead of bail ins, on bank performance and credit activities. Our higher-level research goal is to see whether the new regulatory framework could

turn out to be effective during the next financial crisis that is now emerging as an outcome of the Covid-19 pandemic.

Next, we contribute to the literature on the effectiveness of different resolutions on bank recovery. The systemic effect of a defaulted bank has become a main argument for government interventions, especially since the financial crisis of 2007-08. It is not clear whether and how the new resolution mechanisms would potentially restore the health of distressed banks. So far, academic studies have stressed the importance of the government's role in restoring bank performance. For example, Hakenes and Schnabel (2010) find that government actions have a positive impact because they increase banks' profitability due to access to more favorable funding. Other scholars find that capital injections improve banks' capital positions (e.g., Berger and Bouwman, 2010; Duchin and Sosyura, 2014; Mehran and Thakor, 2011; Rose and Wieladek, 2012). Ding et al. (2012) provide more evidence by finding that government interventions in Asian economies have improved the solvency, credit risk and profitability of troubled banks.

Other scholars find some positive impact of government interventions on bank lending activities, indicating the important role of sufficient recapitalization. For example, Puddu and Walchli (2015) find that Troubled Asset Relief Program (TARP) banks provide more small business loans than non-TARP banks. Giannetti and Simonov (2013) study recapitalizations in Japan and find that banks that received large capital injections were able to increase credit extension while the opposite occurred for undercapitalized banks. Homar (2016) finds similar results for European banks. However, scholars such as Brei and Schclarek (2013) or Davydov (2018) stress the role of government in countercyclical lending. These studies establish that while private banks decrease lending and increase interest rates during a crisis, nationalized banks tended to behave in the opposite way. Brei et al. (2020) analyze 135 cross-country banks to test the effect of the "bad-bank" solution on bank recovery in terms of lending and reduction in NPLs. They find that "bad-bank" approach is only effective when it is coupled with bank recapitalization. Given the recent shift of policy makers from bailouts towards different resolution mechanisms, it is not clear how effective these policies might be in restoring bank health based on inconsistent results from the recent literature in this field.

Finally, we contribute to the literature on the systemic risk. The importance of financial stability and systemic risk was highlighted by the financial crisis of 2007-08, and since then the topic of systemic risk has become particularly important. A large number of scholars have concentrated on identifying sources of systemic risk (e.g., Brunnermeier, 2009; Georg 2013;

Hellwig, 2009; Breckenfelder and Schwaab, 2017; Kirschenmann et al., 2017). However, limited attention has been paid to the investigation of potential tools to mitigate a contagious effect when systemic risk is already present in the market. There are only a few papers that explore the effect as well as the interaction of different regulatory policies with systemic risk measures (e.g., Goodhart et al., 2012; Kashyap et al., 2020; Beck and Gambacorta, 2019; Hüser et al., 2017). In particular, Beck and Gambacorta (2019) analyse how cross-country differences in resolution mechanisms affect the systemic risk in the event of a financial crisis. Hüser et al., (2017), in contrast, use the agent-based model to investigate whether bank bail ins may trigger contagious effects to other banks within a banking network. We are more interested in how the new resolution mechanisms, among those available for banks, rectify banks' financial performance and, thus, limit potential negative contagious effects stemming from the crisis.

3. The application of the financial fragility model

We begin by assessing the effectiveness of resolution mechanisms with a variant of the financial fragility model of Goodhart et al. (2005, 2006a). This model is well-suited to the task. First, the structure of this partially microfounded general equilibrium (GE) model which incorporates multiple heterogenous banks suits the set-up of the studied resolution mechanisms in the context of a banking sector that is suffering from a systemic banking crisis. More formally, the model incorporates three heterogenous banks, $b \in B = \{\gamma, \delta, \tau\}$, four private sector agents $h \in H = \{\alpha, \beta, \theta, \phi\}$, a Central Bank and a regulator (Figure 1). They all operate in incomplete markets with money and default and within the loan, deposit and interbank markets.[1]

[Figure 1]

Second, the model extends over two periods, $t \in T = \{1,2\}$, and two possible states in the second period, $s \in S = \{i, ii\}$. Such time dimensions allow us to apply the event of the systemic banking crisis under consideration. In this model, all uncertainty is resolved in the second period. At time $t \in T$, the probability of state i occurring at $t + 1$ is denoted by p. This probability is assumed to be known by all agents and constant over time. The time structure of

[1] For a more detailed description of the model, please see Goodhart et al. (2005).

the model is presented in Figure 2. At t, markets open and banks decide on how much to lend or borrow in each market in the context of the assumed state of nature, i.e., the good/normal state or the bad/extreme state (i.e., crisis). The good state is represented by i and a probability p of occurring and the bad state ii with probability of occurring, $1-p$. These probabilities are constant over time and are known by the private sector agents. The expected value is taken over all possible states. The central bank conducts open market operations (OMOs) in the interbank market. The capital adequacy requirements on banks are set by the regulator. At $t+1$, depending on the state of nature, all financial contracts are settled, subject to any defaults and/or capital requirements violations which are then penalized. At the end of the second period, all banks are wound up.

[Figure 2]

Third, the banks in the model are assumed to operate under a perfectly competitive environment. This is suitable for our application, in which we need to ensure no monopolistic or oligopolistic banking behavior is present in order to avoid biasing the outcome of our analysis. The banks in the model endogenize their decisions in the loan, deposit and interbank markets. This means that they take interest rates as exogenously given when making their optimal portfolio decisions.

Moreover, the model assumes that an individual bank's borrowers are assigned during two periods, by history or by informational constraint, to borrow from a single bank (i.e., limited participation assumption). Agents α, β, and θ borrow from banks γ , δ and τ, respectively. The remaining agent , Mr. ϕ, represents the pool of depositors in this economy which supplies funds to every bank. There is a single, undifferentiated, interbank market where deficit banks are allowed to borrow from surplus banks, and wherein the Central Bank conducts OMOs.

3.1. Model application to our research topic

We apply the model of Goodhart et al. (2005, 2006a) by incorporating the resolution mechanisms under consideration – bailout (nationalization), government-assisted merger, and a "bad-bank" approach – within its framework in order to see what their impact is on banks' ex-post behavior.

The decisions of private agents and banks are considered to be endogenous under this model while the Central Bank and the regulator, or a government in general, have predefined strategies. Government resolutions are, thus, taken as given which removes the issue of selection bias. Specifically, there is a government agent in our model whose objective is to resolve NPLs in order to maximize the total output generated by the banking sector, net of any costs associated with the resolution mechanism. These resolutions are assumed to be rationally anticipated by the banks and depositors and the government's choice of a bank for intervention as well as the type of resolution mechanism are both assumed to be rational.

The possibility of financial contagion plays a crucial role in motivating government interventions in the banking sector. Namely, owing to the risk of contagion, failure in one bank can generate failures in other banks. But, at the same time, more capital in distressed bank γ can also help to protect depositors in bank δ. In other words, the resolution mechanism could help the distressed bank γ to repair its balance sheet and, at the same time, it could also have a positive impact on the bank δ.

The banks' profit maximization horizon assumption holds. Managers choose to maximize their banks' profit over a finite horizon, because they could depart from these banks for better alternative contracts or they could change jobs. Although the same logic is unlikely to be fully applicable to all forms of bank behavior, it can still be argued that these are likely to be maximized over a finite time period.

In order to be in line with the design of the model, we interpret the bank's default rate as a probability that such a bank chooses to shut down, and, hence, in the short run to default completely on its financial obligations. Thus, a bank's decision to increase its default rates is isomorphic to its decision to adopt a riskier position in pursuit of higher expected performance, whether in terms of its future lending, capital or reserves to NPLs position.[2]

Bank recapitalization is the driving force behind our selected resolution scenarios (Table 1). In our model, banks are endowed with some capital in the initial period. An additional injection of capital to distressed banks (i.e., $e_t^{\gamma} \uparrow 15\%$) is financed by the government through household taxation. Under the bailout and "bad-bank" scenarios, it is Bank γ that receives the capital injection. In the "bad-bad" approach, however, Bank γ can be recapitalized by the government either gradually (Bad Bank 1) or instantly (Bad Bank 2). Under the merger resolution, we study

[2] For more on this point, see Tsomocos and Zicchino (2005).

the case in which the Bank τ instantly receives the capital injection (Merger 2). We also assess the merger scenario with no capital injection (Merger 1). Household loan demand and deposit supply functions are directly affected by tax-funded capital injections into the troubled banks as noted under each scenario in Table 1.

[Table 1]

Hence, bank capital is an exogenous variable in the model. However, bank capital becomes endogenous in the subsequent period, i.e., in the period $t + 1$, which allows us to test fully the impact of government-led resolution mechanisms on banks. However, the model does not consider the lag between the timing of the resolution and the timing at which the impact of such a resolution can be objectively measured. In our empirical analysis, we do, however, look at the first six years after the intervention to evaluate its impact on bank behavior. Table 1 summarizes the setup of the model applied in order to show the dynamics behind our studied resolution mechanisms.

3.2. Model calibration exercise

We now turn to the application of the model under our three studied resolution mechanisms. We use data from the annual accounts of the seven largest UK banks as used in the paper by Goodhart et al. (2006b).[3] In our comparative static exercise, we categories the levels of banks' NPLs in the initial period in order to study the contagious effects between banks and the subsequent impact of the resolutions on banks' ex-post behavior. We, thus, assign Bank γ as a distressed bank with high NPLs, Bank δ as a bank with moderate stock of NPLs and Bank τ as an example of a healthy bank. Since the 2007-08 financial crisis, NPLs are in the spotlight for both regulators and banks as they have been linked to bank failures, and are often the harbingers of a banking crisis (Ghosh, 2015). This deterioration of banks' asset quality is not only financially destabilizing for the banking system but may reduce economic efficiency, impair

[3] In Goodhart et al. (2006b) the seven largest UK banks are assumed to represent the British banking sector. They are measured in terms of their total assets as at the end of 2003 (Abbey National, Barclays, HBOS, HSBC, Lloyds, Royal Bank of Scotland, and Standard Chartered) and other major banks which have either been merged with or acquired by these seven banks over the sample period (NatWest, Bank of Scotland, and Halifax).

social welfare and decrease economic activity (see Barseghyan, 2010; Gonzales-Hermosillo, 1999; Zeng, 2012).

Our calibration procedure follows the steps presented in Goodhart et al. (2006b). In each period t, excluding the Lagrange multipliers, we have a system of 56 equations in 143 unknown variables, 87 of which are exogenous variables in the model. This implies that there are 87 variables whose values have to be chosen in order to obtain the numerical solution to the model. Thus, they represent the degrees of freedom in the system and can either be set appropriately or calibrated against the real data. We present the results from the initial equilibrium in the Online Appendix 1.

We use these results to derive directional responses of the endogenous variables of interest in order to simulate shocks to the economy triggered by our resolution scenarios as outlined in Table 1. We carry out this comparative analysis by changing the exogenous variables in order to reflect the resolution dynamics. We then assess how the equilibrium is impacted by these series of changes. Table 2 reports the summary of this exercise, while Online Appendix 2 presents the detailed result tables behind each resolution scenario.

[Table 2]

Our calibration results identify no clear winner among the resolution mechanisms being considered. In summary, we see that a bank bailout is the least favorable option while merger and "bad-bank" mechanisms seem to deliver the most positive results for all banks in the economy, although with few trade offs. The "bad-bank" approach can improve banks' financial performance when it is coupled with an instant capital injection. More specifically, bank profits as well as capital ratios improve under the "Bad Bank 2" scenario. In contrast, the absence of a quick recapitalization can depress bank financial performance (Bad Bank 1). These results suggest that appropriate recapitalization is required for a successful restructuring of the troubled bank as it has the potential to unlock that bank's recovery. We also find an interesting impact of the "bad-bank" resolution on bank lending. Despite an improvement in bank financial performance under Bad Bank 2 scenario, bank lending activities decrease. The opposite occurs under a Bad Bank 1 scenario with a gradual capital injection. We argue that prolonging the weak financial position of banks under the Bad Bank 1 scenario could provide them with the incentive to engage in "zombie lending". This is in line with empirical studies in this field (see

Peek and Rosengren, 2000). Under the Bad Bank 2 scenario with quick recapitalization, however, banks are more likely to engage in healthy lending that consists of issuing higher quality loans (e.g., bank capital increases which might be a result of a decrease in the denominator, RWA). Overall, our results suggest that a "bad-bank" resolution coupled with an instant capital injection can improve bank financial performance and stimulate better quality lending.

Some trade offs also emerge under the merger resolution mechanisms. Our results suggest that merger could be an effective tool in resolving bank distress at the beginning of the crisis, or in banks that are not severely impacted by the crisis (i.e., banks with moderate level of NPLs). We argue, based on our results, that when the crisis deepens and the distressed bank's position worsens, mergers tend to hamper the financial position of the acquirer. This is because mergers do not aim to tackle the toxic assets on bank's balance sheet, but instead shift the problem with the associated potential losses into the future. Consequently, the future losses might negatively impact the acquirer's financial performance (see results under Merger 2). This trend is in line with the existing literature that argues for deep restructuring measures as a necessary step in restoring bank financial health and lending activities (e.g., Landier and Ueda, 2009). Otherwise, the bank's distress might force them to engage in "zombie lending". This is indicated by the credit activity under Merger 2 scenario which delivers weak financial performance for the banks (i.e., CAR and profits). Thus, we argue that mergers can only temporarily solve problems in the banking sector as they tend delegate them into the future. "Bad-bank" mechanisms, in contrast, can instantly restore banks' financial performance and, thus, can enable stability in the banking sector.

Overall, our results indicate that resolution mechanisms that involve direct restructuring of a bank's balance sheet with sufficient and rapid recapitalization are most effective in restoring a bank's health, in contrast to costly bailouts. This conclusion contributes to the literature findings promoting a deep restructuring of banking sectors instead of massive bailouts (e.g., Brei et al., 2020).

Our results shed some light on bank contagion in the context of systemic risk. The common element in our studied resolution mechanisms (except Merger 1) is the capital injection by the government that is financed from household taxation. Even through the effect of this capital injection is initially concentrated on a single bank (Bank γ, or Bank τ under Merger 2), various contiguous effects occur in other banks in the economy. More capital in the distressed banking sector should translate into a greater market confidence and, thus, lower cost of interbank

borrowing. Our results, however, demonstrate that this effect only holds in the event of "moderate" NPL environment in the banking sector. In the case of a severe crisis (i.e., high NPLs), or "no crisis" environment, capital injections render a negative effect on lending rate resulting in their increase. The effects in the former scenario could be explained by the fact that capital injections do not target the removal of uncertainty with regards to banking sector distress. They target the fulfilment of the solvency criteria at the individual bank level. Thus, the presence of uncertainty, especially with reference to future bank losses, does not allow healthy banks to charge lower lending rates. Under the later scenario of "no crisis" environment, on the other hand, capital injections might send a negative signal to the market about the future, which could result in the increase of interest rates. Our results partially confirm the evidence by Beck and Gambacorta (2019) who argue that resolution mechanisms might not be effective in mitigating the systemic effects of a crisis.

4. Empirical analysis

4.1. Data

We now explore a cross-section of banks from 39 countries that experienced systemic banking crisis. We rely on Laeven and Valencia's (2018) mapping of the systemic banking crisis episodes and their country-level categorization of bank interventions. We select the same three resolution mechanisms for our analysis that we used under the theoretical calibration exercise, namely bailout (nationalization), sale of a distressed bank (merger) and "bad-bank" approach. We then merge the country-level data with an extended version of the bank-level database of Hryckiewicz (2014) which consists of the actual bank names that were involved in government resolutions between 1992 and 2017.

Our initial sample consisted of 215 intervened banks and 5,064 non-intervened banks from 39 countries. We carry out the process of matching the intervened banks with their non-intervened peers following a similar approach to that employed in Hryckiewicz (2014). Namely, we begin with the selection based on the overlap of their lending activities, i.e., loan-to-total asset ratio of the non-intervened banks falling within the range of loan-to-total asset ratio of the intervened banks as at the year in which the given resolution mechanism was introduced. This stage of selection delivers 703 peer banks. Next, we replicate the process but this time based on the total asset figures which results in the selection of 880 peer banks. Following the approach frequently used in micro banking studies, we apply a number of screens to exclude implausible

and unreliable observations. This involves a clean-up process of both selected and non-selected peer banks in order to ensure that the final peer selection is well matched with the characteristics of the intervened banks. For instance, we look only for the banks that are deposit takers which characterizes our intervened banks. We exclude bank observations with (i) negative or missing values for total assets, (ii) negative total loans, (iii) loan-to-asset ratio larger than one, or (iv) capital-to-asset ratio larger than one. The final outcome delivers 757 peer banks.

For the sake of our regression analysis, we reduce the time series of our sample to cover the six years before and after the year in which the given resolution mechanism was introduced. This results in a final sample of 708 peer banks. This is motivated by the desire to focus our regression analysis of the resolution effectiveness within a reliable and consistent time period for all banks.

Table 3 provides the overview of key characteristics behind our sample. The majority of the sample (79%) comes from developed countries. The most common resolution mechanism in these countries is bailout (nationalization), closely followed by a "bad-bank" approach. This is largely an outcome of the financial crisis of 2008 during which large scale bailouts were commonly used, particularly in the UK and USA. In developing countries, a "bad-bank" approach is most frequent. A government assisted merger is the rarest resolution in both country groups. In the vast majority of developing countries, a systemic banking crisis is accompanied by a currency crisis. This is quite uncommon in developed economies.

[Table 3]

We select a wide range of bank-level variables to empirically assess the impact of resolutions on banks. Online Appendix 3 lists all of the variables used in our analysis. We explore four dependent variables to assess the impact of the resolution mechanisms on banks' recovery. First, we use loan ratio and loan growth as proxies for bank lending. Loan ratio also reflects liquidity risk since loans are less liquid and riskier but have a higher expected return than other assets in a bank's portfolio. Next, we proxy a bank's risk position with the ratio of loan loss reserves-to-NPLs. In order to control for any non-linear effects in our regressions and to reduce any bias from outliers, we transform the ratio to its logarithmic form, and truncate it at the 1st and 99th percentiles. This is because of some extreme observations at both tails of the variable's

distribution. Although this paper is looking into banks' performance during periods of financial instability, and, thus, keeping those outliers could have been desirable, the view that some of them may be caused by one-off events, or data errors is applied.[4] Last, we proxy a bank's capital position with total capital ratio and we test alternatives, namely total equity to total assets ratio under the robustness checks.

We can predict a few trends in relation to our studied dependent variables and the type of resolution mechanism. First, we expect that bank resolutions should improve banks' solvency ratios. However, whether or not a bank will start extending loans to the real sector will mostly depend on their expectations on future losses. Thus, we argue that the resolution effect on bank lending will depend on the type of resolution mechanism undertaken. While bailouts and related recapitalizations are necessary, they might not be sufficient to rescue a bank; this is in line with studies that show capital injections not leading to the recovery of bank activity without appropriate restructuring mechanisms (e.g., Brei et al., 2020). Last, we expect banks that are appropriately restructured to exhibit a lower ratio of loan loss reserves-to-NPLs. As credit quality improves, banks will not be pushed to provide higher reserves for future losses. However, we do not expect to see the same effect for bailouts, which are mainly aimed at improving bank solvency ratios.

We capture a range of bank-level explanatory variables in our regressions and we explore how they modify the effectiveness of resolution mechanisms. Specifically, we look into bank profitability (Return on Average Equity, ROAE), liquidity (ratio of liquid assets to total deposits and borrowings), and bank size (total asset ratio). Table 4 shows the descriptive statistics for bank-level variables. The statistics are divided by intervened and non-intervened banks as well as for a period before and after the introduction of the resolution mechanism. By splitting the data along these two dimensions, we can report the difference between intervened and non-intervened banks (column 3) and the difference between the period before and after the resolution (row 3) which is in line with our research question. The bottom right part of the table (column 3, row 3) shows the basic difference-in-difference (DID) results, that indicate how intervened banks differ from non-intervened banks after the resolution is introduced

[4] We look into the results with all observations under the loan loss reserves-to-NPLs ratio under the robustness checks and find no significant difference in our reported results.

relative to the period prior to the resolution launch. Because the selection of banks for intervention is an endogenous choice made by the government in our analysis, it is important for us to control for inherent differences between intervened and non-intervened banks.

[Table 4]

Column 3 in Table 4 shows that the intervened banks were, on average, less capitalized than their non-intervened counterparts prior to the introduction of the resolution. Interestingly though, the intervened banks had slightly lower loan growth than non-intervened banks prior to the resolution period, however they increased their loan growth significantly after the resolution was introduced. This might suggest that overall resolution mechanisms are effective in restoring banks' activity in the real economy. Finally, the data suggest that non-intervened banks had much higher reserves than intervened banks both before and after the implementation of the resolution.

Last, we include several industry- and country- level controls in our regressions, e.g. banking industry concentration ratio, proxies for countries' macroeconomic conditions, corporate governance proxies such as the business extent of disclosure index. The full definitions and sources are available in Online Appendix 3 together with their summary statistics in Online Appendix 4.

4.2. Methodology

Our main research question is whether the resolution mechanisms that aim at restoring bank health turn out to be effective during a systemic banking crisis. These mechanisms were designed to help the distressed institutions to recover and limit the negative contagious effects of the crisis. Our aim is to assess their effectiveness during a systemic crisis episode by regressing a wide range of bank-, industry- and country-level characteristics on banks' lending, reserves-to-NPLs and bank capital. We also intend to investigate whether certain resolution mechanisms are more effective than others. In particular, we aim to assess whether there is any difference in effectiveness between the bailout resolution in comparison to resolution mechanisms that require restructuring of bank balance sheet, i.e., "bad-bank" and bank merger mechanisms.

In order to answer these questions, we apply difference-in-difference (DID) methodology to evaluate the effect of resolution mechanisms on banks. First, we expand on the t-tests presented in Table 4 by examining the change in the average bank behavior parameters for the intervened banks in comparison to the non-intervened banks under different bank sub-samples. We then use the semi-parametric DID regression model to see if the resolution mechanisms affect bank performance, controlling for other factors that could influence the effectiveness of the resolution.

For this, we follow the approach advocated by Abadie (2005) that originates from the identification procedure of Heckman et al. (1997). Abadie (2005) uses a two-step strategy to estimate the average effect of the treatment (ATE) (i.e., resolution mechanism) for the treated (i.e., intervened banks).[5] The model aims to estimate the causal effect of the resolution mechanism on the given dependent variables of bank performance (y) at time t. Each bank in the sample has two potential outcomes: (y_{1t}, y_{0t}). y_{1t} is the value of y if the bank is under a resolution mechanism at time t. y_{0t} is the value of y had the bank not received the government resolution at time t. d_t is equal to 1 when a bank is intervened by time t and 0 otherwise. At baseline b no bank is treated (i.e., intervened). $x_b$is a vector of covariates measured at baseline. Thus, the model attempts to estimate the average treatment effect on the treated (ATET) (i.e., intervened) banks as follows:

$$ATET \equiv \mathbb{E}\,(y_{1t} - y_{0t} |\, d_t = 1) \qquad \textit{Eq. (1)}$$

However, because y_{0t} is unobserved for the treated banks, the ATET cannot be directly estimated. Thus, the model assumes $y_{0b}$is the value y at time $t = 0$ (i.e., baseline). x_b is a set of pre-treatment characteristics. Finally, $(y_t - y_b)$ is the change of y between time t and the baseline b, and $\pi\,(x_b) \equiv \mathbb{P}\,(d = 1|x_b)$ is the conditional probability of being in the treatment group (i.e., propensity score). Abadie (2005) shows that the sample analog of

$$\mathbb{E}\left(\frac{y_t - y_b}{\mathrm{P}\,(d_t = 1)} * \frac{d - \pi\,(x_b)}{1 - \pi\,(x_b)}\right) \qquad \textit{Eq. (2)}$$

given an unbiased estimate of the ATET if the below Equations (3) and (4) hold.

[5] For more details on the semi-parametric DID methodology please see Abadie (2005).

$$\mathbb{E}\,(y_{0t} - y_{0b} |\, d_t = 1, x_b) = \mathbb{E}\,(y_{0t} - y_{0b} |\, d_t = 0, x_b) \qquad \textit{Eq. (3)}$$

$$\mathbb{P}\,(d_t = 1) > 0 \; and \; \pi\,(x_b) < 1 \qquad \textit{Eq. (4)}$$

Most of the banks in our sample comes from a limited number of countries which gives the US-based banks a total share of 29%. Since Abadie's (2005) model does not allow the use of sampling weights, we run our regressions for the sub-samples of non-US banks separately in order to see whether results stay consistent. In all our regressions, we include country-fixed effects ($\alpha \mathrm{country}_t$) to control for any unobservable country characteristics. We also explore additional fixed effects and decide to include time dummies ($\alpha \mathrm{time}_t$) to control for any aggregate effects of the banking crises. We remove these fixed effects under the robustness checks and report no significant change in our results.

4.3. Results

Table 5 provides the extension of the simple average parameters for our studied measures of bank performance. Here, we stratify banks into three categories based on their NPL ratio level. This matches the approach we used in the theoretical part of our paper. In column 3 we can see that the average reserves-NPLs ratio decreases in banks with high and medium NPL levels in the ex-post resolution period over that of non-intervened banks with a similar level of NPLs. In contrast, among banks with low levels of NPLs, the average reserves-NPLs ratio for intervened banks increases sharply by 25.3 per cent relative to non-intervened banks. The total capital of intervened banks declines, on average, in the post resolution period in comparison with the non-intervened banks. This is the first evidence that government resolutions may have a negative impact on banks' capital positions. Similarly, the introduction of resolution mechanisms seems to reduce the loan ratio of intervened banks in comparison to non-intervened banks. Oddly, the resolutions also appear to increase loan growth in intervened banks in all cases except for those banks with low levels of NPLs. This could be explained by the intervened banks embarking on risky lending due to reduced market discipline. Igan and Pinheiro (2011), for instance, argue that aggressive lenders in the banking sector between 2000 and 2007 received the largest bailouts and continued to increase their risk levels in the post-

crisis environment. These mixed results require closer analysis through regression analysis which comes next.

[Table 5]

Tables 6-9 present our main results which are based on the semi-parametric DID regressions. In addition to our assessment of the constant terms that indicate the impact of the given resolution mechanism on the dependent variables, we explore how the effect of a given resolution is modified through key bank characteristics, namely, bank size (i.e., Total Assets, TA), its profitability (i.e., ROAE) and liquidity (i.e., liquid assets-to-total deposits and borrowings, LATDB). We analyze both the full sample and a sub-sample within which we exclude the US banks in order to reduce any risk of bias from the dominance of the US banks in our sample. Moreover, in order to be able to analyze the effect of different resolutions under distinct crisis events, we break our sample into a sub-group of the banks with high NPL levels. This allows us to see whether the effect of resolutions might depend on the severity of the crisis. This approach is consistent with our theoretical modelling. Tables 8-9 present these results.

[Tables 6-9]

We find some interesting results. We show that bailouts are not effective in restoring bank financial strength and, consequently, bank credit activity. The coefficients of the relevant variables are statistically significant and negative in all of our tested regressions. These negative bailout effects hold under all of our dependent variables except for loan growth. We argue that pure capital injection aimed at helping banks to survive might actually leave banks in distress, if appropriate restructuring actions are not undertaken. We find that banks still struggle with the lack of capital (as suggested by the negative impact of bank bailout on capital ratio) within six years after the government intervention. Our results suggest that these banks are not able to restore credit activity, as compared to their peers.

Our results are consistent with Brei et al. (2020) who claim that only capital injections as well as appropriate bank restructuring allow banks to restore their financial strength at the capital level, enabling them to engage in credit expansion. More specifically, they suggest that during a crisis the capital ratio must achieve a certain threshold, above which banks are willing to engage in loan activity. However, pure capital injections mainly concentrate on fulfilling banks' capital requirements which may be not sufficient to restore credit activity at these banks, as shown by our results.

In turn, our findings suggest that new resolution frameworks are more successful in restoring bank health. Especially, the "bad-bank" resolution that eliminates the bank's bad loans from its portfolio, restores bank capital, and, at the same time, encourages the bank to engage in the credit market. We find that all of our dependent variables improve after the implementation of this resolution. Not surprisingly, this tool seems to be mostly effective during crises or situations when the banking sector is severely concerned with the issue of high NPLs (see Tables 8-9). This finding is consistent with our calibration exercise based on the model of Goodhart et al. (2005, 2006a). There, we also find that the positive impact of the "bad-bank" resolution is enhanced when it is coupled with a capital injection, especially in the "high NPL" environment in the banking sector.

Interestingly, we do not see any statistically significant impact of a merger on bank financial health. As suggested by our theoretical results as well as other scholars (e.g. Sheng, 1996), the merger resolution seems only to be effective at the initial stages of a crisis or in the event of a less severe crisis, when the banking sector is not deeply concerned with the problem of bad loans.

4.3.1 Robustness checks

We carry out some standard checks on our main regression results, such as we reduce the time series of our data by two years from six to four years before/after the introduction of the resolution; we drop certain controls as well as swop the variables used in the regressions with alternative proxies (e.g., ROAE with net interest margin; loan loss reserves/NPLs with reserves/gross loans). We record no significant change in our main findings as a result of these checks. We also re-run the regressions using a higher order of approximation and report no substantial change in our results. We also gradually remove the three bank-level variables that we have used to illustrate how they modify our treatment effect of resolutions. Similarly, we add additional bank-level variables to our main regressions in a gradual fashion. Overall, our results stay broadly in line with our conclusions. We provide some of these results in our Online Appendix and the rest are available upon request.

5. Conclusion

For many years governments stood ready to rescue financial institutions in distress through an extensive number of bailouts. These actions have not always been successful and often caused

a so-called moral hazard to emerge in the economy. Thus, regulators across the globe decided to change their attitude toward bank distress by requiring banks to prepare their own resolution plans in the event of distress. It is broadly believed that the new resolution approach should limit losses to the banking sector as well as further negative contagious effects of the crisis. Moreover, the new regulatory reforms assume that potential losses should be initially covered by the bank's own stakeholders, and that government bailouts should only be applied in extreme cases when all other resolution methods fail.

These new reforms raise many questions about how successful the resolution plans will be to restore banks from distressed states and which will be most successful. Moreover, it is not clear how these mechanisms will work out during systemic episodes of a financial crisis when the management of the systemic effect of the crisis often takes priority. We tackle these questions in our paper.

First, we apply the theoretical model of financial fragility by Goodhart et al. (2005, 2006a) to explore the impact of three resolution mechanisms: a bank sale via merger, "bad-bank" approach and a bank bailout. Second, we assess these resolutions using the semiparametric DID methodology by using a novel bank-level database consisting of 215 banks from 39 countries which were subject to these resolution mechanisms during the 1992-2017 periods of systemic banking crises. Our main focus is whether banks that underwent different resolution mechanisms were able to restore their financial health to a level where they could continue their credit activity in the real sector. We also look at how different resolution mechanisms interrelate with other banks' performance and, thus, whether they are able to mitigate the contagious effect of the crisis.

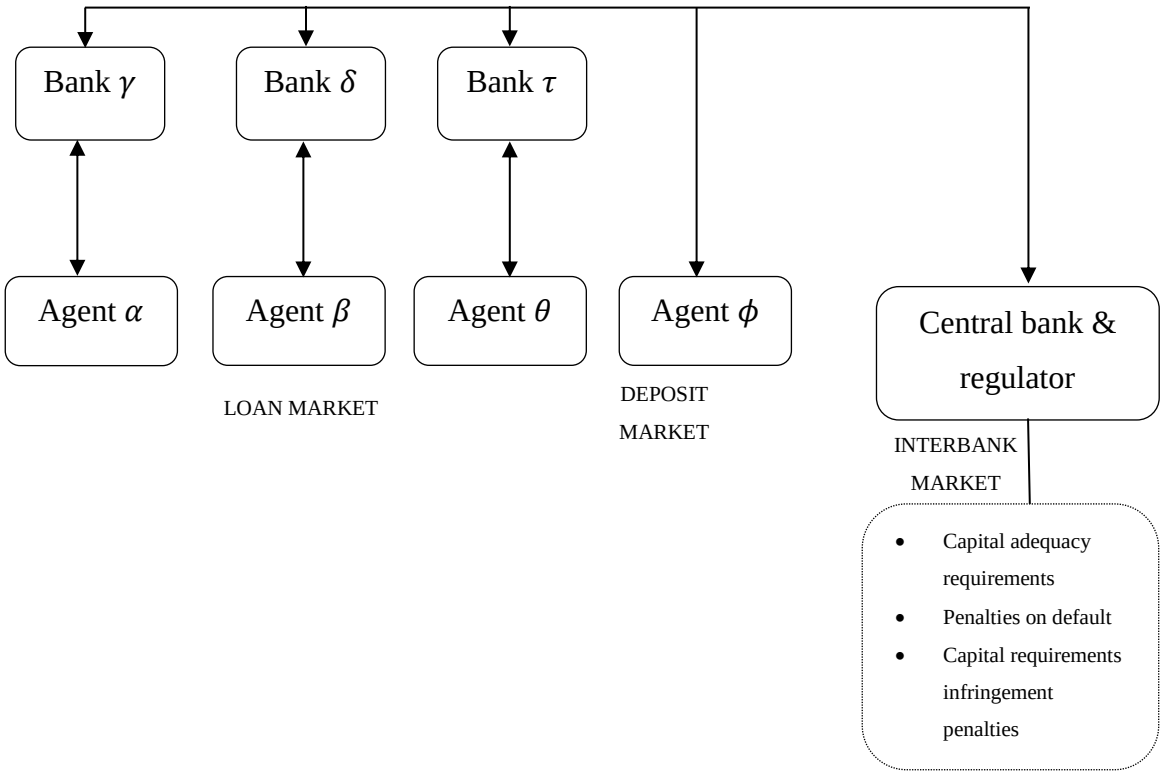
Our findings seem to be very promising. We show that restructuring of a distressed bank is necessary to restore financial health and, consequently, to restore its credit activity. Our results consistently show that a "bad-bank" resolution is an effective mechanism to restructure a bank's portfolio problem and to restore its capital to a level that enables further lending to the real sector. In contrast, pure capital injection in the form of a bank bailout does not deliver desirable results. We find that this form of intervention is negatively related to capital ratio even several years after the government action has taken place. We argue that a lack of appropriate restructuring of a bank's high NPLs is likely to "bite" bank capital. Moreover, uncertainty with regards to asset quality seems to encourage banks to engage in "zombie lending". In contrast, the "bad-bank" mechanism allows banks to restore their capital, which then translates into higher lending activity on the credit market. Interestingly, both empirical

and theoretical models provide similar conclusions. However, the theoretical model also shows that when the systemic shock is not widely spread, a merger involving the distressed bank also seems to support banking sector stability. Finally, our results indicate that the resolution mechanisms under discussion are not able to mitigate the systemic effect of the crisis, especially when the banking sector is exposed to the problem of high NPLs. We notice that despite the injected capital, the uncertainty on the interbank market still exists. However, when the crisis is moderate, the resolutions we have considered may reduce the systemic effect of the crisis due to the resolution applied and banks' performance recovery.

Our paper provides some important policy contributions. First, it contributes to the discussion on the reasons behind the weak performance of European banks after the crisis of 2008-10 despite the significant scale of bailouts carried out during that period. Second, our findings show that the recent regulatory reform, such as the BRRD, the Dodd-Frank Act or Living Will, that shift the focus from bank bailouts into new resolution mechanisms is the right approach which could help ensure better management of the financial crisis through restoring banks' activities in the credit market. Finally, our findings indicate possible ways that bankers and regulators could react to solve problems in the banking sector during such systemic events. Thus, our paper provides a useful contribution to the debate on the new crisis resolution framework.

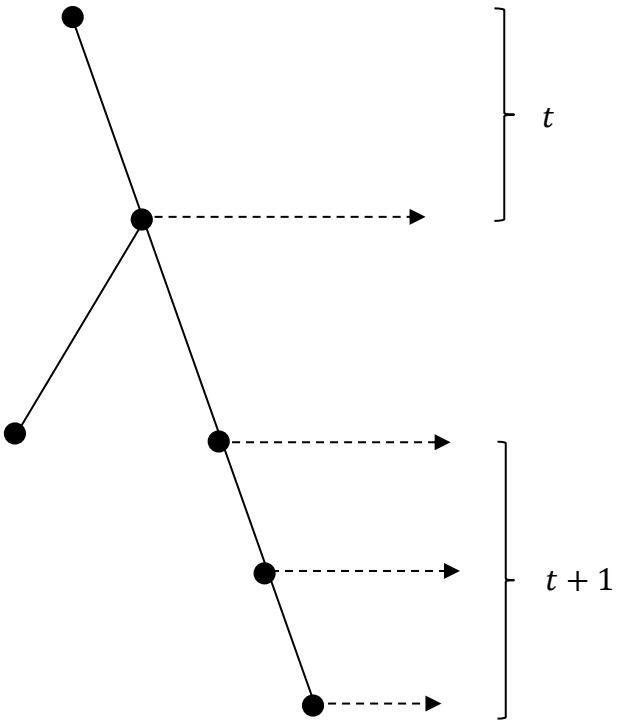
Figures

Figure 1: The model structure – channels of agents and market interactions.



Source: Modified from Lewis (2010).

Figure 2: The time structure of the Goodhart et al. (2005) model.



1. Borrow and deposit in the interbank market (B)
2. OMOs (CB)

Nature decides which of the state $s \in S$ occurs

1. Settlement of loans and deposits (H and B)
2. Settlement of interbank loans and deposits (CB and B)
3. Default and capital requirements' violation

All banks are wound-up

Source: Goodhart et al. (2005).

Tables

Table 1: Setup for the calibration exercise.

Resolution scenario	**Banks setup**	**Setup of the resolution mechanism in the applied model**
1. No resolution (baseline scenario)	Bank γ: high NPLs Bank δ: moderate NPLs Bank τ: no NPLs	n/a *(see Online Appendix 1 for the initial equilibrium's results)*
2. Bailout (nationalization of Bank γ)	Bank γ: high NPLs – intervened Bank δ: moderate NPLs Bank τ: no NPLs	- the government increases household tax to finance the bank resolution in the form of a capital injection into Bank γ - this, in effect, decreases household loan demand and deposit supply functions: $a_{\alpha,\beta,\theta}: \downarrow 15\%$ $z_{b,1}: \downarrow 15\%$ - the resolution involves recapitalization of Bank γ through capital injection: $e_t^{\gamma}: \uparrow 15\%$
3. Bank sale (merger between Bank γ and Bank τ)	Bank γ: high NPLs – intervened Bank δ: moderate NPLs Bank τ: no NPLs – intervened	- the government assists in a merger of Bank γ with Bank τ - all of Bank γ's balance sheet is combined with the balance sheet of Bank τ, and reported under Bank τ - there are two possible options for the government to complete the bank sale resolution: (i). to assist in the merger without any capital injection (**Merger 1**); (ii). to assist in the merger with an instant capital injection (**Merger 2**) - if the latter option is chosen, the government increases household tax to finance the recapitalization of Bank τ through: $e_t^{\tau}: \uparrow 15\%$ - this, in effect, decreases household loan demand and deposit supply functions: $a_{\alpha,\beta,\theta}: \downarrow 15\%$ $z_{b,1}: \downarrow 15\%$
4. "Bad-bank" (Bank γ)	Bank γ: high NPLs – intervened	- the government assists in restructuring the balance sheet of the "bad" bank (i.e., Bank γ) by shifting all of its healthy

Resolution scenario	Banks setup	Setup of the resolution mechanism in the applied model
	Bank δ: <u>moderate</u> NPLs Bank τ: <u>no</u> NPLs – intervened	assets to Bank τ ("good bank") excluding the capital of Bank γ - the government gradually (**Bad bank 1**) or instantly (**Bad bank 2**) injects capital to Bank γ: $e_t^{\gamma}: \uparrow 15\%$ - this capital injection is financed by taxpayer money which, in effect, gradually (**Bad bank 1**) or instantly (**Bad bank 2**) decreases household loan demand and deposit supply functions: $a_{\alpha,\beta,\theta}: \downarrow 15\%$ $z_{b,1}: \downarrow 15\%$

Source: Authors' calculations (2020).

Table 2: Summary of the directional changes in the main endogenous variables in the applied model under each resolution scenario.

Endogenous variable	Bank γ (high NPL)	Bank δ (moderate NPL)	Bank τ (no NPL)
Repayment rate in state i (v_i^b)	No resolution: -	No resolution: -~	No resolution: -~
	Nationalization: +~	Nationalization: -	Nationalization: +~
	Merger 1: n/a	Merger 1: -~	Merger 1: +~
	Merger 2: n/a	Merger 2: -~	Merger 2: -~
	Bad bank 1: +	Bad bank 1: -	Bad bank 1: -~
	Bad bank 2: -~	Bad bank 2: 0	Bad bank 2: +~
Repayment rate in state ii (v_{ii}^b)	No resolution: -~	No resolution: -~	No resolution: -~
	Nationalization: -~	Nationalization: -	Nationalization: -
	Merger 1: n/a	Merger 1: -~	Merger 1: -~
	Merger 2: n/a	Merger 2: +	Merger 2: +
	Bad bank 1: +	Bad bank 1: +	Bad bank 1: +
	Bad bank 2: -~	Bad bank 2: 0	Bad bank 2: -~
Credit in the loan market ($\bar{m}_i^b$)	No resolution: -~	No resolution: -~	No resolution: -~
	Nationalization: -~	Nationalization: +~	Nationalization: +~
	Merger 1: n/a	Merger 1: -~	Merger 1: -~
	Merger 2: n/a	Merger 2: +	Merger 2: +
	Bad bank 1: +	Bad bank 1: +	Bad bank 1: +
	Bad bank 2: -~	Bad bank 2: 0	Bad bank 2: -~
Capital in state i (e_i^b)	No resolution: +~	No resolution: +~	No resolution: +~
	Nationalization: +~	Nationalization: -~	Nationalization: -~
	Merger 1: n/a	Merger 1: +~	Merger 1: 0
	Merger 2: n/a	Merger 2: -~	Merger 2: +
	Bad bank 1: +	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: +~	Bad bank 2: 0	Bad bank 2: 0

Endogenous variable	**Bank γ (high NPL)**	**Bank δ (moderate NPL)**	**Bank τ (no NPL)**
Capital in state ii (e_{ii}^{b})	No resolution: +~	No resolution: +~	No resolution: +~
	Nationalization: +~	Nationalization: -~	Nationalization: -~
	Merger 1: n/a	Merger 1: +~	Merger 1: +~
	Merger 2: n/a	Merger 2: -~	Merger 2: +
	Bad bank 1: +	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: +~	Bad bank 2: 0	Bad bank 2: 0
Profit in state i (π_{i}^{b})	No resolution: -~	No resolution: +~	No resolution: -~
	Nationalization: -~	Nationalization: -~	Nationalization: -~
	Merger 1: n/a	Merger 1: +~	Merger 1: +~
	Merger 2: n/a	Merger 2: -~	Merger 2: -~
	Bad bank 1: -	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: +~	Bad bank 2: 0	Bad bank 2: 0
Profit in state ii (π_{ii}^{b})	No resolution: -~	No resolution: +~	No resolution: +~
	Nationalization: -~	Nationalization: -~	Nationalization: -~
	Merger 1: n/a	Merger 1: +~	Merger 1: -~
	Merger 2: n/a	Merger 2: -~	Merger 2: -~
	Bad bank 1: -	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: +~	Bad bank 2: 0	Bad bank 2: 0
Debt in interbank market ($\mu_{d,t}^{b}$)	No resolution: +~	No resolution: +	No resolution: -~
	Nationalization: -~	Nationalization: -	Nationalization: -
	Merger 1: n/a	Merger 1: +~	Merger 1: -~
	Merger 2: n/a	Merger 2: -	Merger 2: -
	Bad bank 1: -	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: 0	Bad bank 2: 0	Bad bank 2: 0
CAR in state i (k_{i}^{b})	No resolution: +~	No resolution: +	No resolution: +~
	Nationalization: +~	Nationalization: -~	Nationalization: -~
	Merger 1: n/a	Merger 1: +~	Merger 1: +~

Endogenous variable	**Bank γ (high NPL)**	**Bank δ (moderate NPL)**	**Bank τ (no NPL)**
	Merger 2: n/a	Merger 2: -	Merger 2: -
	Bad bank 1: -	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: +~	Bad bank 2: 0	Bad bank 2: -~
CAR in state ii (k_{ii}^{b})	No resolution: +~	No resolution: +	No resolution: +~
	Nationalization: +~	Nationalization: -	Nationalization: -
	Merger 1: n/a	Merger 1: +~	Merger 1: +~
	Merger 2: n/a	Merger 2: -	Merger 2: -
	Bad bank 1: -	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: +~	Bad bank 2: 0	Bad bank 2: -~
Lending rate (r^{b})	No resolution: +~	No resolution: -	No resolution: +~
	Nationalization: +~	Nationalization: -~	Nationalization: -~
	Merger 1: n/a	Merger 1: +	Merger 1: +
	Merger 2: n/a	Merger 2: -	Merger 2: -
	Bad bank 1: -	Bad bank 1: -	Bad bank 1: -
	Bad bank 2: 0	Bad bank 2: -~	Bad bank 2: 0
Deposit rate (r_{d}^{b})	No resolution: 0	No resolution: -	No resolution: 0
	Nationalization: 0	Nationalization: -~	Nationalization: 0
	Merger 1: n/a	Merger 1: +	Merger 1: 0
	Merger 2: n/a	Merger 2: -	Merger 2: 0
	Bad bank 1: 0	Bad bank 1: +~	Bad bank 1: 0
	Bad bank 2: 0	Bad bank 2: +~	Bad bank 2: 0

Note: +(-) substantial increase (decrease); +~(-~) weak increase (decrease); 0 – no change

Source: Authors' calculations (2020).

Table 3: Descriptive statistics at the country level.

Country	Year of the systemic crisis	Currency crisis (Yes =1, No = 0)	Number of non-intervened banks	Number of intervened banks	Number of bailouts (nationalization)	Number of mergers	Number of "bad-bank" cases
Austria	2008	0	19	8	2	0	2
Belgium	2008	0	11	4	3	1	0
Bulgaria	1996	1	11	2	2	0	2
Croatia	1998	0	15	6	4	4	4
Czech Rep.	1996	0	14	1	0	1	0
Denmark	2008	0	17	6	2	6	2
Estonia	1992	1	4	4	0	4	4
Finland	1991	0	1	1	1	0	1
France	2008	0	60	6	5	0	0
Germany	2008	0	40	14	3	0	5
Greece	2008	0	5	4	0	0	0
Iceland	2008	1	2	2	2	0	1
Ireland	2008	0	5	4	4	0	2
Japan	1997	0	6	11	2	8	9
Lithuania	1995	0	6	4	2	1	2
Netherlands	2008	0	9	4	4	0	0
Norway	1991	0	10	5	2	0	4
Slovenia	2008	0	1	5	0	0	3
Spain	2008	0	14	12	3	10	8
Sweden	1991	1	6	2	1	2	2
Switzerland	2008	0	36	2	2	0	0
UK	2007	0	22	14	9	3	3
USA	2007	0	267	6	6	0	4
Sub-total	**-**	**4**	**581**	**152**	**59**	**40**	**58**
Argentina	2002	1	12	4	2	1	3
Colombia	1998	0	14	6	2	5	2
Ecuador	1998	1	3	3	0	0	3

Country	Year of the systemic crisis	Currency crisis (Yes =1, No = 0)	Number of non-intervened banks	Number of intervened banks	Number of bailouts (nationalization)	Number of mergers	Number of "bad-bank" cases
Indonesia	1997	1	17	10	10	1	8
Jamaica	1996	1	5	3	3	3	1
Malaysia	1997	1	24	5	1	4	2
Mexico	1994	1	16	4	1	3	2
Nicaragua	2000	0	2	1	0	0	1
Russia	1998	1	1	2	0	1	1
S Korea	1997	1	7	6	2	4	2
Thailand	1997	1	3	5	4	1	4
Turkey	2000	1	17	8	1	6	5
Ukraine	1998	1	2	2	0	0	2
Uruguay	2002	1	1	2	2	0	1
Venezuela	1994	1	3	2	2	0	2
Sub-total	**-**	**13**	**127**	**63**	**30**	**29**	**39**
Total	**-**	**17**	**708**	**215**	**89**	**69**	**97**

Notes: Data on the dates of systemic banking crises come from Laeven and Valencia (2018). The data on intervened banks in individual countries and their type of government resolution mechanism come from the extended database of Hryckiewicz (2014). It is constructed based on the information from central banks' reports and surveys conducted among the central banks.
Source: Authors' calculations (2020).

Table 4: Descriptive statistics of bank characteristics.

	Non-intervened banks (1)		Intervened banks (2)		Intervened – non-intervened banks (3)	
	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.
(1) Before the introduction of the resolution mechanism (six years)						
Reserves	210.189	200.005	72.250	89.848	-137.939***	7.257
Total capital	17.327	16.661	11.344	6.156	-5.983***	0.497
Loan ratio	57.847	14.971	59.478	16.677	1.631**	0.936
Loan growth	1.737	15.161	1.690	11.827	-0.047*	0.779
ROAE	10.047	23.838	8.334	80.813	-1.714*	3.675
TA (ln)	7.4135	2.377	10.0318	2.634	2.618***	0.121
Liquidity	37.520	23.119	35.069	24.046	-2.450**	1.285
(2) After the introduction of the resolution mechanism (six years)						
Reserves	95.852	111.541	75.158	63.099	-20.694***	3.079
Total capital	16.618	10.286	11.313	18.976	-5.305***	0.808
Loan ratio	59.819	15.858	55.222	18.161	-4.597***	0.796
Loan growth	0.820	11.927	33.306	563.672	32.485**	23.842
ROAE	5.721	39.464	-2.374	114.354	-8.095**	3.872
TA (ln)	8.106	2.442	10.175	2.780	2.068***	0.099
Liquidity	35.965	24.635	33.440	27.461	-2.524**	1.070
(3) Difference between "after" and "before" introduction of resolution mechanisms						
Reserves	-114.336***	5.435	2.909***	5.710	117.246***	4.790
Total capital	-0.709***	0.405	-0.031***	0.858	0.678***	0.375
Loan ratio	1.972***	0.442	-4.257***	1.146	-6.229***	0.415
Loan growth	-0.917***	0.423	31.616***	23.850	32.533***	3.787

	Non-intervened banks (1)		Intervened banks (2)		Intervened – non-intervened banks (3)	
	Mean	Std dev.	Mean	Std dev.	Mean	Std dev.
ROAE	-4.327***	0.818	-10.708***	5.275	-6.381***	1.191
TA (ln)	0.693***	0.062	0.143***	0.143	-0.550***	0.061
Liquidity	-1.556***	0.666	-1.629***	1.534	-0.074***	0.612
No. of banks	708		215			
Total no. of obs.	7,429		2,397		-	-

Notes: this table shows the mean and standard deviation of bank characteristics used in our analysis. Each statistic is differentiated by the period before and after the implementation of the resolution mechanism for a given bank (dimension 1) and whether the bank was intervened (dimension 2). Differences are calculated across both dimensions. Differences-in-differences based on t-tests are shown in the bottom right corner.

** Standard deviations are shown in the respective column, with significance at 10%*

*** Standard deviations are shown in the respective column, with significance at 5%*

**** Standard deviations are shown in the respective column, with significance at 1%.*

Source: Authors' calculations (2020).

Table 5: Average changes in the studied parameters of bank performance in the ex-post period.

	Non-intervened banks (1)		Intervened banks (2)		Intervened – non-intervened banks (3)	
	Mean	**Std dev.**	**Mean**	**Std dev.**	**Mean**	**Std dev.**
FULL SAMPLE						
Reserves-NPLs	95.852	111.541	75.15836	63.0987	-20.694***	3.079
Total capital	16.618	10.285	11.31296	18.9757	-5.305***	0.808
Loan ratio	59.819	15.858	55.22208	18.1613	-4.597***	0.796
Loan growth	0.820	11.9269	33.30551	563.672	32.485**	23.842
SUB-SAMPLES						
High NPL banks						
Reserves-NPLs	66.702	53.928	54.906	31.851	-11.796***	2.121
Total capital	16.852	12.682	12.161	21.069	-4.691***	1.104
Loan ratio	63.968	18.060	57.126	16.933	-6.843***	0.879
Loan growth	1.148	14.201	38.789	608.147	37.641**	27.760
Moderate NPL banks						
Reserves-NPLs	127.069	142.427	116.896	91.273	-10.173*	7.386
Total capital	16.895	7.081	10.879	10.169	-6.016***	0.917
Loan ratio	55.516	11.774	45.402	19.780	-10.114***	2.531
Loan growth	0.589	9.046	4.587	18.877	3.998**	2.512
Low NPL banks						
Reserves-NPLs	51.806	34.134	77.095	50.479	25.289***	5.749
Total capital	11.791	9.026	6.090	18.087	-5.701**	2.561
Loan ratio	56.678	12.266	40.514	23.860	-16.164**	5.096
Loan growth	-2.705	8.340	-11.921	21.941	-9.216**	4.837

*Notes: this table shows changes in the performance of the intervened and non-intervened banks. The amounts shown are the average changes in given variable during the period following the introduction of the resolution mechanism (i.e., the first six years after the implementation of the resolution). The banks are stratified into three sub-samples based on their NPL ratio as at the time of the introduction of the resolution: high (NPL ratio ≥ 63.8), moderate (10 ≥ NPL ratio < 63.8) and low (NPL ratio < 10). * Standard deviations are shown in the respective column, with significance at 10%; ** Standard deviations are shown in the respective column, with significance at 5%; *** Standard deviations are shown in the respective column, with significance at 1%.*
Source: Authors' calculations (2020).

Table 6: Effects of resolution mechanisms on the ex-post bank performance – full sample.

	Reserves to NPLs			Total capital ratio			Loan ratio			Loan growth		
	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank
Bank profit.	0.000124	0.00893	-0.00780*	0.0195	0.00797	-0.0176	-0.0199	0.0849	-0.0593	0.000652	-0.0734	0.0106
(ROAE)	(0.00459)	(0.0236)	(0.00436)	(0.0228)	(0.0450)	(0.0224)	(0.0419)	(0.282)	(0.0538)	(0.0281)	(0.154)	(0.0158)
Bank size (TA)	1.298***	0.399	0.603***	5.122***	2.718**	1.932***	11.14***	9.565	3.571**	0.101	2.263	-0.644
	(0.117)	(0.405)	(0.103)	(0.576)	(1.257)	(0.450)	(1.693)	(6.743)	(1.581)	(0.550)	(2.007)	(0.712)
Bank liquidity	-0.00758	-0.0810	-0.0196	-0.0401*	-0.152	-0.0989	0.187**	-1.119	-0.0582	0.0132	0.442	0.0535
(LATDB)	(0.00556)	(0.0639)	(0.0132)	(0.0228)	(0.248)	(0.0652)	(0.0787)	(0.739)	(0.168)	(0.0383)	(0.362)	(0.0588)
Constant	-15.80***	-2.229	-6.281***	-61.55***	-29.11*	-18.28***	-155.0***	-80.14	-45.35**	-1.748	-43.72	2.068
	(1.470)	(6.450)	(1.318)	(7.074)	(16.49)	(5.649)	(20.79)	(93.07)	(20.32)	(6.266)	(36.62)	(6.764)
No. of banks	793	661	679	794	636	682	795	686	702	787	662	673
Country dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

*Notes: this table reports estimates of the average effect of resolution mechanisms for intervened banks derived from semi-parametric DID regressions. It shows how the effect of each resolution mechanism varies with a bank's profitability, size, and liquidity level. The constant shows the impact of the resolution mechanism on the dependent variable. The reported average treatment effect on the treated (ATET) are estimated using a linear polynomial function to approximate the propensity score. The "number of banks" indicates the number of individual banks used for the estimations that satisfy the condition that their respective estimated propensity score is bigger than 0 and smaller than 1. All regressions include the following control variables: industry control (banking sector concentration ratio), country controls (GDP growth, inflation, business disclosure country index), bank controls (ROAE, bank size, liquidity, capital ratio (except when used as dependent variable), loan ratio (except when used as dependent variable), reserves to NPL ratio (except when used as dependent variable), time and country dummies. Standards errors are in parentheses. Significance levels are denoted as follows: * p<0.10, ** p<0.05, and *** p<0.01.*

Source: Authors' calculations (2020).

Table 7: Effects of resolution mechanisms on the ex-post bank performance – non-US bank sub-sample.

	Reserves to NPLs			Total capital ratio			Loan ratio			Loan growth		
	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank
Bank profit.	-0.000452	0.00887	-0.00195	0.0177	0.00776	0.00606	-0.0338	0.0884	-0.000826	0.00289	-0.0718	0.00781
(ROAE)	(0.00518)	(0.0232)	(0.00532)	(0.0265)	(0.0438)	(0.0275)	(0.0447)	(0.294)	(0.0787)	(0.0286)	(0.149)	(0.0207)
Bank size (TA)	0.986***	0.213	-0.640**	4.069***	2.111	-3.476***	8.456***	8.996	-11.08**	0.197	3.310	-1.072
	(0.143)	(0.551)	(0.285)	(0.791)	(1.647)	(1.328)	(2.223)	(7.942)	(5.159)	(0.692)	(3.283)	(1.423)
Bank liquidity	0.00537	-0.0824	-0.0521***	0.0149	-0.157	-0.214***	0.308***	-1.137*	-0.305**	0.0131	0.450	0.0454
(LATDB)	(0.00460)	(0.0621)	(0.0154)	(0.0217)	(0.245)	(0.0784)	(0.0654)	(0.691)	(0.148)	(0.0412)	(0.337)	(0.0668)
Constant	-12.94***	0.0302	8.361***	-53.06***	-21.80	43.87***	-133.6***	-72.62	118.6**	-2.655	-56.35	6.523
	(1.842)	(8.267)	(2.858)	(10.09)	(21.44)	(12.91)	(27.49)	(111.3)	(51.32)	(8.112)	(51.46)	(15.20)
No. of banks	558	461	480	555	450	476	555	455	487	551	458	458
Country dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

*Notes: this table reports estimates of the average effect of resolution mechanisms for intervened banks derived from semi-parametric DID regressions. It shows how the effect of each resolution mechanism varies with a bank's profitability, size, and liquidity level. The constant shows the impact of the resolution mechanism on the dependent variable. The reported average treatment effect on the treated (ATET) are estimated using a linear polynomial function to approximate the propensity score. The "number of banks" indicates the number of individual banks used for the estimations that satisfy the condition that their respective estimated propensity score is bigger than 0 and smaller than 1. All regressions include the following control variables: industry control (banking sector concentration ratio), country controls (GDP growth, inflation, business disclosure country index), bank controls (ROAE, bank size, liquidity, capital ratio (except when used as dependent variable), loan ratio (except when used as dependent variable), reserves to NPL ratio (except when used as dependent variable), time and country dummies. Standards errors are in parentheses. Significance levels are denoted as follows: * p<0.10, ** p<0.05, and *** p<0.01.*

Source: Authors' calculations (2020).

Table 8: Effects of resolution mechanisms on the ex-post bank performance – high NPL sub-sample (all countries).

	Reserves to NPLs			Total capital ratio			Loan ratio			Loan growth		
	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank
Bank profit.	0.00826	0.00893	-0.00531	0.0128	0.0107	-0.00910	-0.0352	0.0921	-0.0336	0.00438	-0.0644	0.0110
(ROAE)	(0.0556)	(0.0213)	(0.00494)	(0.0211)	(0.0422)	(0.0258)	(0.0419)	(0.300)	(0.0785)	(0.0269)	(0.129)	(0.0205)
Bank size (TA)	0.362	0.243	-0.740***	4.621***	2.369	-4.318***	9.394***	9.416	-12.32**	0.181	3.444	-1.142
	(0.613)	(0.533)	(0.274)	(0.843)	(1.797)	(1.176)	(2.475)	(8.203)	(5.671)	(0.694)	(2.973)	(1.435)
Bank liquidity	0.00226	-0.110**	-0.0543***	-0.00681	-0.333*	-0.253***	0.286***	-1.346**	-0.315**	0.0130	0.398	0.0436
(LATDB)	(0.00510)	(0.0515)	(0.0148)	(0.0189)	(0.189)	(0.0760)	(0.0662)	(0.666)	(0.146)	(0.0413)	(0.293)	(0.0662)
Constant	-4.575	0.841	8.846***	-59.23***	-17.79	51.06***	-144.6***	-69.26	125.0**	-2.468	-56.39	7.364
	(7.623)	(7.942)	(2.813)	(10.92)	(23.00)	(12.22)	(30.86)	(116.5)	(57.15)	(8.144)	(45.98)	(15.54)
No. of banks	596	464	479	553	467	473	550	450	484	556	459	458
Country dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

*Notes: this table reports estimates of the average effect of resolution mechanisms for intervened banks derived from semi-parametric DID regressions. It shows how the effect of each resolution mechanism varies with a bank's profitability, size, and liquidity level. The constant shows the impact of the resolution mechanism on the dependent variable. The reported average treatment effect on the treated (ATET) are estimated using a linear polynomial function to approximate the propensity score. The "number of banks" indicates the number of individual banks used for the estimations that satisfy the condition that their respective estimated propensity score is bigger than 0 and smaller than 1. All regressions include the following control variables: industry control (banking sector concentration ratio), country controls (GDP growth, inflation, business disclosure country index), bank controls (ROAE, bank size, liquidity, capital ratio (except when used as dependent variable), loan ratio (except when used as dependent variable), reserves to NPL ratio (except when used as dependent variable), time and country dummies. Standards errors are in parentheses. Significance levels are denoted as follows: * p<0.10, ** p<0.05, and *** p<0.01.*
Source: Authors' calculations (2020).

Table 9: Effects of resolution mechanisms on the ex-post bank performance – high NPL sub-sample (no-US banks).

	Reserves to NPLs			Total capital ratio			Loan ratio			Loan growth		
	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank	Bailout	Merger	Bad-bank
Bank profit.	-0.00020	0.00822	-0.00250	0.0132	0.00562	0.0107	-0.0302	0.0855	-0.0136	0.00307	-0.063	0.0109
(ROAE)	(0.0054)	(0.0214)	(0.00594)	(0.0216)	(0.0420)	(0.0346)	(0.0469)	(0.301)	(0.0806)	(0.028)	(0.13)	(0.021)
Bank size (TA)	0.991***	0.416	-0.616**	4.413***	3.665**	-3.44***	8.604***	11.38	-11.2**	0.129	3.179	-1.092
	(0.149)	(0.556)	(0.264)	(0.830)	(1.653)	(1.261)	(2.388)	(8.834)	(5.349)	(0.696)	(2.95)	(1.428)
Bank liquidity	0.00411	-0.13***	-0.050***	-1.01e-05	-0.490***	-0.227***	0.302***	-1.573**	-0.284*	0.0142	0.432	0.0444
(LATDB)	(0.00419)	(0.0476)	(0.0150)	(0.0188)	(0.151)	(0.0789)	(0.0650)	(0.634)	(0.145)	(0.0413)	(0.299)	(0.0664)
Constant	-12.93***	-0.724	7.917***	-57.01***	-29.81	44.44***	-135.3***	-87.43	116.1**	-1.763	-54.00	6.878
	(1.935)	(8.140)	(2.670)	(10.76)	(22.17)	(12.14)	(29.75)	(122.0)	(53.78)	(8.177)	(45.81)	(15.47)
No. of banks	548	459	474	549	461	468	543	442	477	548	455	450
Country dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

*Notes: this table reports estimates of the average effect of resolution mechanisms for intervened banks derived from semi-parametric DID regressions. It shows how the effect of each resolution mechanism varies with a bank's profitability, size, and liquidity level. The constant shows the impact of the resolution mechanism on the dependent variable. The reported average treatment effect on the treated (ATET) are estimated using a linear polynomial function to approximate the propensity score. The "number of banks" indicates the number of individual banks used for the estimations that satisfy the condition that their respective estimated propensity score is bigger than 0 and smaller than 1. All regressions include the following control variables: industry control (banking sector concentration ratio), country controls (GDP growth, inflation, business disclosure country index), bank controls (ROAE, bank size, liquidity, capital ratio (except when used as dependent variable), loan ratio (except when used as dependent variable), reserves to NPL ratio (except when used as dependent variable), time and country dummies. Standards errors are in parentheses. Significance levels are denoted as follows: * p<0.10, ** p<0.05, and *** p<0.01.*
Source: Authors' calculations (2020)

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