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## Abolishing Public Guarantees in the Absence of Market Discipline



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Tobias Körner and Isabel Schnabel<sup>1</sup>

## Abolishing Public Guarantees in the Absence of Market Discipline

### Abstract

*This paper shows that the abolition of state guarantees to publicly owned banks in Germany resulted in an increase in funding costs at German savings banks. Rather than being the result of increased market discipline, the increase in funding costs is shown to be driven by spillover effects from German Landesbanken who themselves had suffered from the abolition of guarantees and who spread their own cost increase through the public banking network. Higher funding costs and the resulting drop in bank charter values translated into higher risk-taking at German savings bank.*

*JEL Classification: G21, G28, H11, L32.*

*Keywords: Public bail-out guarantees; savings banks; Landesbanken; market discipline; bank risk-taking; banking networks*

*August 2013*

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<sup>1</sup> Tobias Körner, RGS Econ and Scientific Staff of the German Council of Economic Experts; Isabel Schnabel, Gutenberg School of Management and Economics, Johannes Gutenberg University, Mainz – We thank our discussants Tim Eisert and Christian Leuz, as well as Thomas Bauer, Daniel Baumgarten, Hendrik Hakenes, Alfredo Paloyo, Christoph Schmidt, and Hendrik Schmitz for their valuable comments and suggestions. We also benefited from comments by conference participants at the Max Planck Institute for Research on Collective Goods, the RGS Workshop at RWI Essen, the 1st Research Workshop in Financial Economics at JGU Mainz, the Ifo/CESifo/Bundesbank Conference on ‘The Banking Sector and the State’, the DFG Special Priority Program Conference ‘Financial Market Imperfections and Macroeconomic Performance’, and the Annual Meeting of the German Economic Association, as well as by seminar participants at the Universities of Bonn, Cologne, Mainz, and WHU Otto Beisheim School of Management, and the Joint Lunchtime Seminar (CFS/European Central Bank/Bundesbank). Tobias Körner gratefully acknowledges financial support from the Leibniz Association through RGS Econ and from the Fazit foundation, Isabel Schnabel from the DFG Special Priority Program (SPP 1578) ‘Financial Market Imperfections and Macroeconomic Performance’. We also thank Deutscher Sparkassen- und Giroverband (DSGV) for insightful discussions. The opinions expressed in this paper reflect the personal views of the authors and not necessarily those of the German Council of Economic Experts – All correspondence to: Isabel Schnabel, Gutenberg School of Management and Economics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany, E-Mail: [isabel.schnabel@uni-mainz.de](mailto:isabel.schnabel@uni-mainz.de).

# 1 Introduction

In the recent financial crisis, large-scale bail-outs of banks occurred in all major banking systems. This raised expectations that banks, especially systemic ones, can rely on government support in times of crisis. Such bail-out expectations are a concern for policy makers and economists. They may reduce market discipline, give rise to excessive risk-taking and distort competition in the banking sector. However, the empirical effects of such guarantees are still not well understood because bail-out guarantees are hard to measure, especially if they are not explicit, but implicit (such as too-big-to-fail guarantees).<sup>1</sup>

In this paper, we try to shed more light on these issues by analyzing the effects of the abolishment of *explicit* public guarantees to publicly owned banks – savings banks and Landesbanken (state banks) – in Germany in the year 2001 (the Brussels agreement). Our paper focuses on the effect of the reform on German savings banks’ refinancing costs and risk-taking.<sup>2</sup> Generally, the abolishment of public guarantees affects banks through two different channels. The immediate effect is an increase in funding costs, translating into lower margins and charter values. As high charter values tend to deter banks from taking excessive risks, risk-taking incentives increase when charter values drop (see Keeley, 1990; Hellmann, Murdock, and Stiglitz, 2000). However, there is a countervailing effect on risk-taking. In the absence of guarantees, bank creditors are no longer insulated from losses. Therefore, they become more responsive to the banks’ individual risk profiles. They exert market discipline by demanding higher risk premia or limiting banks’ access to external finance.<sup>3</sup> Higher market discipline should reduce risk-taking incentives. The overall effect of an abolition of guarantees on banks’ risk-taking is thus ambiguous (see Cordella and Yeyati, 2003; Hakenes and Schnabel, 2010).

We argue in this paper that these general predictions do not fully apply to German savings banks, who are part of a public banking network with a division of labor between

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<sup>1</sup>An attempt to measure implicit guarantees was made by Gropp, Hakenes, and Schnabel (2011), who show that bail-out guarantees also distort risk-taking incentives of banks that are not protected by explicit or implicit government guarantees, but are standing in competition with protected banks.

<sup>2</sup>Two recent studies analyze the same policy experiment. Whereas Fischer, Hainz, Rocholl, and Steffen (2011) analyze the reaction of Landesbanken, Gropp, Gruendl, and Guettler (2011) focus on the reaction of savings banks, just as we do. Both papers are discussed in more detail below.

<sup>3</sup>Market discipline in banking has been analyzed, among others, by Flannery (1998), Flannery and Sorescu (1996), Sironi (2003), and Gropp, Vesala, and Vulpes (2006).

Landesbanken and savings banks. Whereas Landesbanken refinance largely through capital markets and act as central institutes in the public banking network, savings banks are locally operating retail banks. For a Landesbank refinancing in national and international capital markets, explicit government guarantees are reflected immediately in lower bond rates. In contrast, German savings banks rely mainly on customer deposit funding. As most depositors are insured by deposit protection schemes, an additional protection in the form of public guarantees is of minor importance and may not even be reflected in deposit rates. Therefore, it is far from clear why an abolition of guarantees should have a direct effect on savings banks' funding costs. For the same reason, one would not expect an increase in market discipline. Hence, the *direct* consequences of the abolishment of public guarantees on savings banks are likely to be small.

However, Landesbanken and savings banks are connected through lending relationships and ownership structures.<sup>4</sup> Therefore, rising funding costs of Landesbanken after the abolition of guarantees may spill over to the corresponding savings banks. In this way, risk-taking incentives of retail banks are altered, too, although most of their creditors are not sensitive to the abolition of guarantees. While affecting refinancing conditions of savings banks, the market discipline exerted through this channel is likely to be small. Therefore, the *indirect* effects constitute a pure charter value effect, which - in theory - unambiguously increases risk-taking incentives of savings banks.

We test this line of reasoning using a difference-in-differences approach. We first analyze the impact of the Brussels agreement on refinancing costs by comparing savings banks with a control group of German cooperative banks, who are similar to savings banks in terms of network structures but who were never subject to public guarantees. Then, to assess the impact of network structures, we make use of two distinct features of the public banking network. First, savings banks are group-wise associated with their regional Landesbank. Second, Landesbanken are heterogeneous, and the impact of the abolition of guarantees on their funding costs varies considerably. This is reflected in different issuer rating downgrades of Landesbanken announced by major rating agencies in face of the abolition of guarantees. Our research design exploits this variation by defining subgroups of savings banks with differing issuer rating downgrades of associated Landesbanken. By comparing the refinancing costs of the different subgroups of savings banks before and

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<sup>4</sup>These structures are also explored by Puri, Rocholl, and Steffen (2011), who document that the losses of Landesbanken from exposures in the U.S. subprime market spilled over to savings banks' domestic retail lending behavior.

after the abolition of guarantees, we test whether charter value losses at Landesbanken were transmitted to savings banks. We also check whether funding cost changes were related to savings banks' risk profiles, as would be expected in the presence of market discipline. Finally, we analyze how banks' risk-taking was affected by the reform.

The comparison between savings banks and (unguaranteed) cooperative banks reveals that savings banks saw a rise in refinancing costs relative to cooperative banks after the policy intervention. This implies that the abolition of public guarantees depressed the charter values of German savings banks. However, this was not driven by their creditors demanding higher risk premia. Within the group of savings banks, the changes in refinancing costs after the abolition of guarantees do not depend on variables measuring individual bank risk of savings banks. Hence, despite the abolition of guarantees, the creditors of savings banks did not impose market discipline on savings banks. Rather, the rise in refinancing costs seems to have been driven by savings banks' relationship to Landesbanken. Savings banks with more severely downgraded Landesbanken experienced an increase in refinancing costs after the Brussels agreement relative to those with less severely downgraded Landesbanken, supporting the presence of indirect effects through banking networks. Finally, savings banks with more severely downgraded Landesbanken also increased their risk-taking relative to other savings banks. This confirms the theoretical prediction that, in the absence of market discipline, reduced charter values of savings banks should give rise to higher risk-taking.

Our paper is related to the large empirical literature on the incentive effects of bail-out guarantees. A number of papers analyze the effects of implicit guarantees towards too-big-to-fail banks on banks' risk-taking. While some papers document excessive risk-taking at such banks (Boyd and Runkle, 1993; Boyd and Gertler, 1994; Schnabel, 2009), others do not find evidence of higher risk-taking of banks benefiting from public guarantees (Gropp, Hakenes, and Schnabel, 2011). These mixed results can be explained by the ambiguity in the theoretical predictions (see Cordella and Yeyati, 2003; Hakenes and Schnabel, 2010). Another strand of the literature deals with the effects of deposit insurance on banks' risk-taking. Overall, this literature supports the view that deposit insurance induces excessive risk-taking (Merton, 1977; Hovakimian and Kane, 2000; Demirgüç-Kunt and Detragiache, 2002; Gropp and Vesala, 2004).

The papers most closely related to ours are two recent studies exploiting the same policy reform as we do in order to identify the effects of public guarantees on banks' risk-taking.



Interestingly, the two papers reach opposing conclusions. Fischer, Hainz, Rocholl, and Steffen (2011) analyze the impact of the Brussels agreement on the risk-taking and loan rates of German Landesbanken. They compare syndicated loans before and after 2001, the date of the Brussels agreement. After 2001, the quality of loans where Landesbanken acted as lead arrangers declined relative to a control sample of loans with other banks as lead arrangers. The effect is particularly strong for Landesbanken with the highest expected decrease in charter values. This indicates that Landesbanken *increased* risk-taking due to the abolition of guarantees. The finding is consistent with evidence that Landesbanken suffered particularly high losses during the subprime crisis (Hau and Thum, 2009), originating from investments following the Brussels agreement. Fischer, Hainz, Rocholl, and Steffen (2011) do not discuss the potential effect of the abolition of guarantees on market discipline. However, their results suggest that, even after 2005, the charter value effect dominated the market discipline effect.

The paper by Gropp, Gruendl, and Guettler (2011) studies the effect of the Brussels agreement on German savings banks, using a rich data set of savings banks' corporate loan customers. They document a *reduction* in the credit risk of savings banks' customers after 2001. The effect is most pronounced for savings banks who were taking higher risks before 2001 and who presumably benefited most from public guarantees before the abolition. The authors interpret these findings as an indication of greater market discipline after the abolition of guarantees. Taken together with the results by Fischer, Hainz, Rocholl, and Steffen (2011), this result is surprising, as – if anything – market discipline effects would have been expected for Landesbanken whose liabilities are more risk-sensitive than those of savings banks.<sup>5</sup>

Our own results are more in line with those by Fischer, Hainz, Rocholl, and Steffen (2011). Just as that paper, our results stress the importance of charter value effects. Our paper emphasizes that losses in charter values may spill over to other connected banks even if those banks are not (or not strongly) affected themselves by the abolition of guarantees. Such effects have to be taken into account by policy makers when designing an exit strategy from the implicit guarantees built up during the recent crisis. An abolition of

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<sup>5</sup>Both Fischer, Hainz, Rocholl, and Steffen (2011) and Gropp, Gruendl, and Guettler (2011) focus on the year 2001 (the date of the Brussels agreement) in their analyses. As is discussed in more detail in Section 2, the actual abolition of guarantees took place no earlier than 2005. Therefore, one would not expect strong market discipline effects before the reform came into effect.

guarantees is likely to lead to strong charter value effects, which affect not only the banks themselves, but also banks connected to them through banking networks.

The paper proceeds as follows. In Section 2, we discuss the institutional background and develop hypotheses to be tested in the empirical analysis. In the following sections, we present the empirical analysis. In each section, we start by presenting the empirical approach before showing and interpreting regression results. In Section 3, we analyze the effect of the abolition of public guarantees on the refinancing costs of savings banks, using cooperative banks as a control group in a difference-in-differences framework. In Section 4, we test for the presence of indirect effects through regional banking networks. In Section 5, we ask whether the reform led to an increase in market discipline for German savings banks. Finally, we evaluate the effect of the reform on savings banks' risk-taking in Section 6. Section 7 concludes.

## 2 Institutions and hypotheses

In the following, we examine two potential channels through which the removal of explicit public guarantees might have affected German savings banks: a direct channel that presumes that savings banks' creditors demand higher risk premia to compensate for increased insolvency risks; and an indirect channel working through savings banks' relationships with Landesbanken, who faced higher refinancing costs in capital markets after the abolition of explicit support mechanism by the government. We start by describing the institutional and network structures of savings banks and Landesbanken. Then we outline the institutional details of the German banking reform leading to the abolition of public guarantees. Based on the institutional background, we develop several hypotheses that will be tested in the empirical analysis.

### 2.1 Germany's public banking network

Savings banks and Landesbanken belong to a network of state-owned financial institutions operating under the brand *Sparkassen-Finanzgruppe*. At the end of 2010, the network comprised 429 savings banks, 8 Landesbanken groups, and numerous specialized financial

institutions, such as mortgage banks and insurance companies.<sup>6</sup> Most companies belonging to the network are autonomous legal entities. There exists no top-to-bottom hierarchy, but the institutions are connected through memberships in regional and federal savings banks associations, direct and indirect capital holdings, and personal linkages, such as multiple executive positions and informal career networks (Wittmann, 2004). At the end of 2010, Sparkassen-Finanzgruppe had an aggregated business volume of 3.3 trillion Euros and an employment of 363,000 (DSGV, 2011a). Savings banks and Landesbanken form the most important part of the network. Savings banks had assets of about 1.1 trillion Euros and an employment of 260,000, whereas Landesbanken had assets of 1.5 trillion Euros and 49,000 employees. Savings banks and Landesbanken together account for 30.5 percent of total assets of all German banks.<sup>7</sup>

Savings banks are locally or regionally operating universal banks chartered under public law.<sup>8</sup> Only municipalities are allowed to charter savings banks. The business activities of savings banks are restricted by law to the geographical boundaries of the chartering municipalities (regional principle). Savings banks are supposed to support the municipalities in their duties in the economic, social and cultural sphere. They also serve as Hausbanks to the municipalities. In spite of these strong associations with municipalities, savings banks are universal banks, which do not differ from their private competitors with regard to their business operations. They are allowed to engage in any kind of banking business. The cornerstone of their business model is retail banking; customer deposits are their most important refinancing source, and medium- and long-term loans to private households and firms dominate the asset side.

Corresponding to the three-level governmental structure in Germany, comprising the federal level, the states (Länder), and municipalities, Landesbanken form the second level in Germany's public banking system. Landesbanken are directly owned by the states and indirectly, through the regional savings bank associations, by the savings banks of their region.<sup>9</sup> Within Germany, Landesbanken usually define the geographical area of their home state as their core business districts. Although there is a considerable heterogeneity with

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<sup>6</sup>Before the Brussels agreement, there existed 12 Landesbanken and 562 savings banks. The decline in the numbers was due to mergers.

<sup>7</sup>The ratio was calculated on the basis of Deutsche Bundesbank (2011).

<sup>8</sup>There exist 6 savings banks that are historically organized as private-law stock corporations.

<sup>9</sup>Originally, each West-German state had its own Landesbank. After reunification, the new Länder, instead of chartering their own Landesbank, became shareholders of existing Landesbanken; the only exception is Saxony, which founded SachsenLB in 1992.

regard to core business fields, specialization, and internationalization, all Landesbanken groups are large, internationally active wholesale banks (see Hackethal, 2004).<sup>10</sup>

The focus of Landesbanken on international markets and wholesale banking follows partly from the division of labor between Landesbanken and savings banks. Landesbanken and savings banks are not supposed to compete with each other. Rather, subsidiarity is the central organizing principle of Sparkassen-Finanzgruppe (Wittmann, 2004). Savings banks focus on retail banking in their home municipalities, whereas Landesbanken provide loans and financial services to large corporate customers and seek refinancing predominantly in national and international interbank and capital markets. Cooperation between Landesbanken and savings banks thus emerges from the capacity limits of savings banks and from the original role of Landesbanken as distributors of liquidity among the savings banks of their region. For example, Landesbanken take over corporate customers that have grown too large or have gone international. Landesbanken also act as lead arrangers of syndicated loans for savings banks. More generally, they provide financial services and products for savings banks and savings banks' customers that would be too costly for single savings banks to produce. Furthermore, Landesbanken traditionally serve as liquidity pools for the network banks. Savings banks deposit excess liquidity at their Landesbanken, and Landesbanken in turn grant credit lines to savings banks.

As savings banks are legally and organizationally autonomous institutions, they are not obliged to engage in any interbank relationship, neither with their associated Landesbank, nor with any other Landesbank of the network. However, with regard to interbank lending, evidence suggests that for the majority of savings banks Landesbanken appear to be the preferred contracting partners (see Upper and Worms, 2004). This applies particularly to the associated Landesbanken, i. e. those Landesbanken that are owned by the savings banks of their region. At the end of 2000, lending by Landesbanken to associated savings banks stood at 121.7 billion Euros, which amounts to 60.8 percent of all liabilities of savings banks to domestic banks (excluding Deutsche Bundesbank).<sup>11</sup>

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<sup>10</sup>With regard to internationalization, some Landesbanken are mainly active in neighboring countries, whereas others understand themselves as global players. Some Landesbanken have access to retail deposits, while others depend mainly on wholesale funding. Some have specialized in certain business fields such as ship and airplane finance (HSH Nordbank, NordLB), real estate finance (NordLB, LBB), or credit cards (LBB), see Berger (2008).

<sup>11</sup>Figures are calculated on the basis of the financial reports of Landesbanken and on the basis of Deutsche Bundesbank (2001).

## 2.2 The abolition of public guarantees

Until 19 July 2005, the creditors of savings banks and Landesbanken were protected by two explicit governmental support mechanisms, *Anstaltslast* and *Gewährträgerhaftung*. *Anstaltslast*, often referred to as maintenance obligation, is the obligation of the owners of public banks to continuously enable their banks to fulfill their functions. This implied a governmental bail-out guarantee for public banks: distressed savings banks were to be bailed out by the chartering municipalities, and distressed Landesbanken by the states. It did not imply an obligation for municipalities or states to run a distressed or unprofitable bank forever. If, however, the municipalities or states decided to dissolve their bank, the second support mechanism, *Gewährträgerhaftung* (guarantor liability) were to become effective. According to guarantor liability, the municipalities are directly liable to the creditors of savings banks that are not able to meet their financial obligations. Likewise, the states are directly liable to the creditors of Landesbanken. Thus, taken together these support mechanisms implied a very low if not ignorable default risk for creditors of savings banks and Landesbanken. Creditors could lose money due to a bank failure only if a Land or municipality defaulted on its debt – an event that is considered highly unlikely due to explicit and implicit mutual support commitments of the federal government, the states, and the municipalities (see Immenga and Rudo, 1998, p. 21). In the past, only *Anstaltslast* has been of practical relevance, in particular with regard to Landesbanken, which repeatedly benefited from capital injections by the states.<sup>12</sup>

There has been a long-standing debate whether public guarantees to Germany's public banking sector distort competition and thus should be abolished. In particular, it was discussed whether the guarantees were in line with European competition law. Finally, on December 21, 1999, the European Banking Federation, a lobby group of European banks, filed a complaint against the Federal Republic of Germany at the European Commission, arguing that the public guarantees are state aid that is incompatible with Article 87 of the EC Treaty. In a proposal to the German government from 8 May 2001, the European Commission made clear that it considered the public guarantees incompatible with the EC Treaty. On 17 July 2001, the European Commission and the German government agreed that maintenance obligation and guarantor liability were to be abolished by 18 July 2005. Furthermore, the agreement included a grandfathering clause according to

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<sup>12</sup>See Wiesel (2002) for examples of bail-outs of Landesbanken and savings banks.

which liabilities existing on 18 July 2001 would continue to be covered by guarantor liability. Besides, liabilities created between 18 July 2001 and 18 July 2005 would be covered by guarantor liability only if they matured before the end of 2015.

Much of the political discussion about the consequences of the abolition of guarantees for Germany's public banking network revolved around the Landesbanken.<sup>13</sup> The reason is that Landesbanken predominantly rely on capital market funding and that lenders in capital markets were expected to demand higher risk premia to compensate for the loss of explicit government support. These expectations were mirrored in the issuer ratings of Landesbanken that were published by leading rating agencies in July 2004, one year before the actual abolition of guarantees. The rating agency Fitch Ratings downgraded the AAA issuer ratings of Landesbanken by 4 to 7 notches (see Table 1).<sup>14</sup> This demonstrates that, in the absence of explicit government support mechanisms, the liabilities of Landesbanken were considered much riskier. Moreover, the heterogeneity in downgrades reveals that the perceived default risk varied considerably among Landesbanken.

The issuer rating downgrades imply that the Brussels agreement constituted a substantial loss in the charter values of Landesbanken. This is also documented by many media reports, interviews and comments of industry experts that emphasized the historic dimensions of the agreement and the fundamental threat that it posed to the traditional business model of Landesbanken.<sup>15</sup> It is difficult, however, to pin down exact figures. Looking at funding costs just before and after 18 July 2005 is misleading because Landesbanken utilized the grandfathering clause to raise high volumes of government guaranteed funds in the years before 2005 (see Fischer, Hainz, Rocholl, and Steffen, 2011). Therefore, there was no need for Landesbanken to issue unsecured debt in the second half of the year 2005 or in 2006. Furthermore, it is occasionally reported that the funding costs of Landesbanken increased already before 2005.<sup>16</sup> Thus, a before-after-comparison around July 2005 tends to underestimate the true effect of the abolition of guarantees on the

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<sup>13</sup>For example, Bundesbank board member Edgar Meister stated that the abolition of guarantees would predominantly affect Landesbanken (*Börsen-Zeitung*, 16 July 2005).

<sup>14</sup>Fitch announced even earlier that Landesbanken will be downgraded from AAA to the single A range due to the abolition of guarantees (Fitch Ratings, 2003). Likewise, Standard & Poor's developed counterfactual ratings for Landesbanken already at an earlier stage, ranging from BBB to A, see *Handelsblatt*, 14 November 2003, 'Landesbanken droht Rating-Schock.'

<sup>15</sup>See, for example, Fitch Ratings (2005, pp. 8), *Börsen-Zeitung*, 16 July 2005, 'Schwerpunkt: Neue Ära für Sparkassen und Landesbanken,' *Handelsblatt*, 18 July 2001, 'Landesbanken vor tiefen Einschnitten.'

<sup>16</sup>See, for example, *Financial Times Deutschland*, 1 March 2002, 'Neuer Landesbanken-Kompromiss.'

**Table 1:** Issuer ratings of Landesbanken

	Issuer rating before July 18, 2005	Shadow rating	Downgrade in notches	Associated with savings banks in ...
HSH Nordbank AG	AAA	A	5	Hamburg Schleswig-Holstein
Bremer Landesbank	AAA	A	5	Bremen Lower Saxony (North-West)
NORD/LB	AAA	A	5	Lower Saxony (North-East, South) Mecklenburg-Vorpommern Saxony-Anhalt
WestLB AG	AAA	A-	6	North Rhine-Westphalia Brandenburg
Helaba	AAA	A	5	Hesse Thuringia
SachsenLB	AAA	A-	6	Saxony
LRP	AAA	BBB+	7	Rhineland-Palatinate
LBBW	AAA	A+	4	Baden-Württemberg
SaarLB	AAA	A	5	Saarland
BayernLB	AAA	A+	4	Bavaria

*Notes:* The table shows the issuer ratings of Landesbanken before 18 July 2005 and issuer ratings announced on 01 July 2004 to be valid after 18 July 2005 (shadow ratings; source: Fitch Ratings, press release from 1 July 2004). Furthermore, the table shows the savings bank regions associated with the given Landesbanken.

funding costs of Landesbanken. Nevertheless, a comparison of interest rates on Landesbanken bonds gives some indication of the actual increase in funding costs. Based on issues of BayernLB and HSH Nordbank in February 2007, industry analysts estimate that interest rates rose by 10 (senior unsecured debt) to 20 base points (subordinated debt) due to the abolition of guarantees.<sup>17</sup> It is emphasized, however, that spreads of corporate bonds generally were very low at that time and that the reported numbers were likely to be higher in regimes with higher spreads.

In contrast to Landesbanken, the implications of the abolition of guarantees for the funding costs of savings banks are less obvious. The principal reason is that the funding of savings banks – as implied by the division of labor between savings banks and Landesbanken – relies mainly on customer deposit funding. At the end of 2000, customer deposits accounted for 60.7 percent of total assets of savings banks (see Figure 1).<sup>18</sup> Since depositors are largely insulated from losses by legally mandated depositor protection schemes, it has been conjectured that they will hardly be responsive to the abolition of guarantees (German Council of Economic Experts, 2004, esp. pp. 374). In particular, it seems unlikely that depositors asked for higher interest rates on savings products to compensate for the loss of government back-up.

The second largest source of funding is lending from banks, which accounts for 24.4 percent of savings banks' total assets (see Figure 1). According to Güde (1995), this balance sheet position is composed of quite diverse types of liabilities, which differ with regard to creditors, maturities, and motivation for borrowing. For example, savings banks distribute loans from public development banks to participants of development programs. Moreover, and more importantly in our context, savings banks call on credit lines from Landesbanken to compensate for temporary liquidity shortages (Güde, 1995, p. 275). Finally, savings banks take out medium- and long-term bank loans for funding purposes. In this regard, bank loans improve the maturity match of liabilities (typically short-term customer deposits) and assets (typically medium- to long-term customer loans) and thus enable savings banks to meet regulatory liquidity requirements (see, e.g. Hackethal, 2004, p. 82).<sup>19</sup> Other sources of external funding for savings banks are rather insignificant.

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<sup>17</sup>See *Börsen-Zeitung*, 22 March 2007, 'Trend zu engeren Spreads kommt Instituten zugute.'

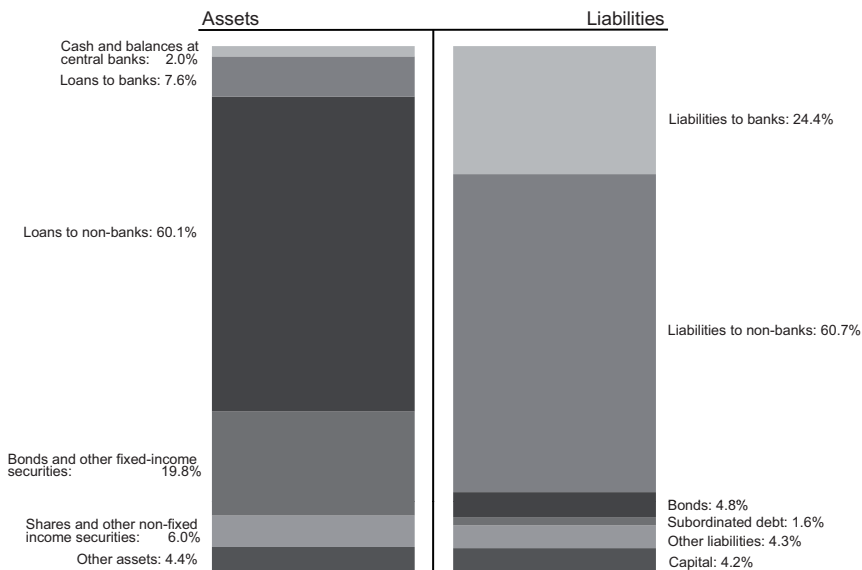
<sup>18</sup>Here and in the following, we report the early figures instead of more recent ones because the situation at the time of the Brussels agreement is more relevant for understanding the potential impact of the agreement on savings banks.

<sup>19</sup>As of year-end 2000, the share of medium- to long-term loans from banks in total liabilities to domestic



Bonds account for only 4.8 percent of total assets and subordinated debt for another 1.6 percent. Besides, bonds are often sold as savings products to private customers.<sup>20</sup> Therefore, the majority of bondholders enjoy the same protection as depositors.<sup>21</sup>

**Figure 1:** Aggregate balance sheet of savings banks



*Notes:* The figure shows the aggregate balance sheet of savings banks and its composition at the end of 2000. Total aggregate assets amounted to 953.9 billion Euros. Source: Own calculations based on Deutsche Bundesbank (2001).

The German banking reform constitutes a natural experiment, which can be exploited for identification. The reform affected only a subset of German banks, which enables us to use a difference-in-differences approach. Moreover, within the group of treated banks,

banks (excluding Deutsche Bundesbank) amounted to 89.8 percent (Deutsche Bundesbank, 2001). This figure also includes forwarded loans of public development banks.

<sup>20</sup>In 2010, 25.2 percent of bonds payable to the bearer were sold to monetary financial institutions, whereas 74.8 percent were sold to other clients (DSGV, 2011b).

<sup>21</sup>The solvency and liquidity of the banks of Sparkassen-Finanzgruppe are supposed to be ensured by 11 regional guarantee funds of savings banks as well as two guarantee funds of Landesbanken and mortgage banks (Institutssicherung). If required, these funds grant mutual support to each other (Haftungsverbund). The statutes of the guarantee funds for savings banks imply that the protection of bond holding customers is given the same priority as the protection of depositors, see Art. 2, Mustersatzung für die Sparkassenstützungsfonds der Regionalverbände.

not all subjects were treated to the same extent, suggesting varying treatment intensities. Importantly, the reform was forced upon Germany by the EU Commission, therefore it can be treated as exogenous.

## 2.3 Hypotheses

We now formulate several hypotheses on the potential effects of the abolition of guarantees on German savings banks. The theoretical literature stresses two types of effects of public guarantees, both working through the banks' refinancing conditions (see, for example, Cordella and Yeyati, 2003; Hakenes and Schnabel, 2010). First, guarantees imply lower refinancing costs because investors require no (or lower) risk premia as compensation for default risk. Second, guarantees reduce investors' incentives to differentiate between riskier and less riskier banks, and hence to exert market discipline. Therefore, an abolition of public guarantees should raise refinancing costs. The rise should be more pronounced for riskier than for safer banks. This leads us to the first two hypotheses.

**Hypothesis 1 (*Refinancing costs*)** *The abolition of state guarantees led to an increase in refinancing costs at German savings banks.*

This first hypothesis leaves it open why savings banks' refinancing costs increased. It is compatible both with direct effects (Hypothesis 2) and indirect effects (Hypothesis 3). However, these two hypotheses offer distinct additional predictions. Note that the three hypotheses are not mutually exclusive.

**Hypothesis 2 (*Market discipline*)** *The abolition of state guarantees led to an increase in refinancing costs at riskier savings banks relative to less risky savings banks.*

If public guarantees affected savings banks *directly* because their creditors reacted to higher risk perceptions, this should show up in a stronger differentiation across savings banks with different risk profiles. This hypothesis features prominently in the literature on bail-out guarantees and also in the paper by Gropp, Gruendl, and Guettler (2011).

However, as outlined above, most creditors of savings banks may be rather insensitive to bank risk. In addition, the major part of interbank liabilities of savings banks is held

by their regional Landesbank. Therefore, we hypothesize that the abolition of guarantees worked *indirectly* through banking networks with the Landesbanken, who themselves suffered from higher risk premia according to their own risk exposures. Specifically, Landesbanken may have charged higher interest rates on loans to savings banks to compensate for the loss in their own charter values or to simply pass through deteriorating funding conditions on international capital markets. Then the effect of the abolition of guarantees should be strongest for those savings banks whose Landesbank suffered most from the abolition of guarantees.

**Hypothesis 3 (*Indirect effects through banking networks*)** *The abolition of state guarantees led to an increase in refinancing costs at savings banks whose Landesbanken were more strongly affected by the abolition of guarantees relative to those whose Landesbanken were less affected.*

Finally, much of the literature on public bail-out guarantees deals with the implications for banks' risk-taking. In theory, higher charter values may deter banks from taking excessive risks (see Keeley, 1990; Hellmann, Murdock, and Stiglitz, 2000). According to this charter value view, an increase in refinancing costs after the abolition of guarantees, and the resulting drop in savings banks' charter values, imply higher risk-taking at formerly protected banks. However, there may be a countervailing effect: According to the market discipline view, pioneered by Flannery (1998), the greater sensitivity of refinancing costs to risk reduces incentives for bank risk-taking. Hence, the three hypotheses above give ambiguous predictions about the resulting change in banks' risk-taking. Whereas the first and third hypothesis tend to support an increase in banks' risk-taking, the second suggests a decrease.

### 3 Refinancing costs

We start by analyzing the impact of the abolition of guarantees on the refinancing costs of savings banks. To this end, we compare the refinancing costs of savings banks before and after the abolition of guarantees with those of non-guaranteed banks in a difference-in-differences fashion. This corresponds to a test of Hypothesis 1. We first describe the empirical approach before presenting regression results.

### 3.1 Empirical approach

In order to gauge the effect of the reform on refinancing costs, we choose German cooperative banks as a comparison group to German savings banks.<sup>22</sup> These banks are a natural choice, since within the population of banks in Germany, they are most similar to savings banks. They are also embedded in a network structure with a division of labor between small retail banks and large capital-market orientated institutions. Just as savings banks, cooperative banks are legally autonomous entities, each of them having its own managing board and supervisory board. Cooperative banks also operate locally, following a regional principle, and they mostly engage in retail banking. The main difference between saving banks and cooperative banks is their ownership status. Cooperative banks are privately owned by their members and thus, in contrast to savings banks, they are not tied to the municipalities or any other governmental authority. Moreover, cooperative banks on average are smaller than savings banks in terms of total assets, and they rely on average even more on customer deposit funding than savings banks.

To estimate the effect of the abolition of guarantees on the refinancing costs of savings banks, we estimate the following regression model:

$$y_{ist} = \gamma_i + \lambda_t + \delta_1 \cdot \text{savingsbank}_i \cdot \text{after2001}_t + \delta_2 \cdot \text{savingsbank}_i \cdot \text{after2005}_t + \beta' \mathbf{x}_{st} + \epsilon_{ist} \quad (1)$$

The dependent variable  $y_{ist}$  is a measure of refinancing costs of bank  $i$  in federal state  $s$  at time  $t$ . It is measured as the ratio of interest expenses over interest-bearing liabilities, or, alternatively, over total assets.<sup>23</sup> In addition, we present results using net interest margins (again divided by total assets) as dependent variables because, in theory, the effect on banks' risk-taking works through interest margins. On the right-hand-side, we include bank fixed effects  $\gamma_i$ , time fixed effects  $\lambda_t$ , two interaction terms of a *savingsbank* dummy variable and the dummy variables *after2001* and *after2005*, indicating the period after the given years, plus a vector of control variables  $\mathbf{x}_{st}$

that vary across states and over time. The coefficients of major interest,  $\delta_1$  and  $\delta_2$ , yield the effect of the banking reform on savings banks' refinancing costs. We include two interaction terms because the reform had two decisive dates: the first was the Brussels

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<sup>22</sup>A similar procedure has been followed by Gropp, Gruendl, and Guettler (2011).

<sup>23</sup>All variable definitions and data sources are given in the Appendix. Tables A.1 and A.2 show descriptive statistics for savings banks and cooperative banks, respectively.

agreement in July 2001, the second the actual abolition in July 2005. While the guarantees were still in force between 2001 and 2005, the anticipation of their abolition already influenced banks before 2005.

All time-invariant bank characteristics are captured by the bank fixed effects,  $\gamma_i$ . Besides, factors that change over time but are common to both savings banks and cooperative banks are captured by the time fixed effects,  $\lambda_t$ . Since the sample banks operate at the regional level, we also control for regional business cycles by including the annual growth rate of real GDP at the state level. Moreover, we control for regional bank competition by including the population density (number of inhabitants per square kilometer)<sup>24</sup> as well as the number of regionally operating banks over the population in the given state. Since savings banks' and cooperative banks' refinancing costs may react differently to changes in the economic and competitive environment, we allow for differential effects of the regional control variables for the two banking groups.

Annual bank balance sheet data is taken from Bureau van Dijk's Bankscope Database, which covers nearly all financial reports of savings banks in the given time period and roughly 60 percent of the financial reports of cooperative banks. Since most savings banks and cooperative banks do not publish consolidated financial reports, we use unconsolidated reports throughout. Moreover, all sample banks report according to national accounting standards (HGB). The regressions refer to the years 1996 until 2007.

## 3.2 Results

Table 2 shows the results of the comparison between savings banks and cooperative banks before and after the abolition of guarantees. We indeed find an increase in refinancing costs of savings banks in reaction to the bank reform. Relative to cooperative banks, interest expenses to liabilities of savings banks increased by 3.3 basis points after the Brussels agreement (column 1 of Table 2). The increase is statistically significant at the 10 percent level. After 2005, refinancing costs increased further by 4.7 basis points. This further increase is statistically significant at the 1 percent level. Given a mean value of the dependent variable for the savings banks of 3.3 percent, with a standard deviation

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<sup>24</sup>This is motivated by the fact that banks in the past tended to withdraw retail business from sparsely populated areas leaving behind less competitive local deposit and loan markets.

of 0.64, the increase is moderate. With regard to interest expenses over total assets, the increase is slightly larger (column 2 of Table 2). Again, the results indicate that refinancing became more expensive for savings banks after 2001 and even more expensive after 2005. Hence, the regression results confirm Hypothesis 1 – the abolition of state guarantees led to an increase in refinancing costs at German savings banks, albeit a small one. Consistent with an increase in refinancing costs, interest margins of savings banks declined after 2001 (column 3 of Table 2). However, after 2005 we observe a reversal, which compensates for the decline after 2001, such that the sum of the two coefficients is not statistically significant. Hence, relative to the period before 2001, the difference in interest margins between savings banks and cooperative has not changed after 2005.

Regional business cycles and competition affect refinancing costs of savings banks and cooperative banks differently (see the interaction terms of the regional variables with the savings bank dummy in columns 1 and 2 of Table 2). This confirms the importance of allowing for heterogeneous regional effects. However, it also raises concerns about the comparability of savings bank and cooperative banks. The comparability of savings banks and cooperative banks is further complicated by singular events in the cooperative network in 2005 and 2006 that may have caused structural breaks in the time series.<sup>25</sup> Since these effects coincide with the abolition of guarantees in the savings bank sector, the preceding results have to be interpreted with caution. Therefore, in the following regressions, we use a modified approach exploiting the variation within the savings bank sector.

Summing up, the results from the difference-in-differences regression indicate a positive effect of the abolition of guarantees on savings banks' refinancing costs and a temporary negative effect on interest margins. This supports the first hypothesis. Note that the increase in refinancing costs is also consistent with Hypotheses 2 and 3. Both the pricing of savings' banks default risk (market discipline) and a drop in the charter values of Landesbanken and the transmission to savings banks (indirect effects) imply an increase in average refinancing costs of savings banks. However, in light of the grandfathering clause, it seems unlikely that market discipline was already effective before 2005 when savings banks' liabilities were still completely covered by guarantor liability. In contrast, it is well conceivable that Landesbanken raised interbank rates already before 2005 because

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<sup>25</sup>These events were related to the conversion of the cooperative banks' central institutes in joint stock companies (2005/2006) as well as a one-time tax refunds (2006). See Deutsche Bundesbank (2006, p. 27) and Deutsche Bundesbank (2007, p. 20, fn. 4).

**Table 2:** Interest expenses and margins of savings banks relative to cooperative banks

	Interest expenses/ liabilities (1)	Interest expenses/ total assets (2)	Interest margins/ total assets (3)
Savings bank $\times$ after 2001	0.033* (0.019)	0.052** (0.021)	-0.093*** (0.024)
Savings bank $\times$ after 2005	0.049*** (0.011)	0.049*** (0.011)	0.136*** (0.014)
Real GDP growth	1.177*** (0.258)	1.022*** (0.243)	-0.016 (0.278)
Real GDP growth $\times$ savings bank	-1.257*** (0.320)	-0.861*** (0.314)	-1.072*** (0.336)
Population density	-0.001 (0.002)	0.000 (0.002)	0.002 (0.002)
Population density $\times$ savings bank	-0.010*** (0.003)	-0.009*** (0.003)	-0.000 (0.003)
Banks per 100,000 inhabitants	0.166*** (0.013)	0.154*** (0.017)	-0.085*** (0.015)
Banks per 100,000 inhabitants $\times$ savings bank	-0.041*** (0.014)	-0.027* (0.016)	0.060*** (0.017)
Sum of rows (1) and (2)	0.082*** (0.023)	0.101*** (0.024)	0.044 (0.029)
$R^2$ within	0.84	0.84	0.51
Observations	16980	16980	16980

*Notes:* All models include year fixed effects and bank fixed effects. Standard errors clustered at the bank level are given in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. In the bottom, the sum of the estimated coefficients of the two savings bank-after interactions is reported, as well as standard errors and significance levels from testing the hypothesis that these coefficients sum up to zero. Detailed variable descriptions are given in the Appendix.

the drop in their charter values occurred already in 2001. Hence, the timing of the increase in savings banks' refinancing costs is consistent with Hypothesis 3, but less so with Hypothesis 2. We now investigate these two hypotheses in more detail by considering differences within the group of savings banks.

## 4 Indirect effects through banking networks

A comparison of savings banks and an untreated control group is informative about changes in mean outcomes induced by the policy intervention, but it does not tell us anything about the underlying mechanisms. In particular, this kind of comparison is not suitable to explore our two hypotheses about the channels through which savings banks were affected by the abolition of guarantees. Therefore, we now restrict our sample to saving banks and exploit the heterogeneity *within* the group of savings banks.<sup>26</sup> Hypotheses 2 and 3 imply that the banking reform did not affect all savings banks to the same extent. Therefore, we now allow for varying treatment intensities for different savings banks. In this section, we examine whether bank network structures, in particular those between savings banks and their corresponding Landesbank, affect the size of the impact that the abolition of guarantees had on savings banks. In Section 4, we test whether effects differ with respect to savings banks' risk profiles.

### 4.1 Empirical approach

Hypothesis 3 predicts that the effect of the reform on refinancing costs is stronger for savings banks whose Landesbanken were themselves more strongly affected by the abolition of guarantees. To test this hypothesis, we have to classify the Landesbanken according to their expected loss in charter value stemming from the abolition of guarantees. The heterogeneity in expected charter value losses is reflected in the issuer ratings of *unguaranteed* Landesbanken that were published by major rating agencies already one year ahead of the actual abolition. Specifically, we use the issuer ratings published by Fitch Ratings in July

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<sup>26</sup>Looking at savings banks only is also advantageous for reasons of sample homogeneity. Although cooperative banks are similar to savings banks in many regards, savings banks certainly are more comparable to other savings banks than to cooperative banks.



2004 (see Table 1).<sup>27</sup> A strong downgrade implies a sharp increase in refinancing cost in capital markets, and thus a high loss in charter value. We divide the Landesbanken into two groups. One group consists of Landesbanken downgraded by 4 or 5 notches (from AAA to A+ or A), and the other group consists of Landesbanken downgraded by 6 or 7 notches (from AAA to A- or BBB+). This dichotomous classification is motivated by the fact that, within the single A range, the difference in bond rates between bonds rated A and A- is larger than the difference between bonds rated A+ and A. Moreover, the difference between A+ and A is relatively small and similar to the difference between A- and BBB+. Thus, the dichotomous classification reflects the discontinuity at the transition from A to A-. Using this classification, we estimate the following regression model:

$$y_{ist} = \gamma_i + \lambda_t + \delta_1 \cdot \text{High Landesbank downgrade}_i \cdot \text{after2001}_t + \delta_2 \cdot \text{High Landesbank downgrade}_i \cdot \text{after2005}_t + \beta' \mathbf{x}_{st} + \epsilon_{ist} \quad (2)$$

This regression only includes savings banks. The dummy variable *High Landesbank downgrade* indicates a savings bank whose Landesbank was strongly downgraded (i. e. by 6 or 7 notches), the remaining notation is as in Equation 1. Alternatively, we interact the number of downgrade notches (ranging between 4 and 7) with the two *after* dummy variables. This approach uses the full rating information, but comes at the cost of ignoring the described discontinuity. Hypothesis 3 (indirect effects through banking networks) implies a positive sign of  $\delta_2$  and potentially also of  $\delta_1$ . To avoid confounding effects, the vector of control variables again includes measures of regional economic growth and regional bank competition.

## 4.2 Results

The regression results in Table 3 show that interest expenses (both over liabilities and total assets) at savings banks belonging to the high-downgrade group rose by 7 basis points after 2001 relative to savings banks belonging to the low-downgrade group (columns 1 and 3). The increase is highly statistically significant. The relative increase in refinancing costs is augmented by a further increase after 2005, leading to a total difference of about 10 basis points. Hence, savings banks in the high-downgrade group experienced a total

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<sup>27</sup>Table 1 also shows the correspondence between savings banks and Landesbanken.

increase in refinancing costs that was approximately 10 basis points higher than at savings banks in the low-downgrade group.<sup>28</sup> The time structure of the increase is similar to that in the savings banks/cooperative banks comparison.

Similar results are obtained in the alternative specification where the downgrade variable enters numerically (columns 2 and 4 of Table 3). The stronger the downgrade of the associated Landesbank, the higher is the relative increase in interest expenses after 2001. For example, a Landesbanken downgrade by one notch is associated with an increase in interest expenses over liabilities (or assets) of savings banks by about 5 basis points after 2001 and a further increase of around 2 basis point after 2005. The regression coefficients are again highly statistically significant. The results on interest margins (columns 5 and 6) indicate a stronger decline in the margins of savings banks associated with highly downgraded Landesbanken. In the dichotomous specification, the effect concentrates on the period after 2005, whereas the alternative specification has a similar pattern over time as the one explaining interest expenses.

These results strongly support Hypothesis 3, stating that savings banks were indirectly affected by the abolition of guarantees through their lending relationships with Landesbanken. They suggest that Landesbanken adjusted lending terms for savings banks in response to the Brussels agreement and that those Landesbanken that were expected to be affected most by the abolition of guarantees raised interbank loan rates for savings banks more than other Landesbanken.

With regard to timing, the adjustments were initiated already before the actual abolition of guarantees in 2005. Although it has been occasionally reported that lending terms of Landesbanken in capital markets deteriorated already before July 2005, it seems unlikely that the increase in savings banks' interest expenses is simply due to a pass-through of Landesbanken rates to savings banks. Rather, we conjecture that Landesbanken anticipated their own refinancing costs to increase sharply after 2005 and charged higher rates on interbank loans to savings banks preemptively. Supporting evidence on this conjecture is presented in Table 4. The table displays the results of regressions that relate savings banks' interest expenses and margins to the actual increase in the refinancing costs of Landesbanken around 2005. Specifically, we measure the change in the refinancing costs of Landesbanken by the growth of interest expenses over liabilities between 2004 and

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<sup>28</sup>The common trend in refinancing costs is captured by the time fixed effects.

**Table 3:** Impact of Landesbanken downgrades on interest expenses and margins of savings banks

	Interest expenses/ liabilities	Interest expenses/ total assets	Interest margins/ total assets			
	(1)	(2)	(3)	(4)	(5)	(6)
High Landesbank downgrade × after 2001	0.070*** (0.021)	0.070*** (0.020)	0.070*** (0.020)	-0.040 (0.025)		
High Landesbank downgrade × after 2005	0.033** (0.015)	0.039*** (0.014)	0.039*** (0.014)	-0.096*** (0.021)		
Landesbank downgrade × after 2001		0.055*** (0.012)	0.053*** (0.011)	-0.029** (0.012)		
Landesbank downgrade × after 2005		0.022** (0.009)	0.025*** (0.008)	-0.048*** (0.011)		
Real GDP growth	0.119 (0.322)	0.041 (0.328)	0.177 (0.307)	0.107 (0.313)	-0.321 (0.350)	-0.241 (0.350)
Population density	0.002 (0.003)	0.005 (0.004)	0.003 (0.003)	0.006 (0.004)	-0.002 (0.003)	-0.005 (0.003)
Banks per 100,000 inhabitants	0.097*** (0.019)	0.088*** (0.017)	0.104*** (0.018)	0.096*** (0.017)	-0.027 (0.023)	-0.028 (0.022)
Sum of rows (1) and (2)	0.104*** (0.024)	0.110*** (0.023)	0.110*** (0.023)	-0.136*** (0.032)		
Sum of rows (3) and (4)		0.076*** (0.014)	0.078*** (0.013)	-0.077*** (0.017)		
$R^2$ within	0.87	0.87	0.87	0.87	0.65	0.65
Observations	6003	6003	6003	6003	6003	6003

*Notes:* All models include year fixed effects, bank fixed effects, and Eastern-German year effects to account for differing East-West trends. Standard errors clustered at the bank level are given in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. In the bottom, the sum of the estimated coefficients of the two downgrade-after interactions is reported, as well as standard errors and significance levels from testing the hypothesis that these coefficients sum up to zero. Detailed variable descriptions are given in the Appendix.

2006 (calculated by taking differences in logs). This variable is interacted with the two *after* dummy variables. As can be seen from Table 4, the increase in savings banks' interest expenses depends positively on the growth of interest expenses of the associated Landesbank between 2004 and 2006. This is true not only after 2005 (second row), but already in the transition period between 2001 and 2004 (first row). This indicates that Landesbanken took into account the expected future increases in refinancing costs when pricing interbank loans to savings banks in the transition period.

## 5 Market discipline

Although we find strong evidence for the hypothesis that the abolition of guarantees affected savings banks through Landesbanken, this does not exclude the possibility that the abolition of guarantees also increased market discipline for savings banks. In fact, it may be that the risk profiles of savings banks are correlated with those of their Landesbank, implying that the above results may have captured market discipline effects rather than the indirect network effects advocated above. To account for this possibility, we now analyze whether the increase in refinancing costs of savings banks varies with individual bank risk.

### 5.1 Empirical approach

To explore whether the abolition of guarantees increased market discipline at savings banks, we test whether riskier savings banks incurred higher increases in refinancing costs than less risky savings banks after the abolition of guarantees. Hence, we run a regression model explaining savings banks' refinancing costs (interest expenses over liabilities),<sup>29</sup> allowing the effect of the abolition of guarantees to depend on the individual risk profiles of savings banks:

$$y_{ist} = \gamma_i + \lambda_t + \delta_1 \cdot risk_{i,1996-2000} \cdot after2001-2004_t + \delta_2 \cdot risk_{i,2001-2004} \cdot after2005_t + \beta' \mathbf{x}_{st} + \epsilon_{ist} \quad (3)$$

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<sup>29</sup>Employing interest expenses to total assets as dependent variable leads to very similar results.

**Table 4:** Interest expenses growth of Landesbanken and interest expenses and margins of savings banks

	Interest expenses/ liabilities (1)	Interest expenses/ total assets (2)	Interest margins/ total assets (3)
Interest expense growth of Landesbank around 2005 $\times$ year 2001–2004	0.432*** (0.109)	0.403*** (0.106)	-0.085 (0.119)
Interest expense growth of Landesbank around 2005 $\times$ after 2005	0.617*** (0.138)	0.609*** (0.131)	-0.100 (0.179)
Real GDP growth	0.509 (0.339)	0.559* (0.324)	-0.313 (0.370)
Population density	0.001 (0.003)	0.002 (0.003)	-0.002 (0.003)
Banks per 100,000 inhabitants	0.102*** (0.017)	0.111*** (0.016)	-0.058** (0.023)
Difference of rows (2) and (1)	0.185 (0.115)	0.207* (0.109)	-0.015 (0.152)
$R^2$ within	0.87	0.87	0.65
Observations	6003	6003	6003

*Notes:* All models include year fixed effects, bank fixed effects, and Eastern-German year effects to account for differing East-West trends. Standard errors clustered at the bank level are given in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. In the bottom, the difference of the estimated coefficients of the two interest expense-after variables is reported, as well as standard errors and significance levels from testing the hypothesis that the difference is equal to zero. Detailed variable descriptions are given in the Appendix.

Given that savings banks' liabilities were still fully guaranteed until 2005, we do not expect to find a significant coefficient  $\delta_1$  in the transition period even under Hypothesis 2. In contrast,  $\delta_2$  is expected to be positive if market discipline is at work because bank debt was no longer guaranteed after 2005.

We employ three different measures of bank risk commonly used in the literature, based on financial reporting data: bank capitalization, risk provisions, and bank liquidity. While each of these measures has some shortcomings, we hope to capture the relevant risk characteristics of savings banks, in particular those that matter most for the providers of external funding to savings banks. In this regard, the use of publicly available financial reporting data seems adequate, since the creditors of savings banks also mainly rely on this type of data.<sup>30</sup> To capture the risk profile of savings banks at the time of the abolition of guarantees, we calculate averages over the years preceding the intervention years; that is, we take averages over 1996-2000 for the interaction with the transition-period dummy (*after2001-2004*), and averages over 2001-2004 for the interaction with the after-2005 dummy. Taking averages over several years reduces measurement error. Besides, creditors are also likely to take into account past developments.

To measure a bank's capitalization, we relate book equity to total assets. The higher the ratio, the better is a bank able to absorb unexpected losses. In order to account for risks on the asset side, we employ financial reporting information on risk provisions on loans and certain fixed-income securities (henceforth denoted reference assets). High risk provisions relative to reference assets indicate risky investment strategies. A disadvantage of this measure is that it is backward-looking. When risk provisions are built up, it is not clear when the underlying investments have been made. Besides, HGB accounting rules enable banks to smooth out deteriorating asset quality silently. Thus, risk provisions tend to understate asset risk. As a measure of resilience against unexpected liquidity shocks, we relate liquid assets to total assets. The more liquid the assets are, the better a bank is able to cope with unexpected withdrawals of deposits or with borrowers refusing to renew credit lines.

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<sup>30</sup>Gropp, Gruendl, and Guettler (2011) measure banks' risk-taking using z-scores. However, z-scores based on balance sheet data with very few observations in the time dimension are not very reliable. Z-scores based on market data are not feasible here, as none of the sample banks is publicly traded.

## 5.2 Results

The results of this approach are displayed in Table 5. The first three columns present the results of separate regressions for each risk measure. Column 4 contains the results of a regression with all risk measures on the right hand side, column 5 adds the interaction terms from the previous section.<sup>31</sup> It is striking that the coefficients on the interaction terms almost exclusively are not statistically significant. Thus, the increase in refinancing costs of savings banks does not depend on individual bank risk, neither in the transition period, nor after the actual abolition of guarantees. The only exception is the interaction between the liquidity measure and the transition-period dummy. However, the sign of the coefficient is positive, suggesting that interest expenses are the higher, the more liquid assets a savings bank holds, which is implausible.<sup>32</sup> Hence, the results clearly reject Hypothesis 2 because there is no indication that creditors exerted market discipline by demanding higher interest rates from those savings banks that were riskier in terms of capital endowment, liquidity buffers, or borrower risk. In contrast, the downgrade interactions used in the previous section continue to be positive and statistically significant (column 5 of Table 5). Therefore, we can exclude the possibility that differences in savings banks' risk characteristics among the two downgrade groups drive the results of the previous section.

As was mentioned above, it is not surprising that we can reject the market discipline hypothesis for the transition period. Creditors of savings banks were still fully protected by the guarantee schemes. Hence, there was no need for creditors of savings banks to adjust interest rates to individual risk profiles. Even providers of long-term funds maturing after July 2005 had no incentives to care about savings banks' creditworthiness, since municipalities continued to be liable for their obligations. In contrast, creditors' incentives may change after July 2005 when both guarantor liability and maintenance obligation were legally terminated. A savings bank without any institutionalized government support mechanisms may be considered less creditworthy than a savings bank protected by explicit guarantee schemes. However, creditors of savings bank apparently did not react to these changes. This can be explained by the liability structure of savings banks. Liabilities are

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<sup>31</sup>The number of observations is lower than in the previous regressions because some banks enter the sample in later years, such that average risk measures cannot be computed for these banks.

<sup>32</sup>From the viewpoint of market discipline, most other coefficients also show 'wrong' signs. We refrain from interpreting these coefficients, since none of them is statistically significant. Note that the implausible result regarding bank liquidity disappears in the final column of Table 5.

**Table 5:** Impact of individual bank risk on interest expenses of savings banks

	(1)	(2)	(3)	(4)	(5)
Book equity/total assets 1996–2000 × year 2001–2004	0.014 (0.012)			0.014 (0.013)	0.015 (0.012)
Book equity/total assets 2001–2004 × after 2005	−0.015 (0.012)			−0.017 (0.012)	−0.015 (0.012)
Liquid assets/total assets 1996–2000 × year 2001–2004		0.002** (0.001)		0.003** (0.001)	0.002 (0.001)
Liquid assets/total assets 2001–2004 × after 2005		0.002 (0.001)		0.002 (0.001)	0.001 (0.001)
Risk provisions/reference assets 1996–2000 × year 2001–2004			−0.031 (0.031)	−0.003 (0.032)	−0.011 (0.032)
Risk provisions/reference assets 2001–2004 × after 2005			−0.038 (0.039)	−0.040 (0.039)	−0.049 (0.040)
High Landesbank downgrade × after 2001					0.061*** (0.021)
High Landesbank downgrade × after 2005					0.040** (0.016)
Real GDP growth	0.403 (0.340)	0.415 (0.336)	0.465 (0.338)	0.385 (0.339)	0.204 (0.332)
Population density	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)	0.002 (0.003)
Banks per 100,000 inhabitants	0.135*** (0.016)	0.137*** (0.016)	0.136*** (0.016)	0.137*** (0.016)	0.098*** (0.019)
$R^2$ within	0.87	0.87	0.87	0.87	0.87
Observations	5700	5700	5700	5700	5700

*Notes:* The dependent variable is interest expenses to liabilities. All models include year fixed effects, bank fixed effects, and Eastern-German year effects to account for differing East-West trends. Standard errors clustered at the bank level are given in parentheses. \*, \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. Detailed variable descriptions are given in the Appendix.

dominated by deposits from customers who could afford to ignore the changes in July 2005, since they still could rely on comprehensive depositor protection schemes. Other liabilities of savings banks mainly stem from interbank loans from Landesbanken, who tend to lend on equal terms to banks within the network, ignoring the riskiness of individual borrower banks.<sup>33</sup> Our results suggest that more risk-sensitive types of liabilities, such as traded

<sup>33</sup>According to Güde (1995, p.93), lending relationships between savings banks and their associated Landesbank were often based on master agreements at the regional level. All savings banks were uniformly offered credit lines at prime conditions.



bonds, are not important enough to induce measurable market discipline for savings banks (cf. Figure 1).

## 6 Bank risk

In the final section, we analyze how the observed changes in refinancing costs translated into changes in savings banks' risk-taking. We have seen that the regressions explaining refinancing costs supported an increase in refinancing costs at German savings banks (Hypothesis 1). This increase was explained by indirect effects through savings banks' relationship with Landesbanken (Hypothesis 3) rather than market discipline (Hypothesis 2). This suggests that the abolition of guarantees constituted a pure charter value effect for German savings banks. In theory, the reduction in charter values leads to stronger risk-taking incentives because banks seek compensation for reduced charter values by following riskier business strategies. Hence, in the absence of market discipline, the abolition of guarantees should lead to higher risk-taking at German savings banks. We test this prediction using similar estimation procedures as in the preceding sections.

### 6.1 Empirical approach

We analyze the determinants of savings banks' risk-taking, employing a regression model that is analogous to Equation 2:

$$\begin{aligned} risk_{ist} = & \gamma_i + \lambda_t + \delta_1 \cdot \text{High Landesbank downgrade}_i \cdot \text{after2001}_t \\ & + \delta_2 \cdot \text{High Landesbank downgrade}_i \cdot \text{after2005}_t + \beta' \mathbf{x}_{st} + \epsilon_{ist} \end{aligned} \quad (4)$$

We regress measures of bank risk on the interaction of the downgrade intensity of Landesbanken with dummies indicating the years after 2001 and 2005, respectively, plus the same set of control variables as before. We conjecture that the variation in charter value losses of Landesbanken (as implied by heterogenous issuer rating downgrades) also induces variation in charter value losses at savings banks. As shown in Section 4, funding costs of savings banks are linked to the charter values of associated Landesbanken through lending relationships. Moreover, the ownership structures between savings banks and Landesbanken imply a reduction of savings banks' charter value. First, the savings banks as

the owners of Landesbanken ultimately incur any financial disadvantage of Landesbanken implied by the abolition of guarantees. Second, higher funding costs of Landesbanken and reduced interest margins make shareholdings in Landesbanken less valuable. Thus, due to lending relationships and ownership structures, a decrease in the charter values of Landesbanken implies also a decrease in the charter values of savings banks.

As dependent variables we use the risk measures introduced in the previous section. Generally, the same measurement issues as discussed before apply here, too. However, since we consider a relatively long time period before and after the policy intervention some of these problems might be attenuated. In particular, risk provisions become much more informative, since smoothing strategies in accounting cannot mask risky investment behavior over the long run. Furthermore, to show that the results do not depend on the specifics of our variable definitions, we employ two additional measures of bank risk. The first is the ratio of security reserves to total assets (as an alternative to the book equity to total assets ratio). Security reserves are accumulated profits that have been retained for the purpose of capital formation. They form the most important capital element for savings banks, since retaining profits is practically the only possibility for savings banks to strengthen their capital basis. Therefore, security reserves form on average about 95 percent of the book equity of savings banks. In addition, we relate risk provisions to book equity rather than banks' reference assets. This ratio indicates to which extent losses are covered by a bank's capital buffer.

## 6.2 Results

According to the regression results displayed in Table 6, risk-taking of banks in the high-versus low-downgrade group differed significantly after the banking reform. Relative to savings banks belonging to the low-downgrade group, savings banks belonging to the high-downgrade group decreased their capital ratios after 2001 (columns 1 and 3), reduced their liquidity (column 5), and increased risk provisions (both relative to reference assets and book equity, columns 7 and 9). All these changes are statistically significant at the 1 percent level. Hence, all risk measures indicate a relative increase in risk of savings banks whose Landesbanken were downgraded more severely. Again, the results are qualitatively the same when using the four-point downgrade-variable instead of the dichotomous classification (even-numbered columns of Table 6). After 2005, the differentials in capital and liquidity ratios increased further, whereas the differentials in risk

**Table 6: Risk-taking of savings banks**

	Security reserves/ total assets (1)	(2)	Book equity/ total assets (3)	(4)	Liquid assets/ total assets (5)	(6)	Risk provisions/ reference assets (7)	(8)	Risk provisions/ book equity (9)	(10)
High Landesbank downgrade × after 2001	-0.232*** (0.046)		-0.190*** (0.041)		-1.848*** (0.491)		0.079*** (0.028)		2.257*** (0.669)	
High Landesbank downgrade × after 2005	-0.064* (0.038)		-0.086** (0.038)		-1.533*** (0.478)		-0.055** (0.024)		-0.543 (0.524)	
Landesbank downgrade × after 2001		-0.092*** (0.028)		-0.069*** (0.024)		-0.944*** (0.267)		0.033* (0.015)		0.888*** (0.332)
Landesbank downgrade × after 2005		-0.024 (0.023)		-0.021 (0.022)		-0.628** (0.247)		-0.009 (0.013)		0.101 (0.275)
Real GDP growth	-0.709 (0.564)	-1.055* (0.574)	-0.841 (0.532)	-1.101** (0.536)	-10.601 (7.514)	-11.013 (7.415)	-1.718*** (0.533)	-1.503*** (0.544)	-41.247*** (12.311)	-35.692*** (12.637)
Population density	-0.006 (0.009)	-0.013 (0.010)	-0.011 (0.008)	-0.016* (0.009)	0.008 (0.067)	-0.063 (0.073)	-0.001 (0.003)	0.001 (0.003)	0.022 (0.076)	0.090 (0.080)
Banks per 100,000 inhabitants	0.064 (0.044)	0.019 (0.045)	0.025 (0.040)	-0.023 (0.040)	0.034 (0.428)	-0.228 (0.420)	0.009 (0.023)	0.013 (0.022)	0.233 (0.535)	0.485 (0.492)
Sum of rows (1) and (2)	-0.296*** (0.069)		-0.276*** (0.063)		-3.380*** (0.681)		0.024 0.031		1.714** (0.700)	
Sum of rows (3) and (4)		-0.116** (0.045)		-0.090** (0.038)		-1.572*** (0.364)		0.024 (0.016)		0.989*** (0.346)
$R^2$ within	0.60 6078	0.59 6078	0.60 6078	0.60 6078	0.17 6078	0.16 6078	0.21 6078	0.21 6078	0.18 6077	0.17 6077

*Notes:* All models include year fixed effects, bank fixed effects, and Eastern-German year effects to account for differing East-West trends. Standard errors clustered at the bank level are given in parentheses. \*, \*\*, and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. In the bottom, the sum of the estimated coefficients of the two downgrade-after interactions is reported, as well as standard errors and significance levels from testing the hypothesis that these coefficients sum up to zero. Detailed variable descriptions are given in the Appendix.

provisions tended to revert and are statistically significant for only one of the two measures for the period after 2005 (see the sums of coefficients in the last two lines of columns 7 to 10).<sup>34</sup> The effects are also economically significant. For example, the overall relative decrease in security reserves amounts to 0.3 percentage points, compare to a mean value of 4.4 (see Table A.1). The overall relative decrease in the liquidity ratio is 3.4 percentage points, compared to a mean value of 31.1. Summing up, the regression results support the hypothesis that savings banks increased their risk-taking in reaction to decreasing charter values after the abolition of public guarantees.

In a robustness check, we also compare savings banks and cooperative banks, similar to the analysis in Section 3. As was explained earlier, we believe that a comparison within the savings banks sample is much cleaner due to singular events in the cooperative sector. Moreover, capital ratios of savings banks and cooperative banks are not directly comparable. Savings banks rely almost exclusively on retained profits, whereas capital of cooperative banks stems also from member shares. Despite these shortcomings, we report the results of the comparison in Table A.3 in the Appendix. All risk measures point in the same direction: after 2001, savings banks decreased capital and liquidity and increased risk provisions relative to cooperative banks. The coefficients are statistically significant throughout (first row of Table A.3).<sup>35</sup> An additional change in capital and liquidity ratios occurred after 2005 (second row of Table A.3). These results indicate that the abolition of guarantees was associated with higher risk-taking of savings banks, again confirming the theoretical predictions.<sup>36</sup>

The results on savings banks' risk-taking are consistent with theoretical predictions when we combine them with our earlier findings. When the abolition of guarantees was agreed upon in July 2001, savings banks experienced a decrease in charter values, which increased risk-taking incentives. At the same time, liabilities continued to be guaranteed during the transition period until July 2005, and hence there was no market discipline, which could have mitigated risk-taking incentives. Even after the actual abolition of guarantees, savings banks creditors have not become sensitive to individual risk-taking of savings

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<sup>34</sup>For the other measure, the sum of the coefficients of both interactions is still positive, but not statistically different from zero.

<sup>35</sup>We do not analyze security reserves for lack of an equivalent balance sheet position at cooperative banks.

<sup>36</sup>As a further robustness check, we delete cooperative banks from the sample that underwent the aforementioned extraordinary reporting events. The results remain largely unchanged (Table A.4 in the Appendix).

banks, as was shown in Section 5. Therefore, it is not surprising that the differential in banks' risk-taking becomes even larger after 2005 for most risk measures. In theory, an abolition of guarantees in the absence of market discipline unambiguously raises the risk-taking of banks. This is confirmed by our empirical results.

## 7 Conclusion

Our analysis has shown that the abolition of public guarantees to German public banks raised the refinancing costs of German savings banks and thereby depressed their charter values. This was not driven by higher risk premia on banks' refinancing because the extent of cost increases was not related to savings banks' risk profiles. Hence, in contrast to earlier work by Gropp, Gruendl, and Guettler (2011), we do not find any indication that the creditors of savings banks started to impose market discipline after the abolition of government guarantees. Rather, the increase in refinancing costs appears to have been driven by the savings banks' relationship to Landesbanken. Due to lending relationships and ownership structures, the drop in the charter values of Landesbanken documented by Fischer, Hainz, Rocholl, and Steffen (2011) spilled over to the corresponding savings banks. Since market discipline was not effective, the drop in charter value translated into higher risk-taking, confirming theoretical predictions. Hence, the abolition of public guarantees in Germany did not succeed in re-establishing market discipline in the public banking sector, but rather led to a destabilization of both Landesbanken and savings banks.

These results have broader policy implications. They suggest that the effects of public guarantees - and of their removal - depend crucially on the structure of banking systems. In a world where financial institutions are highly interconnected, a shock to one bank is likely to spill over to other banks in the system. Therefore, a removal of guarantees, just as the guarantees themselves, is likely to diffuse into the remaining financial system. Furthermore, the experience of the German public banking sector is a warning sign that an abolition of guarantees has to be designed with great care in order to avoid undesirable consequences. In combination with the results by Fischer, Hainz, Rocholl, and Steffen (2011), our paper suggests that the abolition of guarantees in Germany was poorly implemented. It is to be hoped that policy makers take this experience into account when

designing an exit strategy from the implicit guarantees built up during the recent financial crisis.

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# A Appendix

## A.1 Variable description

### A.1.1 Bank data

For each bank variable, one percent of the observations were winsorized (0.5% on each side). The savings bank sample and the cooperative bank sample were winsorized separately.

**Interest expenses/liabilities.** Interest expenses divided by interest-bearing liabilities in percent. Interest-bearing liabilities are loans from banks, liabilities to customers, subordinated debt, and participation certificates. Liabilities are averaged over the current and previous year. *Source:* Own calculations based on Bankscope.

**Interest expenses/total assets.** Interest expenses divided by total assets in percent. Total assets are averaged over the current and previous year. *Source:* Own calculations based on Bankscope.

**Interest margins/total assets.** Interest income minus interest expenses divided by total assets in percent. Interest income includes interest from lending, money market transactions, and fixed-income securities. Total assets are averaged over the current and previous year. *Source:* Own calculations based on Bankscope.

**Security reserves/total assets.** Profits retained and accumulated divided by total assets in percent. *Source:* Own calculations based on Bankscope.

**Book equity/total assets.** Book equity divided by total assets in percent. Book equity is total assets minus total liabilities. Book equity of public-law savings banks typically consists of security reserves, balance sheet profits, and capital contributions of silent (i. e. non-controlling) partners (*stille Einlagen*). Book equity of cooperative banks additionally consists of share capital. *Source:* Own calculations based on Bankscope.

**Liquid assets/total assets.** Liquid assets divided by total assets in percent. Liquid assets are: cash, treasury securities and bills of exchange eligible for advances from central banks, due from banks on demand, bonds and other fixed-income securities, shares and other non-fixed income securities, recovery claims against public authorities. *Source:* Own calculations based on Bankscope.

**Risk provisions/reference assets.** Risk provisions minus income from write-backs and releases from risk provisions divided by reference assets in percent. Reference assets are assets that risk provisions can be made for. These include loans to banks, loans to customers, bonds and other fixed-income securities, shares and other non-fixed income securities. *Source:* Own calculations based on Bankscope.

**Risk provisions/book equity.** Risk provisions minus income from write-backs and releases from risk provisions divided by book equity in percent. Book equity is total assets minus total liabilities. *Source:* Own calculations based on Bankscope.

## **B. Control variables**

**Real GDP growth.** Yearly difference in log real GDP of federal states. *Source:* Own calculations based on data from the Federal Statistical Office (Destatis).

**Population density.** Number of inhabitants per km<sup>2</sup> in each federal state. *Source:* Own calculations based on data from the Federal Statistical Office (Destatis).

**Banks per 100,000 inhabitants.** Number of savings banks, cooperative banks, and other regional banks per 100,000 inhabitants in each federal state. *Source:* Own calculations based on data from Deutsche Bundesbank and the Federal Statistical Office (Destatis).

## A.2 Appendix tables

**Table A.1:** Descriptive statistics for the savings banks sample

	Mean	St. D.	Min.	Max.	Median	Obs.
Interest expenses/liabilities (%)	3.30	0.64	1.86	4.78	3.34	6003
Interest expenses/assets (%)	3.08	0.60	1.72	4.49	3.12	6003
Interest margins/assets (%)	2.28	0.48	0.91	3.54	2.26	6003
Security reserves/assets (%)	4.35	1.02	1.90	7.98	4.22	6078
Book equity/assets (%)	4.55	1.00	2.45	8.14	4.41	6078
Liquid assets/assets (%)	31.11	11.10	9.10	69.26	29.44	6078
Risk provisions/reference assets (%)	0.52	0.36	-0.50	1.97	0.50	6078
Risk provisions/book equity (%)	11.23	8.55	-11.31	49.36	10.31	6077

*Note:* For each variable, one percent of the observations were winsorized (0.5% on each side).

**Table A.2:** Descriptive statistics for the cooperative banks sample

	Mean	St. D.	Min.	Max.	Median	Obs.
Interest expenses/liabilities (%)	3.14	0.68	1.66	4.97	3.17	10977
Interest expenses/assets (%)	2.90	0.65	1.51	4.65	2.93	10977
Interest margins/assets (%)	2.59	0.52	0.60	4.01	2.61	10977
Book equity/assets (%)	5.43	1.29	2.68	10.90	5.25	12092
Liquid assets/assets (%)	26.87	9.90	6.66	62.27	25.50	12092
Risk provisions/reference assets (%)	0.52	0.41	-0.53	2.27	0.46	12092
Risk provisions/book equity (%)	9.27	7.82	-8.94	50.00	8.05	12092

*Note:* For each variable, one percent of the observations were winsorized (0.5% on each side).

**Table A.3:** Risk-taking of savings banks relative to cooperative banks

	Book equity/ total assets (1)	Liquid assets/ total assets (2)	Risk provisions/ reference assets (3)	Risk provisions/ book equity (4)
Savings bank $\times$ after 2001	-0.111*** (0.039)	-1.459*** (0.483)	0.078*** (0.025)	2.544*** (0.541)
Savings bank $\times$ after 2005	-0.065** (0.029)	-0.970*** (0.293)	0.002 (0.018)	-0.425 (0.370)
Real GDP growth	0.072 (0.423)	-18.536*** (5.216)	-0.715* (0.394)	-12.094 (7.617)
Real GDP growth $\times$ savings bank	-2.232*** (0.493)	16.808** (6.570)	-1.253*** (0.460)	-22.885** (9.742)
Population density	-0.003 (0.004)	0.016 (0.034)	0.000 (0.001)	0.029 (0.025)
Population density $\times$ savings bank	-0.007 (0.007)	0.045 (0.065)	0.002 (0.003)	0.084 (0.076)
Banks per 100,000 inhabitants	0.011 (0.029)	-2.294*** (0.302)	-0.006 (0.012)	0.060 (0.245)
Banks per 100,000 inhabitants $\times$ savings bank	-0.031 (0.031)	0.524 (0.322)	0.044*** (0.017)	1.258*** (0.370)
Sum of rows (1) and (2)	-0.175*** (0.055)	-2.430*** (0.583)	0.079*** (0.028)	2.119*** (0.611)
$R^2$ within	0.48	0.10	0.13	0.10
Observations	18170	18170	18170	18169

*Notes:* All models include year fixed effects and bank fixed effects. Standard errors clustered at the bank level are given in parentheses. \* \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. In the bottom, the sum of the estimated coefficients of the two savings bank-after interactions is reported, as well as standard errors and significance levels from testing the hypothesis that these coefficients sum up to zero. Detailed variable descriptions are given in the Appendix.

**Table A.4:** Risk-taking of savings banks relative to cooperative banks, excluding years with extraordinary accounting events

	Book equity/ total assets (1)	Liquid assets/ total assets (2)	Risk provisions/ reference assets (3)	Risk provisions/ book equity (4)
Savings bank $\times$ after 2001	-0.086** (0.038)	-1.324*** (0.486)	0.116*** (0.025)	3.044*** (0.550)
Savings bank $\times$ after 2005	-0.023 (0.027)	-1.258*** (0.306)	0.073*** (0.018)	0.630* (0.376)
Real GDP growth	0.738 (0.464)	-29.056*** (5.875)	-1.245*** (0.419)	-18.294** (8.487)
Real GDP growth $\times$ savings bank	-2.791*** (0.569)	21.423*** (7.451)	0.319 (0.500)	-0.945 (10.707)
Population density	-0.002 (0.003)	0.013 (0.034)	0.000 (0.001)	0.027 (0.024)
Population density $\times$ savings bank	-0.009 (0.006)	0.047 (0.065)	0.003 (0.003)	0.097 (0.076)
Banks per 100,000 inhabitants	-0.020 (0.025)	-2.339*** (0.295)	-0.014 (0.012)	-0.040 (0.248)
Banks per 100,000 inhabitants $\times$ savings bank	-0.016 (0.030)	0.584* (0.321)	0.058*** (0.017)	1.435*** (0.371)
Sum of rows (1) and (2)	-0.109** (0.051)	-2.582*** (0.598)	0.188*** (0.029)	3.673*** (0.631)
$R^2$ within	0.47	0.11	0.13	0.10
Observations	16925	16925	16925	16924

*Notes:* All models include year fixed effects and bank fixed effects. Standard errors clustered at the bank level are given in parentheses. \* \*\* and \*\*\* denote significance at the 10, 5 and 1 percent level, respectively. In the bottom, the sum of the estimated coefficients of the two savings bank-after interactions is reported, as well as standard errors and significance levels from testing the hypothesis that these coefficients sum up to zero. Detailed variable descriptions are given in the Appendix.