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Bank bailouts, interventions, and moral hazard

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Abstract

To test if safety nets create moral hazard in the banking industry, we develop a simultaneous structural two-equations model that specifies the probability of a bailout and banks' risk taking. We identify the effect of expected bailout probabilities on risk taking using exclusion restrictions based on regional political, supervisor, and banking market traits. The sample includes all observed capital preservation measures and distressed exits in the German banking industry during 1995-2006. The marginal effect of risk with respect to bailout expectations is 7.2 basis points. A change of bailout expectations by two standard deviations increases the probability of official distress from 6.2% to 9.9%. Only interventions directly targeting bank management and, to a lesser extent, penalties mitigate moral hazard. Weak interventions, such as warnings, do not reduce moral hazard.

Key words: banking, supervision, moral hazard, intervention, bailouts

JEL: C30, C78, G21, G28, L51

Non-technical summary

We analyze in this paper if safety nets in banking create moral hazard. Specifically, we answer the question if capital preservation measures induce additional risk-taking. To this end, we develop a simple game-theoretical model to describe the actions of regulatory institutions and banks. The model is used to derive a structural system of equations.

The first equation yields estimates of expected probabilities to receive capital support if a bank is in distress. The second equation then measures if and how expected bail-out probabilities affect the risk of banks. This allows us to test, if moral hazard exists and how large it is. We estimate this system with both two-stage and joint maximum likelihood methods using data on observed capital injections and distressed exits among German banks during the period 1994 until 2006.

Results show that capital preservation measures create moral hazard. The marginal effect of risk with respect to bailout expectations is 7.2 basis points. A change of bailout expectations by two standard deviations increases the probability of official distress from 6.2% to 9.9%. Only interventions directly targeting bank management and, to a lesser extent, penalties mitigate moral hazard. Weak interventions, such as warnings, do not reduce moral hazard.

Nichttechnische Zusammenfassung

Die vorliegende Studie untersucht, ob die Existenz von Sicherungssystemen zu einer höheren Risikoneigung im Bankwesen führt, das so genannte "Moral Hazard" Problem. Wir betrachten, ob kapitalerhaltende Maßnahmen seitens der Säulen-spezifischen Sicherungssysteme zu einer höheren Wahrscheinlichkeit einer Schieflage bei Banken führen. Wir entwickeln ein einfaches Spiele-theoretisches Modell, um das Verhalten von Banken und Regulatoren ab zu bilden. Das Modell dient dazu, ein strukturelles Gleichungssystem auf zu stellen.

Die erste Gleichung des Systems dient der empirischen Schätzung von Beistandswahrscheinlichkeiten. Die zweite Gleichung misst, ob und wie stark erwartete Beistandswahrscheinlichkeiten das Risiko einer Bank beeinflußen. Wir schätzen dieses Gleichungssystem mittels eines zweistufigen und eines simultanen Verfahrens und nutzen eine Stichprobe beobachteter Kapitalhilfen und Marktaustritte deutscher Banken im Zeitraum von 1994 bis 2004.

Die Ergebnisse belegen die Existenz von "Moral Hazard". Der marginal Effekt einer höheren Beistandswahrscheinlichkeit auf die Wahrscheinlichkeit einer Schieflage beträgt 7,2 Basispunkte. Eine Veränderung der erwarteten Beistandswahrscheinlichkeit um zwei Standardabweichungen steigert die Wahrscheinlichkeit einer Schieflage somit von 6.2% auf 9.9%. Die Analyse von Interaktionseffekten mit regulatorischen Eingriffen zeigt außerdem, dass bestimmte Interventionen "Moral Hazard" reduzieren können. Allerdings sind dies nur jene Eingriffe, welche direkt auf das Management einer Bank abzielen. Schwache Maßnahmen, zum Beispiel Warnungen, haben keinen signifikanten Effekt.

Contents

1 Introduction

Many economies maintain deposit insurance schemes to protect depositors against losses when a bank fails to meet its debt obligations. In addition, selected banks may receive capital from regulatory authorities or governments when in distress, in the form of so-called "bailouts". Financial safety nets for individual banks aim to reduce the social cost of bank failures [1] and promote financial stability (Demirgüç-Kunt and Detragiache, 2002). For example, deposit insurance can help prevent bank runs (Diamond and Dybvig, 1983) and mitigate the potential spill over effects of bankruptcies. Yet such safety nets also can create moral hazard in the form of excessive risk-taking behavior. [2] We develop a structural model to estimate empirically the extent to which bank bailouts create moral hazard.

When a bank is in distress, it is difficult to determine if this state is due to bad luck or bad behavior. To address this problem, we develop a structural simultaneous equations model based on a simple game between supervising authorities (the regulator) and individual banks. Individual banks first choose their preferred risk level. Then nature determines if the bank is in distress, and the regulator must decide whether to bail out distressed banks. The model therefore identifies a distressed bank's latent bailout probability, and we test if bailout expectations explain risk-taking behavior.

Specifically, we estimate a structural system of two equations. The first equation relates bailout probabilities to individual bank characteristics and several (identifying) covariates. It therefore provides an expected bailout probability for *all* banks, including sound ones. The second equation then

[1] Due to, for example, distorting credit markets (Puri et al., 2011) or bank competition (Gropp et al., 2011).

[2] See Gale and Vives (2002), Cordella and Yeyati (2003), and Freixas et al. (2004).

relates banks' risk-taking propensity to these expected bailout probabilities. If they affect banks' risk taking, safety nets create moral hazard.

The structural estimation approach thus represents the first contribution of this paper. Most empirical studies rely on reduced-form analyses and regress risk proxies on indicators of safety net membership (e.g., Demirgüç-Kunt and Detragiache, 2002). But insurance scheme membership does not permit inference about banks' bailout *expectations* when in distress. Instead, we need to observe actual bailouts to predict bailout expectations, conditional on factors that are unrelated to risk taking. This identification issue is usually neglected, which precludes the separation of bad luck from bad behavior when analyzing the effects of safety nets on risk taking. [3] To this end, we use regional variables that capture political factors (Brown and Dinç, 2005), historical bailout policies (Acharya and Yorulmazer, 2007), banking market structure, and regulators' traits (Brown and Dinç, 2011), which explain bailout probabilities, but do not directly affect risk taking. These covariates are specified in the bailout equation but not in the risk-taking equation. We use this model to quantify the moral hazard effect in terms of additional risk.

As our second contribution, we use a novel data set that includes *actual* bailouts and official records of distress, as defined by regulatory authorities for all 3,517 German banks during the period 1995-2006. Observing capital injections allows us to exploit regional differences across supervisory authorities involved in the bailout decision to identify bailout expectations in the structural model. Observing incidences that constitute bank distress according to the definition of the regulator also enables us to measure risk

[3] Keeley (1990) uses deposit insurance *payouts* to explain risk, but does not model bailout expectations explicitly.

more directly. Specifically, the regulator defines distress as a situation in which *"an institution's existence will be endangered [...] without support measures."* (Deutsche Bundesbank, 2007, p. 75). Support measures are either exits through restructuring mergers or capital injections. Observations of either bailout or exit thus reveal when the regulator deems the ultimate risk faced by a bank as too high, namely that it ceases to operate as a going concern. Relating bailout expectations to distress probabilities is thus in line with the metric used by regulators to conduct policy and with so-called bank hazard studies that estimate the risk of an entire financial institution failing, conditional on multiple sources of banking risk (Wheelock and Wilson, 1995; Berger et al., 2000). On average 8% of all banks were distressed, and around 6.1% received capital support.

Third, this article answers the question of whether potential moral hazard effects due to the existence of safety nets can be mitigated by supervisory policy. To this end, we exploit detailed information regarding a range of supervisory intervention measures, such as hearings, the dismissal of managers, or penalties levied on the bank, that were applied to both distressed and sound banks. To our knowledge, we are the first to test if such supervisory interventions can help mitigate moral hazard and to provide an estimate of how effective various supervisory measures are.

Our results reveal that an increase in the expected bailout probability by 1% increases risk taking, measured as the likelihood of distress, by 7.2 basis points. A change in the expected bailout probability from one standard deviation below the mean to one standard deviation above the mean increases predicted distress probabilities from 6.15% to 9.85%. This economically significant increase in risk taking is due to moral hazard. The result is robust across a range of alternative measures of risk, estimation techniques, and subsamples. Only supervisory interventions directly targeting bank management and, to a lesser extent, those involving penalties change risk taking due to bailout expectations. Supervisors thus have means to mitigate moral hazard. Other interventions, such as warnings or business restrictions, may reduce risk taking, but they seem ineffective to reduce moral hazard.

In the remainder of this article, we discuss the theoretical structural equations model we propose and our specification in Section 2. The data and identification strategy are described in Section 3. We discuss the results in Section 4 before concluding.

2 Structural model and econometrics

To identify moral hazard in the German banking system, we cannot simply regress a bank's risk-taking behavior on bailouts, because such a procedure suffers from endogeneity problems. Any bailed out bank is of course in some sort of distress. Thus, imposing some structure on the data is necessary to separate bad luck from bad behavior. We describe the multiple authorities involved in the bailout decision in Section 3. For ease of exposition, we refer to them collectively as "the regulator." We consider a static game played every period between individual banks and the regulator and assume that an individual bank disregards the actions of peers when making its own choices. We therefore can model many simultaneous two-player games between individual banks and the regulator. The model is similar to Cordella and Yeyati's (2003) but tailored to our empirical estimation.

–Figure A.1 around here –

The timing and choices are depicted in Figure A.1. At $T = 0$, an individual banks chooses its "riskiness", z_{it}, which can be mapped directly to the probability of distress $P(z_{it})$.[4] The regulator cannot observe this riskiness directly. At $T = 1$ though, the consequences of the risk-taking behavior of banks are revealed, and the regulator may declare a bank "distressed" and weigh the cost of a bailout against the cost of a bank exiting.

It is clear that *always* bailing out a bank that is in distress causes severe moral hazard problems (Gale and Vives, 2002). The regulator instead wants to devise a bailout policy that balances distress due to bad luck with distress due to bad behavior. The regulator faces a classical commitment problem though and cannot credibly "announce" a certain bailout probability for every bank at $T = 0$. For example, if a bank is "too big to fail," it gets saved irrespective of what the regulator has announced a priori.[5]

Because the static game is sequential, a mixed strategy is not optimal, and the regulator will only play pure strategies: bail out or not (as in Cordella and Yeyati, 2003). The only way for the regulator to mitigate the moral hazard problem is by not revealing which bank "types" it will bail out and thus trying to be unpredictable. Individual banks do not know which type they are and thus do not know for sure which pure strategy the regulator will

[4] Although banks do not choose distress probabilities directly, they make business choices, about lending or trading for example, that influence the distress likelihood. Different sources of risk may offset one another. For example, high credit risk due to subprime lending does not have to imply a high risk of distress for the entire bank if the loan share is low and most assets are risk-free securities. In practice, the regulator therefore rates banks based according to the likelihood that the entire institution is distressed, conditional on multiple risk drivers (Deutsche Bundesbank, 2007).

[5] This commitment problem also rules out dynamic strategies. Intuitively, if a bank is not bailed out, the game ends. The only dynamic strategy is thus to bail out the bank for a certain maximum number of periods before letting it exit. Such a strategy can only be optimal for banks that are worth saving. But this cannot be a Perfect Bayesian Nash Equilibrium, because once it is revealed that a bank that is worth saving is in distress, the regulator will not commit to this strategy, because it can improve by bailing out the bank anyway. Cordella and Yeyati (2003) deal with such dynamics by only considering Markov strategies, so that the dynamic problem becomes recursive.

play. However, individual banks (and researchers) can infer a probability of a bailout by linking bailout behavior to observables.

To capture the banks' expectations of the regulator's behavior, we model the bailout probability π_{it} when a bank is in distress as:

$$\pi_{it} = E[I_{it}] = \Phi(X'_{it-1}\alpha + Z'_{it}\beta) \qquad \textit{(bailout)}\,, \qquad (1)$$

where I_{it} is an indicator equal to 1 if the regulator decides to inject capital and bail out the bank, $\Phi(\cdot)$ is the standard-normal distribution function, and X_{it-1} is a lagged vector of observable bank i (and macro) variables at time $t-1$. To discern the effect of bailout probabilities on risk taking, we require two assumptions. First, the necessary vector of identifying covariates Z_{it} must be orthogonal to risk taking. Because identification is crucial, we motivate the choices for Z_{it} separately in Section 3. Second, we assume that a bailed out bank otherwise would have exited: that is, the regulator only rescues banks that really need support. This assumption is necessary because of the missing counterfactual.[6] The implied error term is standard-normally distributed. It captures information that is unobservable by individual banks, but taken into account by the regulator. Because of the private information available to the regulator, we have $\pi_{it} < 1$, and no bank expects zero downside risk or a guaranteed safety net. At $t = 0$, a bank's management determines its riskiness, z_{it}, which maximizes its expected value:[7]

$$E_t[V_{i,t}] = \frac{E_t[c_i(z_{it})]}{1+R_{it}} + [1 - P(z_{it})(1-\pi_{it})]\frac{E_t[V_{i,t+1}]}{1+R_{it}}, \qquad (2)$$

[6] It is impossible to know if some bailed out banks would have survived without an injection.

[7] We consider a Perfect Bayesian Nash Equilibrium. Individual beliefs $\hat{\pi}_{it}$ about a bailout must correspond to the actual bailout distribution in equilibrium, so that $\hat{\pi}_{it} = \pi_{it}$. For brevity, we use real probabilities directly.

such that we directly write the objective in recursive form. Furthermore, $V_{i,t}$ is the value of bank i at time t, R_{it} is the discount rate, and $E_t[c_i(z_{it})]$ is the expected cash flow c_i, which depends on the riskiness z_{it}. The expected value $E[V_{i,t}]$ therefore equals the expected value of the net cash flows plus the expected value at time $t+1$ if the bank has not exited. Distress happens with probability $P(z_{it})$. If banks are never bailed out, distress means exit, and the probability of exiting is equal to the probability of distress. The probability of exiting declines with $1 - \pi_{it}$ though. We see that $\pi_{it} = 1$ implies that the bank will not exit for sure and the expected future value $E[V_{i,t+1}]$ is guaranteed.

Assuming an interior solution [8], we consider a linear approximation of the first-order condition for optimal individual bank behavior

$$z_{it} = \gamma \pi_{it} + X'_{it-1}\kappa, \tag{3}$$

where X_{it-1} is the same set of covariates as in the bailout Equation (1). Consequently, we can write the equation for the probability of distress as

$$P(z_{it}) = E[D_{it}] = \Phi(\gamma \pi_{it} + X'_{it-1}\kappa) \qquad (\textit{distress}), \tag{4}$$

where D_{it} is an indicator equal to 1 if the bank is in distress and 0 if sound. This is the second key equation of our model.

In summary, the parameter of interest is γ, the coefficient for the bailout probability. We aim to identify, for example, if large banks take more risk simply because they are large (direct effect through κ) or because they are more likely to be bailed out (indirect effect through γ). It is impossible to

[8] As in Cordella and Yeyati (2003) this assumption rules out implausible outcomes such as infinite risk.

draw such inferences by regressing probabilities of distress on bank characteristics directly, which constitutes the appeal of our structural model.

We estimate this system of simultaneous equations defined by Equations (1) and (4) in a two-step procedure. First, we estimate Equation (1) with maximum likelihood to estimate the bailout probability conditional on the bank being in distress. With $\hat{\alpha}$ and $\hat{\beta}$ at hand, we calculate the fitted (or expected) bailout probability $\hat{\pi}_{it}$ for the entire sample of banks. Second, we estimate Equation (4) while including this generated regressor $\hat{\pi}$. Under standard regularity conditions, the first-step maximum likelihood estimate yields consistent estimates of the true parameters. Therefore, we also obtain consistent estimates for the second equation (see Murphy and Topel, 2002). [9]

3 Identification and data

3.1 Bailouts and risk

Bailouts are defined as a bank receiving a capital injection from the responsible banking association's insurance fund. The baseline specification is Equation (4), which measures risk taking with an indicator if the regulator deems the bank in distress. As noted before, distress is defined as a situation

[9] We also estimate Equations (1) and (4) jointly using maximum likelihood and substitute the equation for π_{it} directly into the equation for $\Phi(z_{it})$. The individual contributions l_{it} to the likelihood are:

$$l_{it} = 1 - \Phi(\gamma\Phi(X'_{it-1}\alpha + Z'_{it}\beta) + X'_{it-1}\kappa) \text{ if } D = 0, \tag{5a}$$

$$l_{it} = \Phi(\gamma\Phi(X'_{it-1}\alpha + Z'_{it}\beta) + X'_{it-1}\kappa)(1 - \Phi(X'_{it-1}\alpha + Z'_{it}\beta)) \text{ if } D = 1 \text{ and } I = 0, \text{ and} \tag{5b}$$

$$l_{it} = \Phi(\gamma\Phi(X'_{it-1}\alpha + Z'_{it}\beta) + X'_{it-1}\kappa)\Phi(X'_{it-1}\alpha + Z'_{it}\beta) \text{ if } D = 1 \text{ and } I = 1. \tag{5c}$$

This estimation procedure yields consistent and efficient estimates, but it is computationally involved.

where the bank's existence will be endangered without support measures (Deutsche Bundesbank, 2007). Support measures are either a bailout or the exit of the bank in the form of a restructuring merger. In Germany, both events are recorded by the central bank, the Bundesbank. Observing these policies, bailout or exit, therefore reveals when the regulator deems the ultimate risk faced by a bank too high, namely to cease as a going concern.

This approach to measure risk is consistent with, for example, U.S. bank hazard studies that estimate the risk that an entire financial institution will fail, conditional on multiple sources of banking risk, rather than considering only individual components, such as credit risk (Wheelock and Wilson, 1995; Berger et al., 2000). [10] Measuring risk with distress probabilities is also in line with the metric used by regulators to rate banks and determine policy. [11] To assess the generalizability of our results, we specify alternative risk-taking proxies according to Equation (3). These continuous measures pertain to specific sources of risk (see Table B.1 in the Appendix), which we discuss with the relevant results subsequently.

Table 1 shows the descriptive statistics of distressed and sound banks over time. On average 8% of all banks were distressed per year between 1995 and 2006. Most banks have been bailed out (6.1%), and the share of exits due to restructuring mergers is fairly low (1.9%).

–Table 1 around here –

For ease of exposition, we use the single term regulator, though in prac-

[10] Prompt corrective action in the U.S. implies that troubled banks are immediately closed. In Germany, distressed banks are either supported through recapitalization or merged with healthy banks (Koetter et al., 2007). The subtle difference between failures and distress reflects preemptive rather than prompt corrections.

[11] Since 2004, the Bundesbank has published probabilities of distress conditional on risk sources, as reflected by so-called CAMEL covariates (capitalization, asset quality, management, earnings, liquidity) in financial stability reports.

tice, the decision to bailout or merge a bank involves multiple authorities. First, the German Financial Supervision Authority (BaFin) is responsible for banking supervision in Germany. Second, the central bank is responsible for ongoing supervision. Third, audits for the savings and cooperative banking sectors are conducted by regional banking associations.

Insurance funds reflect the structure of the German banking industry, which features three sectors, or "pillars": commercial banks, cooperative banks, and savings banks. [12] Compulsory and sector-specific, voluntary insurance schemes coexist and are organized in 38 national [13] or regional banking associations per pillar (IMF, 2009). Insurance protection comprises deposit insurance and institutional warrants (*"Institutssicherung"*). The latter provide the capital injections that we consider. [14]

Insurance funds generally obtain information on the financial health of member banks from auditors, but prudential supervisors also can directly inform insurance funds if they deem a bank excessively risky. For example the charter of regional insurance funds in the savings bank sector stipulates that the board of a regional savings associations must decide, with a two-thirds majority, whether to declare a member bank distressed. [15] Declaring a member distressed triggers according support measures, either a restructuring merger or a capital injection. The insurance fund of the association then informs the management and owners of the bank of the decision. They are also required by law to inform the supervisory authorities, namely, the BaFin and Bundesbank. Supported member banks are required to reveal

[12] Krahnen and Schmidt (2004) provide a comprehensive overview of the German banking system. We detail our results for sub-samples to control, for example, for different ownership of banks from the three pillars.
[13] The Association of German Banks (*"BdB"*), the German Savings and Loan Association (*"DSGV"*), and the Federal Association of Cooperative Banks (*"BVR"*).
[14] Note that we do not consider bailouts by the government or the Banking Sector Stabilization Fund (*"Sofin"*).
[15] See http://www.sparkasse.de/s_finanzgruppe/haftungsverbund/sicherungsreserve.html.

any information to the fund to allow for a transparent assessment of their financial situation.

Insurance schemes' objectives may not always be in line with those of official supervisory institutions. Eventually though, all institutions involved collectively contribute to the decision to bail out a bank or not. For our purposes, we do not need to know *how* the decision to bail out is made, but only *whether* it is made. We simply try to discern whether the system of institutions as a whole induces moral hazard. It is the very diversity of institutions involved in the bailout and distress resolution procedure that we exploit for identification, which we describe next.

3.2 Identification

The identification of the moral hazard parameter γ, based on functional form alone, is possible but not compelling because we might simply measure a nonlinear relationship. Instead, we assume that banks that receive support would have failed otherwise, and we need exclusion restrictions on the covariates. Therefore, we specify identifying covariates Z_{it} in Equation (1) that are correlated with the bailout probability but not with the probability of distress, as we describe in Table 2.

–Table 2 around here –

First, multiple regional and pillar-specific insurance funds exist to support troubled member institutions in regional banking markets, which may differ in their willingness and ability to save distressed banks (Acharya and Yorulmazer, 2007; IMF, 2009).[16] We exploit this variation to explain bailout

[16] Data on insurance funds' finances and/or pricing schemes are not available.

probabilities in Equation (1), because the willingness and ability to bail out as such suggests limited correlation with the direct risk taking of banks. We specify the number of rescued banks as a share of all distressed banks per state in the previous period to capture the historical capital injection frequency in each of the 16 states. We also acknowledge that the "too-many-to-fail" notion suggests that bailouts are less likely if the system already is weak (Acharya and Yorulmazer, 2007; Brown and Dinç, 2011). Regulators might consider the number of banks left to provide financial services to the region insufficient if no bailout was conducted. Therefore, we also specify the number of banks in each of the 413 German counties.

Second, we create a set of covariates motivated by studies that emphasize the importance of politicians in economic decisions, including bailouts (Brown and Dinç, 2005) and privatization (Dinç and Gupta, 2011). Political considerations may be important in the German banking industry for three reasons. First, board members of both the BaFin and the Bundesbank are suggested by politicians. Formally, the Ministry of Finance appoints board members. But e.g. Bundesbank board members are suggested by (alternating) state governments. Second, around 20% of all banks are (regional) government-owned savings banks. Local politicians often serve on the supervisory boards of savings banks and influence regional associations, which both audit member banks and maintain regional insurance funds. Third, for banks of the remaining two pillars, commercial and cooperative, (local) politicians often serve on the supervisory boards. Ideally, we would use direct information on the political membership of individual bank managers and directors, but such data are unavailable. Instead, we use indirect proxies and specify an indicator for state elections, that is, the margin of votes casted for the state cabinet coalition relative to the main opposition, as in Dinç and Gupta (2011), and the political stance of the governing state cabinet (e.g., conservatives vs. socialists). We discuss each variable in greater detail when presenting the baseline results in Subsection 4.1.

Third, we use identifying covariates to capture regulator traits. Political controls in a bank's region might influence bailouts indirectly by shaping the attitude of supervisors, supervisory boards, management, and the general public. But eventually, one of 38 responsible regional banking association audits and insures banks. Also, nine branches of the central bank (*"Hauptverwaltung"*) conduct ongoing (on-site) supervision of banks in their regions. Both institutions may differ in terms of auditor capacity, practices to implement federal guidelines and laws for prudential supervision, or funds to conduct bailouts. Detailed data on staffing, practices, or funding of banking associations, insurance funds, or central bank branches are unavailable. However, we have data on both banking association membership and the responsible central bank branch for each individual bank and therefore can specify indicator variables to control for unobservable differences among regulatory institutions.

3.3 Covariates

Following previous bank hazard studies and the practice of regulators to rate banks, we select bank-specific covariates X_{it-1} from a long list of candidate covariates using a statistical selection procedure (Hosmer and Lemshow, 2000). All covariates are lagged by one period to mitigate simultaneity concerns (Wheelock and Wilson, 1995; Berger et al., 2000). Table 3 shows the means and standard deviations of the bank characteristics per type of event.

–Table 3 around here –

The sub-samples are not too heterogeneous, which is comforting because we use fitted values to extrapolate predicted bailout probabilities from Equation (1) to estimate the moral hazard effect on risk taking in Equation (4).

Hidden reserves are used to smooth income and are an important indicator of solvency risk. They result from mark-below-market valuation, in line with §340f of the German commercial code (HGB), and are measured as a share of total assets. Non-performing loans measure credit risk and are defined as the share of all audited loans that are at latent risk. We measure the share relative to total audited loans. Customer loans are the share of household and corporate to total loans, and they measure credit risk, too.

Profitability is measured as operating return relative to total equity. To control for the increasing importance of non-credit-based activities and asset price risk, we also specify the ratio of fee and trading income relative to interest income. Cost efficiency measures managerial skill. It is the percentage of actual cost that would have sufficed to provide observed production plans, derived from a stochastic frontier model (for details, see Koetter and Poghosyan, 2009). To control for liquidity risk, we specify the sum of cash and overnight interbank assets relative to total assets. A dummy for joint stock or limited partnerships (*"Kapitalgesellschaften"*) accounts for the stricter publication requirements that these forms of incorporation entail.

The importance of a bank for the financial system clearly is a key determinant for both bailouts and risk taking, such as when they serve to reduce negative externalities if a large and highly connected bank fails. We control for size with a decile indicator based on the distribution of gross total assets.[17] We also specify the bank's market share of gross total assets in its county (*"Kreis"*).

To control for the health of the corporate sector, the economic cycle, and the financial stance of households, we specify three regional macro covariates. These are the share of enterprises that filed for bankruptcy per state relative to all firms, annual growth of real Gross State Product (GSP) per capita, and state unemployment rates, all of which may influence both bailouts and risk-taking. In addition, we include banking-pillar and time dummies.

4 Results

4.1 Identification of moral hazard effects on risk taking

Table 4 shows the marginal effects from two-step probit estimations of the bailout Equation (1) and the distress Equation (4). Standard errors are clustered at the bank level, and we control for cross-sectional correlation by specifying time dummies, as suggested by Petersen (2009).

–Table 4 around here –

The main result in the first pair of columns, labeled *Parsimonious*, is the significantly positive effect of higher bailout probabilities on risk taking. An increase of predicted bailout probability by 1% increases the likelihood of distress by 6.3 basis points. Consider Figure A.2 for an illustration of the economic significance of this marginal effect. The figure shows the distribution of conditional bailout expectations and predicted distress, together

[17] Total assets and log total assets yield similar results. We prefer decile indicators because they attribute less weight to the tails of the skewed size distribution when extrapolating bailout probabilities to sound banks.

with the mean and standard deviation. An increase of bailout expectations from one standard deviation below the mean (bailout expectation = 37.8%) to one standard deviation above the mean (bailout expectation = 89.4%), multiplied by the marginal effect, yields an increase in predicted risk of 51.6% $\times$ 0.063 = 3.2%. As shown in the right-hand panel of Figure A.2, the average distress probability is 8%, so this increase amounts to roughly one-third of the average distress probability.

Therefore, the effect of moral hazard is economically substantial and among the largest compared with other risk drivers. The only risk determinant of similar magnitude that can be influenced directly by managers is the share of hidden reserves.

This estimate of γ relies on four identifying covariates. The first relates to an arguably important event to influence the behavior of politicians: elections. Governments that hold a stake in the banking system may abuse their influence to pursue non-value-maximizing objectives to realize political objectives, such as re-election (Sapienza, 2004; Brown and Dinç, 2005). The indicator for state parliament elections is significantly negative. Bank bailouts seem unpopular among political constituents, and they are significantly less likely during election periods.

Dinç and Gupta (2011) similarly show that the privatization of Indian enterprises is more likely if political competition from the main opposition is low. They measure political competition by the margin of votes earned by the governing coalition in a region compared with the vote share of the main opposition coalition. We specify this vote share difference in *state* parliament elections using votes cast at the *county* level. Although the direct effect of vote share differences is insignificant in our sample, it may matter which political party has larger vote share difference (e.g., conservatives or socialists). Therefore, we interact vote share differences with categorical dummies based on the political stance of the cabinet coalition and discuss these results subsequently.

The number of banks has no significant influence in bailout considerations. Historical rescues measured by lagged injection frequency per state, in turn, increase the likelihood of a bank bailout significantly. As such, the injection frequency per state signals local reputation effects to the banks. States with traditionally low bail-out frequencies are likely to maintain that stance. More frequent recourse to insurance funds does not seem to render subsequent bailouts less likely because the funds are depleted.

The fit of the bailout and the distress equations is good: pseudo-R^2s are around 17%. Marginal effects of bank-specific covariates are plausible and in line with prior evidence regarding bank distress in Germany (Koetter et al., 2007). Larger banks with high local market shares are more likely to receive capital support, which corroborates the too-big-to-fail effect documented by O'Hara and Wayne (1990) for the U.S. banking market, for example. Higher insolvency risk, as reflected by lower lower hidden reserves, and more credit risk, as measured by the non-performing loan and customer loan shares, are also associated with a higher likelihood of a bailout. Profitability levels, income structure, and liquidity are not, or only weakly significant.[18] Regarding macroeconomic factors, only a fragile corporate sector, measured by corporate insolvencies, has a positive effect on the bailout likelihoods of banks. Repullo and Martinez-Miera (2010) show that risk (and competition) in banking interacts with corporate sector stability, and

[18] Ideally, we would use superior liquidity measures based on maturities, as suggested by Berger and Bouwman (2009). The necessary data unfortunately are unavailable.

regulators may aim to avoid aggravating corporate distress by letting banks fail if the non-financial sector is weak.

Proper identification is central in our study of moral hazard effects on risk taking. Therefore, we include in the second pair of columns, labeled *Politics*, identifying covariates to control for coalitions' substantially different attitudes toward market interventions. We assume that cast votes reflect the political preferences of the constituency in the county; thus, a regional population with a communist heritage in regions of the former German Democratic Republic is likely to take a fundamentally different stance toward rescuing banks compared than are liberal democrats. [19]

The effect of different parties' stances on bailout policies should be reflected in the formed coalition and amplified if the margin of votes is larger. We therefore define an indicator for three different types of coalitions that have been formed in parliament elections of the 16 states of Germany since 1992. *Conservatives* denotes coalitions that involve the Christian Democratic Party (CDU) or the Christian Socialist Union (CSU), its sibling party in the state of Bavaria. *Socialists* denotes coalitions that involve the Social Democratic Party (SPD). In addition, three smaller parties are increasingly important to form coalitions at both the state and the federal level. [20] The two main political camps have lost considerable ground in recent years to these smaller parties. Consequently, so-called *great coalitions* between CDU/CSU and SPD have often become necessary to obtain the majority of votes, which are the

[19] For example, Dinç and Gupta (2011) specify the vote share of the communist party to explain privatization choices in India. Alternative specifications using the vote shares of different parties directly did not yield a more precise identification. Results are available on request.

[20] Namely, the ecologically oriented *Grünen*, the successor of the communist party in the GDR *Die Linke*, and the liberals *FDP*. We also considered alternative codings of coalitions emphasizing whether more "extreme" political opinions represented by these smaller parties were involved in the cabinet. These specifications did not explain the variation in bailouts very well but are available on request.

third group that we specify. The effect of political preferences represented by these different coalitions on bailout policies should be amplified if the vote share difference relative to the main opposition is larger. Therefore, we specify interaction effects.

Marginal interaction effects in the columns labeled *Politics* in the second panel of Table 4 highlight that bailouts are more likely if the bank is located in states governed by a great coalition relative to conservative cabinets. The direct effect of a socialist state cabinet is only weakly significant. Larger vote share differences exert no differential effect if either a great coalition or socialists are in office. Conservative cabinets, in turn, are significantly more inclined to bail out troubled banks if they face less political competition from the opposition. Even when taking into account the additional identifying covariates, the positive effect of moral hazard on risk taking, individual covariates' effects, the significant contribution of past injection frequencies, and the election dummy to explain bailouts all remain intact.

The next two pairs of results feature specifications that control more explicitly for potential differences among the various regulatory bodies that are relevant for explaining observed bailout events. Consider first the pair of columns labeled *Associations*, which includes fixed effects for the 38 banking associations with which individual banks are affiliated. For the savings and cooperative banking pillars, these associations develop and conduct prudential audits of their member banks and host the regional insurance funds that provide capital injections if needed. Also for the commercial banks, these association memberships provide a good estimation about monitoring mechanisms across banks in the association.[21] F-tests reported in the

[21] The mission statement of regional associations of commercial banks mentions for example the dialogue and joint pursuit of the interests of their members as an objective. Each regional association is member of the federal

bottom panel of Table 4 show that the added identifying covariates are jointly significant. The specification of association indicators leaves other parameter estimates, especially the moral hazard coefficient, intact.

The last pair of results, in the columns labeled *Regulator*, adds dummies for the nine regional branches of the Bundesbank, which conduct the ongoing supervision of banks in their regions. These central bank regions do not coincide with political borders of the 16 states or the organizational borders of banking associations' regions. Therefore, they add information pertaining to regulatory differences that could exist due to, for instance, different implementations of prudential auditing rules, staffing differences in the regional central bank branches, and the like. F-tests confirm the joint significance of these covariates. Overall, all previous effects remain unchanged, and we consider this specification the baseline model.

4.2 Alternative risk measures

We argue that the probability of distress is a comprehensive and preferred measure to assess multiple sources of risk managed by banks. But we acknowledge that supervisory data on financial distress is rarely publicly available. To test whether and to what extent we can generalize the identified moral hazard effect, we show in Table 5 the relation between moral hazard and five alternative measures of bank risk. To facilitate comparisons, the first column of Table 5 reproduces the baseline result. [22]

–Table 5 around here –

banking association, which is the legal entity maintaining the voluntary deposit insurance scheme of this pillar.

[22] Descriptive statistics of the alternative risk measures are provided in Table B.1 in the Appendix. Predicted bailout probabilities are obtained from the baseline specification (column *Regulator* in Table 4).

First, we specify the so-called z-scores. Laeven and Levine (2009) define the z-score as $\frac{RoA+\frac{Equity}{RWA}}{\sigma_{RoA}}$, where RoA denotes return on risk-weighted assets, RWA denotes risk-weighted assets, and σ_{RoA} is the standard deviation of RoA.[23] Assuming that insolvency occurs when losses cannot be covered by equity, the probability of insolvency can be expressed as $P(RoA < \frac{Equity}{TA})$. If RoA follows a normal distribution, z-scores are inversely related to the probability of insolvency (Laeven and Levine, 2009). Thus, z-scores can be interpreted as the number of standard deviations that a bank's RoA must fall below its expected value before equity is exhausted and the bank becomes insolvent. Lower z-scores therefore indicate riskier banks. The second column in Table 5 confirms that higher bailout probabilities increase risk according to this measure, too. The smaller sample size is due to the limited availability of risk-weighted assets as opposed to the gross total assets employed in the baseline.

Second, credit risk remains among the most important individual risk drivers of financial institutions. Most studies proxy for credit risk using the share of non-performing loans (NPL; Demirgüç-Kunt and Detragiache, 2002). We provide the results using the NPL share as the dependent variable in the third column of Table 5. The main result of increasing moral hazard due to higher bailout likelihood is confirmed.[24]

Third, we follow Laeven and Levine (2009) and specify only one component of the z-score, namely Tier I capital ratios, which measure most directly the risk of critical under capitalization. Note that capital preservation

[23] This measure is calculated on a rolling-window basis of the preceding three years where possible. Using a constant standard deviation calculated for all available observations per bank does not affect the results.

[24] We also ran dynamic panel estimations specifying the lagged values of the NPL share as explanatory variable. Both the direction and the significance of the moral hazard effect are confirmed, but a violation of the Hansen test casts doubt on the adequacy of the specification.

measures are not part of core capital, so there is no reverse causality by construction. The insignificance of the bailout effect underscores that core capital ratios are hardly adjusted by management in the first place. Instead, capital buffers held as insurance against cyclical shocks pertain primarily to Tier II-type of capital and hidden reserves (see also Heid, 2007). This result underscores the importance of accounting for multiple risk drivers simultaneously, which is what we do by using the distress indicator.

Fourth, an important source of risk to banks is their sensitivity to interest rate shocks. One approach to measure interest rate sensitivity is to calculate duration gaps, which is infeasible for our sample though because we lack data about the maturities of bank's assets and liabilities. We calculate two alternative measures available for a subsample of banks. The first is the difference between the volume of assets with a fixed interest rate and liabilities with a fixed interested rate. Net fixed interest rate assets (NFIRA) are on average positive (22.8 million €). Larger NIRFA insulate banks from interest rate shocks compared with banks with large shares of net variable interest assets. Higher bailout probabilities have a significantly negative effect on NIRFA, which corroborates the notion that moral hazard prevails in the form of banks reducing interest rate shock insensitive exposures. Another measure of interest rate risk is the difference in average interest rates contracted for fixed assets and liabilities, respectively. The mean fixed interest rate gap (FIRG) is 1.31%, so banks earned a positive margin on their fixed income exposures. The marginal effect is significantly negative too. This finding confirms an increase of interest rate risk in response to higher bailout expectations.

In summary, all our alternative risk measures confirm the existence of moral hazard effects due to bank bailouts.

4.3 Robustness

The non-standard nature of the two-equation structural model warrants multiple robustness checks. Table 6 features coefficients from four tests that address potential concerns regarding inconsistent parameter estimates, biased standard errors, and bias due to the extrapolation of estimated bailout probabilities. For ease of comparison, we reproduce the coefficients from the *Baseline* two-stage probit estimation in the first pair of columns.

–Table 6 around here –

We begin by estimating the system with ordinary least squares (OLS) in the columns labeled *Identification*. Although OLS estimates can be inefficient and standard errors might be biased, this approach yields consistent and unbiased estimates for the coefficients. More important for our study, OLS identifies the moral hazard effect solely through the exclusion restriction on the covariates, which mitigates any concern that we have merely estimated a nonlinear relationship and labeled it moral hazard. The main coefficient of interest on moral hazard remains positively significant and resembles a magnitude similar to the marginal effect of $\hat{\pi}$ (0.072) reported previously. Overestimation is plausible, given the non-linearity accounted for by the probit model.

We previously clustered standard errors at the bank level and accounted for cross-sectional correlation by using time dummies, as suggested by Petersen (2009, p. 458). Yet Petersen also cautions that standard errors still may be biased if time effects are not fixed and suggests two-way clustering of standard errors by bank and period. Although such an effect is probably less an issue in our short panel of 11 periods, the results in the *Two-way clustering* columns confirm the positive moral hazard effect, previous estimates of identifying covariates, and almost all other explanatory variables. Note that the magnitude of coefficients cannot be compared directly to the baseline specification because of the scaling by the two-way clustered standard errors.

As a third check of the robustness of standard errors, we bootstrap the system of two equations jointly. In contrast with conventional bootstrapping of standard errors in the risk equation based on identical bailout probability estimates, we draw random samples with replacements for *both* the bailout and the risk equation. Standard errors in the columns *System bootstrap* are slightly larger but do not affect the qualitative implications we reported previously; all the key parameters remain statistically significant. [25]

Finally, we estimate Equations (1) and (4) simultaneously with maximum likelihood estimation (MLE) according to Equations (5a)-(5c). This approach also addresses the concern that the standard errors in the two-step approach might suffer from bias and be inefficient. The upshot of the result in the *Joint system* columns is that the moral hazard coefficient $\hat{\pi}$ remains significantly positive. The magnitude of the coefficient is hard to interpret due to the re-scaling of the coefficients in binary dependent variable models. Most bank-specific covariates are also in line with previous results. For various specifications, maximization is difficult if certain traits discriminate one of the three outcomes almost deterministically – a common problem in

[25] Further robustness checks included two-way clustering by bank and state, as well as state and year, random effects probit, and annual estimation. Results are qualitatively unchanged and available on request.

polytonomous limited dependent models. Therefore, we rely on two-stage estimates, which are consistent with the MLE results.

4.4 Ownership

Banks from the three banking pillars differ, among other things, according to their ownership structure and the regional scope of their activities (Krahnen and Schmidt, 2004). Ownership structure is of crucial importance for the governance of banks (Adams, 2010) so in Table 7, we provide the subsample results to account for these differences (see also Gropp et al., 2011).[26]

–Table 7 around here –

In the second pair of columns labelled *Local banks*, we compare results from a subsample that excludes the largest banks from all three pillars to the marginal effects of the baseline. Within each sector, only a few large banks are active nation-wide, namely, the so-called big four in the commercial sector,[27] one central cooperative bank (DZ Bank), and central savings banks (*"Landesbanken"*).[28] These excluded largest banks are monitored by international financial markets, which trade their equity and/or securitized debt. But the vast majority of the 3,517 banks in our sample confine their operations either *de jure* (savings banks) or *de facto* (cooperatives, many commercial banks) to regionally demarcated markets. These banks are all legally independent institutions. Hence, group holdings highlighted by Dinç (2006)

[26] A full-fledged analysis of bank ownership, governance, and moral hazard, would require data on executive and supervisory board traits. Because publication requirements for most banks are mild, such data are not readily, if at all, available. Therefore, that approach is beyond the present paper's scope.

[27] Deutsche Bank, Commerzbank, HypoVereinsbank, and Postbank as of 2010.

[28] BayernLB, Bremer Landesbank, HSH Nordbank, Landesbank Baden-Wurttenberg, Landesbank Berlin, Landesbank Hessen-Thuringen, Norddeutsche Landesbank, Landesbank Saar, and WestLB.

as instrumental to the governance of Japanese banks are absent for virtually all German banks. Observations in both bailout and risk-taking equations are reduced, but obviously only slightly. The estimated moral hazard effect remains significantly positive and is somewhat larger.

A first test for ownership differences refers to savings banks, which are owned by (regional) governments. Government-owned banks may pursue different, non-value-maximizing objectives (Sapienza, 2004). The pair of columns labelled *Local non-savings banks* shows the effects after excluding all savings banks, both local and Landesbanken. The marginal effect of bailout probability with respect to distress is 0.101%; moral hazard thus is not a phenomenon driven by government ownership in German banking. This effect is confirmed when we include large non-savings banks in the columns *All non-savings banks*. The results resemble those of Barth et al. (2004), who find no effect of government ownership on bank risk after controlling for regulatory traits and supervisory practices.

Apart from government ownership, Gorton and Rosen (1995) show that larger equity stakes of managers can lead to excessive risk taking by large and listed bank holding companies. In our sample, commercial and cooperative banks are privately owned. However, the share of publicly incorporated banks is only 4%, of which only few are joint stock companies with free-floating equity traded in capital markets. The vast majority are cooperative banks, which are mutually owned by their members. Members are the depositors and are dispersed. Although we have no information on ownership shares of managers, (dominant) ownership by managers is therefore unlikely to play as an important role in German banking.

To test for the potentially important role of capital markets for governance though, and hence risk taking, we split the sample into publicly and privately incorporated banks. For the latter, publication requirements are stricter. The last two pairs of columns of Table 7 show that moral hazard has a significantly positive effect for non-listed banks. We recommend caution about interpreting the absence of moral hazard for publicly incorporated banks as evidence of better governance by capital markets. More likely, this result is due to the substantially reduced sample size, rather than a robust case in favor of capital markets efficiently monitoring the risk taking of banks.

In summary, the moral hazard effect is driven by the large group of mutually owned cooperative banks that dominate the sample. Differences in the regional scope of activities, government ownership, and public incorporation do not contaminate the overall result.

4.5 Can Supervisors Mitigate Moral Hazard?

The BaFin can intervene with different degrees of severity in the going concerns of financial institutions that it deems at risk. This scenario begs the question: Can supervisory actions mitigate moral hazard? We obtain data from the supervisory department of the Bundesbank that collects all intervention measures and categorize them into four groups. Interventions differ from capital preservations measures, which are conducted by the insurance schemes of each banking sector in consultation with the auditors of the respective banking organizations (e.g., DSGV, BVR). Interventions, instead, are actions taken solely by the official authority (BaFin) in pursuit of its mandate to ensure financial stability.

Table B.2 in the Appendix reveals the frequency and detailed composition of intervention categories. The first category, called "warnings," groups admonishment hearings, official disapproval with the bank, or threats of further measures. The second category, "management," comprises events that interfere with staffing decisions of the bank, such as the rejection of branch director appointments, limitations of the permitted scope of managers' responsibilities, or appointment of a supervisory officer. The "restrictions" category includes events such as prohibitions against distributing dividends, accepting new loans, or accepting new deposits. The category "penalties" contains measures that require the bank or managers to pay fines.

Sound banks may be subject to interventions based on their behavior, too. For example, a bank that has gambled and won might receive a warning but not require a capital injection. The distribution of intervention types for both sound and distressed banks is in Table B.2 in the Appendix. For example, warnings pertain primarily to sound banks, but outright restrictions occur more often for banks that eventually exit or receive capital support. Table B.2 indicates that regulators intervene rather frequently in banks considered sound, according to our definition. Thus, interventions neither mimic capital preservation measures taken by insurance schemes nor are they an ultimate resort of the regulator in terms of forcing banks to exit through mergers.

Table 8 shows the marginal effects of different specifications of Equations (4) and (3) with direct effects of predicted bailout probabilities and interaction terms with intervention category indicators. Across all specifications, the moral hazard parameter remains significantly positive and thus corroborates our baseline results. We focus on the interaction effect of interventions on risk to test if moral hazard is mitigated by supervisory actions.

–Table 8 around here –

Consider first the specification labelled *Distress* in Table 8, which resembles the baseline specification, though augmented with direct and interacted intervention category indicators. Positive marginal effects for the direct terms of management and restriction interventions indicate that distressed banks are significantly more likely to receive regulatory attention. Note that this effect does not imply that the regulator fails to reduce moral hazard. Instead, the effect of interventions on moral hazard is reflected in the interaction term.

Only the interaction effects for the categories “Management” and “Penalties” are significantly negative. There is some discussion about how to interpret interaction effects in nonlinear models. Ai and Norton (2003) caution that a proper evaluation of marginal interaction terms in non-linear (probit) models requires consideration of the cross-partial derivative of the dependent variable, that is, the probability of distress in our setting. Figures A.3 and A.4 in the Appendix show the distribution for the total interaction terms according to the Management and Penalty interventions. Interaction effects are observation specific and indicate that supervisory actions against managers reduce the probability of distress by 0.62 percentage points (see the notes to Figure A.3). Given an average probability of distress of 8%, this reduction is substantial. The mitigating effect of penalties is 0.45 percentage points. But as indicated by the distribution of z-statistics in the right panel of Figure A.4, the effect is insignificant for many observations in the sample at the 5%-level (indicated by the red horizontal lines), as is corroborated by the mean z-statistic (A.4).

This result has important policy implications, because it shows that supervisors have effective tools to discipline banks at their disposal. Sturdy supervisory measures penalizing management and involving pecuniary fines can reduce the adverse effects of moral hazard. However, frequently used weak supervisory measures, namely warnings, do not discipline moral hazard. [29]

An important caveat is raised however by Greene (2009), who acknowledges that Ai and Norton (2003) are technically correct but also questions whether the interpretation of total marginal effects is informative to test hypotheses or the economic magnitude of individual total marginal effects even can be interpreted. Our aim is not to resolve this debate. However, to qualify our analysis, we show in the remaining columns of Table 8 the specifications of Equation (3) using alternative risk measures.

These linear alternatives avoid the discussion of total marginal effects and highlight that the effects of interventions depend on how risk gets measured. The mitigation of moral hazard is confirmed for pecuniary penalties: z-scores and Tier I capital ratios increase, and the share of NPL and net fixed interest rate assets are reduced. The large marginal effects for the relevant interaction terms reflect the low frequency of interventions in this category (see Table B.2 in the Appendix). The mitigating effect of management interventions is never significant though. Only warnings reduce risk, as measured by core capital ratios or fixed interest rate gaps.

[29] Note that warnings may reduce the *risk taking* of banks as such, which we cannot identify in this specification. If a warning was needed and if it was successful, we do not observe differences between sound banks and banks that have been warned and changed their behavior accordingly.

In summary, the effect of different interventions on mitigating moral hazard differs across risk measures. An exception are penalties, which reduce moral hazard according to almost any risk measure. For our preferred distress indicator, moral hazard due to safety nets can be reduced by interventions targeting the bank's management. Weak interventions are ineffective.

5 Conclusion

We test if bailout expectations increase moral hazard in the banking industry in terms of excessive risk-taking behavior. To this end, we develop a simultaneous structural equations model. In a first stage we estimate bailout probabilities, and in a second stage we regress measures for risk-taking behavior on the estimated bail out probabilities. Moral hazard is estimated as the sensitivity of distress probabilities with respect to an increase in the expected probability of a bank receiving capital preservation measures.

To separate bad luck from bad behavior, we suggest several novel identifying covariates that explain bailouts, but do not directly affect risk-taking behavior. Specifically, we identify the effect of moral hazard on risk taking based on regional political factors, differences across regulatory institutions responsible per bank, and regional banking market traits.

We combine these identifying covariates with a unique sample provided by the German central bank that contains detailed information on capital injections, regulatory interventions, and distressed exits at the bank level. The sample includes 3,517 German banks from 1995 until 2006, covering virtually the entire population, of which approximately 8% are in distress.

Our results reveal that an increase in the expected bailout probability by 1% increases the probability of being in distress by 7.2 basis points. The marginal effect of moral hazard on risk taking is large compared to other bank-specific risk determinants. In fact, an increase of bailout expectations from one standard deviation below the mean to one standard deviation above the mean implies an increase in predicted distress probabilities by 3.2%. Given the mean distress probability of 8%, this effect is substantial.

The result that safety nets in banking fuel moral hazard is robust across a wide range of alternative methods we used to estimate this structural model. Five alternative measures of risk taking corroborate the significance of moral hazard, too. Estimations for different subsamples of banking groups show that the moral hazard effect is not driven by government-owned banks. Instead, the results are predominantly driven by the largest group of mutually owned cooperative banks. For the subsample of publicly incorporated banks, we cannot detect a significant moral hazard effect, which is likely to reflect the small subsample of listed banks in Germany.

An important policy implication is the result that selected supervisory interventions can mitigate moral hazard. The moral hazard effect on the probability of distress is significantly reduced if interventions aim directly at the bank's management or involve pecuniary penalties. Therefore, stern interventions are effective, whereas weaker measures such as warnings which are more often used, actually are ineffective in reducing moral hazard. Managerial intervention effects differ though when we consider alternative measures of risk, though the mitigation of moral hazard is robust for penalties.

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6 Tables

Table 1
Sound and distressed banks over time

Year	Sound		Distressed				Total
			Bailout		Exit		
	N	*% of total*	*N*	*% of total*	*N*	*% of total*	*N*
1995	3,238	94.3	165	4.8	32	0.9	3,435
1996	3,111	93.8	176	5.3	28	0.8	3,315
1997	2,975	92.7	189	5.9	47	1.5	3,211
1998	2,812	92.0	174	5.7	69	2.3	3,055
1999	2,576	91.5	169	6.0	71	2.5	2,816
2000	2,323	90.9	167	6.5	65	2.5	2,555
2001	2,114	89.6	171	7.2	74	3.1	2,359
2002	1,946	89.5	172	7.9	56	2.6	2,174
2003	1,819	89.7	157	7.7	52	2.6	2,028
2004	1,767	91.6	135	7.0	27	1.4	1,929
2005	1,728	92.6	113	6.1	26	1.4	1,867
2006	1,696	94.0	87	4.8	21	1.2	1,804
Total	28,105	92.0	1,875	6.1	568	1.9	30,548

Notes: Based on banks with complete cases in the regression analysis. Distress is defined as the occurrence of either a bailout or exit of the bank due to a restructuring merger induced by the regulator. Bailout is defined as a capital injection by the responsible insurance fund of the bank.

Table 2
Descriptive statistics identifying variables

Event	Variable	Mean	SD	Percentile		N
				1st	*99th*	
Bailout	Injection frequency per state$_{t-1}$	79.15	12.87	50.00	100.00	1,875
	Number of banks in county$_t$	17.58	35.17	1.00	239.00	1,875
	State parliament election$_t$	0.20	0.40	0.00	1.00	1,875
	Vote share difference cabinet and opposition$_t$	20.28	14.22	1.97	65.18	1,875
	State government vote share$_t$	53.83	6.91	35.87	78.82	1,875
	(Major) opposition vote share$_t$	33.55	9.63	10.73	46.81	1,875
	Conservatives$_t$	0.59	0.49	0.00	1.00	1,875
	Socialists$_t$	0.30	0.46	0.00	1.00	1,875
	Great coalition$_t$	0.11	0.31	0.00	1.00	1,875
Exit	Injection frequency per state$_{t-1}$	73.74	14.86	16.67	100.00	568
	Number of banks in county$_t$	17.83	22.54	2.44	101.00	568
	State parliament election$_t$	0.25	0.43	0.00	1.00	568
	Vote share difference cabinet and opposition$_t$	16.50	12.03	1.18	65.18	568
	State government vote share$_t$	52.26	6.21	35.87	78.82	568
	(Major) opposition vote share$_t$	35.76	8.19	10.73	46.81	568
	Conservatives$_t$	0.61	0.49	0.00	1.00	568
	Socialists$_t$	0.34	0.47	0.00	1.00	568
	Great coalition$_t$	0.06	0.23	0.00	1.00	568
Total	Injection frequency per state$_{t-1}$	77.89	13.55	35.71	100.00	2,443
	Number of banks in county$_t$	17.64	32.67	1.00	230.00	2,443
	State parliament election$_t$	0.21	0.41	0.00	1.00	2,443
	Vote share difference cabinet and opposition$_t$	19.40	13.83	1.97	65.18	2,443
	State government vote share$_t$	53.46	6.79	35.87	78.82	2,443
	(Major) opposition vote share$_t$	34.06	9.36	10.73	46.81	2,443
	Conservatives$_t$	0.59	0.49	0.00	1.00	2,443
	Socialists$_t$	0.31	0.46	0.00	1.00	2,443
	Great coalition$_t$	0.10	0.30	0.00	1.00	2,443

Notes: Injection frequencies per state are the ratio of bailed-out banks relative to distressed banks lagged by one period. State parliament election is an indicator equal to 1 in the year of elections, which are held every four to five years, but at different dates in each of the 16 federal states. Vote share difference is calculated, as in Dinç and Gupta (2011), as the difference between the vote share of total votes cast for the governing coalition less the vote share cast for the main opposition. All shares of votes pertain to cast votes per county (*"Kreis"*) in state parliament elections. State government and (main) opposition vote share are the two components to calculate the vote share difference. Conservatives is an indicator equal to 1 if the state government is led by the Christian Democratic Union (*"CDU, Christlich Demokratische Union"*). Socialists is an indicator equal to 1 if the state government is led by the Social Democratic Party (*SPD, Sozialdemokratische Partei Deutschlands*). Great coalition is an indicator equal to 1 if the state government is composed of both Conservatives and Socialists.

Table 3
Descriptive statistics explanatory variables

	Sound		Bailout		Exit		Total	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Size$_{t-1}$	5.56	2.90	6.12	2.11	4.50	2.55	5.58	2.86
Hidden reserves$_{t-1}$	0.36	0.57	0.08	0.22	0.12	0.35	0.33	0.55
Non-performing loan share$_{t-1}$	9.78	8.72	13.22	10.30	11.77	10.39	10.03	8.90
Customer loan share$_{t-1}$	81.79	14.13	78.70	14.02	76.97	17.76	81.51	14.23
Return on equity$_{t-1}$	22.22	12.37	15.99	14.49	13.86	14.68	21.68	12.69
Fee to interest income ratio$_{t-1}$	29.88	398.53	28.16	29.42	30.48	59.69	29.79	382.42
Cost efficiency$_{t-1}$	76.25	5.65	74.70	6.65	74.51	8.47	76.13	5.80
Liquid asset share$_{t-1}$	2.08	1.13	2.40	1.11	2.19	1.12	2.10	1.13
Regional market share$_{t-1}$	15.34	22.01	15.58	20.90	9.58	17.21	15.24	21.88
Public limited company indicator$_t$	0.04	0.20	0.04	0.20	0.06	0.24	0.04	0.20
Corporate insolvencies$_{t-1}$	0.89	0.39	1.08	0.54	0.97	0.47	0.90	0.41
Annual real GSP per capita growth$_{t-1}$	1.30	1.39	1.72	1.78	1.45	1.74	1.33	1.43
State unemployment rate$_{t-1}$	8.82	3.04	10.15	4.52	9.35	4.07	8.91	3.19
Observations	28,105		1,875		568		30,548	

Notes: Variables are defined as follows: Size deciles are based on the distribution of gross total assets across all banks per year. Hidden reserves due to below market value valuations, according to §340f commercial code (HGB), represent a share of total assets. Non-performing loans equal the share of latent risk loans relative to the total of audited loans. Customer loans are the share of lending volume to private and non-financial corporate customers relative to total loans. Profitability is measured as operating return relative to total equity. The income structure is measured by the ratio of net fee income relative to net interest income. Cost efficiency is the percentage of actual cost that would have sufficed to provide observed production plans, derived from a stochastic cost frontier model. Liquidity is measured as the sum of cash and overnight interbank assets relative to total assets. Market shares are based on gross total asset shares of each bank in each year of aggregate gross total assets in their county (*"Kreis"*). Public limited company is a dummy equal to 1 if the banking firm is incorporated either as a stock listed company or a private limited partnership (*"Kapitalgesellschaft"*). Corporate insolvencies are the ratio of corporate firms in the state that filed for bankruptcy relative to the total number of firms. Gross state product per capita growth is measured per state and in real terms in prices of 2005. The unemployment rate per state equals the share of registered unemployed workers and employees as a share of the entire social-security insured population.

Table 4
Identification of bailout probabilities and moral hazard effects

	Parsimonious		**Politics**		**Associations**		**Regulator**	
Equation	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*
Explanatory covariates (X)								
Predicted bailout		0.063***		0.059***		0.057***		0.072***
probability$_t$		[0.021]		[0.020]		[0.016]		[0.012]
Size$_{t-1}$	0.062***	0.005***	0.063***	0.005***	0.062***	0.005***	0.064***	0.005***
	[0.005]	[0.002]	[0.005]	[0.002]	[0.005]	[0.002]	[0.005]	[0.001]
Hidden reserves$_{t-1}$	-0.098***	-0.075***	-0.096***	-0.076***	-0.074**	-0.078***	-0.076**	-0.075***
	[0.034]	[0.008]	[0.033]	[0.008]	[0.033]	[0.007]	[0.033]	[0.007]
Non-performing	0.002**	0.001***	0.002***	0.001***	0.003***	0.001***	0.003***	0.001***
loan share$_{t-1}$	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
Customer loan	0.002**	-0.000	0.002**	-0.000	0.002**	-0.000	0.002**	-0.000
share$_{t-1}$	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
Return on equity$_{t-1}$	0.000	-0.002***	0.000	-0.002***	0.000	-0.002***	0.000	-0.002***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
Fee to interest	0.000*	-0.000***	0.000*	-0.000***	0.000	-0.000***	0.000	-0.000***
income ratio$_{t-1}$	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Cost efficiency$_{t-1}$	-0.001	-0.001***	-0.001	-0.001***	-0.001	-0.001***	-0.001	-0.001***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
Liquid asset share$_{t-1}$	0.010	0.003*	0.010	0.003*	0.011	0.003*	0.008	0.003*
	[0.012]	[0.002]	[0.012]	[0.002]	[0.012]	[0.002]	[0.012]	[0.001]
Regional market	0.002***	-0.000	0.002**	-0.000	0.002***	-0.000	0.002**	-0.000
share$_{t-1}$	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]
Public limited	-0.183*	-0.026***	-0.190*	-0.027***	-0.203**	-0.027***	-0.206**	-0.027***
company indicator$_t$	[0.099]	[0.007]	[0.101]	[0.007]	[0.101]	[0.007]	[0.104]	[0.007]
Corporate insolvencies$_{t-1}$	0.093*	0.029***	0.122**	0.030***	0.134**	0.031***	0.179***	0.028***
	[0.052]	[0.010]	[0.054]	[0.010]	[0.055]	[0.009]	[0.056]	[0.009]
Annual real GSP	0.003	0.006***	0.005	0.006***	0.009	0.006***	0.011	0.006***
per capita growth$_{t-1}$	[0.008]	[0.001]	[0.008]	[0.001]	[0.008]	[0.001]	[0.008]	[0.001]
State unemployment	-0.006	0.003**	-0.014*	0.003**	-0.010	0.003**	-0.020**	0.003**
rate$_{t-1}$	[0.006]	[0.001]	[0.007]	[0.001]	[0.009]	[0.001]	[0.009]	[0.001]

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	Parsimonious		Politics		Associations		Regulator	
	Bailout	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*
Identifying covariates (Z)								
Injection frequency	0.003***		0.003***		0.002***		0.002**	
per state$_{t-1}$	[0.001]		[0.001]		[0.001]		[0.001]	
Number of banks	0.001		0.001		0.000		0.001*	
in county$_t$	[0.000]		[0.000]		[0.000]		[0.001]	
State parliament	-0.057***		-0.057***		-0.058**		-0.055**	
election$_t$	[0.022]		[0.022]		[0.023]		[0.023]	
Vote share difference	0.002							
cabinet to opposition$_t$	[0.001]							
Conservatives $\times$			0.004***		0.006***		0.005**	
vote share difference$_t$			[0.001]		[0.002]		[0.002]	
Socialists $\times$			0.001		0.001		0.004	
vote share difference$_t$			[0.002]		[0.002]		[0.003]	
Great coalition $\times$			-0.003		-0.005*		-0.007***	
Vote share difference$_t$			[0.002]		[0.002]		[0.003]	
Socialists$_t$			0.068*		0.036		-0.018	
			[0.040]		[0.050]		[0.054]	
Great coalition$_t$			0.183***		0.201***		0.212***	
			[0.044]		[0.032]		[0.028]	
Dummies included for:								
Years	x	x	x	x	x	x	x	x
Banking 'pillar'	x	x	x	x	x	x	x	x
Responsible banking association					x		x	
Regional Bundesbank branch							x	
Diagnostics and F-tests for identifying covariates								
Observations	2,443	30,548	2,443	30,548	2,443	30,548	2,443	30,548
Pseudo-R^2	0.18	0.165	0.182	0.165	0.205	0.166	0.217	0.170
Log-likelihood value	-1,087	-7,105	-1,084	-7,105	-1,053	-7,097	-1,037	-7,064
F-test all	29.6		33.8		270.7		874.3	
p-value all	0.000		0.000		0.000		0.000	
F-test base			23.1		14.5		12.6	
p-value base			0.000		0.002		0.000	
F-test politics			9.5		14.9		10.6	
p-value politics			0.090		0.011		0.060	
F-test association					218.3		401.3	
p-value association					0.000		0.000	
F-test regulator							418.4	
p-value regulator							0.000	

Notes: Marginal effects from two-stage probit estimations of Equations (1) and (4). The dependent variable in the bailout equation is an indicator equal to 1 if the bank received capital preservation measures (bailout). The control group consists of bank-year observations of exits due to a restructuring merger. The dependent variable in the distress equation is equal to 1 if a bank either exited due to a restructuring merger or received capital preservation measures. Expanatory and identifying covariates are defined as in Tables 2 and 3 and and are lagged, as indicated by subscripts. Time and banking pillar indicators are included but not reported. There are 37 responsible banking association indicators and eight central bank branch (*"Hauptverwaltung"*) indicators. F-tests pertain to identifying covariates, and labels indicate the groups tested to be jointly significant. Standard errors clustered at the bank-level are in brackets. */**/*** denote significance at the 10%/5%/1% levels, respectively.

Table 5
Marginal effects for alternative risk measures

Dependent	**Distress**	**z-score**	**NPL share**	**Tier I**	**NFIRA**	**FIRG**
Predicted bailout probability$_t$	0.072***	-1.485**	5.497***	-0.522	-1.935**	-0.079**
	[0.012]	[0.598]	[0.908]	[0.469]	[0.953]	[0.036]
Size$_{t-1}$	0.005***	-0.213***	0.031	-0.314***	-0.312***	-0.055***
	[0.001]	[0.063]	[0.097]	[0.062]	[0.097]	[0.004]
Hidden reserves$_{t-1}$	-0.075***	-0.108	-0.298*	0.852***	3.414***	0.027**
	[0.007]	[0.200]	[0.176]	[0.114]	[0.385]	[0.013]
Non-performing loan share$_{t-1}$	0.001***	-0.002		-0.022***	-0.104***	0.000
	[0.000]	[0.011]		[0.008]	[0.015]	[0.001]
Customer loan share$_{t-1}$	-0.000	-0.036***	0.089***	-0.169***	-0.023	0.004***
	[0.000]	[0.011]	[0.011]	[0.017]	[0.016]	[0.001]
Return on equity$_{t-1}$	-0.002***	-0.024**	-0.009	-0.028***	0.047***	0.007***
	[0.000]	[0.012]	[0.009]	[0.010]	[0.014]	[0.001]
Fee to interest income ratio$_{t-1}$	-0.000***	-0.000**	-0.000*	0.001	-0.000***	-0.000**
	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]
Cost efficiency$_{t-1}$	-0.001***	0.121***	0.005	-0.135***	-0.072***	-0.004***
	[0.000]	[0.015]	[0.013]	[0.041]	[0.027]	[0.001]
Liquid asset share$_{t-1}$	0.003*	-0.343***	0.132*	0.114	0.249	0.037***
	[0.001]	[0.095]	[0.079]	[0.204]	[0.166]	[0.007]
Regional market share$_{t-1}$	-0.000	0.007	-0.032***	0.001	0.005	0.002***
	[0.000]	[0.005]	[0.005]	[0.004]	[0.010]	[0.000]
Public limited company indicator$_t$	-0.027***	-0.023	-0.133	-4.869**	-5.541***	-0.206**
	[0.007]	[1.009]	[1.190]	[1.892]	[1.856]	[0.102]
Corporate insolvencies$_{t-1}$	0.028***	-1.776***	-2.623***	0.555	-0.895	-0.164***
	[0.009]	[0.377]	[0.390]	[0.342]	[0.755]	[0.035]
Annual real GSP per capita growth$_{t-1}$	0.006***	-0.279***	0.364***	-0.136***	-0.189**	0.005
	[0.001]	[0.054]	[0.062]	[0.037]	[0.089]	[0.004]
State unemployment rate$_{t-1}$	0.003**	-0.234***	0.436***	-0.147**	0.261***	0.030***
	[0.001]	[0.054]	[0.059]	[0.061]	[0.095]	[0.005]
Observations	30,548	30,090	30,548	30,090	27,495	27,418
(Pseudo-)R^2	0.17	0.104	0.092	0.337	0.146	0.182

Notes: Marginal effects for the estimation of the risk Equation (3). The dependent variable in the distress equation is equal to 1 if a bank either exited due to a restructuring merger or received capital preservation measures and parameters are obtained from probit estimation. Remaining risk proxies are continuous, as described in Table B.1, and the estimation relies on OLS. Time and banking pillar indicators are included but not reported. The z-score is defined following Laeven and Levine (2009) as $\frac{RoA+TierIcapitalratio}{\sigma_{RoA}}$. The Tier I capital ratio is equal to core capital according to Basel II regulation relative to risk-weighted assets (RWA). Return to assets equals operating net income of the bank relative to RWA. Non-performing loans share is the ratio of the lending volume considered at latent risk by auditors relative to the total volume of audited loans. NFIRA equals the difference between fixed interest-bearing assets and fixed interest-bearing liabilities. FIRG denotes the difference between the average interest rate on fixed interest rate assets and the average interest rate on fixed interest rate liabilities. Standard errors clustered at the bank-level are in brackets. */**/*** denote significance at the 10%/5%/1% levels, respectively.

Table 6
Robustness checks for consistency and biased standard errors

Robustness check for:	**Baseline**		**Identification (OLS)**		**Two-way cluster (i & t)**		**System bootstrap**		**Joint system (MLE)**	
Dependent	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*
Predicted bailout probability$_t$		0.760***		0.106***		0.081***		0.760		4.713
		[0.116]		[0.018]		[0.018]		[0.140]***		[0.988]***
Size$_{t-1}$	0.247***	0.048***	0.067***	0.006***	0.247***	0.077***	0.234	0.048	0.124	0.284
	[0.019]	[0.013]	[0.005]	[0.002]	[0.022]	[0.011]	[0.018]***	[0.010]***	[0.016]***	[0.028]***
Hidden reserves$_{t-1}$	-0.292**	-0.787***	-0.085***	-0.047***	-0.292*	-0.827***	-0.336	-0.787	-0.418	-1.439
	[0.126]	[0.088]	[0.032]	[0.005]	[0.174]	[0.107]	[0.129]***	[0.084]***	[0.073]***	[0.186]***
Non-performing loan share$_{t-1}$	0.010***	0.013***	0.002***	0.002***	0.010***	0.014***	0.008	0.013	-0.003	0.011
	[0.004]	[0.002]	[0.001]	[0.000]	[0.004]	[0.002]	[0.003]**	[0.001]***	[0.002]	[0.003]***
Customer loan share$_{t-1}$	0.007**	-0.002	0.002**	-0.000	0.007**	-0.001	0.006	-0.002	0.004	0.005
	[0.003]	[0.001]	[0.001]	[0.000]	[0.003]	[0.001]	[0.003]**	[0.001]**	[0.001]***	[0.002]**
Return on equity$_{t-1}$	0.001	-0.018***	0.000	-0.003***	0.001	-0.018***	0.001	-0.018	-0.005	-0.027
	[0.003]	[0.002]	[0.001]	[0.000]	[0.003]	[0.002]	[0.003]	[0.001]***	[0.002]**	[0.004]***
Fee to interest income ratio$_{t-1}$	0.001	-0.000***	0.000	-0.000***	0.001	-0.000***	0.002	-0.000	0.000	-0.000
	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]*	[0.000]	[0.000]
Cost efficiency$_{t-1}$	-0.004	-0.009***	-0.001	-0.002***	-0.004	-0.010**	-0.003	-0.009	-0.001	-0.012
	[0.005]	[0.003]	[0.001]	[0.000]	[0.005]	[0.004]	[0.005]	[0.002]***	[0.003]	[0.005]**
Liquid asset share$_{t-1}$	0.029	0.027*	0.008	0.005**	0.029	0.032*	0.027	0.027	0.011	0.049
	[0.045]	[0.015]	[0.010]	[0.003]	[0.032]	[0.018]	[0.043]	[0.012]**	[0.011]	[0.017]***
Regional market share$_{t-1}$	0.007**	-0.002	0.002***	-0.000	0.007***	-0.001	0.006	-0.002	0.009	0.008
	[0.003]	[0.002]	[0.001]	[0.000]	[0.002]	[0.002]	[0.003]**	[0.001]*	[0.002]***	[0.002]***
Public limited company indicator$_t$	-0.637**	-0.376***	-0.169**	-0.058***	-0.637**	-0.424***	-0.550	-0.376	-0.540	-1.230
	[0.278]	[0.129]	[0.071]	[0.022]	[0.299]	[0.120]	[0.266]**	[0.085]***	[0.138]***	[0.245]***
Corporate insolvencies$_{t-1}$	0.687***	0.297***	0.142***	0.053***	0.687***	0.361*	0.537	0.297	0.287	0.711
	[0.215]	[0.097]	[0.045]	[0.015]	[0.166]	[0.186]	[0.192]***	[0.075]***	[0.133]**	[0.163]***
Annual real GSP per	0.041	0.061***	0.010	0.011***	0.041	0.066***	0.029	0.061	0.063	0.125
capita growth$_{t-1}$	[0.032]	[0.013]	[0.007]	[0.002]	[0.030]	[0.022]	[0.031]	[0.011]***	[0.019]***	[0.026]***
State unemployment rate$_{t-1}$	-0.078**	0.033**	-0.012	0.006***	-0.078**	0.030	-0.068	0.033	-0.015	0.029
	[0.036]	[0.013]	[0.008]	[0.002]	[0.034]	[0.024]	[0.031]**	[0.009]***	[0.018]	[0.022]

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Robustness check for:	**Baseline**		**Identification (OLS)**		**Two-way cluster (i & t)**		**System bootstrap**		**Joint system (MLE)**	
Dependent	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*
Injection frequency per state$_{t-1}$	0.007**		0.002**		0.007**		0.010		0.001	
	[0.003]		[0.001]		[0.003]		[0.003]***		[0.001]	
Number of banks in county$_t$	0.003*		0.001*		0.003*		0.005		0.001	
	[0.002]		[0.000]		[0.002]		[0.002]***		[0.000]***	
State parliament election$_t$	-0.201**		-0.052***		-0.201***		-0.204		-0.040	
	[0.079]		[0.019]		[0.055]		[0.081]**		[0.023]*	
Conservatives $\times$ vote share difference$_t$	0.018**		0.003**		0.018**		0.013		0.007	
	[0.007]		[0.002]		[0.008]		[0.007]*		[0.002]***	
Socialists $\times$ vote share difference$_t$	0.014		0.003		0.014*		0.006		-0.008	
	[0.010]		[0.002]		[0.008]		[0.009]		[0.003]***	
Great coalition $\times$ vote share difference$_t$	-0.026***		-0.005***		-0.026**		-0.014		0.000	
	[0.010]		[0.002]		[0.011]		[0.009]		[0.003]	
Socialists$_t$	-0.069		-0.013		-0.069		0.082		0.108	
	[0.203]		[0.054]		[0.142]		[0.181]		[0.047]**	
Great coalition$_t$	1.595***		0.312***		1.595***		1.149		0.109	
	[0.543]		[0.106]		[0.501]		[0.505]**		[0.144]	
Constant	-1.511*	0.285***	0.134	0.040	-1.511*	0.245	-1.994	-1.813	-0.995	0.291
	[0.784]	[0.060]	[0.196]	[0.048]	[0.838]	[0.275]	[0.668]***	[0.189]***	[0.382]***	[0.725]
Observations	2,443	30,548	2,443	30,548	2,443	30,548	2,443	6,266	30,548	
(Pseudo-)R^2	0.217	0.17	0.222	0.091	0.217	0.167	0.190	0.118		
Log-likelihood value	-1,037	-7,064	-1,055	-2,026	-1,037	-7,092			-8,191	

Notes: The first pair of columns shows the baseline results from the two-stage probit estimations of Equations (1) and (4). *Identification* show the OLS, which are always consistent and do not rely on functional form for identification. *Two-way cluster* show standard errors clustered for both banks and years, as in Petersen (2009). *System bootstrap* provide standard errors from bootstrapping Equations (1) and (4) jointly using 1,000 iterations and sampling with replacement. *Joint system* shows MLE according to Equations (5a)-(5c). Time and banking pillar indicators are included but not reported. Standard errors clustered at the bank-level are in brackets for baseline, OLS, and bootstrap specifications. */**/*** denote significance at the 10%/5%/1% level, respectively.

Table 7
Moral hazard and banking groups with different ownership and governance structures

Sample	Baseline: All banks		Local banks		Local non-savings banks		All non-savings banks		Public incorporation		Private incorporation	
Equation	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*
Predicted bailout probability$_t$		0.072***		0.079***		0.101***		0.102***		0.001		0.077***
		[0.012]		[0.012]		[0.018]		[0.018]		[0.015]		[0.012]
Size$_{t-1}$	0.064***	0.005***	0.065***	0.004***	0.062***	0.006***	0.062***	0.006***	-0.000	-0.004	0.074***	0.004***
	[0.005]	[0.001]	[0.005]	[0.001]	[0.005]	[0.002]	[0.005]	[0.002]	[0.000]	[0.004]	[0.005]	[0.001]
Hidden reserves$_{t-1}$	-0.076**	-0.075***	-0.077**	-0.076***	-0.056	-0.103***	-0.056	-0.102***	-0.002	-0.148	-0.074**	-0.073***
	[0.033]	[0.007]	[0.033]	[0.007]	[0.040]	[0.010]	[0.040]	[0.010]	[0.034]	[0.093]	[0.031]	[0.007]
Non-performing loan share$_{t-1}$	0.003***	0.001***	0.003***	0.001***	0.003***	0.002***	0.003***	0.002***	-0.000	0.002***	0.002	0.001***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]
Customer loan share$_{t-1}$	0.002**	-0.000	0.002**	-0.000**	0.002**	-0.000**	0.002**	-0.000*	0.000	0.000	0.001	-0.000*
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]
Return on equity$_{t-1}$	0.000	-0.002***	0.000	-0.002***	0.000	-0.002***	0.000	-0.002***	-0.000	-0.002***	0.001	-0.002***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]
Fee to interest income ratio$_{t-1}$	0.000	-0.000***	0.000	-0.000***	0.000	-0.000***	0.000	-0.000***	0.000	-0.000***	-0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Cost efficiency$_{t-1}$	-0.001	-0.001***	-0.001	-0.001***	-0.001	-0.001***	-0.001	-0.001***	-0.000	0.001	-0.002	-0.001***
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.001]	[0.002]	[0.000]
Liquid asset share$_{t-1}$	0.008	0.003*	0.008	0.002	0.006	0.003	0.006	0.003	0.000	-0.004	-0.005	0.003*
	[0.012]	[0.001]	[0.012]	[0.001]	[0.012]	[0.002]	[0.012]	[0.002]	[0.000]	[0.005]	[0.011]	[0.002]
Regional market share$_{t-1}$	0.002**	-0.000	0.002**	-0.000	0.001	0.000	0.001	0.000	0.000	-0.001	0.001*	-0.000
	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]
Public limited company indicator$_t$	-0.206**	-0.027***	-0.207**	-0.024***	-0.208**	-0.032***	-0.208**	-0.036***				
	[0.104]	[0.007]	[0.104]	[0.008]	[0.103]	[0.011]	[0.103]	[0.010]				
Corporate insolvencies$_{t-1}$	0.179***	0.028***	0.180***	0.027***	0.186***	0.046***	0.186***	0.046***	0.000	0.005	0.139**	0.027***
	[0.056]	[0.009]	[0.056]	[0.009]	[0.060]	[0.014]	[0.060]	[0.014]	[0.003]	[0.040]	[0.057]	[0.009]
Annual real GSP per capita growth$_{t-1}$	0.011	0.006***	0.011	0.006***	0.013	0.007***	0.013	0.007***	0.000	0.009	0.009	0.005***
	[0.008]	[0.001]	[0.008]	[0.001]	[0.008]	[0.002]	[0.008]	[0.002]	[0.000]	[0.007]	[0.008]	[0.001]
State unemployment rate$_{t-1}$	-0.020**	0.003**	-0.021**	0.003**	-0.021**	0.003*	-0.021**	0.003*	-0.000	0.003	-0.014	0.003**
	[0.009]	[0.001]	[0.009]	[0.001]	[0.010]	[0.002]	[0.010]	[0.002]	[0.000]	[0.006]	[0.009]	[0.001]

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Sample	**Baseline: All banks**		**Local banks**		**Local non-savings banks**		**All non-savings banks**		**Public incorporation**		**Private incorporation**	
Equation	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*	*Bailout*	*Distress*
Injection frequency per state$_{t-1}$	0.002**		0.002**		0.002**		0.002**		-0.000		0.002**	
	[0.001]		[0.001]		[0.001]		[0.001]		[0.000]		[0.001]	
Number of banks in county$_t$	0.001*		0.001*		0.001		0.001		0.000		0.000	
	[0.001]		[0.001]		[0.001]		[0.001]		[0.000]		[0.001]	
State parliament election$_t$	-0.055**		-0.056**		-0.053**		-0.053**		-0.923		-0.053**	
	[0.023]		[0.023]		[0.023]		[0.023]		[0.608]		[0.023]	
Conservatives × vote share difference$_t$	0.005**		0.005**		0.004*		0.004*		0.000		0.004**	
	[0.002]		[0.002]		[0.002]		[0.002]		[0.000]		[0.002]	
Socialists × vote share difference$_t$	0.004		0.004		0.004		0.004		0.000		0.003	
	[0.003]		[0.003]		[0.003]		[0.003]		[0.000]		[0.003]	
Great coalition × Vote share difference$_t$	-0.007***		-0.007***		-0.007***		-0.007***		-0.000		-0.006**	
	[0.003]		[0.003]		[0.003]		[0.003]		[0.000]		[0.003]	
Socialists$_t$	-0.018		-0.018		-0.033		-0.033		-1.000***		-0.015	
	[0.054]		[0.055]		[0.056]		[0.056]		[0.004]		[0.056]	
Great coalition$_t$	0.212***		0.215***		0.208***		0.208***		0.000		0.196***	
	[0.028]		[0.029]		[0.027]		[0.027]		[0.004]		[0.032]	
Observations	2,443	30,548	2,438	30,314	2,297	23,813	2,297	23,895	112	1,252	2,314	29,274
(Pseudo-)R^2	0.217	0.170	0.216	0.172	0.210	0.149	0.210	0.149	0.766	0.150	0.232	0.179

Notes: Marginal effects of the two-stage probit estimation of the bailout and distress Equations (1) and (4) for different subsamples of banks. The columns labelled *Baseline* contain all banks for comparison. *Local Banks* excludes the fairly few (inter)nationally active banks from all three banking pillars. *Local non-savings banks* excludes government-owned savings banks from this set and contains only regional banks from the commercial and cooperative sector. *All non-savings banks* adds back the (inter)nationally active large banks from the commercial and cooperative pillar to the sample. The last two specifications distinguish banks based on private versus public incorporation. Time and banking pillar indicators are included but not reported. Standard errors clustered at the bank-level are in brackets. */**/*** denote significant at the 10%/5%/1% level, respectively.

Table 8
Regulatory intervention and moral hazard

Dependent variable	Distress	z-score	Tier I	NPL	NFIRA	FIRG
Predicted bailout probability$_t$	0.071***	-1.466**	0.332	5.458***	-1.931**	-0.075**
	[0.011]	[0.599]	[0.972]	[0.905]	[0.953]	[0.036]
Warnings	0.056	-1.566	-4.548**	1.364	-4.692**	0.115
	[0.052]	[1.185]	[1.843]	[1.286]	[2.092]	[0.084]
Warnings $\times \hat{\pi}$	-0.018	0.816	6.098***	0.345	3.412	-0.238**
	[0.036]	[1.521]	[2.147]	[1.943]	[2.770]	[0.114]
Management	0.826***	-6.399**	-8.152	-4.229	-9.431	0.119
	[0.181]	[3.051]	[7.473]	[3.123]	[7.723]	[0.363]
Management $\times \hat{\pi}$	-0.400**	6.221	5.859	3.117	17.034	-0.455
	[0.161]	[4.701]	[9.195]	[6.225]	[13.216]	[0.561]
Restrictions	0.348*	-0.819	37.247	0.335	-8.363	-0.223
	[0.197]	[4.097]	[35.165]	[2.489]	[7.331]	[0.301]
Restriction $\times \hat{\pi}$	0.047	-1.048	-38.353	-0.309	6.786	0.125
	[0.060]	[4.565]	[36.451]	[2.785]	[8.779]	[0.348]
Penalties	0.658	-31.552***	-9.911*	25.342*	55.140***	1.098
	[0.506]	[2.171]	[5.912]	[14.294]	[19.943]	[1.043]
Penalties $\times \hat{\pi}$	-0.320*	44.081***	14.466*	-30.268*	-68.386***	-1.572
	[0.167]	[2.414]	[7.557]	[16.303]	[23.617]	[1.199]
Size$_{t-1}$	0.004***	-0.212***	-0.505***	0.030	-0.312***	-0.055***
	[0.001]	[0.063]	[0.165]	[0.097]	[0.097]	[0.004]
Hidden reserves$_{t-1}$	-0.071***	-0.122	0.794***	-0.292*	3.402***	0.026**
	[0.007]	[0.200]	[0.231]	[0.176]	[0.377]	[0.013]
Non-performing loan share$_{t-1}$	0.001***	-0.001	-0.069**		-0.102***	0.001
	[0.000]	[0.011]	[0.031]		[0.015]	[0.001]
Customer loan share$_{t-1}$	-0.000	-0.036***	-0.248***	0.089***	-0.023	0.004***
	[0.000]	[0.011]	[0.057]	[0.011]	[0.016]	[0.001]
Return on equity$_{t-1}$	-0.002***	-0.025**	-0.001	-0.009	0.046***	0.007***
	[0.000]	[0.012]	[0.034]	[0.009]	[0.014]	[0.001]
Fee to interest income ratio$_{t-1}$	-0.000***	-0.000**	0.002	-0.000*	-0.000***	-0.000**
	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]	[0.000]
Cost efficiency$_{t-1}$	-0.001***	0.120***	-0.289***	0.006	-0.073***	-0.004***
	[0.000]	[0.015]	[0.093]	[0.013]	[0.027]	[0.001]
Liquid asset share$_{t-1}$	0.003*	-0.344***	0.645	0.132*	0.248	0.037***
	[0.001]	[0.095]	[1.191]	[0.079]	[0.166]	[0.007]
Regional market share$_{t-1}$	-0.000	0.007	-0.001	-0.031***	0.005	0.002***
	[0.000]	[0.005]	[0.010]	[0.005]	[0.010]	[0.000]
Public limited company indicator$_t$	-0.026***	-0.033	-8.969	-0.129	-5.558***	-0.207**
	[0.007]	[1.009]	[6.500]	[1.188]	[1.857]	[0.102]
Corporate insolvencies$_{t-1}$	0.021**	-1.721***	2.108*	-2.652***	-0.833	-0.160***
	[0.009]	[0.376]	[1.100]	[0.390]	[0.754]	[0.035]
Annual real GSP per capita growth$_{t-1}$	0.006***	-0.282***	-0.194	0.368***	-0.193**	0.005
	[0.001]	[0.054]	[0.118]	[0.062]	[0.088]	[0.004]
State unemployment rate$_{t-1}$	0.003***	-0.233***	-0.491**	0.435***	0.265***	0.030***
	[0.001]	[0.054]	[0.212]	[0.059]	[0.095]	[0.005]
Observations	30,548	30,090	30,090	30,548	27,495	27,418
(Pseudo-) R^2	0.191	0.105	0.076	0.093	0.147	0.182
Log-likelihood value	-6,888	-104,355	-138,244	-107,294	-105,307	-18,238

Notes: Marginal effects for the risk Equation (4) for different measures of risk as the dependent variable. Bailout probabilities from probit estimates of the bailout equation (first-stage results from specification labelled "Regulator" in Table 4). Risk measures are defined in Table B.1. The distress specification is estimated with probit, and all other specifications with OLS. Time and banking pillar indicators are included but not reported. Direct and interaction terms refer to four different types of intervention. Warnings comprise events such as hearings and official letters from the supervisor. Management comprises measures targeting bank managers, such as replacement. Restrictions comprise interventions prohibiting certain business activities, such as granting loans or taking deposits. Penalties are payments of fines. The detailed intervention group composition is shown in Table B.2. Standard errors clustered at the bank-level are in brackets. */**/*** denote significant at the 10%/5%/1% level, respectively.

A Appendix: Figures

Figure A.1. Game Tree

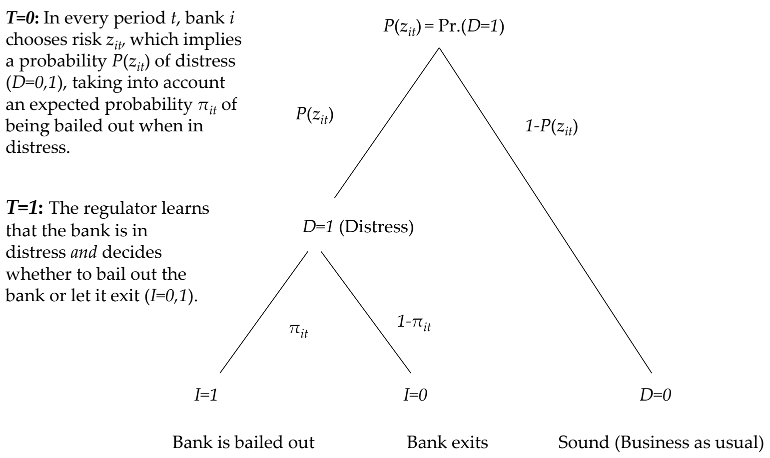


Figure A.2. Predicted probabilities of bailouts and distress

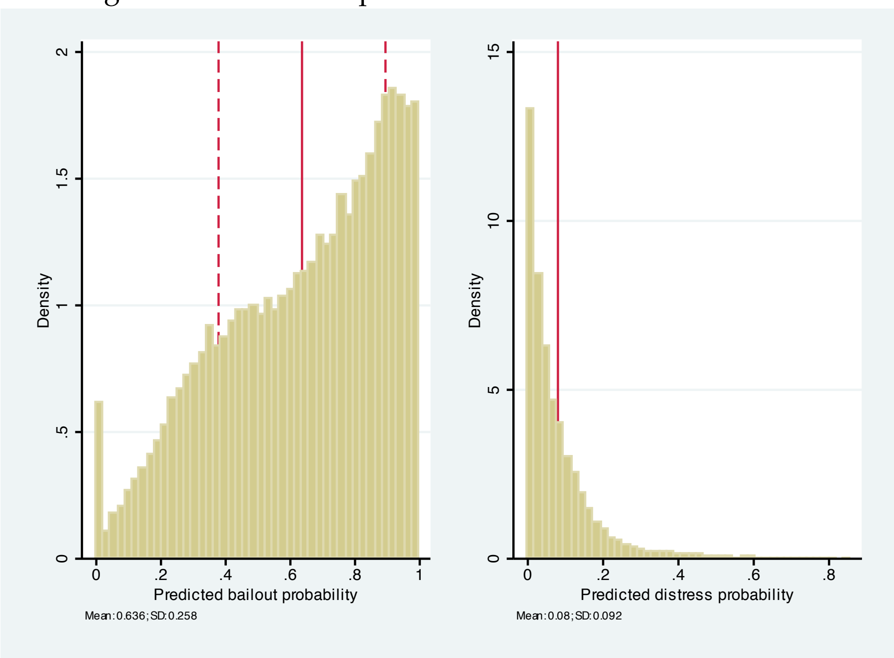


Figure A.3. Interaction effects of management interventions and moral hazard on distress

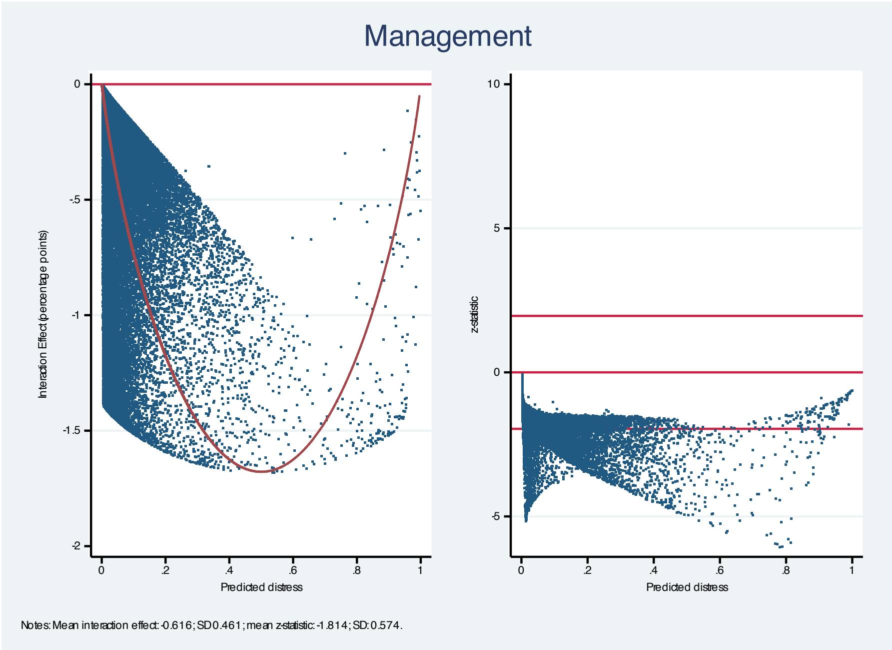
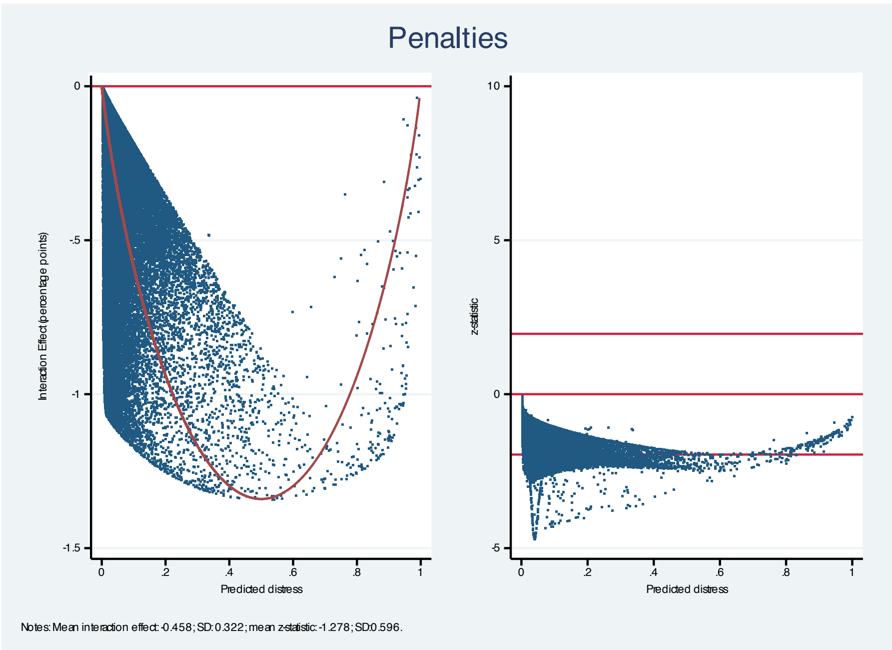


Figure A.4. Interaction effects of penalty interventions and moral hazard on distress



B Appendix: Tables

Table B.1
Descriptive statistics for alternative risk-taking proxies

Variable	Mean	SD	Percentile		N
			1st	*99th*	
z-score	16.04	8.20	2.55	47.00	30,090
Tier 1 capital ratio	9.49	24.90	4.84	30.98	30,090
Return on risk-weighted assets (RoA)	1.69	6.92	-2.22	5.12	30,090
σ_{RoA}	1.12	5.85	0.21	6.85	30,093
Non-performing loan share	9.40	8.52	0.00	38.17	30,548
Net fixed interest rate assets (NFIRA)	22.79	12.07	-8.14	49.32	27,495
Fixed interest rate gap (FIRG)	1.31	0.52	0.20	3.07	27,418

Notes: The z-score is defined, following Laeven and Levine (2009), as $\frac{RoA+TierIcapitalratio}{\sigma_{RoA}}$. Relevant components are defined as follows: The Tier I capital ratio is equal to core capital according to the Basel II regulation relative to risk-weighted assets (RWA). Return to assets equals operating net income of the bank relative to RWA. Non-performing loans share is the ratio of the lending volume considered at latent risk by auditors relative to the total volume of audited loans. NFIRA equals the difference between fixed interest-bearing assets and fixed interest-bearing liabilities. FIRG denotes the difference between the average interest rate on fixed interest rate assets and the average interest rate on fixed interest rate liabilities.

Table B.2
Detailed components of regulatory intervention categories

	Sound	Bailout	Exit	Total
Warnings	707	190	28	925
Management	21	5	9	35
Restrictions	38	173	29	240
Penalties	7	3	0	10
Total interventions	**773**	**371**	**66**	**1,210**

Notes: Number of measures categorized into the four intervention classes. Multiple events are possible and accounted for in the regressions by a count of intervention variables per bank and year. KWG refers to the German Banking Act (*"Kreditwesengesetz"*). Provisions according to the respective sections of the Banking Act are categorized as shown, depending on the specific nature of the regulatory measure taken.

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