

Appendix to  
Bank Risk and Competition:  
Evidence from Regional Banking Markets

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**Abstract**

In this appendix we present the results of some additional exercises and robustness checks discussed in the main paper but which are not shown.<sup>1</sup>

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# 1 Appendix A: Comparison of Adjusted and Unadjusted Lerner Indices

To see how important it is to account for potential production inefficiencies in the calculation of the Lerner index, we compare the adjusted Lerner index with a standard, unadjusted Lerner index. For the unadjusted Lerner we follow standard practices and approximate average revenues in the equation for the Lerner index  $L_{it} = \frac{ar_{it}-mc_{it}}{ar_{it}}$  by the share of total revenues in total assets. In Table 1 in this appendix we show the mean estimates of the adjusted and unadjusted Lerner indices together with the results of a simple paired t-test of equality of means. The results show that, on average over the sample period, the adjusted Lerner index exceeds the unadjusted Lerner index. Furthermore, as shown by the confidence bands of the difference estimate, this difference is statistically highly significant. The finding that unadjusted Lerner indices underestimate the true amount of market power corroborates evidence for the US presented in Koetter et al. (2012).

Table 1: Differences in Adjusted and Unadjusted Lerner Indices

Variable	Mean	SD	99% Conf. Interval lower	Interval upper
ADJUSTED LERNER	0.240	0.066	0.239	0.241
UNADJUSTED LERNER	0.204	0.056	0.203	0.204
Difference	0.036	0.053	0.035	0.037

Table 2: Correlation Between Competition Measures

	LERNER INDEX	LOCAL MARKET SHARE	BOONE INDICATOR
LERNER INDEX	1		
LOCAL MARKET SHARE	-0.379	1	
BOONE INDICATOR	-0.001	0.051	1

## 2 Appendix B: Estimation Methods and Endogeneity Issues

A potential concern with regard to the results presented in the paper is the potential endogeneity of the Lerner index. Schaeck and Čihák (2010), for instance, argue that the level of bank risk might also affect the competitive conduct of banks. Banks facing a high probability of default, in an attempt to “gamble for resurrection”, might try to attract new business by aggressively pricing its products, ultimately affecting measures of bank competition such as the Lerner index. One might argue that our modeling approach mitigates endogeneity issues by including the explanatory variables with a lag of one period. However, endogeneity between bank risk and bank competition might still be an issue if bank managers form expectations about their default probability and anticipate future distress events. Our strategy to deal with the endogeneity of the Lerner index is to instrument the Lerner index with appropriate instrumental variables.

Following Koetter et al. (2012) and motivated by the dynamic panel literature (e.g., Blundell and Bond (1998)), our first instrumental variable consists of the lagged values of the Lerner index. The second set of instruments consists of the bank’s home county’s ability to bear debt (debt sustainability). The idea behind this instrument is that German counties rely heavily on (local) banks to cover their (short-term) financing needs, with savings banks and Landesbanken having a predominant position in this market. We reckon that banks located in more indebted counties have different avenues for exerting pricing power against the public sector. On the other hand, given that German counties have, so far, never defaulted there should not be a direct relationship between the relative indebtedness of counties and the

probability of default at the bank level. Our final two sets of instruments consist of the share of bank employees relative to the overall credit portfolio and of the Herfindahl-Hirschman Index (HHI) of bank branches at the regional level.<sup>1</sup>

We present the results from our Instrumental Variables (IV) approach in Table 3. We use both a two-step IV probit approach (column one and column three) and an IV linear probability model (column two and column four). The first two columns correspond to the model using the broader distress definition as the dependent variable (BANK DISTRESS) while the third and fourth columns use the distress definition taking into account only outright bank failures (BANK DEFAULT). We also estimate our benchmark regressions using simple linear probability models and probit models: the results from these robustness checks, available upon request, do not alter the main message of the previous results. For completeness we also present the results of the IV regressions of the models using the  $z$ -score and the NPL ratio as dependent variables.

The results of IV probit regressions using the broader distress measure (column one) tell the same story as the simple logit approach of the previous sections that: Increasing bank-level pricing power reduces the probability of experiencing a distress event, providing further support for the *competition-fragility hypothesis*. Simultaneously, more concentrated banking markets are, *ceteris paribus*, characterized by riskier banks. Finally, banks located in federal states with a lower competitive conduct (i.e., higher values for the Boone indicator) also have higher distress probabilities. The results are slightly different if we apply the IV linear probability model. The Lerner index and the Boone indicator enter significantly and have familiar signs (negative and positive, respectively). In contrast, the variable measuring the market contestability/concentration, although still positive, loses its significant effect. Concerning the results of the IV regressions employing the narrowly defined distress indicator (column three and column four), we again find that all our previous results remain valid when applying an IV probit approach (column(3)). The same holds for the IV linear probability model, except that the Lerner index remains significant (column four). Column five and

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<sup>1</sup>Clearly, the HHI is conceptually similar to the variable LOCAL MARKET SHARE. We therefore tested the validity of including the HHI in the set of excluded instruments, besides the more formal test presented below, by including the HHI directly in our benchmark regression. The results support our choice since the HHI never entered the model with a significant coefficient.

column six present the results from IV regressions when using as the dependent variable the  $z$ -score and the NPL ratio, respectively. Again, the findings of the previous sections are confirmed. Furthermore, the negative coefficient of the local market share is now significant at the 10% level.

The lower part of Table 3 presents formal tests on the validity of our IV setup. Note that we only present results for the test statistics based on the linear probability model simply because these tests are not properly defined in a (non-linear) probit framework. The first test statistic corresponds to the relevance of the instruments, i.e. whether the instrument variables are sufficiently correlated with the bank's pricing power. We report the Wald  $F$ -statistic based on the Kleibergen-Paap rk statistic. The results show that the  $F$ -statistic is well above the commonly used critical value of 10 in all model setups. An  $F$ -statistic well above 10 is generally viewed as indication that instrument weakness is not a problem.<sup>2</sup> The Hansen J-test concerns the validity of the instruments—that is, whether they are uncorrelated with the error term of the main equation. The null hypothesis is that the instruments can be excluded from the main equation. The results indicate that we cannot reject the null hypothesis only at the 1% level in the regression when using the narrowly defined distress measure (*BANK\_DEFAULT*) as the dependent variable; for the remaining three models rejection is possible even beyond the 10% level.

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<sup>2</sup>Note that the values of the Kleibergen-Paap statistic are identical in both IV linear probability models simply because in both models the first stage regressions are identical.

Table 3: Sensitivity to Estimation Method and Endogeneity Issues

This table shows regression results from IV probit models and IV linear-probability models (IV LPM): a two-step IV probit approach is shown in column (1) and column (3) and an IV LPM in column (2) and column (4). The first two columns correspond to the model using the broader distress definition as the dependent variable (BANK DISTRESS) while the third and fourth columns use the distress definition taking into account only outright bank failures (BANK DEFAULT); column (5) and column (6) report results from IV regressions with the  $z$ -score and non-performing loans to total loans (NPL RATIO) as the dependent variable, respectively. In the instrumental variables regression we instrument the Lerner index using the lagged Lerner index, a bank's home county's debt sustainability, the share of bank employees relative to the overall credit portfolio and the Herfindahl-Hirschman Index (HHI) of bank branches at the regional level (see the main text for a detailed discussion). \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5% and 1% level respectively; standard errors (clustered at the bank level) in parentheses.

	BANK DISTRESS		BANK DEFAULT		Z-Score	NPL RATIO
	(1)	(2)	(3)	(4)	(5)	(6)
	IV probit	IV LPM	IV probit	IV LPM	IV	IV
EQUITY RATIO	-0.031*** [0.012]	-0.002*** [0.001]	-0.022* [0.012]	-0.001*** [0.000]	0.035*** [0.006]	-0.003 [0.021]
BANK RESERVES	-0.576*** [0.054]	-0.016*** [0.002]	-0.548*** [0.070]	-0.005*** [0.001]	0.015 [0.014]	-0.145*** [0.055]
DUMMY RESERVE REDUCTION	0.161*** [0.049]	0.011* [0.007]	0.318*** [0.061]	0.017*** [0.004]	-0.163*** [0.015]	0.301*** [0.060]
SHARE OF CUSTOMER LOANS	-0.008*** [0.002]	-0.001*** [0.000]	-0.001 [0.002]	-0.000*** [0.000]	0.008*** [0.001]	0.054*** [0.006]
CREDIT PORTFOLIO CONCENTR.	0.000 [0.003]	0.000 [0.000]	0.000 [0.003]	0.000 [0.000]	-0.001 [0.002]	0.004 [0.006]
DUMMY FOR HIDDEN LIABILITIES	0.342*** [0.051]	0.049*** [0.007]	0.271*** [0.062]	0.014*** [0.003]	0.019 [0.018]	0.027 [0.067]
SHARE OF FEE INCOME	0.006 [0.005]	0.000 [0.000]	0.016*** [0.005]	0.001*** [0.000]	-0.003 [0.004]	-0.054*** [0.015]
RETURN ON EQUITY	-0.018*** [0.002]	-0.002*** [0.000]	-0.014*** [0.002]	-0.001*** [0.000]	0.004*** [0.001]	-0.051*** [0.003]
NPL RATIO	0.090*** [0.006]	0.015*** [0.001]	0.041*** [0.007]	0.003*** [0.000]	-0.017*** [0.004]	- -
OFF-BALANCE SHEET ACTIVITY	0.021** [0.008]	0.000 [0.001]	0.013 [0.010]	0.000 [0.000]	-0.004 [0.005]	0.069*** [0.020]
PER CAPITA GDP GROWTH	0.000 [0.005]	0.000 [0.000]	-0.000 [0.007]	0.000 [0.000]	0.001 [0.001]	0.006351* [0.003]
LERNER INDEX	-1.825*** [0.508]	-0.222*** [0.039]	-0.971 [0.599]	-0.049*** [0.018]	1.308*** [0.452]	-4.512*** [1.626]
LOCAL MARKET SHARE	0.008*** [0.003]	0.000 [0.000]	-0.011*** [0.004]	-0.000*** [0.000]	-0.006** [0.003]	-0.012* [0.007]
BOONE INDICATOR	0.121** [0.058]	0.014*** [0.005]	0.088 [0.066]	0.003* [0.002]	-0.045** [0.020]	0.243*** [0.081]
Number of Observations	32,578	32,578	32,578	32,578	29,229	29,026
$R^2$	NA	0.13	NA	0.041	0.124	0.116
Banking Group Dummies	YES	YES	YES	YES	YES	YES
Year Dummies	YES	YES	YES	YES	YES	YES
Bank Fixed Effects	NA	YES	NA	YES	YES	YES
Weak Identification Test						
F-statistic	NA	2004	NA	2004	182	225
Overidentification Test						
Hansen J-statistic	NA	3.698	NA	10.505	3.69	3.508
p-value	NA	0.296	NA	0.015	0.158	0.1731
Endogeneity Test						
F-statistic	NA	11.247	NA	0.656	7.194	3.105
p-value	NA	0.0008	NA	0.4178	0.007	0.078

## References

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