

Kaposty, Florian; Pfingsten, Andreas; Domikowsky, Christian

**Conference Paper**

## Market Discipline, Deposit Insurance, and Competitive Advantages: Evidence from the Financial Crisis

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2017: Alternative Geld- und Finanzarchitekturen - Session: Banking I, No. A15-V3

**Provided in Cooperation with:**

Verein für Socialpolitik / German Economic Association

*Suggested Citation:* Kaposty, Florian; Pfingsten, Andreas; Domikowsky, Christian (2017) : Market Discipline, Deposit Insurance, and Competitive Advantages: Evidence from the Financial Crisis, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2017: Alternative Geld- und Finanzarchitekturen - Session: Banking I, No. A15-V3, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/168146>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Market Discipline, Deposit Insurance, and Competitive Advantages: Evidence from the Financial Crisis \*

Christian Domikowsky<sup>†</sup>      Florian Kaposty<sup>†,§</sup>      Andreas Pfingsten<sup>†</sup>

February 27, 2017

## Abstract

This study empirically investigates two issues that are largely unexplored in the literature on market discipline and deposit insurance. We first explore whether it is possible to offer full insurance for non-financial depositors whilst maintaining market discipline. We answer this question using a comprehensive panel of German banks which are subject to privately funded and administered deposit insurance schemes relying on peer monitoring. The second aim is to exploit the heterogeneity between the three major deposit insurance schemes in Germany to analyze whether a more credible deposit insurance scheme can be a competitive advantage for banks in a systemic crisis, i.e. at a time when stable funding is of particular importance. Using a dynamic panel data model, we find (1) some market discipline to be prevalent as measured by the growth rates of customer and interbank deposits, (2) this finding to be stronger for uninsured interbank deposits, and (3) banks *ceteris paribus* achieving higher growth rates of customer deposits in the financial crisis if they are part of a deposit insurance scheme that is more credible to the general public.

**Key Words:** Market discipline, deposit insurance, systemic risk, financial crisis.

**JEL Classification:** G01(financial crisis), G21 (banks), G28 (regulation).

---

\* We are grateful for valuable comments from Andrea Schertler as well as participants and discussants of the 77th Annual Meeting of the German Academic Association for Business Research (VHB) in Vienna and seminar participants at the University of Kiel and the University of Muenster.

<sup>†</sup> University of Muenster.

<sup>§</sup> Corresponding author, Finance Center Muenster, Universitaetsstr. 14-16, 48143 Muenster, Germany, phone +49-251-83-29924, fax +49-251-83-22882, [florian.kaposty@wiwi.uni-muenster.de](mailto:florian.kaposty@wiwi.uni-muenster.de).

## I Introduction

Banks that rely on deposits as a major source of funding are generally exposed to the risk of a bank run, particularly in systemic crises. In theory, credible deposit insurance can be a suitable tool to protect depositors and ensure financial stability ([Diamond and Dybvig \(1983\)](#)). This concept led to the introduction of different deposit insurance schemes across the globe ([Demirgüç-Kunt and Detragiache \(2002\)](#)). However, it has as well been frequently argued that the existence of explicit deposit insurance reduces insured depositors' incentives to monitor bank activities and to punish banks for excessive risk-taking by imposing direct costs on high-risk banks in order to discipline these banks to engage in less riskier business activities ([Grossman \(1992\)](#) and [Martinez Peria and Schmukler \(2001\)](#)). This form of market-induced regulation is known as market discipline and it has been established by the Basel Committee on Banking Supervision as the third of the three pillars of the Basel framework.<sup>1</sup> In this context, two questions have so far remained largely unexplored. First, it has not yet been analyzed how far it is possible to offer full insurance for non-financial depositors whilst maintaining market discipline. Second, it remains an open question how far a comprehensive and particularly credible deposit insurance scheme can be a competitive advantage for banks in a systemic crisis, i.e. at a time when stable funding is of utmost importance.

To address these questions, Germany provides a unique testing ground because each of the three major German banking sectors has a different and privately funded deposit insurance scheme in place. Cooperative banks and savings banks both rely on the principle of “institutional protection”, meaning that banks in financial distress get support from a sector-specific deposit insurance fund and, with its help, are then usually acquired by a sound, regionally adjacent bank from the respective sector. As a result, no cooperative bank or savings bank has ever officially failed since the establishment of their deposit insurance schemes in the middle of the seventies. On the other hand, commercial banks regularly pay into a deposit insurance fund that compensates depositors in case of a bank failure. This happened a few times in the past years.<sup>2</sup> All three banking sectors basically guarantee full protection of customer deposits and rely on peer monitoring rather than

---

<sup>1</sup> A comprehensive review of previous literature on market discipline can be found, for instance, in [Bennett et al. \(2015\)](#).

<sup>2</sup> There is no official number of failures since the introduction of the scheme, but the Compensation Scheme of German Banks reports eight cases since 2003 on its homepage, one of those cases being the German subsidiary of Lehman Brothers ([Compensation Scheme of German Banks \(2016\)](#)).

monitoring by non-financial depositors ([Beck \(2002\)](#)), which is important for the first question.

Regarding the second question, two incidents are remarkable: First, right after the collapse of Lehman Brothers in September 2008, German newspapers interviewed some cooperative banks and savings banks which reported a considerable increase of demand deposits and term deposits. In many cases, the banks reported that new customers, some even from abroad, explicitly asked about the deposit insurance scheme of the bank (e.g., [FOCUS Online \(2008\)](#)). Second, the comparatively large number of bank runs across the globe during the financial crisis has led to a heated debate about a common deposit insurance scheme in the EU. This debate triggered massive opposition in Germany, especially from cooperative banks and savings banks. To emphasize this, the presidents of their respective umbrella associations released a joint press statement in September 2012 in which they strongly refused the introduction of a common deposit insurance scheme in Europe, arguing that the banks participating in their respective deposit insurance schemes would not be willing to subsidize financially distressed banks in other EU countries ([German Savings Bank Association \(2012\)](#)). Bringing both incidents together, anecdotal evidence suggests itself that depositors and banks as well treat the specific design of certain deposit insurance schemes as a competitive advantage in terms of collecting customer deposits.

In this context, our paper contributes to the literature on deposit insurance in several ways. First, we test if fully insured depositors on average, i.e. after controlling for time and hence crisis effects, exert market discipline and we compare our findings to the behavior of uninsured financial depositors that are both supposed and incentivized to exert market discipline. This is not just because interbank deposits are uninsured, but as well because peer banks fund the deposit protection scheme that is required to step in in case of a bank failure. Finding evidence of market discipline by peer banks indicates that private funding of deposit insurance schemes is a feasible way to combine reasonable safety for non-financial depositors, at least in normal market conditions, with efficient market discipline.

Second, and most importantly, we analyze whether and how far a deposit insurance scheme that has more credibility in a systemic crisis can be a competitive advantage in such a crisis. For this purpose, we exploit the heterogeneity across the deposit insurance schemes of the three German banking sectors to analyze whether banks under a deposit insurance scheme that is more credible to the general public showed significantly higher deposit growth rates

in the financial crisis.<sup>3</sup> This is particularly important for four reasons: First, a stable deposit business can be crucial for a bank's refinancing operations in times of economic uncertainty (Ivashina and Scharfstein (2010)). Second, a higher level of protection in privately funded deposit insurance schemes is usually associated with higher costs for the participating banks (for the costs of deposit insurance, we refer to Laeven (2002)). Finding evidence for benefits of a higher level of protection would thus be a signal for banks that a high level of protection can also be rewarding. Third, deposit withdrawals during bank runs can have severe long-term effects for the banks concerned since depositors often do not return to the bank after a run (Iyer and Puri (2012)). Fourth, competitive effects of different deposit insurance schemes should be taken into account by the legislator in the development of legal requirements regarding deposit insurance.<sup>4</sup>

Summarizing our main results, we find tentative evidence that even fully insured depositors exert market discipline while there is stronger evidence for market discipline by uninsured depositors. The latter is expected since all deposit insurance schemes in Germany are privately funded and largely rely on peer monitoring (Beck (2002)). We find strong evidence that banks that are part of a deposit insurance scheme with institutional protection had a competitive advantage in the financial crisis, as measured by the growth rates of insured customer deposits. This advantage is not sector-specific, but holds across both sectors with institutional protection, i.e. cooperative banks and savings banks.

The remainder of the paper is organized as follows: Section II introduces the institutional background of the German banking system with a particular focus on the design of the different deposit insurance schemes as well as the development of deposit protection levels in the course of the financial crisis. Section III briefly presents related literature and develops our main hypotheses. Section IV describes our data and methodology. Section V discusses the empirical results. Section VI presents a variety of robustness tests. Section VII concludes.

---

<sup>3</sup> We refer to Allen et al. (2012) for a more general discussion about the various facets of the credibility of deposit insurance schemes.

<sup>4</sup> The German legislation does not allow banks to use their deposit insurance in their advertising (Section 5 of the Law against Unfair Competition (UWG)). However, banks are obviously allowed to explicitly *inform* their customers about the specific features of their deposit insurance scheme.

## II Institutional background

### II.1 Deposit insurance schemes in Germany

The German banking system consists of three main sectors: savings banks, cooperative banks, and commercial banks.<sup>5</sup> Each of these sectors has been operating its own privately funded and self-administered deposit insurance scheme since 1975 (or even longer in the case of cooperative banks). Nonetheless, all three sectors are subject to the same strong regulatory and institutional environment, which is important from a moral hazard perspective ([Demirgüç-Kunt and Detragiache \(2002\)](#)).

The deposit insurance schemes of cooperative banks and savings banks are very similar and guarantee the solvency of their member institutions rather than the compensation of depositors in case of a bank failure which is often referred to as “institutional protection”.<sup>6</sup> This is possible because banks from both sectors mostly operate in local markets that rarely overlap. Hence competition is by far stronger between institutions from the different banking sectors than within them. For the purpose of institutional protection, savings banks have several regional funds that are combined in a national compensation scheme ([German Savings Bank Association \(2011\)](#)). Similarly, cooperative banks run one single nationwide fund ([National Association of German Cooperative Banks \(2016\)](#)). It applies for both sectors that, if a member institution is unable to fulfill its obligations, the deposit insurance fund steps in. With its support, the distressed bank is usually “forced” to merge with a regionally adjacent bank from the same banking sector in the medium term. Consequently, neither has any cooperative bank or savings bank ever officially become insolvent since the introduction of their deposit insurance schemes, nor was there any need to explicitly compensate a depositor. In the general public, which is admittedly not very knowledgeable, both cooperative banks and savings banks are hence considered to be very safe and particularly credible since depositors enjoy unlimited protection unless the respective sector collapses as a whole ([Goedde-Menke et al. \(2014\)](#)). In both sectors, the contributions from the member banks are calculated on the basis of individual risk ex-

---

<sup>5</sup> This section draws heavily on [Beck \(2002\)](#) and [Goedde-Menke et al. \(2014\)](#) who both provide an excellent description of the German banking system and deposit insurance in Germany. Moreover, [Arnold et al. \(2016\)](#) give an extensive overview about differences in the bank governance models of the three German banking sectors.

<sup>6</sup> According to the realignment of the European deposit insurance schemes, deposits with savings banks and cooperative banks are legally secured up to €100,000. See below for a more detailed discussion.

posures which are measured somewhat in line with risk variables defined by the regulatory authorities. Consequently, the member banks are monitored and audited by their respective umbrella associations which highlights that their schemes as a first line of defense build upon peer monitoring instead of market discipline exercised by non-financial depositors. In addition to the institutional protection, substantial amendments of the existing regulation of deposit insurance schemes adopted by the European parliament in order to harmonize and align the deposit insurance schemes throughout Europe necessitate an adoption of the existing deposit insurance schemes of cooperative banks and savings banks (EC Directive 2014/49/EU as of April 16, 2014). In order to meet these new regulatory requirements no later than July 2015 while maintaining to offer the same protection level as before, both cooperative banks and savings banks establish besides an institution operating the institutional protection scheme a new institution to explicitly ensure that depositors are compensated in accordance with European law in case of a bank failure.<sup>7</sup> However, the case that a depositor of a cooperative bank or savings bank has to be compensated will still not occur due to the existing institutional protection as the by far most important part of their respective deposit insurance schemes.<sup>8</sup>

Mainly due to stronger intra-sector competition<sup>9</sup>, the deposit protection system of commercial banks is quite different. Insuring deposits rather than institutions, the deposit insurance scheme of commercial banks consists of two main building blocks. The first is the aforementioned compulsory deposit guarantee scheme that is mandated by German law since 1998. For commercial banks, it is managed by the Association of German Banks and provides compensation of up to €100,000 per non-financial depositor ([Association of German Banks \(2013\)](#)). The second building block is an additional deposit protection fund that was established in 1976. It is funded by the participating banks with member fees being collected on a regular basis. In principle, membership is voluntary, but non-members face high barriers like the inability to be part of the Association of German Banks, and

---

<sup>7</sup> The European law pledges banks to protect customer deposits to a maximum amount of €100,000 per customer per bank and therefore much less than guaranteed through institutional protection. Hence, the institutional protection already comprises the protection level of €100,000. This view was shared by the German legislator, who exempts savings banks and cooperative banks from the compulsory deposit insurance scheme that has been mandated by German law since 1998 according to the Deposit Guarantee and Investor Compensation Act following the EC Deposit Guarantee Directive (94/19/EC of May 30, 1994) and the EC Investor Compensation Directive (97/9/EC of March 3, 1997) until July 2015 and thus during the period under consideration in this paper.

<sup>8</sup> Hence, the introduction of the new European legislation does not affect the protection level of deposits held by cooperative banks or savings banks and has mainly organizational implications for these banks.

<sup>9</sup> It is hardly conceivable that these banks in general are interested in saving a failing competitor.

hence just very few banks opt not to be part of the scheme (Beck (2002)).<sup>10</sup> All non-financial deposits of the members are covered up to a ceiling of 20 % of the relevant liable capital of each member, with a minimum of €1,000,000 per customer and usually far more, implying virtually unlimited protection under normal conditions (International Monetary Fund (2013)).<sup>11</sup> Contributions to the fund are risk-adjusted and members have to inform their customers about the covered amount. Altogether, the total volume of the two funds is unknown to the public and it has often been assumed that it would be insufficient in case of a major bank failure or a systemic crisis (Beck (2002)), although it was as well suspected that the government would intervene in that case (Deutsche Bundesbank (1992)). Moreover, there are at least eight cases since 2003 where depositors of commercial banks have to be compensated due to a bank failure. This in turn might cast strong doubts on the safety of their deposits during a crisis and thus remarkably reduces the credibility of the deposit insurance scheme even if all depositors got refunded according to the law. Similar to cooperative banks and savings banks, the member institutions are monitored and audited by the Association of German Banks. Hence, the scheme also relies on peer monitoring rather than market discipline by non-bank depositors.

Overall, we cannot finally judge which of the two basic schemes (institutional protection vs. depositor protection) will perform better in a systemic crisis since privately funded deposit insurance schemes can, almost by definition, not absorb a systematic run on a majority of participating banks. However, for the reasons we outlined above, we argue that the deposit insurance schemes of cooperative banks and savings banks are more credible to the general public, and that this additional credibility can be a competitive advantage in times of financial distress.

## II.2 Deposit insurance during the financial crisis

It is a difficult task to define unambiguous start and end dates of the financial crisis, and they probably differ across countries. Whilst the bank run on Northern Rock happened in September 2007, indicating that the crisis had arrived in the UK at that time, Goedde-Menke et al. (2014) report that a search of the LexisNexis press report database showed a surprisingly small number of only 100 press reports mentioning the German translation

---

<sup>10</sup> Dropping those banks does not affect our results in terms of economic or statistical significance. We provide more details in Section IV.1.

<sup>11</sup> Until December 2014 the protection limit has amounted to 30 % of a bank's liable capital. From January 2015 on, this ratio will gradually be lowered to a minimum of 8.75 % in 2025 (Association of German Banks (2013)).



of the term “deposit insurance” (“Einlagensicherung”) between October and December 2007 in Germany, right after the bank run on Northern Rock. This changed dramatically after the collapse of Lehman Brothers when a search for the same key word and period in 2008 yielded 1,194 hits.<sup>12</sup> Indeed, the collapse of Lehman Brothers and the bailout of Hypo Real Estate, a major German mortgage lender, were followed by extensive media coverage, including TV documentaries about deposit insurance.

On October 5th, the government made a statement in which it guaranteed all private bank deposits which arrested wide attention in newspapers and on television ([New York Times \(2008\)](#)). In theory, this should have brought all three deposit insurance schemes to the same level of customer protection. Thus, if depositors actually consider their deposits as safe for all the banking sectors (and hence their respective deposit insurance schemes as credible), there should be no reasons to move with their deposits to banks with a different deposit insurance scheme. At the same time and shortly afterwards, however, some cooperative banks and savings banks that were interviewed by German newspapers reported a massive increase of demand and term deposits along with some customers explicitly asking for the deposit insurance of the bank (e.g., [FOCUS Online \(2008\)](#)). With some delay, the EU issued amendments to the EC Deposit Guarantee Directive (94/19/EC of March 11, 2009) which raised the minimum protection banks had to guarantee from €20,000 to €50,000, scheduling another increase to €100,000 for January 2011. In Germany, the increase to €50,000 became effective as of July 2009. This EU measure should, in theory, as well have contributed to aligning the three German deposit insurance schemes.

---

<sup>12</sup> Working with annual data, it is thus most reasonable to assume a crisis period for Germany that covers the years 2008 and 2009. A detailed explanation is provided in Section IV.

### III Related literature and development of hypotheses

Theoretically, informed depositors are assumed to revise their risk assessment of a bank in the consequence of a sufficiently large decrease in its overall condition which in turn should lead to the exercise of market discipline ([Flannery \(1996\)](#)). However, in [Section II.1](#) we outlined that all three deposit insurance schemes in Germany by construction rely mostly on peer monitoring and less on market discipline exercised by non-financial depositors. Peer monitoring is additionally accompanied by a strong regulatory and institutional environment that was shown to have a mitigating effect on market discipline ([Demirgüç-Kunt and Kane \(2002\)](#)). Furthermore, [Goedde-Menke et al. \(2014\)](#) find the knowledge about deposit insurance in the general public to be low in times of no crises. Altogether, we cannot expect non-financial depositors to exert market discipline to an economically significant degree. If there is market discipline, it is potentially limited to comparatively simple accounting ratios ([Berger and Turk-Ariss \(2015\)](#) discuss this in a similar context). Hence, we hypothesize:

**H1.** Fully insured non-financial depositors do not exert market discipline to a significant extent as a reaction to weak fundamentals.

Prior work often focused on market discipline by non-financial depositors. However, [Distinguin et al. \(2013\)](#) find that uninsured interbank deposits play an important role in exerting market discipline in Central and Eastern European countries. These results are underlined by [Furfine \(2001\)](#) who provides evidence for effective peer-monitoring in the US interbank market.<sup>13</sup> Moreover, theoretic work shows that agency problems arising from information asymmetries between lenders and borrowers on interbank markets can be reduced through peer-monitoring (e.g., [Rochet and Tirole \(1996\)](#)). Thus, banks participating in the interbank market should have intrinsic incentives for monitoring the activities of their competitors thoroughly and hence for exerting market discipline. In Germany, interbank deposits are not insured and traditionally remain within the same sector, i.e. banks tend to place excess liquidity with banks from the same banking sector, in particular among cooperative banks and savings banks. Since those are the banks that contribute to the deposit insurance scheme (and/or might even have to acquire a failing

---

<sup>13</sup> In addition, [Cocco et al. \(2009\)](#) find that banks in the Portuguese interbank market with a higher proportion of non-performing loans have to pay higher interest rates on lending money on the interbank market suggesting the existence of market discipline.

bank in case of cooperative banks and savings banks), they should have an incentive to monitor their peers. Consequently, we hypothesize:

**H2.** Interbank depositors exert market discipline as a reaction to weak fundamentals.

Section II.2 implies that bank runs were an imminent threat to financial stability in the recent crisis. In that context, [Demirgüç-Kunt and Huizinga \(2004\)](#) and [Hadad et al. \(2011\)](#) find that credible government guarantees reduce market discipline and [Martinez Peria and Schmukler \(2001\)](#) argue that banking crises affect deposit growth, regardless of fundamentals. However, they argue as well that a credible deposit guarantee reduces market discipline. We transfer this to the introduction of a governmental blanket guarantee in 2008 and hypothesize:

**H3.** The comparatively strong deposit protection in Germany in combination with a governmental blanket guarantee in October 2008 led to deposit withdrawals of non-financial depositors in the financial crisis being insignificant.

We emphasized in Section II that the deposit insurance schemes in Germany differ across banking sectors. Whilst no depositor of a cooperative bank or savings bank ever had to be compensated due to institutional protection, depositors of commercial banks had to be compensated in eight cases since 2003 ([Compensation Scheme of German Banks \(2016\)](#)). Although the aforementioned governmental blanket guarantee in October 2008 in combination with increased minimum deposit protection guaranteed by the EU should have aligned the protection level of the three German banking sectors, newspapers reported a massive increase of customer deposits in some cooperative banks and savings banks (e.g., [FOCUS Online \(2008\)](#)). Arguing that this increase is caused by the higher credibility of their deposit insurance schemes is consistent with [Iyer et al. \(2016\)](#) whose results suggest that non-financial depositors' concerns about the safety of their deposits leads to a re-allocation of their personal funds in times of crisis towards banks which they perceive as safer. Transferring this to our institutional environment, we argue banks operating under a deposit insurance scheme which is perceived as more credible in the general public (i.e. cooperative banks and savings banks) should be able to generate competitive advantages over commercial banks during a crisis. Moreover, the findings by [Boyle et al. \(2015\)](#) suggest that introducing a deposit insurance scheme during a financial crisis as done by the German government in 2008 results in a lower credibility of this new insurance scheme compared to the existing schemes of cooperative as well as savings banks and is therefore

less likely to reduce withdrawal risk. This leads us to the question whether cooperative banks and savings banks benefited from the very specific design of their deposit protection schemes in the financial crisis. Since stable funding is particularly important in times of crises, we express our key hypothesis as follows:

**H4.** The highly credible deposit insurance schemes of cooperative banks and savings banks served as a competitive advantage in the financial crisis as measured by the growth rate of customer deposits.

## IV Data and methodology

### IV.1 Sample

Accounting data are obtained from Bureau van Dijk’s BankScope database. Since our study focuses on a comparison of the deposit insurance schemes of commercial banks vs. cooperative banks and savings banks, we eliminate financial institutions with other business models (e.g., investment banks). Furthermore, we drop bank-year observations that are classified as “dissolved” or “dissolved (merger)”. This is because BankScope treats merging banks as one new bank that is assigned a new ID and consolidates the figures from the annual reports backwards. Hence dropping aforementioned observations avoids double counting of bank-year observations. Our final unbalanced panel comprises 22,031 bank-year observations of German commercial banks (1,464), cooperative banks (13,805), and savings banks (6,762) from 1997 to 2013, thus covering both crisis and non-crisis periods.<sup>14</sup> As described in Section II.1, membership in the additional protection scheme of commercial banks is voluntary and there is no official number of the share of commercial banks that are not part of the voluntary deposit protection fund.<sup>15</sup> According to a list published by the [Association of German Banks \(2013\)](#), over 210 banks contributed to the voluntary deposit protection fund in 2012. We manually match the 99 commercial banks of our sample in 2012 with that list and, if a bank is not on the list, verify the deposit protection of that bank on the internet or by phoning the bank. Altogether, the deposit protection of eleven banks was limited to €100,000 in 2012. For the main part of this paper, we keep those banks in the sample since the protection level of the compulsory guarantee scheme is still considerable. However, we drop those banks for robustness reasons and our results do not differ in terms of economic or statistical significance. Macro variables originate from the IMF and Thomson Reuters Datastream. We winsorize all non-binary variables at the 1 % and 99 % levels.

---

<sup>14</sup> Note that this number will decrease considerably in the empirical analysis since our models require lags and first differences of some variables. Altogether, the distribution of observations across banking sectors reflects the structure of the German banking system quite well (e.g., [Deutsche Bundesbank \(2016\)](#) for more recent years).

<sup>15</sup> [Dreher \(1998\)](#) reports five and [Steuer \(1998\)](#) 36 banks.

## IV.2 Empirical strategy

In line with the more recent literature ([Maechler and McDill \(2006\)](#), [Hadam et al. \(2011\)](#), and [Hasan et al. \(2013\)](#)), the empirical results on the association of different bank-specific characteristics as well as time and sector specifics with deposit growth in German banks are derived from a dynamic generalized method of moments (GMM) estimation technique (“two-step system GMM”, [Blundell and Bond \(1998\)](#)) with [Windmeijer \(2005\)](#) correction for standard errors. System GMM is an extension of the standard GMM proposed by [Arellano and Bond \(1991\)](#) for dynamic “large N, small T” panels. Employing a dynamic panel data model is particularly suitable compared to a standard fixed effects OLS model or IV panel regressions to address two econometric concerns in our setting: First, we recognize the potential endogeneity of one explanatory variable, namely the implicit interest rate (cf. [Section IV.3](#) for an explanation). Second, we see the need to account for potential dynamics in the development of the dependent variable which is generally done by including the first lag of the dependent variable.<sup>16</sup> However, including the lagged dependent variable into standard OLS estimations leads to biased coefficients (“Nickell bias”) since the lagged dependent variable is inevitably correlated with the error term of the regression ([Nickell \(1981\)](#)). We account for the existence of unobservable bank-individual effects by including bank-fixed effects. The Hansen test of overidentifying restrictions ([Blundell and Bond \(1998\)](#)) and the Arellano-Bond test for autocorrelation are applied to assess the validity of the instruments used. Wald tests are used to assess the joint significance of bank fundamentals. In our empirical application, we carefully follow the guidelines on the appropriate empirical use of system GMM by [Roodman \(2009b\)](#).<sup>17</sup> We use a limited number of instruments to mitigate potential concerns regarding the applicability of the Hansen test ([Roodman \(2009a\)](#)). Furthermore, and based on [Arellano and Bover \(1995\)](#), we use forward orthogonal deviations instead of first differences which prove to be more suitable in unbalanced panels.<sup>18</sup> However, the findings are robust to both options.

---

<sup>16</sup> We re-estimate our models with static IV and GMM panel regressions assuming no dynamics as a robustness test and obtain qualitatively the same results.

<sup>17</sup> Usually, using fixed effects OLS as robustness test is very useful since it has been shown that the bias is rather small for small coefficients of the lagged (predetermined) dependent variable and simply ignoring the bias might lead to more efficient results, particularly in “large T” panels ([Beck and Katz \(2011\)](#)). With  $T = 17$ , our sample has a comparatively large time dimension. However, due to the endogeneity of the implicit interest rate, fixed effects OLS cannot be applied in our setting.

<sup>18</sup> Note that the Arellano-Bond test for autocorrelation is not possible for orthogonal deviations and is thus automatically run on differenced residuals.

### IV.3 Variables

The literature usually concentrates on market discipline by depositors that is exerted by requiring higher interest rates (Hadad et al. (2011)) as well as Cubillas et al. (2012)) or by withdrawing deposits (Hasan et al. (2013)). In many cases, both is examined (Park and Peristiani (1998), Martinez Peria and Schmukler (2001), Fueda and Konishi (2007), and Pfingsten et al. (2008)). For this study, we argue that the second approach to measure market discipline is more appropriate. First, we can accurately distinguish between the growth rates of customer and interbank deposits. Second, non-financial depositors are often price takers, especially in the retail business. This makes them more likely to exert market discipline by withdrawing deposits. Third, one of the key issues in this study is the behavior of depositors in the 2008/2009 financial crisis. Prior research has suggested that depositors attach much greater importance to the safety of their deposits than to high rates of return during such times (Goedde-Menke et al. (2014) and Bennett et al. (2015)). Thus, we use the growth rate of customer deposits of bank  $i$  in year  $t$  ( $\Delta CDEPOSIT_{i,t}$ ) as dependent variable in most parts of the study to measure both market discipline as well as the competitive advantage in the crisis.<sup>19</sup> As regards Hypothesis 2, we explicitly use the growth rate of interbank deposits ( $\Delta IDEPOSIT_{i,t}$ ) as dependent variable.

To measure the impact of bank risk on deposit growth and hence the existence of market discipline, we use a comprehensive set of accounting variables (“bank fundamentals”) that are supposed to reflect the well established CAMEL rating criteria in the best possible way.<sup>20</sup> We use lagged variables since financial statements for year  $t-1$  are usually published in year  $t$ , mostly not until months after the official closing date. Decisions to withdraw money from or place more money with a particular bank are likely to be based on this information, all the more so for non-financial depositors. To control for capital adequacy, we use  $EQUITY_{i,t-1}$  which is the equity ratio of bank  $i$  in year  $t-1$ .<sup>21</sup> We expect a higher equity ratio to be associated with higher deposit growth.

---

<sup>19</sup>  $\Delta CDEPOSIT_{i,t}$  is the change in the sum of demand, savings, and term deposits of bank  $i$  in year  $t$ . This is because we assume that customers react similarly with respect to the different types of deposits that they place with a bank. Moreover, by combining them in one variable, we avoid a potential source of endogeneity. Nonetheless, we analyze the different components separately whilst taking account of their potential endogeneity as a robustness test in Section VI. Our results indicate that depositors react similarly with respect to all three deposit types.

<sup>20</sup> The CAMEL rating criteria used in this study are Capital adequacy, Asset quality, Management quality, Earnings, and Liquidity. For an early discussion of CAMEL ratings and their components, cf. Cargill (1989).

<sup>21</sup> We cannot use the regulatory capital ratio due to insufficient coverage of that variable in BankScope.

We use the relative loan loss provisions on the bank-level ( $REL\_LLP_{i,t-1}$ ) as reported by BankScope to account for asset quality. However, although BankScope reports loan loss provisions for almost every bank-year observation in our sample, we are certain that this is rather the net income/expense from loan loss provisions, write-offs, value changes in certain securities and in the additional hidden reserves that German banks are allowed to create pursuant to Section 340f of German Commercial Code to provision against “specific banking risks” (Bornemann et al. (2012)). The reason for this assumption is that German banks are not required to report their loan loss provisions in the income statement and usually exercise their right to conceal this information from the public. Consequently, a high volume of loan loss provisions as reported by BankScope can arise from an increase in credit risk or from an increased build-up of reserves. Thus, we do not have an unambiguous expectation as to the sign of the coefficient of  $REL\_LLP_{i,t-1}$ , although we believe that a higher number of that position in the income statement is mostly interpreted as an outcome of increased credit risk.

The cost-income ratio ( $CIR_{i,t-1}$ ) is used as a proxy for (inverse) management quality. We expect a higher cost-income ratio to be negatively correlated with deposit growth. We use the ratio of liquid assets to total assets ( $LIQUID_{i,t-1}$ ) to account for liquidity risk and expect higher liquidity to be perceived positively by depositors.  $ROA_{i,t-1}$  is used to assess whether the profitability of a bank plays a role in depositors’ assessments of the bank. We expect a positive coefficient to prevail.

Finally,  $\ln ZSCORE_{i,t-1}$  is the natural logarithm of the latest available Z-Score of bank  $i$ . In the literature it has become a standard measure of a bank’s distance to default since its introduction by Boyd et al. (1993). Closely related to Distinguin et al. (2013) and Hadad et al. (2011), we calculate the Z-Score as the sum of the return on assets (ROA) and the average equity ratio, divided by the 3-year rolling window standard deviation of ROA.<sup>22</sup> Because the Z-score is highly skewed, Laeven and Levine (2009) recommend to use the natural logarithm of the Z-score, which is normally distributed. A higher Z-Score indicates a larger distance to default and thus increased stability.

In addition to bank fundamentals, we control for unspecified size effects by including  $\ln TA_{i,t-1}$  which is the lagged natural logarithm of total assets.  $IR\_imp_{i,t}$  is the implicit interest rate calculated as the total interest expense divided by the average total debt

---

<sup>22</sup> We acknowledge that ROA and the equity ratio are both separate regressors as well as part of  $\ln ZSCORE_{i,t-1}$ . Although the Pearson correlations reported in Table 3 are low, indicating that multicollinearity is not an issue, we replace  $\ln ZSCORE_{i,t-1}$  by a simple standard deviation of ROA as a robustness test. The results remain qualitatively unchanged.



funding of the period. We use an implicit interest rate because actual interest rates are not observable.  $IR_{imp_{i,t}}$  is treated as endogenous and is instrumented by its own lags because of a potential simultaneity bias, i.e. interest rates might drive deposit growth, but banks might as well adjust interest rates quickly in response to unexpectedly low or high deposit growth (Maechler and McDill (2006)). Like most of the more recent literature (e.g., Maechler and McDill (2006), Hadad et al. (2011), and Hasan et al. (2013)), we include  $\Delta CDEPOSIT_{i,t-1}$  (or  $\Delta IDEPOSIT_{i,t-1}$ , respectively) to account for potential dynamics in the development of the dependent variable. We follow Flannery and Sorescu (1996), Park and Peristiani (1998), and Martinez Peria and Schmukler (2001) in most parts of the study by including time dummies to control for general macroeconomic conditions and developments in the banking system. Hadad et al. (2011) use common macro variables instead of time dummies. We come back to this approach in the analysis of Hypotheses 3-4. Table 1 provides a comprehensive summary of all variables that we use (some of them are only introduced in Section IV.4).

**Table 1:** Variable descriptions.

Variable	Description
$i, t$	Index for bank $i$ and time period $t$ .
$\Delta CDEPOSIT_{i,t}$	Growth rate of the sum of demand, savings, and term deposits by non-financial depositors.
$\Delta IDEPOSIT_{i,t}$	Growth rate of interbank deposits.
$IR_{imp_{i,t}}$	Implicit interest rate calculated as total interest expense divided by average total debt funding.
$\ln TA_{i,t-1}$	Natural logarithm of total assets.
$EQUITY_{i,t-1}$	Equity ratio calculated as total equity divided by total assets.
$RELLP_{i,t-1}$	Loan loss provisions (as reported by BankScope) divided by gross loans.
$CIR_{i,t-1}$	Cost-income ratio calculated as operating profit divided by total non-interest expense.
$LIQUID_{i,t-1}$	Ratio of liquid assets to total assets.
$\ln ZSCORE_{i,t-1}$	Natural logarithm of the Z-Score, which is the sum of the return on assets and the average equity ratio from $t-1$ to $t$ , divided by the 3-year rolling window standard deviation of the return on assets.
$ROA_{i,t-1}$	Ratio of net income to average total assets of the respective period.
$D\_COOP_i$	Dummy that takes the value 1 for cooperative banks.
$D\_THRIFT_i$	Dummy that takes the value 1 for savings banks.
$D\_CREDIT_i$	Dummy that takes the value 1 for commercial banks.
$D\_LISTED_{i,t}$	Dummy that takes the value 1 for listed commercial banks.
$D\_INST_i$	Dummy that takes the value 1 for banks with institutional protection.
$DAX_t$	Annual rate of return of the DAX 30 stock index.
$GDP_t$	Annual growth rate of real German GDP.
$D\_TIME_t$	Year dummies. TIME needs to be replaced with the respective year dates.
$D\_20082009_t$	Dummy that takes the value 1 for all banks in the 2008/2009 financial crisis.
$D\_CO20082009_{i,t}$	Dummy that takes the value 1 for cooperative banks during the financial crisis.
$D\_TH20082009_{i,t}$	Dummy that takes the value 1 for savings banks during the financial crisis.
$D\_CR20082009_{i,t}$	Dummy that takes the value 1 for commercial banks during the financial crisis.
$D\_LIST20082009_{i,t}$	Dummy that takes the value 1 for listed commercial banks during the financial crisis.
$D\_INST20082009_{i,t}$	Dummy that takes the value 1 for banks with institutional protection during the financial crisis.

#### IV.4 Empirical model

To empirically test Hypothesis 1, we establish Equation (IV.1) as our baseline model:

$$\begin{aligned}
\Delta CDEPOSIT_{i,t} = & \beta_0 + \beta_1 \cdot \Delta CDEPOSIT_{i,t-1} + \beta_2 \cdot IR\_imp_{i,t} \\
& + \beta_3 \cdot \ln TA_{i,t-1} + \beta_4 \cdot EQUITY_{i,t-1} \\
& + \beta_5 \cdot REL\_LLP_{i,t-1} + \beta_6 \cdot CIR_{i,t-1} \\
& + \beta_7 \cdot LIQUID_{i,t-1} + \beta_8 \cdot \ln ZSCORE_{i,t-1} \\
& + \beta_9 \cdot ROA_{i,t-1} + \sum_{j=10}^{21} (\beta_j \cdot D\_TIME_{j,t}) + \mu_i + \epsilon_{i,t}.
\end{aligned} \tag{IV.1}$$

We argue that market discipline exists if the coefficients of the bank fundamentals are significant and if their signs are as we expect. If they are found to be insignificant, we do not reject Hypothesis 1. To empirically test Hypothesis 2, we apply the same methodology for interbank deposits and establish Equation (IV.2):

$$\begin{aligned}
\Delta IDEPOSIT_{i,t} = & \beta_0 + \beta_1 \cdot \Delta IDEPOSIT_{i,t-1} + \beta_2 \cdot IR\_imp_{i,t} \\
& + \beta_3 \cdot \ln TA_{i,t-1} + \beta_4 \cdot EQUITY_{i,t-1} \\
& + \beta_5 \cdot REL\_LLP_{i,t-1} + \beta_6 \cdot CIR_{i,t-1} \\
& + \beta_7 \cdot LIQUID_{i,t-1} + \beta_8 \cdot \ln ZSCORE_{i,t-1} \\
& + \beta_9 \cdot ROA_{i,t-1} + \sum_{j=10}^{21} (\beta_j \cdot D\_TIME_{j,t}) + \mu_i + \epsilon_{i,t}.
\end{aligned} \tag{IV.2}$$

Extensions to Equations (IV.1) and (IV.2) include dummies for cooperative banks and savings banks ( $D\_COOP_i$  and  $D\_THRIFT_i$ , respectively) as well as listed commercial banks ( $D\_LISTED_{i,t}$ ). As before, we argue that market discipline exists if the coefficients of the bank fundamentals are significant and if their signs are as we expect. If they are found to be significant, we confirm Hypothesis 2. As outlined in the previous section, time dummies are used to control for general macroeconomic conditions and developments in the banking system. In the tests of Hypotheses 1 and 2, the use of time dummies compared to macro variables is particularly appropriate because the autocorrelation test and the robust estimates of the coefficients' standard errors in system GMM assume no correlation across individuals in the idiosyncratic disturbances, which is an assumption that is more likely to hold when time dummies are included (Roodman (2009b)). Consequently, we should obtain the most reliable results for the bank fundamentals this way.

Although the use of time dummies is most suitable in the test of Hypotheses 1 and 2, it causes one specific issue in the empirical test of Hypothesis 3. If we want to isolate

(additional) deposit growth in the financial crisis, we need to compare deposit growth in the crisis with a baseline period. The use of time dummies limits this baseline period to one specific year that the researcher considers to be economically justifiable. Another approach is to drop time dummies and only include a dummy for the crisis period, which results in a comparison of the financial crisis with one large “non-crisis period”. The additional use of macro variables in this setting can help to mitigate concerns with respect to potential cross-correlation in the idiosyncratic disturbances as previously described, but at the same time it captures some of the crisis effects. As all those approaches have some advantages and disadvantages, it makes good economic sense to test different models. Their basic structure is shown in Equation (IV.3):

$$\begin{aligned}
\Delta CDEPOSIT_{i,t} = & \beta_0 + \beta_1 \cdot IR\_imp_{i,t} + \sum_{j=2}^k (\beta_j \cdot CONTROLS_{j,i,t-1}) \\
& + \sum_{j=k+1}^l (\beta_j \cdot CAMEL_{j,i,t-1}) \\
& + \sum_{j=l+1}^m (\beta_j \cdot SPECIALIZATION_{j,i}) \\
& + \sum_{j=m+1}^n (\beta_j \cdot CRISIS_{j,t}) \\
& + \sum_{j=n+1}^o (\beta_j \cdot TIME_{j,t}/MACRO_{j,t}) + \mu_i + \epsilon_{i,t}.
\end{aligned} \tag{IV.3}$$

$CONTROLS_{j,i,t-1}$  comprises the different control variables from Equation (IV.1). The bank fundamentals are part of  $CAMEL_{j,i,t-1}$ .  $SPECIALIZATION_{j,i}$  covers the different sectors as well as listed commercial banks.  $CRISIS_{j,t}$  is either a dummy for the full crisis period or comprises two dummy variables for 2008 and 2009, and  $TIME_{j,t}/MACRO_{j,t}$ , if applicable, comprises the remaining time dummies or macro variables. We confirm Hypothesis 3 if the coefficient(s) for  $CRISIS_{j,t}$  is (are) insignificant or even positive. We then re-estimate Equation (IV.3) for interbank deposits and compare the results to those we obtain for customer deposits.

Testing Hypothesis 4 (our key hypothesis) requires some further model extensions. As we aim at isolating additional crisis effects of cooperative banks and savings banks, we therefore need to interact the sector dummies with a crisis dummy (or dummies for the individual crisis years, respectively;  $INTERACT_{j,i,t}$ ). From a methodological perspective, including a full set of time dummies should yield the best results because our focus in this model is not on the crisis dummy (dummies), but on the interactions which are independent from the choice of the baseline year. Nonetheless, we re-estimate all models that we discussed for Equation (IV.3) including crisis interactions. We use commercial banks as our baseline category for the banking sectors since our focus is on the additional effects for cooperative banks and savings banks with their very similar deposit protection

schemes.<sup>23</sup> As further robustness, we distinguish between banks with deposit protection and banks with institutional protection, i.e. we create a dummy  $D\_INST_i = D\_THRIFT_i + D\_COOP_i$ .

The basic structure of our model for Hypothesis 4 is outlined in Equation (IV.4):

$$\begin{aligned}
\Delta CDEPOSIT_{i,t} = & \beta_0 + \beta_1 \cdot IR\_imp_{i,t} + \sum_{j=2}^k (\beta_j \cdot CONTROLS_{j,i,t-1}) \\
& + \sum_{j=k+1}^l (\beta_j \cdot CAMEL_{j,i,t-1}) \\
& + \sum_{j=l+1}^m (\beta_j \cdot SPECIALIZATION_{j,i}) \\
& + \sum_{j=m+1}^n (\beta_j \cdot CRISIS_{j,t}) \\
& + \sum_{j=n+1}^o (\beta_j \cdot TIME_{j,t} / MACRO_{j,t}) \\
& + \sum_{j=o+1}^p (\beta_j \cdot INTERACT_{j,i,t}) + \mu_i + \epsilon_{i,t}.
\end{aligned} \tag{IV.4}$$

We argue that cooperative banks and savings banks had a competitive advantage during the financial crisis if the coefficients of the interactions are positive and significant.

---

<sup>23</sup> For robustness, we use cooperative banks as our baseline category. See Section V.2 more a more detailed discussion.

## V Empirical results

### V.1 Descriptive statistics and correlations

Table 2 presents the descriptive statistics for the raw, i.e. non-lagged and non-logarithmized, variables of the full sample. We see that the growth rate of customer deposits is on average 5.3 % and hence a bit lower than the average growth rate of interbank deposits (6.9 %). However, the former is at the same time less volatile, which is not surprising. The distribution of total assets confirms that German banks are, on average, relatively small. The distribution of the other variables is largely as one would expect.

**Table 2:** Descriptive statistics for all non-binary variables.

Variable	N	Mean	Std. dev.	p1	p50	p99
<b>1997-2013 — Full sample</b>						
$\Delta CDEPOSIT$	20,045	0.053	0.138	-0.165	0.028	0.907
$\Delta IDEPOSIT$	20,028	0.069	0.293	-0.520	0.020	1.531
$IR_{imp}$	20,009	0.026	0.009	0.008	0.026	0.050
$TA$ (in billion €)	22,031	3.007	42.200	0.028	0.494	13.300
$EQUITY$	22,031	0.068	0.037	0.028	0.060	0.292
$RELLLP$	21,764	0.006	0.009	-0.028	0.006	0.036
$CIR$	21,939	0.750	0.142	0.404	0.738	1.400
$LIQUID$	22,031	0.022	0.012	0.001	0.021	0.079
$ZSCORE$	15,884	658	1,399	15	181	8,767
$ROA$	20,109	0.003	0.002	-0.002	0.002	0.016

NB: “N” is the number of observations for each variable. “Mean” (“Std. dev.”) describes the mean (standard deviation) of each variable across all observations. “p1” (“p50” and “p99”, respectively) refers to the 1st (50th and 99th, respectively) percentile of the distribution of each variable. Comprehensive variable descriptions are provided in Table 1.

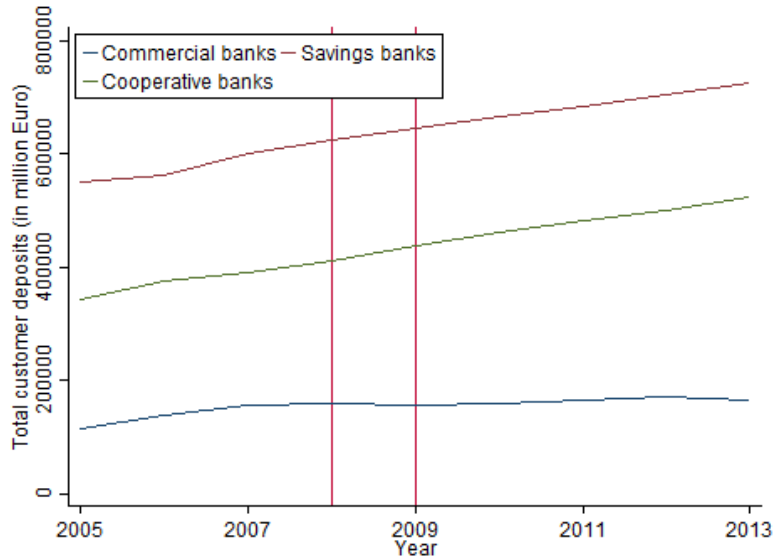
It only stands out that the raw Z-Score numbers are very high compared to those that are usually reported for the German banking system (e.g., [Beck et al. \(2009\)](#)). This is due to the 3-year rolling window for the standard deviation of returns which results in much lower ROA standard deviations than considering the full sample period. However, taking the standard deviation for the full sample period would generally mean to include observations that are not yet known and can by definition not be included in the decision-making process of depositors.<sup>24</sup> The values for total assets and the Z-Score indicate those variables to be skewed (which is confirmed by unreported skewness). Therefore, we use

<sup>24</sup> Calculating one single Z-Score per bank results in numbers in line with those that are usually reported.

their natural logarithms in the multivariate analysis. For the sake of brevity, descriptive statistics for the different banking sectors are reported in Table 8 in the Appendix. We note that the differences between the three banking sectors, for instance in total assets, reflect the structure of the German banking system very well.

Table 3 reports the Pearson correlation coefficients for all non-binary variables of interest that are actually used in the models of Section IV.4. Following Equations (IV.1) and (IV.2), Panels A and B of Table 3 focus on the relationship of the independent variables and the respective dependent variable, i.e. customer deposits and interbank deposits. The simple correlations are intended to provide a first tentative overview of those relationships. Two observations are important: First of all, the correlations are generally low (only the correlation between  $ROA_{i,t-1}$  and  $EQUITY_{i,t-1}$  is slightly higher than 30 %), indicating that multicollinearity is not an issue. Second, the correlations between  $\Delta CDEPOSIT_{i,t}$  and the independent variables are highly significant. However, the first evidence on market discipline by depositors as measured by the reaction of deposit growth to different bank fundamentals is mixed. In Panel A, the numbers for  $EQUITY_{i,t-1}$ ,  $REL\_LLP_{i,t-1}$  and  $ROA_{i,t-1}$  match our expectations. In Panel B,  $CIR_{i,t-1}$  adds to this list. The numbers for  $LIQUID_{i,t-1}$  and  $\ln ZSCORE_{i,t-1}$  are unexpectedly negative in both panels. The correlation between the deposit growth variables and the implicit interest rate is always positive and highly significant.

**Figure 1:** Annual development of the total customer deposits per banking sector within a four year window around the financial crisis.



With respect to differences in the growth rate of customer deposits of the different banking sectors during the last financial crisis, Figure 1 carefully indicates a slight drop in the total

**Table 3:** Correlations between non-binary variables.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<b>Panel A</b>										
(1) $\Delta CDEPOSIT_{i,t}$	1									
(2) $\Delta CDEPOSIT_{i,t-1}$	0.032***	1								
(3) $IR\_imp_{i,t}$	0.185***	0.061***	1							
(4) $EQUITY_{i,t-1}$	0.096***	0.037***	-0.182***	1						
(5) $REL\_LLP_{i,t-1}$	-0.016**	0.014*	0.151***	-0.058***	1					
(6) $LIQUID_{i,t-1}$	-0.019***	-0.018**	-0.103***	0.041***	0.073***	1				
(7) $lnTA_{i,t-1}$	-0.030***	0.043***	0.066***	-0.245***	-0.040***	0.128***	1			
(8) $CIR_{i,t-1}$	0.034***	0.034***	0.009	0.043***	-0.088***	0.121***	-0.168***	1		
(9) $ROA_{i,t-1}$	0.071***	0.071***	-0.028***	0.322***	-0.088***	-0.055***	-0.178***	-0.195***	1	
(10) $lnZSCORE_{i,t-1}$	-0.039***	-0.094***	-0.129***	0.019**	-0.065***	-0.033***	0.069***	-0.076***	-0.248***	1
<b>Panel B</b>										
(1) $\Delta IDEPOSIT_{i,t}$	1									
(2) $\Delta IDEPOSIT_{i,t-1}$	0.019***	1								
(3) $IR\_imp_{i,t}$	0.194***	0.106***	1							
(4) $EQUITY_{i,t-1}$	0.007	-0.040***	-0.182***							
(5) $REL\_LLP_{i,t-1}$	-0.035***	-0.028***	0.151***	-0.058***	1					
(6) $LIQUID_{i,t-1}$	-0.010	-0.047***	-0.103***	0.041***	0.073***	1				
(7) $lnTA_{i,t-1}$	-0.062	0.005	0.066***	-0.245***	-0.040***	0.128***	1			
(8) $CIR_{i,t-1}$	-0.007	0.003	0.009	0.043***	-0.088***	0.121***	-0.168***	1		
(9) $ROA_{i,t-1}$	0.048***	0.038***	-0.028***	0.322***	-0.088***	-0.055***	-0.178***	-0.195***	1	
(10) $lnZSCORE_{i,t-1}$	-0.039***	-0.062***	-0.129***	0.019	-0.065***	-0.033***	0.069***	-0.076***	-0.248***	1

NB: Pearson's correlation coefficients are reported. Panel A displays the correlations between the bank fundamentals as well as between all independent variables of Equation (IV.1) and the corresponding dependent variable, i.e.  $\Delta CDEPOSIT_{i,t}$ . Panel B displays the correlations between the independent variables and the dependent variable  $\Delta IDEPOSIT_{i,t}$  of Equation (IV.2). The correlations between the bank fundamentals in Panel B are grayed out since they are identical to those in Panel A. Comprehensive variable descriptions are provided in Table 1. \*, \*\*, and \*\*\* indicate statistical significance at the 10 %, 5 %, and 1 % levels.



customer deposits for commercial banks whereas the customer deposits for cooperative banks and savings banks increase remarkably over this period. This effect seems to be less pronounced outside the crisis period. Thus, we find first evidence in favor of a competitive advantage for cooperative banks and savings banks in the financial crisis as measured by their additional deposit growth (Hypothesis 4). However, solely based on the descriptive statistics, we cannot directly attribute these observations to the higher credibility of the deposit insurance schemes of cooperative banks and savings banks. It is worth noting that the growth rate of customer deposits for cooperative banks and savings banks is systematically lower than for commercial banks. This is exactly what one would expect given the rapid growth of foreign banks as well as direct banks in Germany over the last decade ([Deutsche Bank Research \(2013\)](#)). In general, it becomes evident that we need to turn to the multivariate analysis to reveal the actual drivers of deposit growth.

## V.2 Multivariate analysis

Table 4 reports the main results for Hypotheses 1 and 2. Model (1) indicates mixed results regarding market discipline by non-financial depositors (Hypothesis 1). First of all, it is important to note that the signs of all but one coefficient ( $CIR_{i,t-1}$ ) for the variables reflecting bank fundamentals are in line with our hypothesis which is a first tentative sign of market discipline. However, only the equity ratio and the ROA and thus only two out of six variables have a statistically significant impact on the growth rate of customer deposits. Adding banking sector dummies in Model (2) leads to a loss of statistical significance of ROA whilst the coefficient of relative loan loss provisions becomes significant. Hence, only the equity ratio is consistently significant, which is somewhat in line with [Berger and Turk-Ariss \(2015\)](#) whose results suggest that non-financial depositors react stronger to equity ratios than to measures of loan performance. The Wald tests in the two versions of the baseline model suggest that the variables reflecting bank fundamentals are jointly significant, which is another indicator of market discipline. However, the Wald test does not allow a clear interpretation as to the signs of the coefficients or the main drivers of the results. Overall, there is some evidence on market discipline by fully insured non-financial depositors in line with earlier work by [Pfingsten et al. \(2008\)](#) and [Arnold et al. \(2016\)](#), but it is limited.

The conclusions for interbank deposits and hence for peer monitoring (Hypothesis 2) are somewhat different. Whilst the signs of all coefficients as regards bank fundamentals in Model (3) of Table 4 meet our expectations, three out of six coefficients are significant.

**Table 4:** Impact of bank fundamentals and sector-specific effects on the growth rate of customer/interbank deposits.

Independent variables	Exp.	Model (1)	Model (2)	Model (3)	Model (4)
		Dependent variables			
		$\Delta CDEPOSIT_{i,t}$	$\Delta CDEPOSIT_{i,t}$	$\Delta IDEPOSIT_{i,t}$	$\Delta IDEPOSIT_{i,t}$
$\Delta CDEPOSIT_{i,t-1}$	(+)	-0.028** (0.013)	-0.029** (0.013)		
$\Delta IDEPOSIT_{i,t-1}$	(+)			-0.046*** (0.015)	-0.048*** (0.015)
$IR\_imp_{i,t}$	(+)	3.673** (1.699)	3.863** (1.698)	12.427*** (3.121)	13.168*** (3.067)
$\ln TA_{i,t-1}$	(+/-)	-0.004** (0.002)	-0.004** (0.002)	-0.026*** (0.004)	-0.019*** (0.003)
$EQUITY_{i,t-1}$	(+)	0.529*** (0.136)	0.426*** (0.133)	0.149 (0.240)	0.093 (0.235)
$REL\_LLP_{i,t-1}$	(-)	-0.276 (0.181)	-0.360* (0.186)	-1.188*** (0.379)	-1.343*** (0.385)
$LIQUID_{i,t-1}$	(+)	0.053 (0.210)	0.016 (0.196)	1.590*** (0.500)	1.443*** (0.485)
$CIR_{i,t-1}$	(-)	0.002 (0.016)	-0.009 (0.015)	-0.033 (0.028)	-0.052* (0.027)
$ROA_{i,t-1}$	(+)	2.236** (0.926)	1.511 (0.964)	5.402** (2.182)	4.117* (2.218)
$\ln ZSCORE_{i,t-1}$	(+)	0.000 (0.001)	0.001 (0.001)	0.001 (0.002)	0.002 (0.002)
$D\_THRIFT_i$	(-)		-0.056*** (0.014)		-0.061** (0.026)
$D\_COOP_i$	(-)		-0.039*** (0.014)		-0.004 (0.026)
$D\_LISTED_{i,t}$	(+/-)		0.034 (0.033)		0.044 (0.050)
Observations		13,809	13,809	13,804	13,804
No. of banks		1,461	1,461	1,461	1,461
No. of instruments		28	31	28	31
Wald (CAMEL)		54.30***	43.18***	48.71***	45.68***
AR(1) (p-value)		0.000	0.000	0.000	0.000
AR(2) (p-value)		0.663	0.744	0.761	0.738
Hansen (p-value)		0.296	0.361	0.119	0.266
Time dummies		YES	YES	YES	YES
Baseline year		2006	2006	2006	2006
Baseline banking sector		COMM.	COMM.	COMM.	COMM.

NB: Coefficient estimates stem from dynamic panel estimations with [Windmeijer \(2005\)](#) corrected standard errors (in parentheses). Comprehensive variable descriptions are provided in Table 1. “Exp.” reveals the sign we expect to prevail for each coefficient. (+/-) indicates that we do not have a clear a priori expectation and  $\Delta=0$  indicates that we explicitly expect to see no significant effect. \*, \*\*, and \*\*\* indicate statistical significance at the 10 %, 5 %, and 1 % levels. “Wald (CAMEL)” reports the joint significance of bank fundamentals.

Compared to non-financial depositors, financial depositors seem to put more emphasis on the quality of the loan portfolio and on liquidity than on the ratio of equity to total assets. This is no surprise since both a bad loan portfolio and low liquidity are important drivers of bank defaults. Besides, the equity ratio does not perfectly reflect the regulatory capital ratio which is a figure banks (probably in contrast to non-financial depositors) will rather take into account in the assessment of other banks. Additionally, there is strong evidence on market discipline via interbank deposits than via customer deposits, supporting Hypothesis 2. Moreover, it is perfectly reasonable that the growth rate of interbank deposits is far more sensitive to the implicit interest rate than the growth rate of customer deposits. The results for market discipline via interbank deposits remain valid and become even stronger, unlike for customer deposits, when we add banking sector dummies in Model (4) of Table 4. Overall, the results clearly support Hypothesis 2, i.e. that market discipline is at work via interbank deposits. The results for Hypothesis 1, however, are less strong.

The results for the different models to test Hypothesis 3 (Equation (IV.3)) are shown in Table 5.  $D_{20082009_t}$  in Model (1) measures the additional deposit growth in the financial crisis compared to our baseline year. We choose 2006 as the baseline year because it is on the one hand close to the crisis, and on the other hand well before the crisis, which makes it a natural candidate. With respect to this baseline year, we even observe a positive and significant growth rate of customer deposits in the crisis, which indicates that non-financial depositors did not systematically withdraw their deposits at this time. If we split up  $D_{20082009_t}$  in  $D_{2008_t}$  and  $D_{2009_t}$  (Model (2)), we observe that this effect mainly stems from 2009, which can be explained by many assets having fixed maturities that could only be moved in 2009. In Model (3), the time dummies are replaced with macro variables. Those are the growth rate of real GDP to capture general macroeconomic effects and the return of the German DAX 30 stock index as a measure of opportunity costs. Thus, the negative and significant impact of DAX 30 returns on the growth rate of customer deposits is not surprising. The results with respect to the variable of primary interest,  $D_{20082009_t}$ , remain qualitatively unchanged indicating that non-financial depositors did not systematically withdraw their deposits in the crisis. Altogether, our primary focus is on the full crisis and the positive and significant (Model (1)) or the insignificant (model (3)) coefficients clearly indicate that non-financial depositors did not systematically withdraw deposits in the financial crisis. In accordance with prior research, this can be explained by the existing deposit insurance schemes in connection with the governmental blanket

guarantee announced in October 2008 which both have been found to reduce systematic withdrawal risk.<sup>25</sup>

For interbank deposits we even observe significantly positive growth rates in 2008 and 2009, no matter what baseline we choose (Models (4)–(6) of Table 5). This essentially means that German banks placed more deposits with other banks during the crisis, potentially because so many markets were plunging.

To examine whether the deposit insurance schemes of cooperative banks and savings banks, which are perceived as more credible by the general public, leads to competition advantages in times of distressed markets (Hypothesis 4), we estimate Equation (IV.4). The results are presented in Table 6. It is noteworthy that once the banking sector dummies for cooperative banks and savings banks are interacted with the crisis dummy, the previously insignificant or even positive and significant crisis dummy (Models (1) and (3) of Table 5) turns negative (Models (1) and (3)–(5) of Table 6). However, the interaction coefficients ( $D\_TH20082009_{i,t}$  and  $D\_CO20082009_{i,t}$ ) are positive and significant, particularly in the model that we deemed most appropriate before (Model (1)). This effect is so strong that it at least compensates the usually substantially lower deposit growth of cooperative banks and savings banks. This is particularly striking since the blanket guarantee issued by the German government in October 2008 should essentially work against this finding. If we replace the crisis dummy and the corresponding interactions by separate year dummies and year-sector interaction terms (Model (2)), we again observe stronger effects for the second year of the crisis, which is consistent with our previous findings (Table 5). As outlined in Section IV.4, we introduce  $D\_INST_i = D\_THRIFT_i + D\_COOP_i$  and the corresponding interaction in Model (3) of Table 6 to create a clear cut between deposit protection and institutional protection. The results do not change. Overall, the results strongly support Hypothesis 4.

In Model (4) of Table 6, we change the baseline banking sector to cooperative banks. The reasons are twofold: First, this is the largest sector in terms of observations, which makes it a natural candidate, and second, it helps to analyze differences in deposit growth between cooperative banks and savings banks during the financial crisis. In contrast to cooperative banks, savings banks are usually owned by the cities and counties in their region of business and even benefited from additional governmental guarantees until 2005 (Pfingsten et al. (2008) as well as Körner and Schnabel (2013)). Hence, we can almost certainly attribute

---

<sup>25</sup> We acknowledge that the annual frequency of our data does not allow us to attribute this finding to the blanket guarantee with certainty.

**Table 5:** Impact of the 2008/2009 financial crisis on the growth rate of customer/interbank deposits.

Independent variables	Exp.	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
		Dependent variables					
		$\Delta CDEPOSIT_{i,t}$			$\Delta IDEPOSIT_{i,t}$		
<i>CONTROLS</i>		YES	YES	YES	YES	YES	YES
<i>CAMEL</i>		YES	YES	YES	YES	YES	YES
<i>SECTOR</i>		YES	YES	YES	YES	YES	YES
<i>LISTED</i>		YES	YES	YES	YES	YES	YES
<i>DAX<sub>t</sub></i>	(-)			-0.013** (0.006)			-0.007 (0.012)
<i>GDP<sub>t</sub></i>	(+/-)			0.047 (0.067)			-0.020 (0.159)
<i>D-20082009<sub>t</sub></i>	(+/ $\Delta=0$ )	0.012** (0.006)		0.005 (0.004)	0.085*** (0.013)		0.093*** (0.011)
<i>D-2008<sub>t</sub></i>	(+/ $\Delta=0$ )		0.002 (0.011)		0.044** (0.020)		
<i>D-2009<sub>t</sub></i>	(+/ $\Delta=0$ )		0.020*** (0.005)		0.115*** (0.014)		
Observations		13,809	13,809	13,809	13,804	13,804	13,804
No. of banks		1,461	1,461	1,461	1,461	1,461	1,461
No. of instruments		30	31	22	30	31	22
AR(1) (p-value)		0.000	0.000	0.000	0.000	0.000	0.000
AR(2) (p-value)		0.746	0.744	0.757	0.874	0.738	0.596
Hansen (p-value)		0.374	0.361	0.569	0.236	0.266	0.039
Time dummies		YES	YES	NO	YES	YES	NO
Baseline year		2006	2006	NC	2006	2006	NC
Baseline banking sector		CREDIT	CREDIT	CREDIT	CREDIT	CREDIT	CREDIT

NB: Coefficient estimates stem from dynamic panel estimations with [Windmeijer \(2005\)](#) corrected standard errors (in parentheses). Comprehensive variable descriptions are provided in Table 1. "Exp." reveals the sign we expect to prevail for each coefficient. (+/-) indicates that we do not have a clear a priori expectation and  $\Delta=0$  indicates that we explicitly expect to see no significant effect. \*, \*\*, and \*\*\* indicate significance at the 10 %, 5 %, and 1 % level.

the additional growth of customer deposits in cooperative banks and savings banks during the crisis to their deposit insurance schemes if we do not see any other significant difference between the two sectors. Looking at the year-sector interaction terms, the on average higher growth rate of customer deposits for commercial banks ( $D\_CREDIT_i$ ) is offset by a significantly negative crisis effect for commercial banks compared to cooperative banks. This could be expected given the previous results. More importantly, we do not observe any significant differences between the two sectors with institutional protection.<sup>26</sup> We thus draw the conclusion that the competitive advantage we observe for cooperative banks and savings banks in the crisis is due to their highly credible deposit insurance schemes.

It is important to note that in Table 7, where we re-estimate Equation (IV.4) for interbank deposits, we do not systematically observe additional deposit growth for cooperative banks and savings banks during the crisis. Hence, this advantage (at least under the blanket guarantee in Germany after October 2008) seems to be restricted to customer deposits. Again, this is perfectly reasonable since financial depositors should have a better knowledge about deposit insurance schemes and their actual potentials. One result in Model (4) of Table 7 might be striking at first glance. The growth rate of interbank deposits was significantly lower for savings banks than for cooperative banks in the crisis. A convincing explanation for this finding is offered by Puri et al. (2011) who report that some of the central institutions of savings banks (“Landesbanken”) had significant exposures to the US subprime market and were substantially hit in the wake of the financial crisis. Apart from direct effects via those central institutions, this finding might be due to spillover effects from “Landesbanken” to savings banks (cf. Körner and Schnabel (2013) for a similar topic).

---

<sup>26</sup> This is in line with Arnold et al. (2016) who find that depositors of German cooperative banks and savings banks behave different from depositors of commercial banks in terms of deposit withdrawals. Furthermore, this finding seems to be even more pronounced during the financial crisis which we attribute to the high credibility of the deposit insurance schemes of cooperative banks and savings banks.

**Table 6:** Sector-specific impact of the 2008/2009 financial crisis on the growth rate of customer deposits.

Independent var.	Exp.	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
		Dependent variable: $\Delta CDEPOSIT_{i,t}$				
<i>CONTROLS</i>		YES	YES	YES	YES	YES
<i>CAMEL</i>		YES	YES	YES	YES	YES
<i>D_THRIFT<sub>i</sub></i>	(-)	-0.063*** (0.015)	-0.064*** (0.015)		-0.018*** (0.004)	-0.038*** (0.005)
<i>D_COOP<sub>i</sub></i>	(-)	-0.046*** (0.016)	-0.047*** (0.016)			-0.022*** (0.005)
<i>D_CREDIT<sub>i</sub></i>	(+)				0.046*** (0.016)	
<i>D_LISTED<sub>i</sub></i>	(+/-)	0.026 (0.038)	0.025 (0.037)	0.031 (0.037)	0.026 (0.038)	0.052 (0.035)
<i>D_INST<sub>i</sub></i>	(-)			-0.053*** (0.016)		
<i>DAX<sub>t</sub></i>	(-)					-0.013** (0.006)
<i>GDP<sub>t</sub></i>	(+/-)					0.055 (0.068)
<i>D_20082009<sub>t</sub></i>	(+/-)	-0.040 (0.025)		-0.040 (0.025)	0.015** (0.006)	-0.020 (0.020)
<i>D_TH20082009<sub>i,t</sub></i>	(+)	0.054** (0.024)			-0.001 (0.004)	0.026 (0.021)
<i>D_CO20082009<sub>i,t</sub></i>	(+)	0.055** (0.024)				0.027 (0.021)
<i>D_CR20082009<sub>i,t</sub></i>	(-)				-0.055** (0.024)	
<i>D_LIST20082009<sub>i,t</sub></i>	( $\Delta=0$ )	0.056 (0.089)		0.057 (0.089)	0.056 (0.089)	0.027 (0.089)
<i>D_INST20082009<sub>i,t</sub></i>	(+)			0.055** (0.024)		
<i>D_2008<sub>t</sub></i>	(+/-)		-0.024 (0.046)			
<i>D_2009<sub>t</sub></i>	(+/-)		-0.051* (0.031)			
<i>D_TH2008<sub>i,t</sub></i>	(+)		0.029 (0.045)			
<i>D_CO2008<sub>i,t</sub></i>	(+)		0.027 (0.045)			
<i>D_LIST2008<sub>i,t</sub></i>	( $\Delta=0$ )		-0.081 (0.084)			
<i>D_TH2009<sub>i,t</sub></i>	(+)		0.071** (0.030)			
<i>D_CO2009<sub>i,t</sub></i>	(+)		0.076** (0.030)			
<i>D_LIST2009<sub>i,t</sub></i>	( $\Delta=0$ )		0.161 (0.103)			
Observations		13,809	13,809	13,809	13,809	13,809
No. of banks		1,461	1,461	1,461	1,461	1,461
No. of instruments		33	37	31	33	25
AR(1) (p-value)		0.000	0.000	0.000	0.000	0.000
AR(2) (p-value)		0.719	0.701	0.695	0.719	0.727
Hansen (p-value)		0.338	0.327	0.280	0.338	0.534
Time dummies		YES	YES	YES	YES	NO
Baseline year		2006	2006	2006	2006	NC
Baseline banking sector		CREDIT	CREDIT	CREDIT	COOP.	CREDIT

NB: Coefficient estimates stem from dynamic panel estimations with [Windmeijer \(2005\)](#) corrected standard errors (in parentheses). Comprehensive variable descriptions are provided in Table 1. “Exp.” reveals the sign we expect to prevail for each coefficient. (+/-) indicates that we do not have a clear a priori expectation and  $\Delta=0$  indicates that we explicitly expect to see no significant effect. \*, \*\*, and \*\*\* indicate statistical significance at the 10 %, 5 %, and 1 % levels.

**Table 7:** Sector-specific impact of the 2008/2009 financial crisis on the growth rate of interbank deposits.

Independent var.	Exp.	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
		Dependent variable: $\Delta IDEPOSIT_{i,t}$				
<i>CONTROLS</i>		YES	YES	YES	YES	YES
<i>CAMEL</i>		YES	YES	YES	YES	YES
<i>D_THRIFT<sub>i</sub></i>	(+/-)	-0.064** (0.026)	-0.061** (0.026)		-0.044*** (0.007)	-0.004 (0.012)
<i>D_COOP<sub>i</sub></i>	(+/-)	-0.021 (0.026)	-0.019 (0.026)			0.033*** (0.012)
<i>D_CREDIT<sub>i</sub></i>	(+/-)				0.022 (0.025)	
<i>D_LISTED<sub>i</sub></i>	(+/-)	0.048 (0.044)	0.056 (0.042)	0.067 (0.043)	0.047 (0.044)	0.119*** (0.036)
<i>D_INST<sub>i</sub></i>	(+/-)			-0.039 (0.026)		
<i>DAX<sub>t</sub></i>	(-)					-0.004 (0.012)
<i>GDP<sub>t</sub></i>	(+/-)					-0.028 (0.159)
<i>D_20082009<sub>t</sub></i>	(+/-)	0.028 (0.056)		0.031 (0.056)	0.108*** (0.014)	0.087* (0.051)
<i>D_TH20082009<sub>i,t</sub></i>	( $\Delta=0$ )	-0.001 (0.056)			-0.083*** (0.014)	-0.053 (0.052)
<i>D_CO20082009<sub>i,t</sub></i>	( $\Delta=0$ )	0.085 (0.056)				0.031 (0.052)
<i>D_CR20082009<sub>i,t</sub></i>	( $\Delta=0$ )				-0.089* (0.054)	
<i>D_LIST20082009<sub>i,t</sub></i>	( $\Delta=0$ )	-0.088 (0.116)		-0.082 (0.115)	-0.094 (0.117)	-0.141 (0.107)
<i>D_INST20082009<sub>i,t</sub></i>	( $\Delta=0$ )			0.060 (0.055)		
<i>D_2008<sub>t</sub></i>	(+/-)		0.083 (0.090)			
<i>D_2009<sub>t</sub></i>	(+/-)		0.004 (0.068)			
<i>D_TH2008<sub>i,t</sub></i>	( $\Delta=0$ )		-0.079 (0.091)			
<i>D_CO2008<sub>i,t</sub></i>	( $\Delta=0$ )		-0.028 (0.090)			
<i>D_LIST2008<sub>i,t</sub></i>	( $\Delta=0$ )		0.100 (0.299)			
<i>D_TH2009<sub>i,t</sub></i>	( $\Delta=0$ )		0.040 (0.067)			
<i>D_CO2009<sub>i,t</sub></i>	( $\Delta=0$ )		0.153** (0.067)			
<i>D_LIST2009<sub>i,t</sub></i>	( $\Delta=0$ )		-0.252** (0.113)			
Observations		13,804	13,804	13,804	13,804	13,804
No. of banks		1,461	1,461	1,461	1,461	1,461
No. of instruments		33	37	31	32	25
AR(1) (p-value)		0.000	0.000	0.000	0.000	0.000
AR(2) (p-value)		0.896	0.720	0.890	0.901	0.606
Hansen (p-value)		0.170	0.211	0.085	0.192	0.041
Time dummies		YES	YES	YES	YES	NO
Baseline year		2006	2006	2006	2006	NC
Baseline banking sector		CREDIT	CREDIT	CREDIT	COOP.	CREDIT

NB: Coefficient estimates stem from dynamic panel estimations with [Windmeijer \(2005\)](#) corrected standard errors (in parentheses). Comprehensive variable descriptions are provided in Table 1. “Exp.” reveals the sign we expect to prevail for each coefficient. (+/-) indicates that we do not have a clear a priori expectation and  $\Delta=0$  indicates that we explicitly expect to see no significant effect. \*, \*\*, and \*\*\* indicate statistical significance at the 10 %, 5 %, and 1 % levels.



## VI Robustness and further analyses

We split our several robustness tests into three parts.<sup>27</sup> In the first part, we address the economic robustness of all results whereas the second part puts a special emphasis on the robustness of Hypothesis 4. Finally, the third part underlines the econometric robustness of our results.

First, and with respect to the economic robustness, we replace the Z-Score with the log standard deviation of ROA based on a 3-year rolling window because ROA and the equity ratio are both separate regressors as well as part of  $\ln ZSCORE_{i,t-1}$ . The coefficient for the log standard deviation is insignificant (as the Z-Score before) and does not influence the size or statistical significance of the other bank fundamentals to a relevant extent. Second, and motivated by Körner and Schnabel (2013) who find an increase in funding costs for savings banks following the abolition of state guarantees, which is driven by spillover effects from their central institutions, we re-estimate Equations (IV.1) and (IV.2) including additional year-sector interactions for savings banks ( $D\_TH2005_{i,t}$ ,  $D\_TH2006_{i,t}$ , and  $D\_TH2007_{i,t}$ ) to control for the abolition of governmental guarantees in 2005. Their coefficients are positive, just partly significant, and do not change any of the results we derived in Section V. Third, we re-estimate Equation (IV.4) with a focus on the growth rate of *demand* deposits instead of *total* customer deposits whilst controlling for the growth rates of potentially endogenous savings and term deposits.<sup>28</sup> The results complement our findings from Model (4) of Table 6 in the sense that we find positive and strongly significant coefficients for  $D\_TH2008_{i,t}$  and  $D\_CO2008_{i,t}$ , but no significant effects for  $D\_TH2009_{i,t}$  and  $D\_CO2009_{i,t}$ . This can be interpreted as non-financial depositors moving their demand deposits in 2008 whilst savings and term deposits that make up for a large share of total customer deposits could only be moved in 2009. Fourth, we drop all bank-year observations of those commercial banks that we cannot verify to be a member of the voluntary protection scheme of commercial banks in 2012. Our results remain the same in terms of both economic and statistical significance. Fifth, we add a dummy for banks that compile their annual accounts in line with IFRS. Its coefficient is insignificant and all other results remain qualitatively unchanged.

To demonstrate the robustness of our results regarding Hypothesis 4, we discuss further factors which might also have influenced the deposit growth in the recent financial crisis.

---

<sup>27</sup> All unreported robustness tests are of course available from the authors upon request.

<sup>28</sup> The growth rates of savings and term deposits are instrumented with their own lags.

First, a depositor's decision to place money with a specific bank might be affected by a bank's physical presence. More precisely, one may argue that the higher a bank's physical presence in a certain region (as measured by their branches in this area) the more likely it is that people take note of this bank and put therefore money withdrawn at any other bank to a more present bank. To address this topic, we manually collect the number of branches for a each bank in our sample from the register of German banks officially published by Deutsche Bundesbank (see for instance [Deutsche Bundesbank \(2013\)](#)). These data are only available since 2004 which naturally restricts our sample in terms of the observation period from 2004 to 2013. However, the available data covers a sufficient large period well before and after the crisis which is most important for us.<sup>29</sup> As a first simple approach, we include total assets over the number of branches as well as interactions with the crisis years in our regression. As one would expect given that cooperative banks and savings banks are, on average, smaller and mainly operate in local markets, the average ratio is highest for commercial banks with a distinct distance from the other two sectors. Its coefficient is positive but insignificant (the same as for the interaction effects with the crisis years) and our results as regards Hypothesis 4 do not change. Given that cooperative banks and savings banks, in contrast to commercial banks, are geographically restricted and mainly operate in local markets that rarely overlap, we also include an alternative measure of a bank's physical presence that accounts for the number of branches in the business region of a certain bank. In a first step, we group all banks into regions based on the first two digits of the five-digit zip code of their headquarter and calculate the total number of branches located in each region for a given year. However, as commercial banks do mostly not operate in local markets but rather in the entire German market, it might be an unsuitable approach to assign all branches to the region associated with the zip code of the headquarter. To overcome this issue, we assume that the number of branches of commercial banks is equally distributed over all regions and assign the number of branches of a commercial bank divided by the total number of regions to each region. In a second step, we compute a bank's share of own branches in total branches in its respective business region as follows: For cooperative banks and savings banks, we divide the number of branches of a given bank by the total number of branches of its business region because these banks are generally operating locally. For nationwide operating commercial banks instead, we calculate the share of own branches in the total number of branches for *each* region and then calculate the average share over all regions for each commercial bank. Our measure of a bank's physical presence enters the regression with a positive but insignificant

---

<sup>29</sup> At this point, it is noteworthy that the results derived in the previous section remain qualitatively unchanged for this shorter period.

coefficient.<sup>30</sup> This is completely reasonable remembering that the safety of their deposits was of particular importance for non-financial depositors in the financial crisis as ensured by the highly credible deposit insurance schemes of cooperative banks and savings banks. Most important, we find no variations in our results with respect to Hypothesis 4.<sup>31</sup>

Second, we add a measure of a bank's retail or wholesale component in our model as retail banks are often assumed to report faster growth rate of customer deposits than other banks. Following [Hasan et al. \(2013\)](#), we include the bank's share of net commission and fee income in operating income to control for a bank's retail activities. Its coefficient is insignificant and does not change any of the results derived above regarding Hypothesis 4. As we are particularly interested in the deposit growth rate of cooperative banks and savings banks during the financial crisis, we additionally interact our proxy for a bank's retail or wholesale component with dummies for the crisis years. As before, all results as regards Hypothesis 4 remain valid.<sup>32</sup>

All in all, controlling for further factors potentially influencing the additional deposit growth of cooperative banks and savings banks during the crisis does not affect any of our results obtained in the previous section. Hence, our findings are very robust against further model specifications allowing us to attribute the competitive advantage of cooperative banks and savings banks in the financial crisis most likely to their highly credible deposit insurance scheme.

In terms of econometrics, we re-estimate Equation (IV.4) in two different ways. First, we use first differences instead of forward orthogonal deviations although [Arellano and Bover \(1995\)](#) note that the forward orthogonal deviations transform instead of first differencing variables may be more suitable in unbalanced panels. Second, we re-estimate Equation (IV.4) as a static model (using both IV panel regressions and GMM). As before, the significance of the bank fundamentals varies slightly, leaving room for interpretations with respect to market discipline via customer deposits, but our results as regards Hypotheses 2, 3 and 4 remain unchanged.

---

<sup>30</sup> As a further robustness test, we drop all commercial banks with zero branches because these banks are not directly competing with cooperative banks and savings banks in terms of their physical presence. However, our results remain qualitatively unchanged.

<sup>31</sup> This holds true if we additionally include interaction effects of our variable measuring a bank's physical presence with dummies for the crisis years.

<sup>32</sup> Moreover, we employ the share of real estate loans in total loans as an alternative proxy to control for a bank's retail activities (see [Lamers \(2015\)](#) for a similar approach). Again, our results do not change.

## VII Conclusions

This paper's focus is on two issues that are largely unexplored in the extant literature on market discipline and deposit insurance. First, we test whether fully insured depositors on average, i.e. after controlling for time and hence crisis effects, exert market discipline and we compare our findings with the behavior of uninsured financial depositors that are supposed to exert market discipline. Second, and most importantly, we ask whether and how far a deposit insurance scheme that has more credibility in a systemic crisis can be a competitive advantage in such a crisis. The German banking sector provides a unique testing ground for these questions since its three banking sectors have different deposit insurance schemes whilst operating in the same regulatory and institutional environment.

Using a panel of more than 20,000 bank-year observations over a period of 17 years (1997-2013), we find evidence of market discipline through interbank deposits, whereas evidence for market discipline through customer deposits is less distinct. Whilst the former was expected since interbank deposits in Germany are largely unprotected, it is more surprising that, despite of deposit insurance, there seems to be at least some market discipline through customer deposits as well. Our results additionally indicate that non-financial depositors put more emphasis on the capitalization of a bank and financial depositors critically assess the quality of the loan portfolio and the solvency of a bank, which is reasonable because bad loan portfolios and low liquidity are two main drivers of bank defaults.

Most importantly, we find that in the financial crisis cooperative banks and savings banks were able to more than compensate their otherwise lower growth rates of customer deposits compared to commercial banks. In that sense, their deposit growth was comparatively higher than the deposit growth of commercial banks in the crisis. We attribute this to their highly credible deposit insurance schemes. Our results therefore highlight that depositors' perception of the credibility of deposit insurance schemes has played an important role in the recent financial crisis. This finding is strengthened by the fact that we do not find similar results for interbank deposits. In addition, there is no significant difference in the growth rate of customer deposits during the crisis between cooperative banks and savings banks with their very similar deposit insurance schemes, indicating that our findings are indeed due to the credibility of the deposit insurance schemes.

We derive two main policy implications from our results. First, our findings suggest that privately funded and administered deposit insurance schemes may help to maintain market discipline whilst offering full insurance for non-financial depositors, at least in

normal times. Of course, this applies in particular for banks that rely comparatively more on interbank funding. Second, credible deposit insurance can be a competitive advantage in times of economic uncertainty. We deem this finding particularly important in the current debate about a common deposit insurance scheme in the EU. It may be worth thinking about incentivizing banks (or rather groups of banks) to develop competitive deposit insurance schemes that are privately funded, administered and audited and offer full protection during normal times instead of concentrating different bank types with heterogeneous business models and risk profiles under one common deposit protection scheme. In any case, the legislator should at least also consider deposit insurance from a competition perspective when developing future legal requirements.

## References

- Allen, F., E. Carletti, and A. Leonello (2012). Deposit insurance and risk taking. *Oxford Review of Economic Policy* 27(3), 464–478.
- Arellano, M. and S. Bond (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies* 58, 277–297.
- Arellano, M. and O. Bover (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics* 68, 29–51.
- Arnold, E. A., I. Gröbl, and P. Koziol (2016). Market discipline across bank governance models: Empirical evidence from German depositors. *The Quarterly Review of Economics and Finance* 61, 126–138.
- Association of German Banks (2013). The voice of the private banks. <https://bankenverband.de/publikationen/the-association-of-german-banks-the-voice-of-the-private-banks/>. (accessed 11/08/2016).
- Beck, N. and J. N. Katz (2011). Modeling Dynamics in Time-Series-Cross-Section Political Economy Data. *Annual Review of Political Science* 14, 331–352.
- Beck, T. (2002). Deposit insurance as private club: is Germany a model? *The Quarterly Review of Economics and Finance* 42, 701–719.
- Beck, T., H. Hesse, T. Kick, and N. von Westernhagen (2009). Bank Ownership and Stability: Evidence from Germany. *Working Paper*.
- Bennett, R. L., V. Hwa, and M. L. Kwast (2015). Market discipline by bank creditors during the 2008–2010 crisis. *Journal of Financial Stability* 20, 51–69.
- Berger, A. N. and R. Turk-Ariss (2015). Do Depositors Discipline Banks and Did Government Actions During the Recent Crisis Reduce this Discipline? An International Perspective. *Journal of Financial Services Research* 48(2), 103–126.
- Blundell, R. and S. Bond (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87, 115–143.
- Bornemann, S., T. Kick, C. Memmel, and A. Pfingsten (2012). Are banks using hidden reserves to beat earnings benchmarks? Evidence from Germany. *Journal of Banking & Finance* 36, 2403–2415.

- Boyd, J. H., S. L. Graham, and S. R. Hewitt (1993). Bank holding company mergers with nonbank financial firms. *Journal of Banking & Finance* 17, 43–63.
- Boyle, G., R. Stover, A. Tiwana, and O. Zhylyevskyy (2015). The impact of deposit insurance on depositor behavior during a crisis: A conjoint analysis approach. *Journal of Financial Intermediation* 24(4), 590–601.
- Cargill, T. F. (1989). CAMEL Ratings and the CD Market. *Journal of Financial Services Research* 3, 347–358.
- Cocco, J. F., F. J. Gomes, and N. C. Martins (2009). Lending relationships in the interbank market. *Journal of Financial Intermediation* 18(1), 24–48.
- Compensation Scheme of German Banks (2016). Aktuelle Entschädigungsaktionen. <http://www.edb-banken.de/entschaedigungsfaelle/>. (accessed 11/08/2016).
- Cubillas, E., A. R. Fonseca, and F. González (2012). Banking crises and market discipline: International evidence. *Journal of Banking & Finance* 36, 2285–2298.
- Demirgüç-Kunt, A. and E. Detragiache (2002). Does deposit insurance increase banking system stability? An empirical investigation. *Journal of Monetary Economics* 49, 1373–1406.
- Demirgüç-Kunt, A. and H. Huizinga (2004). Market discipline and deposit insurance. *Journal of Monetary Economics* 51, 375–399.
- Demirgüç-Kunt, A. and E. J. Kane (2002). Deposit Insurance Around the Globe: Where Does It Work? *Journal of Economic Perspectives* 16, 175–195.
- Deutsche Bank Research (2013). Bankeinlagen in Deutschland: Auslandsbanken im Aufwind, Sparkassen verlieren. [https://www.dbresearch.de/PROD/DBR\\_INTERNET\\_DE-PROD/PROD0000000000303054/Bankeinlagen\\_in\\_Deutschland%3A\\_Auslandsbanken\\_im\\_Auf.pdf](https://www.dbresearch.de/PROD/DBR_INTERNET_DE-PROD/PROD0000000000303054/Bankeinlagen_in_Deutschland%3A_Auslandsbanken_im_Auf.pdf). (11/08/2016).
- Deutsche Bundesbank (1992). Monthly Report July 1992.
- Deutsche Bundesbank (2013). Verzeichnis der Kreditinstitute.
- Deutsche Bundesbank (2016). Bankstellenbericht 2015.
- Diamond, D. W. and P. H. Dybvig (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy* 91, 401–419.

- Distinguin, I., T. Kouassi, and A. Tarazi (2013). Interbank deposits and market discipline: Evidence from Central and Eastern Europe. *Journal of Comparative Economics* 41, 544–560.
- Dreher, M. (1998). Die neue deutsche Einlagensicherung im Bereich der privaten Banken und das Europarecht. *Zeitschrift für Wirtschaftsrecht* 43, 1777–1786.
- Flannery, M. J. (1996). Financial Crises, Payment System Problems, and Discount Window Lending. *Journal of Money, Credit and Banking* 28(4), 804.
- Flannery, M. J. and S. M. Sorescu (1996). Evidence of Bank Market Discipline in Subordinated Debenture Yields: 1983-1991. *Journal of Finance* 51, 1347–1377.
- FOCUS Online (2008). Sparkassen als große Gewinner. [http://www.focus.de/finanzen/boerse/finanzkrise/finanzkrise-sparkassen-als-grosse-gewinner\\_aid\\_338818.html](http://www.focus.de/finanzen/boerse/finanzkrise/finanzkrise-sparkassen-als-grosse-gewinner_aid_338818.html). (accessed 11/08/2016).
- Fueda, I. and M. Konishi (2007). Depositors' Response to Deposit Insurance Reforms: Evidence from Japan, 1990-2005. *Journal of Financial Services Research* 31, 101–122.
- Furfine, C. H. (2001). Banks as Monitors of Other Banks: Evidence from the Overnight Federal Funds Market. *The Journal of Business* 74(1), 33–57.
- German Savings Bank Association (2011). Financial Report 2011.
- German Savings Bank Association (2012). “Die Einlagen sind sicher”. [https://www.dsgv.de/de/presse/pressemitteilungen/120912\\_PE\\_DSGV-BVR\\_EU-Einlagensicherung.html](https://www.dsgv.de/de/presse/pressemitteilungen/120912_PE_DSGV-BVR_EU-Einlagensicherung.html). (accessed 11/08/2016).
- Goedde-Menke, M., T. Langer, and A. Pfingsten (2014). Impact of the financial crisis on bank run risk - Danger of the days after. *Journal of Banking & Finance* 40, 522–533.
- Grossman, R. S. (1992). Deposit Insurance, Regulation, and Moral Hazard in the Thrift Industry: Evidence from the 1930's. *American Economic Review* 82, 800–821.
- Hadad, M. D., A. Agusman, G. S. Monroe, D. Gasbarro, and J. K. Zumwalt (2011). Market discipline, financial crisis and regulatory changes: Evidence from Indonesian banks. *Journal of Banking & Finance* 35, 1552–1562.
- Hasan, I., K. Jackowicz, O. Kowalewski, and L. Kozlowski (2013). Market discipline during crisis: Evidence from bank depositors in transition countries. *Journal of Banking & Finance* 37, 5436–5451.



- International Monetary Fund (2013). IMF Country Report No. 13/66: Technical Note on Deposit Insurance.
- Ivashina, V. and D. Scharfstein (2010). Bank lending during the financial crisis of 2008. *Journal of Financial Economics* 97, 319–338.
- Iyer, R., T. Jensen, N. Johannesen, and A. Sheridan (2016). The Run for Safety: Financial Fragility and Deposit Insurance. *Working Paper*.
- Iyer, R. and M. Puri (2012). Understanding Bank Runs: The Importance of Depositor-Bank Relationships and Networks. *American Economic Review* 102, 1414–1445.
- Körner, T. and I. Schnabel (2013). Abolishing Public Guarantees in the Absence of Market Discipline. *Working Paper*.
- Laeven, L. (2002). Bank Risk and Deposit Insurance. *World Bank Economic Review* 16, 109–137.
- Laeven, L. and R. Levine (2009). Bank governance, regulation and risk-taking. *Journal of Financial Economics* 93, 259–275.
- Lamers, M. (2015). Depositor discipline and bank failures in local markets during the financial crisis. *Working Paper*.
- Maechler, A. M. and K. M. McDill (2006). Dynamic depositor discipline in US banks. *Journal of Banking & Finance* 30, 1871–1898.
- Martinez Peria, M. and S. L. Schmukler (2001). Do Depositors Punish Banks for Bad Behavior? Market Discipline, Deposit Insurance, and Banking Crises. *Journal of Finance* 56, 1030–1051.
- National Association of German Cooperative Banks (2016). Statute of the Protection Scheme. [https://www.bvr.de/About\\_us/Our\\_protection\\_scheme](https://www.bvr.de/About_us/Our_protection_scheme). (accessed 11/08/2016).
- New York Times (2008). Germany guarantees bank deposits. <http://www.nytimes.com/2008/10/05/business/worldbusiness/05iht-hypo.4.16708030.html>. (accessed 11/08/2016).
- Nickell, S. (1981). Biases in Dynamic Models with Fixed Effects. *Econometrica* 49, 1399–1416.
- Park, S. and S. Peristiani (1998). Market Discipline by Thrift Depositors. *Journal of Money, Credit and Banking* 30, 347–364.

- Pfingsten, A., N. Sträter, and D. Wissing (2008). Market discipline at German savings banks. *Working Paper*.
- Puri, M., J. Rocholl, and S. Steffen (2011). Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects. *Journal of Financial Economics* 100, 556–578.
- Rochet, J.-C. and J. Tirole (1996). Interbank Lending and Systemic Risk. *Journal of Money, Credit and Banking* 28(4), 733.
- Roodman, D. (2009a). A Note on the Theme of Too Many Instruments. *Oxford Bulletin of Economics and Statistics* 71, 135–158.
- Roodman, D. (2009b). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal* 9, 86–136.
- Steuer, S. (1998). Das Gesetz zur Umsetzung der EG-Einlagensicherungs- und Anlegerentschädigungsrichtlinien und seine Umsetzung in der Praxis. *Zeitschrift für Wirtschafts- und Bankrecht* 52, 2449–2455.
- Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics* 126, 25–51.

## VIII Appendix

**Table 8:** Descriptive statistics for non-binary variables of the different bank sectors.

Variable	N	Mean	Std. dev.	p1	p50	p99
<b>1997-2013 — Cooperative banks</b>						
$\Delta CDEPOSIT$	12,665	0.055	0.133	-0.084	0.031	0.844
$\Delta IDEPOSIT$	12,640	0.083	0.293	-0.477	0.027	1.448
$IR_{imp}$	12,585	0.025	0.009	0.008	0.025	0.044
$TA$ (in billion €)	13,805	0.860	10.100	0.024	0.306	4.731
$EQUITY$	13,805	0.068	0.027	0.033	0.062	0.170
$REL\_LLP$	13,694	0.006	0.008	-0.024	0.006	0.029
$CIR$	13,774	0.760	0.133	0.455	0.750	1.250
$LIQUID$	13,805	0.022	0.009	0.004	0.022	0.046
$ZSCORE$	10,155	575	1,219	15	170	7,561
$ROA$	12,657	0.003	0.002	-0.000	0.003	0.011
<b>1997-2013 — Savings banks</b>						
$\Delta CDEPOSIT$	6,126	0.033	0.086	-0.060	0.024	0.450
$\Delta IDEPOSIT$	6,118	0.030	0.216	-0.440	0.006	0.816
$IR_{imp}$	6,114	0.028	0.008	0.010	0.028	0.044
$TA$ (in billion €)	6,762	2.131	2.712	0.171	1.367	12.500
$EQUITY$	6,762	0.059	0.023	0.029	0.053	0.130
$REL\_LLP$	6,714	0.006	0.009	-0.028	0.007	0.030
$CIR$	6,741	0.715	0.093	0.502	0.709	0.973
$LIQUID$	6,762	0.021	0.008	0.008	0.020	0.049
$ZSCORE$	4,791	910	1,759	21	253	8,767
$ROA$	6,118	0.002	0.001	0.000	0.002	0.006
<b>1997-2013 — Commercial banks</b>						
$\Delta CDEPOSIT$	1,254	0.123	0.288	-0.167	0.045	0.914
$\Delta IDEPOSIT$	1,270	0.117	0.510	-0.520	0.006	1.558
$IR_{imp}$	1,310	0.030	0.013	0.003	0.029	0.051
$TA$ (in billion €)	1,464	27.3	159	0.009	0.780	625
$EQUITY$	1,464	0.113	0.095	0.028	0.076	0.297
$REL\_LLP$	1,356	0.008	0.014	-0.028	0.005	0.037
$CIR$	1,424	0.805	0.298	0.404	0.778	1.398
$LIQUID$	1,464	0.026	0.034	0.001	0.015	0.171
$ZSCORE$	938	256	827	15	68	4,621
$ROA$	1,334	0.006	0.005	-0.002	0.003	0.016

NB: “N” is the number of observations for each variable. “Mean” (“Std. dev.”) describes the mean (standard deviation) of each variable across all observations. “p1” (“p50” and “p99”, respectively) refers to the 1st (50th and 99th, respectively) percentile of the distribution of each variable. Comprehensive variable descriptions are provided in Table 1.