Online Appendix:
Bank recapitalization, regulatory intervention, and repayment

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Abstract

This online appendix provides supplementary and ancillary data, results, and information to accompany "Bank recapitalization, regulatory intervention, and repayment"

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1. Further information on insurance funds

1.1. Commercial banks

By law, each depositor at a bank chartered in Germany during the 1994-2010 sample period was insured for up to 100,000 Euros during the sample period 1994–2010. This scheme is operated by the "Entschädigungseinrichtung deutscher Banken GmbH" (EdB). In addition to the deposit insurance scheme required by law, commercial banks maintain a voluntary insurance scheme, as described at http://bankenverband.de. This scheme was founded in 1976, two years after the Herstatt failure. In 1974, the bankruptcy of German privately owned bank Herstatt was the largest bank failure in post-war Germany. Besides the introduction of the insurance scheme, it triggered several changes in German banking law and the establishment of the Basel Committee on Banking Supervision. It is organized as a fund to which member banks – which include virtually all private commercial banks operating in Germany – contribute risk-adjusted, individual insurance premiums. Member banks have no obligation to stock the funds in case of payouts. Contrary to the insurance schemes maintained for savings and cooperative banks, this insurance does not aim per se to prevent bank failures (Bundesverband deutscher Banken, 2012). Rather, it seeks to minimize negative impact of bank defaults on consumers and avoid influencing competition among commercial banks. The latter objective is reflected by bank-specific insurance premia and heterogeneous insurance coverage, about which depositors can inquire online.

1.2. Cooperative banks

The insurance protection by the "Bundesverband der Deutschen Volksbanken und Raiffeisenbanken" (BVR) comprises two elements: (1) deposit insurance and (2) institutional warrants ("Institutssicherung") (BVR, 2011). The purpose of the deposit insurance is, first, to foster trust among depositors that their savings are safe and, second, to keep distressed member banks afloat by means of capital injections or warrants by the fund. A central federal fund is financed by risk-oriented annual contributions by member banks, repayment of previous capital injections, and returns from capital investments. The purpose of institutional

warrants (by member banks) is to constitute more extensive insurance against insolvency in the cooperative banking sector. Yet these warrants are limited to a pre-defined maximum amount per member bank. A distressed member bank's eligibility for institutional warrants is conditioned on its expected recovery within the next five years.

1.3. Savings banks

Protection by the "Deutscher Sparkassen- und Giroverband" (DSGV) relies on a pre-defined, risk-oriented fund volume that is financed by direct ex ante contributions to the fund (at least one–third) and the obligation for additional contributions (up to two–thirds). Usage of the fund for bank rescues implies an obligation to immediately restock the fund, resulting in a fairly constant fund size over time. The DSGV system comprises 11 regional funds to insure regional savings banks, one fund for central savings banks ("Landesbanken"), and one fund for mortgage savings banks ("Landesbausparkassen"). When a regional savings bank requires a rescue, the responsible regional fund is initially liable, but recourse to the other regional and both functional funds also is possible. Every recourse to the fund implies the obligation for additional contributions.

2. Instrument validity

The results in Table 5 in the main paper underscore the importance of accounting for endogenous interventions to banks, conditional on them having received capital injections. Table 1 details our preferred choice of covariates and displays several combinations.

– Table 1 around here –

The first column reproduces the baseline results. The main coefficients of interest pertain to the regulatory interventions dummy (INT) and the Inverse Mills ratio (IMR), together with diagnostic statistics to assess the validity of instruments in the bottom panel of Table 1.

Specifications (1) through (3) show the permutations when we combine only two instruments that also exhibit the joint significance of the instrumental variables (IV) covariates

that pass the weak identification test. Beyond rejecting weak identification, the Hansen test confirms that none of the first four combinations of IV is excessively correlated with the outcome variable, that is, the annual probability of repayment. At the same time, the instrumented intervention variable in the second stages of the respective specifications remains significant and positive, thereby confirming the previous results.

Specifications (4) through (6) replace the interaction between inverse distance and the number of employees with the direct distance term, as suggested by Kedia and Rajgopal (2011). The overall results in these specifications do not change qualitatively, such that the instrumented interventions dummy remains highly significant in each specification. Both more experienced boards and more active regulators increase the likelihood of being subjected to regulatory interventions. Likewise, a shorter distance of the bank from the supervisory authority BaFin increases these odds. We prefer to continue using the interaction term of inverse distance and bank employees, because the F-statistics in the bottom panel of Table 1 indicate that the variation in geographical distance can be reinforced by the interaction with employees to explain a larger portion of intervention variation across banks. Interaction with the number of employees as an indicator of bank importance in regional labor markets thus aids identification.

3. Alternative macroeconomic conditions

In addition to the initial financial condition of distressed banks, the restoration of bank health depends critically on the macroeconomic environment (Kashyap and Bonaccorsi di Patti, 2014; Hoshi and Kashyap, 2010). After controlling in the baseline specification for year and state fixed effects, we found no independent effect of GDP per capita growth at the county level on repayment patterns. This absence is surprising, because during our sample period, the business cycle contracted twice: Once after the burst of the technology bubble in 2000 and then again after the Lehman and AIG defaults in 2008. These macroeconomic conditions may have affected regions within states differently over the business cycle, which

is important because savings banks and cooperative banks in particular are closely linked to within-state regional business and household conditions. Therefore, we specify a range of alternative proxies of (regional) macroeconomic conditions in the IV probit model and provide the results in Table 3.

– Table 3 around here –

We begin by accounting for the key intermediation functions of banks to conduct the maturity transformation. We specify the spread between long- and short-term government bond rates and include the yield curve as an additional measure of macroeconomic conditions in all these permutations. Next, we add eight regional macroeconomic measures, individually and jointly, in Table 3. Macroeconomic covariates that gauge inflation, corporate health, employment, credit, public debt, and money market vulnerabilities at different regional levels (federal, state, county) may be significant individually, but overall they fail to exhibit a clear relationship with annual repayment odds. When specified jointly, only larger corporate insolvency rates per state reduce repayment likelihood significantly, consistent with Hoelscher and Quintyn's (2003) emphasis on the importance of restructuring corporate and credit contracts as well in response to systemic banking crises.

The upshot of Table 3 is that both the coefficients for INT and the selection bias remain statistically significant even after we include a plethora of macroeconomic controls. Therefore, the results in Table 3 corroborate the main findings and suggest that fixed effects for states and the business cycle capture the most important share of variation.

4. Bank size and age

Banks' abilities to repay received capital support may differ fundamentally according to their size. Larger banks can absorb restructuring cost more easily (Dahl and Spivey, 1995), may be treated with greater leniency by regulators (and suppliers of funds) because of their importance for the financial system (Freixas and Rochet, 2013), and could benefit from potential economies of scale (Mester and Hughes, 2013).

– Table 4 around here –

Banking group indicators largely control for the unobservable size effects on repayment odds across universal banks in Germany's three-pillar system. In addition, we specify in the first column of Table 4 the baseline model for a subsample of small savings banks, cooperative banks, and regional commercial banks. The number of observations shows that small banks dominate the sample. Accordingly, the results mimic those of the baseline. The effect of interventions on repayment remains significantly positive and of a similar magnitude, while sample selection bias remains relevant. Next, we specify the log of total assets to control explicitly for bank size. After controlling for banking group fixed effects, this size measure is not statistically significant, whereas the effect of interventions remains unaffected. Therefore, both size-related estimations indicate that the odds of repayment are not dependent on the size of the particular bank, one year before the capital injection.

The third column in Table 4 controls for the finding by DeYoung (2003) that young U.S. banks were more likely to fail. Younger banks may be more opaque and pursue untested business models, such that they could be systematically harder for the insurance schemes and regulators to assess in terms of their viability and turnaround potential. Consequently, repayment patterns and supervisory interventions may differ for this group of banks. We exclude all banks founded after 1970. We also excluded banks founded after the start of our sample period in 1994. However, new entries in Germany's consolidating banking markets are very rare. The results are unaffected. The results remain virtually identical; intervention effects are not driven by the group of unexperienced and potentially opaque, young banks.

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Tables

Table 1: **Instrument validity**

	Baseline Model	**Specification (1)**	**Specification (2)**	**Specification (3)**	**Specification (4)**	**Specification (5)**	**Specification (6)**
				First Stage			
Instruments							
Average executive board experience	0.70348***		0.72018***	0.68840**	0.70361***		0.67962***
	[2.633]		[2.685]	[2.573]	[2.642]		[2.577]
Distance to BaFin					-3.35363*	-3.40859*	-3.68243**
					[-1.890]	[-1.894]	[-2.004]
Inverse distance to BaFin × Bank jobs	0.19053***	0.19186***		0.21612***			
	[3.410]	[3.425]		[3.713]			
Regulatory activism	0.19286***	0.19423***	0.20937***		0.19966***	0.20139***	
	[4.135]	[4.150]	[4.294]		[4.134]	[4.141]	
				Second Stage			
Instrumented intervention	0.23142***	0.23104***	0.24285**	0.23342***	0.26754***	0.26494***	0.30797***
	[3.431]	[3.238]	[2.173]	[4.065]	[3.012]	[2.696]	[3.273]
Inverse Mills ratio	1.05994**	1.02845**	1.04514**	1.14043**	0.97486**	0.97340**	1.03083**
	[2.358]	[2.139]	[2.223]	[2.527]	[2.196]	[2.076]	[2.329]
Controls / Fixed effects							
Controls	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES
State	YES	YES	YES	YES	YES	YES	YES
Banking group	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES
Diagnostics							
Observations	2,146	2,146	2,146	2,146	2,146	2,146	2,146
Pseudo log-likelihood	-1,078	-1,080	-1,087	-1,090	-1,082	-1,084	-1,096
Hansen J-statistic	0.077	0.003	0.046	0.046	0.068	0.006	0.039
p-Value Hansen	0.962	0.957	0.830	0.830	0.966	0.937	0.843
Kleibergen-Paap LM statistic	23.26	18.97	21.14	10.17	22.33	17.71	9.63
p-Value LM statistic	0.000	0.000	0.000	0.006	0.000	0.000	0.008
Kleibergen-Paap F-statistic	15.71	19.72	10.73	13.30	8.27	9.16	5.46

Notes: The table shows the marginal effects in terms of elasticities (Greene, 2011, p. 783) of the first- and second-stage estimation results from the IV probit model pertaining to Equation (1a) in the main text. The dependent variable in the first stage indicates whether a bank received a regulatory intervention, whereas in the second-stage estimation, the dependent variable is a binary measure, equal to 1 when a bank recovered after capital support events in the previous years. Diagnostics are obtained from the IV LPM. The different specifications are estimated with different combinations of instrumental variables in the first stage. Control variables are equal to those in the baseline specification of Table 5 in the main paper, but the estimation results are not shown here. A detailed description of the explanatory variables is available in Table 1 in the main paper. Clustered t-statistics are in brackets. */**/*** denote significance at the 10%/5%/1% levels, respectively.

Table 2: **SoFFin Support Measures**

Bank	**2008**		**2009**		**2010**	
	Recapitalization	**Guarantees**	**Recapitalization**	**Guarantees**	**Recapitalization**	**Guarantees**
In Sample						
Aareal	0.0	0.0	0.5	2.0	0.4	4.0
Bayerische Landesbank	0.0	0.0	0.0	5.0	0.0	4.7
Commerzbank	8.2	0.0	18.2	5.0	18.2	5.0
HSH Nordbank	0.0	7.0	0.0	17.0	0.0	9.0
West LB	0.0	0.0	0.7	0.0	3.0	0.0
Sum	**8.2**	**7.0**	**19.4**	**29.0**	**21.6**	**22.7**
Not in Sample						
Coreal Credit	0.0	0.0	0.0	0.5	0.0	0.4
Düssel Hyp	0.0	0.0	0.0	2.5	0.0	2.4
HRE/FMS-WM	0.0	16.9	6.3	95.0	7.7	15.0
IKB	0.0	0.0	0.0	7.0	0.0	9.7
SdB	0.0	0.0	0.0	6.7	0.0	5.4
Sum	**0.0**	**16.9**	**6.3**	**111.7**	**7.7**	**32.9**
Total Sum	**8.2**	**23.9**	**25.7**	**140.7**	**29.3**	**55.6**

Notes: This table shows the identity of SoFFin-supported banks, as well as the nature and size of the support measures in billions of Euro, as documented at http://www.fmsa.de/en/fmsa/soffin/index.html, as of May 8, 2014.

Table 3: **Controlling for regional macroeconomic conditions**

Macroeconomic covariate	**Inflation** (1)	**Insolvencies** (2)	**Workforce** (3)	**Credit Growth** (4)	**Credit/GDP** (5)	**Public Debt** (6)	**90-Days Stdev** (7)	**10-Year Stdev** (8)	**Jointly** (9)
Identification									
Instrumented intervention	0.23182***	0.30377***	0.23054***	0.23142***	0.23143***	0.23458***	0.23143***	0.23143***	0.30485***
	[3.425]	[4.795]	[3.400]	[3.431]	[3.432]	[3.301]	[3.431]	[3.432]	[4.579]
Inverse Mills ratio	1.03189**	0.79164**	1.08070**	1.05995**	1.05993**	1.08385**	1.05993**	1.05993**	0.82566**
	[2.301]	[2.110]	[2.384]	[2.358]	[2.358]	[2.403]	[2.358]	[2.358]	[2.153]
Macroeconomic Controls									
Regional GDP growth	-0.03415	-0.05802*	-0.02137	-0.02967	-0.02967	-0.03035	-0.02967	-0.02967	-0.05524
	[-1.102]	[-1.786]	[-0.670]	[-0.973]	[-0.973]	[-0.994]	[-0.973]	[-0.973]	[-1.610]
Yield curve	-1.87405**	0.68004*	-1.88868**	0.60661	0.51735	-2.14927***	0.53517	1.14458**	-4.41387
	[-2.309]	[1.719]	[-2.366]	[1.381]	[1.181]	[-2.752]	[1.221]	[2.436]	[-0.978]
Change GDP-deflator	0.12045								0.13957
	[0.767]								[0.933]
Insolvency rate		-0.71166***							-0.72623***
		[-2.940]							[-2.887]
Workforce growth			-0.01257						-0.01216
			[-0.942]						[-1.136]
Real credit growth				0.94104***					-5.47594
				[4.050]					[-1.115]
Credit/GDP					-7.12852***				46.09099
					[-4.050]				[1.021]
Public debt/GDP						-0.09008			-0.03850
						[-0.604]			[-0.240]
90-Days-Loan Stdev.							-2.30304***		0.23958
							[-4.050]		[0.562]
10Y Bund Yield Stdev.								1.32780***	17.89617
								[4.050]	[1.084]
Diagnostics									
Observations	2,146	2,021	2,146	2,146	2,146	2,146	2,146	2,146	2,021
Pseudo log-likelihood	-1,078	-978	-1,077	-1,078	-1,078	-1,077	-1,078	-1,078	-975
Hansen J-statistic	0.076	0.010	0.080	0.077	0.077	0.068	0.077	0.077	0.017
p-Value Hansen	0.963	0.995	0.961	0.962	0.962	0.967	0.962	0.962	0.991
Kleibergen-Paap LM statistic	23.19	17.38	23.24	23.26	23.26	23.03	23.26	23.26	17.44
p-Value LM statistic	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Kleibergen-Paap F-statistic	15.67	11.54	15.71	15.71	15.71	14.51	15.71	15.71	10.97

Notes: The table shows the marginal effects in terms of elasticities Greene (2011, p. 783) for the second-stage estimation results of the baseline and different specifications of the IV probit model pertaining to Equation (1a), after adding alternative macroeconomic covariates. Diagnostics are obtained from the IV LPM. The dependent variable indicates whether a bank recovered after capital support events in the previous years. In each specification, we include another macroeconomic control variable in addition to regional GDP growth and the yield curve. In column (9), we include all macroeconomic control variables simultaneously. Inflation is the year-on-year change in the GDP-deflator at the state level. Insolvencies denote the insolvency rate per state. Workforce growth depicts the employee growth rate per county. Real credit growth indicates the growth rate of deflated credit volume granted to domestic non-banks and banks per county. Credit/GDP (credit of domestic non-banks and banks) is measured at the federal level. Public debt/GDP is measured at the county level. 90-Days-Loan Stdev. and 10Y Bund Yield Stdev. indicate standard deviations in 90 days' loan interest rates (FIBOR until 1998, EURIBOR thereafter) and ten-year government bond yields for a period of 12 months, respectively. Except for the standard deviations, all variables are measured in percentages. The data are provided by the Bundesbank, the German Federal Statistical Offices, or State Statistical Offices. Control variables and fixed effects for years, banking groups, and states are included but not reported. All explanatory variables are lagged by one period. Clustered t-statistics are in brackets. */**/*** denote significance at the 10%/5%/1% levels, respectively.

Table 4: **Intervention effects for banks of different size and age**

	Small Banks	**Bank Size Control**	**Age <1970**
Instrumented intervention	0.23390***	0.21821***	0.24433***
	[3.393]	[3.123]	[3.695]
Inverse Mills ratio	1.04512**	0.75311	1.20434***
	[2.346]	[1.557]	[2.888]
Controls			
CI/Total assets	-0.53404***	-0.55356***	-0.53919***
	[-4.804]	[-5.153]	[-4.691]
Equity capital ratio	0.09488	0.49640***	0.26992
	[0.507]	[2.908]	[0.977]
NPL share	-0.15589	-0.27325	-0.07591
	[-0.775]	[-1.275]	[-0.357]
OBS activities/Total assets	0.03380	0.01660	-0.02392
	[0.468]	[0.221]	[-0.288]
Customer loans/Total assets	-0.34524	-0.26944	-0.30385
	[-1.363]	[-1.009]	[-1.046]
Hidden liabilities	0.04320	0.03257	0.05466
	[1.067]	[0.768]	[1.403]
Fee income	0.41901**	0.49797***	0.62014***
	[2.523]	[2.742]	[2.899]
ROE	0.04759*	0.04619*	0.05280
	[1.688]	[1.661]	[1.567]
HHI	0.11234*	0.15349**	0.17052**
	[1.728]	[2.515]	[2.148]
Regional GDP growth	-0.03302	-0.02607	-0.04914
	[-1.073]	[-0.861]	[-1.641]
Ln bank size		1.11476	
		[1.038]	
Fixed effects			
Year	YES	YES	YES
State	YES	YES	YES
Banking group	YES	NO	YES
Constant	YES	YES	YES
Diagnostics			
Observations	2,133	2,146	1,940
Pseudo log-likelihood	-1,057	-1,090	-944
Hansen J-statistic	0.108	0.327	0.068
p-Value Hansen	0.947	0.849	0.966
Kleibergen-Paap LM statistic	24.10	22.10	22.14
p-Value LM statistic	0.000	0.000	0.000
Kleibergen-Paap F-statistic	15.95	14.62	14.38

Notes: The table shows the marginal effects in terms of elasticities (Greene, 2011, p. 783) of the second-stage estimation results from the IV probit model pertaining to Equation (1a) in the main paper. Diagnostics are obtained from the IV LPM. The "Small banks" specification estimates the baseline model for a subsample of banks indicated as small savings, cooperative, and regional commercial banks. The "Bank size control" specification includes the natural logarithm of GDP-deflated total bank assets as an explicit control for bank size. In the"Age<1970" column, the sample is restricted to banks founded before 1970. A detailed description of the explanatory variables is available in Table 1 in the main paper. All explanatory variables in the second stage are lagged by one period. Clustered t-statistics are in brackets. */**/*** denote significance at the 10%/5%/1% levels, respectively.

Table 5: **Years between initial capital support and interventions**

Years between initial capital support and interventions	All supervisory interventions	Severe supervisory interventions
-12	1	0
-11	0	0
-10	1	0
-9	0	0
-8	0	0
-7	2	0
-6	3	0
-5	2	0
-4	8	2
-3	4	0
-2	8	2
-1	17	5
0	46	27
1	57	48
2	29	20
3	22	13
4	9	6
5	9	3
6	5	2
7	4	3
8	2	0
9	4	1
10	0	0
11	1	0
12	0	0

Notes: The table shows the distributions of supervisory interventions and severe supervisory interventions, on the basis of their occurrence. A negative distance means that the supervisory intervention occurred before the initial capital support, a zero distance means that the supervisory intervention occurred in the same year of the initial capital support, and a positive distance means that the supervisory intervention occurred after the initial capital support.