# Depositor discipline during good and bad times: The role of the guarantor of last resort[♣]

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**Abstract**

In this paper, we investigate, for the first time in the literature, whether the ability of the public sector or government, for convenience purposes called the guarantor of last resort (GLR), to effectively help banks or guarantee bank liabilities affects the sensitivity of interest costs and deposit dynamics to banks' fundamentals. To test our hypothesis, we gathered a global bank sample covering the period from 1991 to 2012. We proxy for the GLR's risk using sovereign ratings, credit default swap spreads, bond yields and changes in macroeconomic indicators. Additionally, we observe the period subsequent to systemic financial crises. Regardless of the method we apply to describe the GLR's risk and the estimation procedure employed, we find that interest cost sensitivity to banks' fundamentals, especially equity capital, is generally an increasing function of the GLR's risk. Moreover, we provide evidence that the relationship between interest cost sensitivity to banks' fundamentals and the GLR's risk is non-linear and is even U-shaped in certain cases. Therefore, in economic terms, our results indicate that, paradoxically, moderate GLR risk levels may foster market monitoring by depositors.

**Key words:** depositor discipline, banking, financial stability

**JEL:** G21; G28

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## 1. Introduction

There are literally hundreds of works on market discipline in banking. However, despite all of these efforts, a consensus on whether market participants are able to effectively control bank risk and help regulators has not been reached. Even more surprising, based on our review of studies on market discipline, imbalances and gaps in the literature still exist. For example, the majority of the studies published so far concern so-called market monitoring, not market influence, using the distinction introduced by Bliss and Flannery (2000). With regard to gaps, we have identified one particularly striking in the literature. To the best of our knowledge, and we must admit that this finding was unexpected, no authors have directly addressed the issue of whether the strength of market discipline in banking is conditional on the government or public sector's ability to play the role of guarantor of last resort (GLR) for deposits and other bank liabilities in a contemporary institutional setting involving the presence of different safety net arrangements within the financial system. We thus hypothesize that during difficult economic times, market participants do consider the GLR's standing when monitoring banks and influencing their decisions. The recent crisis dramatically showed that even in the case of developed countries, including members of the European Union, the GLR's risk is not trivial. One may argue that the perception of a non-zero GLR risk is a quite new phenomenon, and, as a consequence, there are too few observations to draw valid conclusions. However, this statement is not true because since the early 1990s, many countries in Asia, Latin America and Europe have witnessed periods of severe economic downturns and/or banking crises that at least potentially and partially undermined the GLR's credibility. Therefore, we believe that there are sufficient historical observations to study the link between depositor discipline and the GLR's risk.

Although we are not aware of any studies that closely resemble our investigation considering its scope and aims, two groups of previously published works are of special interest to us. First, Kane (1987) and Cook and Spellman (1991, 1994 and 1996) analyzed the impact of deposit insurers' financial problems on depositor discipline within the U.S. economy. Second, several authors have used cross-country samples to provide evidence on market monitoring by depositors (Demirgűç-Kunt and Huizinga 2004, 2013; Berger and Turk-Assis 2010; Cubillas et al. 2012; Hasan et al. 2013) and depositors' influence on banks' decisions (Nier and Baumann 2006; Fonseca and Gonzáles 2010; Forssbaeck 2011; Distinguin et al. 2013). The first group of studies is important because it documents that there is a link between the traits of depositor discipline and the financial situation of the institution

guaranteeing deposits. The second group constitutes a natural base for comparisons with our results obtained in a cross-country setting. Because we study periods subsequent to banking crises, we also analyze papers that examine depositor discipline in the context of financial turmoil (for example, Martinez Peria and Schmukler 2001; Hosono et al. 2005; Levy-Yeyati et al. 2010; Beyhaghi et al. 2014).

In our study, we use a global sample of banks from almost 100 countries covering the period from 1991 to 2012. We combine banks' financial statements with information on banking crises and safety net arrangements. To determine the GLR's risk, we apply several different measures, thus ensuring that our results are not driven by a particular choice of measure. Namely, we proxy for the GLR's risk by employing foreign and local currency sovereign ratings (and, implied by these ratings, default rates), credit default swap (CDS) spreads and government bond yields as well as changes in selected macroeconomic indicators. Additionally, we assume that a GLR's standing is weakened following systemic banking crises. Regardless of our methodological choices, the results indicate that the sensitivity of the interest cost incurred by banks to their fundamentals is an increasing function of the GLR's risk. This relationship is especially robust with regard to equity levels as a measure of a bank's ability to absorb losses. When we apply continuous variables to describe a GLR's risk and we allow for the non-linearity of the studied phenomenon, we establish that the overall sensitivity of interest costs both to equity level and current profitability is very low for modest values of GLR risk, and then it surges as the GLR's situation worsens. In some cases, the sensitivity function is even U-shaped, and for high values of GLR risk, the sensitivity to fundamentals ceases to increase. As a consequence, our findings suggest that bank fundamentals are more important when the GLR's risk is not trivial; however, the increase in sensitivity persists to a certain point where general economic instability may eliminate the significance of banks' fundamentals. Moreover, after a crisis period, including those with depositors' losses, the sensitivity of interest costs to fundamentals increases in the case of the equity levels and decreases for return on assets ratios. The latter result should be considered expected because during difficult times current profitability is uninformative about future financial results.

In more general terms, from a policy-making perspective, our findings highlight three important features of depositor discipline. First, when assessing and predicting the strength of depositor discipline, it is not sufficient to consider bank fundamentals and market participants' incentives or safety net arrangements. As we argue, this type of market discipline

is in reality also shaped by the GLR's risk. Second, as a consequence, in countries with low values of GLR risk, it will be extremely difficult to significantly strengthen market discipline and entrust market participants with the task of promoting financial stability unless the government and/or regulatory authorities are able to credibly exclude the possibility that the GLR will act in the case of a systemic banking crisis. Paradoxically, countries with a non-trivial but limited GLR risk are better positioned in this respect. Third, our findings suggest that regulatory discipline should be more stringent during good economic times because a low GLR risk diminishes the sensitivity of depositors' decisions to bank fundamentals and, as a result, weakens market discipline.

Our research contributes to the existing literature in three ways. First, as previously noted, the study is the first to directly examine the influence of the GLR's risk on the strength of depositor discipline and more precisely on the sensitivity of interest costs and deposit growth ratios to banks' fundamentals. We therefore concentrate on an important but also almost completely ignored trait of market discipline in the contemporary world. Second, we formulate policy recommendations concerning the possibility of entrusting market discipline with the task of promoting financial stability. We conclude that such a solution is especially difficult to implement during favorable economic times and in countries where the GLR has good financial standing. Third, the paper uses a large sample to shed new light on phenomena that have been previously studied in the literature, such as the sheer existence of market monitoring in an international context and the existence of the so-called wake-up call effect.

The remainder of the study is organized as follows. In section two, we review the literature relevant to our investigation, and then we formulate hypotheses. Section three describes our empirical strategy and presents the various data sources that we employ. Section four presents the results and their interpretation. In section five, we conclude and provide policy recommendations.

## 2. Literature review and hypotheses

The literature on market discipline is extremely abundant, with numerous studies covering the discipline imposed on banks by depositors, subordinated debtholders, shareholders and specialized information firms. Therefore, we have decided to apply two criteria to select the works that are most relevant for our investigation. First, we concentrate only on research regarding depositor discipline. Second, we choose works that are related in scope or aims to our study. Namely, we discuss the findings of research projects regarding the

role of the guarantor in depositors' decisions, the functioning of depositor discipline in an international context and the impact of crises on depositor discipline.

The first strand of the literature, and to the best of our knowledge, the least popular one, focuses on depositors' sensitivity to a guarantor's risk, although not the GLR. Kane (1987) described the events that followed the failure of the Ohio Deposit Guarantee Fund in 1985. He observed unusual deposit withdrawals from Ohio thrift institutions that were insured by the failing fund. The rationality of depositors was also reflected by the fact that federally insured institutions, and even several uninsured thrifts, experienced no extraordinary withdrawals during the crisis. Similar conclusions were presented by Cook and Spellman (1991, 1994 and 1996) in three related papers. Their empirical results were derived from sample data of Federal Savings & Loan Insurance Corp. guaranteed obligations from the late 1980s. The evidence showed that the market response to a decline in the financial condition of the guarantor affected the value of insured certificates of deposits by raising their rates in relation to the US Treasury curve. Although the rates offered by thrifts generally rose and fell together during the analyzed period, the authors proved that it was not a contagion effect. Instead, this shared variation resulted from depositors' pricing of the guarantor's insolvency rather than the probability of only a thrift's default. Considering this evidence and the role played by central banks, governments and various guarantee organizations during the recent crisis but also during other crisis episodes, we formulate our main hypothesis H1.

H1: *The strength of market discipline is an increasing function of the GLR's risk.*

The second strand of literature on which we base our research project encompasses cross-country studies on depositor discipline. Within this group, for presentational purposes, we distinguish between market monitoring and market influence analyses, as defined by Bliss and Flannery (2000). Demirgüç-Kunt and Huizinga (2004) contributed to the former category of studies. Their sample covered the period from 1990-1997 and included banks from all of the OECD countries as well as many developing countries. The authors showed that the existence of explicit insurance, as well as higher coverage, coverage of interbank funds, the existence of ex-ante funding, government provision of funds, and exclusively public management of insurance schemes makes interest payments less sensitive to bank risk. However, co-insurance, coverage of foreign currency deposits, and private and joint management of insurance schemes might improve market discipline. Notably, Demirgüç-Kunt and Huizinga (2004) did not find consistent evidence regarding the impact of deposit insurance on market discipline through deposit growth. The monitoring abilities of bank

depositors were also analyzed by Berger and Turk-Ariss (2010) in their study, which covered banks and bank holding companies from the U.S. and 22 EU nations over the period from 1997-2007. First, the authors found stronger depositor discipline in the U.S. than in the EU, which is consistent with the conjecture that government bailouts were considered more likely in the EU. Second, they showed that depositors appear to react more consistently to equity ratios than to measures of loan portfolio performance, which is consistent with the conjecture that the latter may sometimes be too manipulatable to be trusted. Third, the authors determined that depositors believed in too-big-to-fail protections for larger organizations, especially listed firms. However, Bertay et al. (2013) did not confirm the latter observation. In their market discipline study, which was conducted using a sample of large international banks over the period from 1991-2011, the authors identified a too-big-to-save category of banks. The authors indicated that systemically important and large banks are subject to greater market discipline, as evidenced by the higher sensitivity of their funding costs to risk proxies. Interestingly, the authors were unable to present conclusive evidence on market discipline through deposit growth. Nevertheless, they showed that market discipline of systemically large banks via interest costs existed before the crisis and was not materially different during the recent crisis. This observation can be partly explained by evidence presented by Cubillas et al. (2012), who examined a sample of 79 crises in 66 countries over the period 1989-2007. The authors found that the adoption of explicit blanket guarantees, forbearance, government recapitalization, and nationalization programs were among the instruments that weakened deposit cost sensitivity to bank risk measures after a crisis. These factors counterbalanced a potential wake-up call effect and generally led to a negative impact of the crisis on market discipline through costs, but to different degrees across countries. Cubillas et al. (2012) additionally showed that depositors' risk awareness was most muted in environments where the regulatory climate and the country's institutions enhanced it before a crisis.

More recently, Hasan et al. (2013) examined depositor discipline in 11 Central and Eastern European countries during the 1994-2011 period. The authors found that the recent crisis did not alter the sensitivity of deposit growth rates to accounting risk measures. Because their dataset included not only financial statements for each bank but also information about parent companies and mass-media rumors, the authors were able to show that depositors' decisions were more strongly influenced by press rumors regarding a parent company's condition than by fundamentals. Moreover, depositors' reactions to negative rumors were surprisingly rational, as outflows of deposits were concentrated in banks for which negative

rumors turned out ex post to be well founded. However, significant inflows of deposits during the recent crisis were recorded only by subsidiaries controlled by the most highly praised parent companies.

Several cross-country studies on market discipline have concentrated on depositors' influence on banks' risk taking. The authors of these studies have usually constructed proxies for the strength of market discipline and then analyzed their impact on banks' capital buffers or other risk measures. For example, Nier and Baumann (2006) examined 729 individual listed banks from 32 different countries over the period from 1993-2000 and noted the general effectiveness of market discipline mechanisms. However, this effectiveness was negatively influenced by implicit government safety nets and strengthened by a bank's accounting disclosures, i.e., the observability of the bank's risk choices to the public, as well as by a high degree of funding through uninsured liabilities. The authors also found an influential role of market discipline in reducing bank risk-taking initiatives in countries that underwent a banking crisis. However, the latter result was not confirmed by Forssbæck (2011), who analyzed several hundred banks worldwide over the period from 1995-2005. Although his results generally support the prediction of a negative stand-alone effect of market discipline on bank risk, he did not find evidence of increased market discipline during financial crises. Conversely, Nier and Baumann's (2006) observations of higher market discipline effects in cases of weaker safety nets and better accounting disclosures were fully confirmed by Fonseca and González (2010), who analyzed determinants of capital buffers in 70 countries between 1992 and 2002. These authors also suggested that restrictions on bank activities and strong official supervision reduce the role of market discipline. The aforementioned findings are generally in line with observations made by Distinguin et al. (2013) for 10 Central and Eastern European countries during the 1995-2006 period. The authors indicated that the regulatory environment affects the significance of market discipline. To be more precise, they showed that market discipline is effective only when deposit insurer's power is low, which suggests that the presence of a more powerful insurer undermines market discipline by lowering the incentives of market participants to monitor banks. The results found by Distinguin et al. (2013) additionally suggested that uninsured creditors perceive the existence of implicit insurance for state-owned banks and do not exercise market discipline on them.

All of the previously presented studies on market influence used bank-level data. In contrast, Angkinand and Wihlborg (2010) contributed to the literature with a country-level study that analyzed 52 countries, including 14 industrial countries, 32 emerging markets, and

6 developing countries. Their results suggested that the relationship between depositors' ability to influence banks' risk taking and explicit deposit insurance coverage can be described as U-shaped. Thus, high levels of insurance coverage weaken market discipline. However, the incentives of market participants to monitor banks are also undermined at low coverage because in such a case, comparably high implicit insurance is expected by depositors. According to the authors, the coverage that maximizes market discipline depends on country-specific characteristics of bank governance.

In summary, the cross-country studies of market monitoring generally confirm its existence. Nevertheless, because our study provides such an opportunity, we re-test the traditional market monitoring hypothesis H2. Of course, we treat H2 only as an auxiliary hypothesis in relation to our main hypothesis H1.

H2: *Deposit growth is negatively influenced by bank risk, while interest costs are positively related to bank risk*.

Moreover, the studies in the second strand of literature highlight two important features of depositor discipline. First, the characteristics of discipline exercised through prices (interest costs) and volumes (deposit growth ratios) may significantly differ (Demirgüç-Kunt and Huizinga 2004; Bertay et al. 2013). Second, the intensity of market monitoring and influence depends on a complex interplay between safety net arrangements, bank size and ownership and crisis experience. Therefore, it is theoretically advisable to control for all of these factors when studying depositor discipline. Unfortunately, in a global setting such as our investigation, it is not always feasible to consider the specificities of each country included in the sample. However, one of these factors, namely, crisis experience, is especially important for our research. On the one hand, as Cubillas et al. (2012) indicated in their cross-country study, crisis experience shapes depositor discipline. On the other hand, we exploit post-crisis observations to additionally test our main hypothesis H1. Thus, the third strand of literature that we regard as especially relevant examines depositor discipline in the context of banking or, more generally, financial crises.

In their seminal study, Martinez Peria and Schmukler (2001) described the experience of Argentina, Chile and Mexico during the 1980s and 1990s. The authors showed that after a crisis, an increase in market discipline is likely to occur. In other words, traumatic episodes during a severe crisis may act as 'wake-up calls' for depositors. Depositors' reactions to crises in emerging economies were also described by Hosono et al. (2005). They investigated the effectiveness of market discipline by depositors during the period from 1992-2002 in four crisis-hit Asian countries: Indonesia, Korea, Malaysia and Thailand. In Indonesia, the crisis

first weakened and then strengthened depositors' risk sensitivity, which is consistent with the wake-up call effect. However, the authors were unable to find a similar phenomenon in the other three countries. In Korea and Thailand, depositor discipline instead decreased after the crisis. The authors concluded that the wake-up call hypothesis does not hold if market discipline existed before the crisis and deposit protection schemes are constructed to ensure credibility under stable political conditions. Ungan and Caner (2004) presented comparable results for Turkey. The authors argued that depositor discipline relaxed in the country after the 2001 crisis. The announcement of a blanket guarantee for uninsured bank debts hindered the monitoring motives of depositors and uninsured debtholders of the banks. Thus, the responsibility to monitor the Turkish banking system shifted to the government and regulatory authorities. As shown by Beyhaghi et al. (2014), a shift in monitoring responsibilities is also evident in a developed economy that has an implicit government guarantee. Those authors studied the extent of market discipline in the Canadian banking sector and showed that bank-specific risk factors lost their significance in explaining funding costs during the crisis of 2007-2009, especially for deposits. This finding is consistent with the argument that market awareness of government guarantees heightened during the crisis. However, it cannot be ruled out that during times of financial crisis, returns on different assets became positively correlated because they all moved together. This result could also lead to less sensitivity to firm-specific risk factors across asset returns.

The issue of the impact of macroeconomic risk on depositor discipline was raised by Levy-Yeyati et al. (2010) in their study of the 2000-2002 bank runs in Argentina and Uruguay. The authors established that during crises, a bank's exposure to macroeconomic factors can explain differences in deposit withdrawals. The authors divided their sample of banks into two groups according to whether their exposure to macroeconomic factors was above or below the median exposure and evaluated whether the decrease in deposits during the crises was significantly larger for highly exposed banks. To quantify banks' exposure to macroeconomic risk, the authors computed bank-level ratios on exposure to country and exchange rate risk. The estimation results revealed that in the pre-crisis period, measures of country and currency risk were never significant in explaining the logarithm of time deposits. By contrast, during the crisis periods, macroeconomic factors become highly significant and in some cases even overshadowed the importance of bank-specific factors.

A few studies in the strand of literature on the wake-up call effect and the influence of crises influence concern the Japan economy. Murata and Hori (2006) and Hori et al. (2009)

observed an increase in depositors' risk sensitivities in 1995. This shift was associated with the failure of Hyogo Bank and two large credit cooperatives. Fueda and Konishi (2007) additionally found that depositor discipline in Japan was most significant during the 1997-2001 period despite the government's blanket guarantee. The authors hypothesized that depositors' caution about bank risk during that period was due to the collapse of two long-term credit banks and one city bank in 1997 and 1998, which resulted in a loss of public trust in the banking system.

Several studies indirectly analyzed the wake-up call effect when primarily examining the impact of explicit deposit insurance on incentives to monitor banks because explicit guarantees are often introduced in reaction to a crisis. This type of methodological approach is evident in the case of Karas et al. (2013), who contributed the first test in the literature of the combined effect of financial crises and deposit insurance on market discipline. By using quarterly Russian data from 1995 to 2007, the authors compared risk sensitivity across depositor types and multiple banking crises. They found evidence that both households and firms reacted to the banking crisis that struck at roughly the same time that the insurance scheme was introduced. Nevertheless, the wake-up call effect of financial crises on household depositors was substantially muted by the numbing effect of deposit insurance. In other words, the market discipline imposed by households after the crisis was still evident but was clearly less vigorous than that by uninsured groups. These results contradict the research presented by Ungan et al. (2008), who concluded that the establishment of a deposit insurance system in 2004 in Russia was not effective in influencing depositors' behavior. However, these authors did not distinguish between depositor types, and they used data from a shorter period (the first quarter of 2000 to the first quarter of 2005); thus, it cannot be ruled out that the impact of the establishment of explicit insurance on depositor discipline needed slightly more time to become fully evident.

More recently, the combined effect of a financial crisis and the introduction of explicit deposit guarantees on market discipline was analyzed by Yan et al. (2014). The authors found that household depositors no longer responded to bank risk taking after the establishment of explicit insurance in Australia in 2008. For non-household depositors, the insurance also weakened the market discipline for the group of banks that accessed the guarantee scheme. However, for banks not paying to use the scheme, the transition from strong implicit deposit insurance to an explicit deposit guarantee represented less perceived support for their non-household depositors and thus raised their risk sensitivity. The authors acknowledged that the

results may be confounded by a wake-up call effect of the 2008 global financial crisis. Nevertheless, because weakened discipline was identified for two out of three depositor groups after the guarantee was introduced, the authors concluded that the wake-up call effect, if present, was not strong and was offset by the weakening effect of the explicit guarantees.

To recapitulate, the evidence pertaining to the wake-up call effect provoked by a crisis experience is not conclusive. Some studies confirm its existence (Martinez Peria and Schmukler 2001; Fueda and Konishi 2007; Hori et al. 2009), some deny it (Cubillas et al. 2012; Ungan and Caner 2004) and some provide mixed or conditional results based on different factors (Hosono et al. 2005; Karas et al. 2013, Yan et al. 2014). Consequently, we test one more auxiliary hypothesis – H3 - to our main hypothesis H1.

H3. *The sensitivity of depositors' decisions to bank fundamentals increases after a crisis*.

It should be noted, however, that the veracity of H3 may stem both from the wake-up call effect and from the reduced credibility of the government as the GLR during a post-crisis period. The reduced sensitivity to fundamentals after a crisis can in turn suggest that the strengthening of the formal safety net and the tightening of regulatory discipline have a stronger impact on depositors' decisions than their awakened awareness of bank-specific risk and risks related to the GLR's standing.

## 3. Empirical strategy and data

To test our hypotheses and particularly to determine the role of GLR risk in shaping depositor discipline around the world, we estimate panel models. Their general construction is illustrated by the Equation (1).

$$DV_{itk} = f(MD_{it-1k}; MD_{it-1k}xGLR\_RISK_{tk};\ CONTROL_{itk};\ MACRO\_CONTROL_{tk};\ SAFETY\_NET_{tk}) \quad (1)$$

where $DV_{itk}$ denotes the value of the dependent variable for a bank *i* observed in year *t* and country *k*. The set of independent variables includes five groups of variables. The first – MD – is designed to test the traditional market monitoring discipline hypothesis, i.e., H2. The second group consists of an interaction term between the variables that illustrates banks' fundamentals and the GLR's financial standing (MD x GLR_RISK), which allows for

verification of our main hypothesis H1 and the auxiliary hypothesis concerning the wake-up call effect H3. The third group controls for the bank-level factors (CONTROL) that affect the dependent variable. As highlighted by several empirical works reviewed in the previous section regarding the role of safety net features in depositors' decisions, we also use variables that reflect the character and the scope of deposit insurance systems (SAFETY_NET). Finally, we introduce macroeconomic variables into our models to control for the common factors impacting the dependent variable in all banks in a given country and year.

The vast majority of studies on bank monitoring by depositors consider two channels of market discipline: prices and volumes. We follow the standard set by the literature and construct two types of dependent variables. The first – DEP_RGR – is calculated as a real deposit growth ratio, i.e., the nominal growth ratio adjusted for inflation. The second – INT_COST – is calculated as an implied by the profit and loss account as well as balance sheet interest rate cost ratio of liabilities. The INT_COST variable is also adjusted for inflation. Alternative solutions encountered in the literature, for example, the use of the proportion of insured and uninsured deposits (for example, Billet et al. 1998; Maechler and McDill, 2006) or the interest rates offered by certificates of deposit (for example, Hannan and Hanweck, 1988; Ellis and Flannery, 1992), are not applicable in a broad cross-country study due to a lack of the appropriate data.

We describe a bank risk and test for the presence of market monitoring using two independent variables, EQUITY and ROA, which reflect a bank's capital position and current profitability, respectively. We selected EQUITY and ROA variables because on the one hand, they are among the risk measures that are the most comparable across time and countries, and, on the other hand, they have the best coverage in the available sources of bank financial statements. Of course, it would be interesting to study the impact of non-performing loans on depositors' behaviors, for example, but the definitions of such loans are not stable both across time and geographically. Furthermore information on non-performing loans is scarce in comparison to the variable we chose. We expect that a solid capital base and high profitability should be rewarded in terms of deposit inflows and/or lower interest rate costs.

To investigate the veracity of our main hypothesis – H1 - we need a reliable measure of the GLR's risk. However, there is no a single, widely accepted measure of this type that is available for a large number of countries around the world. Therefore, we decided to employ several measures to avoid a situation in which our empirical findings are sensitive to this critical choice. Generally, we measure the GLR's risk by applying two methods that for

simplicity purposes we call direct and indirect methods. On the one hand, direct measures summarize all of the available information on a GLR's potential ability to support banks and the banking system and to guarantee deposits, and on the other hand, they are forward looking. We managed to compel the dataset including three kinds of direct measures, namely country ratings, CDS spreads and government bond yields. Indirect measures encompass both macroeconomic indicators and situations where the GLR's standing is potentially threatened. We again indirectly proxy for the GLR's risk in two ways. First, we consider the periods after systemic banking crises when the GLR's financial resources are potentially depleted. Second, we use changes in selected macroeconomic variables to measure increasing external and internal imbalances for a given country. In contrast to the direct method, the indirect approach encompasses only a small portion of the information on a GLR's risk each time, and it ignores other important factors that shape depositors' decisions. For example, when we analyze only increasing internal government debt, we disregard the efficiency of the fiscal system, the level of enforcement mechanisms or the level of corruption. Moreover, indirect approaches are backward looking because they ignore information on a country's prospects.

We interact all of the direct and indirect measures of the GLR's risk with the variables from the MD group. Regardless of the type of bank risk measure (EQUITY or ROA) used, our main hypothesis would be supported by a positive and significant coefficient in the regression explaining deposit growth or a negative and significant coefficient in the equation explaining the level of interest costs obtained for the interaction term MD x GLR_RISK. Such empirical outcomes would suggest that the sensitivity of depositors' decisions to bank fundamentals is higher when the GLR's risk increases. For presentational purposes, we delay the detailed definition of the interaction terms to section four because we apply numerous variants.

With regard to bank-level control variables (CONTROL), we include variables in each model that illustrate a bank's asset portfolio composition (LOANS), size (LNA), the quality of management (C/I) and the dominating component of the bank's business (NON_INT). Additionally, in the models examining deposit inflows, we add as a regressor the interest rate cost ratio of deposits (INT_COST) to account for depositors' behaviors marked by moral hazard. The group of macroeconomic control variables consists of two variables. The first (GDP_PC) reflects the accumulated wealth of a country and to a certain degree the sophistication of its market participants, and the second variable (MARKET_CAP) indicates the structure of the country's financial system and its current economic situation. To avoid

redundancies, we leave the discussion of the expected signs of the parameters for the bank-level and macroeconomic control variables to section four, which begins with the presentation of our baseline results.

The final group of independent variables – SAFETY_NET – includes two variables that we use interchangeably. The first (EXPICIT) is a binary variable that takes the value of one for years in which an explicit deposit insurance scheme was in place in a given country and zero otherwise. The second (COVERAGE) reflects a country's amount of guaranteed deposits in relation to GDP *per capita*. Several cross-country studies that were reviewed in the previous section showed that safety net features significantly impact depositors' behavior, and very similar conclusions stem from single-country investigations. For example, Mondchean and Opiela (1999) found that the passage of a formal deposit insurance scheme in late 1994 in Poland made bank-specific variables less important in explaining differences in the interest rates paid by private banks on their time deposits. Further, Schumacher (2000) established that the deposit insurance scheme put in place in Mexico during a crisis had a deterrent effect on withdrawals from failing and merging banks whose solvency had been previously questioned by depositors. However, as soon as depositors discovered that the coverage was in fact nonoperational, they resumed their attempts to protect their deposits by withdrawing assets from ex ante 'bad banks' and redepositing their funds in ex ante 'good' banks. Ioannidou and de Dreu (2006) showed that in the neighboring economy of Bolivia, an explicit insurance program caused a significant reduction in market discipline and that the effect of deposit insurance on market discipline depended on the coverage rate. As the coverage rate increased above 60 percent, market discipline was significantly muted and almost completely disappeared when the coverage rate reached 100 percent. In a related study, Ioannidou and Penas (2010) found evidence that after the introduction of a generous deposit insurance scheme in 2001, banks were more likely to initiate riskier loans, i.e., with worse internal ratings at origination and worse *ex-post* performance.

In our choice of control variables from the groups CONTROL, MACRO_CONTROL, and SAFETY_NET, we were double constrained. On the one hand, we tried to follow the standard set by the literature. On the other hand, to test our main hypothesis, we needed as many countries as possible in our sample. Therefore, we were forced to refrain from introducing variables into our models for which information on their values was scarce. For example, it would undoubtedly be interesting to study the effect of loan portfolio composition on depositors' decisions or to analyze the difference between funded and unfunded deposit

insurance schemes. However, considering the aim of our study, we could not afford to drop too many countries from the sample before studying the impact of the GLR's risk on depositor discipline. Table 1 summarizes the information on the variables used in our study, excluding the interaction terms.

[Table 1]

To carry out our study, we combined several data sources. The financial statements for banks around the world were retrieved from the Bankscope database. The macroeconomic indicators were derived from *World Development Indicators* published by the World Bank. The vast majority of information on deposit insurance was borrowed from Demirgüç-Kunt et al. (2005; 2014). However, we verified, updated and supplemented these data using publications by Al-Ja'fari and Walker (2011), the Association of Supervisors of Banks of the Americas (2006), the International Association of Deposit Insurers (2012), the Financial Stability Board (2009, 2010, 2012), and KPMG (2012), and we also employed information that was available over the Internet, particularly regarding institutions guaranteeing deposits in different countries. We gathered the information on banking crises and depositors' losses from studies by Laeven and Valencia (2008; 2010; 2012). We reconstructed the history of local currency and foreign currency sovereign ratings from the Standard and Poor's publication entitled *Sovereign Rating and Country T&C Assessment Histories* (2013). The data on CDS spreads on sovereigns and government bond yields were provided to us by courtesy of Deutsche Bank Poland.

In each regression, as shown in Equation (1), we introduce both bank-level variables and two types of country-level variables. Because the data sources do not overlap perfectly with regard to the years and countries covered, the number of effectively used observations is lower than the number of annual bank financial statements. Therefore, to illustrate the real sample size and its diversity, we have chosen as a reference point a baseline specification (3) from Table 5. The distribution of the observations by year and number of countries covered and the concentration of observations within one, three and five of the biggest banking sectors is described in Table 2. As the table shows, we obtained 102,457 observations for the period from 1991 to 2012. The yearly number of observations and countries covered increases steadily over time. The 267 observations for 1991 came from only 26 countries, while in 2011, 10,587 observations originated from 95 countries around the world. From an econometric point of view, our sample possesses one important and rather undesirable feature, namely, a high concentration of observations within one to five of the biggest banking

systems in the world. Consequently, to draw valid conclusions about the role of the GLR's risk, we apply the maximum likelihood random effect estimator with weights as the main method. A straightforward idea would be to create a vector of weights that equals one divided by the total number of observations from a given country. Such a weighting would lead to the same importance of each country in our panel models, but such an approach could be undesirable from a rational point of view – our estimation results could then be driven by numerous small markets with undeveloped banking systems. Thus, we decided to logarithmically transform the importance of the countries, i.e., each observation was assigned a weight that equaled one divided by the natural logarithm of the total number of observations from a given country. To illustrate the effect of the weighting schema, it is easy to refer to the following example. If 1,000 and 100 observations are gathered for country A and country B, respectively, then their relative importance in an unweighted panel equals 10:1. After the weighting is applied, country A is still more important than country B, but the relation equals 20:3. However, to study the robustness of our results, we also estimate our models using the GLS random effect estimator after excluding US banks from the sample and for the whole sample without weighting schemes.

[Table 2]

The data on GLR risk are the most important for our study and for the testing of H1. As previously noted, we proxy for the GLR's risk in several ways. Table 3 provides the number of countries for which we have values for the GLR's risk measures in each year of the sample period. All of the values contained in this table concern only the subgroup of countries with non-missing values for the bank-level and country-level control variables. With regard to the local currency and foreign currency sovereign ratings, the mean yearly number of countries present in our sample stands at 61.71 and 63.41, respectively. Additionally, the number of countries with ratings increases from a level below 20 at the beginning of the 1990s to above 80 in the last four years of the studied period. The time series of observations of CDS spreads on sovereigns and government bond yields are shorter, starting in 2001 and 1993, respectively. The mean number of countries for which we have CDS quotes is equal to 42.33, while the appropriate mean in the case of bond yields amounts to 34.95. Both means were only calculated for the period of data availability. The indirect method of inferring the GLR's standing requires the identification of systemic banking crises or calculations of the changes in macroeconomic variables. The number of countries covered by Laeven and Valencia's database on banking crises (2008; 2010; 2012) increased from 24 in 1991 to 77 in 2012, as

shown in Table 3. However, the number of countries actually in crisis in a given year is much lower and ranges from 0 in 2006 to 25 in the last years of the sample period. In total, there were 217 country-year crisis episodes from 1991 to 2012. As is the case with the other GLR risk measures, the information on current account balance, external debt and government debt is more extensive for the later years of the analyzed period.

[Table 3]

Finally, Table 4 presents the descriptive statistics for the bank-level variables, including both dependent variables. The mean real growth ratio of deposits (DEP_RGR) calculated for the observations effectively used for estimation purposes equals 7%. The median value of this variable is lower and stands at 3%. On average, the interest cost ratio, which is also expressed in real terms, is close to zero (0.3%). The median value is almost identical and amounts to 0.4%. The descriptive statistics for the explanatory variables make good economic sense. For example, the mean cost to income ratio equals 54.5%, while the median of ROA is 0.9%. As expected in a cross-country sample, the variables are characterized by significant variability. It should be noted that we eliminated outliers and the observations with clearly erroneous values from the sample, i.e., values lying outside the theoretically allowable ranges.

[Table 4]

## 4. Results

### *4a. Baseline results concerning market monitoring*

We start our analysis with a traditional test of the existence of market monitoring. We assume that depositors' decisions can affect either both real deposit growth ratios and real interest cost levels or only one of the dependent variables. The baseline results regarding the monitoring by depositors in our sample are presented in Table 5. Generally speaking, they support H2, which claims that banks' fundamentals are observed by at least some depositors. As expected, profitability measured by ROA positively and significantly influences deposit growth, while it has negative and significant impact on interest cost levels. Interestingly, a solid capital base significantly increases the inflow of deposits, but it is not significantly related in specifications (3) and (4) to the banks' interest costs. However, when we do not use a weighting procedure for the estimation, the EQUITY variable negatively and significantly affects the interest costs incurred by banks, as forecasted by the market monitoring hypothesis. These latter results, which are not reported in Table 5 for the sake of brevity, are available upon request from the authors.

Bank-specific variables influence both dependent variables in the expected directions, with only one exception. As shown in specifications (1) and (2), banks that offer higher deposit rates benefit from accelerated deposit inflows. Wholesale banks, which show high values for the NON_INT and LOANS variables, are obliged to pay more for deposits, likely because of their dependence on money market financing (specifications (3) and (4)). Well-run banks that have relatively modest cost-to-income ratios attract more deposits and incur lower interest costs. Bigger banks report more favorable deposit growth ratios; however, somewhat unexpectedly, they also have higher interest costs. This result can be explained using our previous findings. Namely, as specifications (1) and (2) demonstrate, offering better deposit rates pays off in terms of deposit growth ratios. Therefore, bigger banks, which usually have deeper financial resources, may consciously choose to pay more for deposits to grow faster.

With regard to the country-level control variables, we establish that in relatively wealthier countries (the GDP_PC variable) with more mature banking systems, banks' deposit bases grow more slowly, and the banks incur higher real interest costs. The positive and significant influence of market capitalization on deposit growth rates may stem from the fact that high values of the MARKET_CAP variable correspond to periods of economic prosperity, during which all financial intermediaries record better growth records. Finally, the positive and significant coefficient obtained for market capitalization in specification (4) suggests that disintermediation within financial systems increases banks' interest costs for competitive reasons.

The variables describing safety net arrangements are insignificant in three out of the four specifications. The existence of an explicit deposit insurance system is negatively and statistically significantly correlated with deposit growth ratios in only specification (1). This result may be caused by the fact that explicit deposit insurance systems were more common and existed for longer periods in countries with more mature financial systems.

[Table 5]

*4b. Direct method of assessing the GLR's risk and its impact on depositor discipline*

Direct measures of the GLR's risk should summarize all of the relevant information available to market participants. As explained previously, we have managed to gather three types of such measures, namely, sovereign ratings, CDS spreads on sovereigns and government bond yields. In this subsection, we test whether the GLR's risk approximated in

this manner influenced depositors' sensitivity to bank fundamentals from a broad historical perspective.

In Table 6, we investigate whether the sensitivity of interest costs to fundamentals is dependent on the GLR's risk as measured by the country rating. We introduce three dummy variables: WORST25, WORST33 and WORST50 that take the value of one for the top 25%, 33% and 50% of observations, respectively, with the highest default rates implied by the worst yearly ratings in the case of foreign currency (FCU) or local currency (LCU) ten-year debt. To verify H1, we interact these dummies with the variables describing banks' capital bases and current profitability. As Table 6 demonstrates, the ROA variable preserves its unconditional statistical significance as a determinant of banks' interest costs in four out of six specifications, while the variable EQUITY is statistically significant in only one specification. At the same time, all of the interaction terms, including the EQUITY variable, are statistically significant (predominantly at the 1% level) and influence the dependent variable negatively. In economic terms, this result means that the banks' capital base increases in relevance in countries with low ratings in which, at least theoretically, the ability of the GLR to repay banks' liabilities or effectively help banks is the lowest. In contrast, the empirical evidence regarding the interaction terms that contain the ROA variable is far less conclusive. Only two out of six specifications in Table 6 suggest that the sensitivity of interest costs to the ROA variable increases in countries with high default rates as implied by ratings. Moreover, the relevant interaction terms are statistically significant only at 5% and 10% levels. Our main empirical finding from Table 6, which supports H1, withstands a battery of robustness checks. The increased role of the capital base in countries with relatively high GLR risk is observable when we use the end of the year ratings instead of the worst yearly ratings, when we replace the variable describing the amount of insured deposits with a binary variable encoding countries equipped with an explicit deposit insurance system, when we exclude US banks from the sample, and when we apply an unweighted random effects estimator in our static panel models. The results of those and the other robustness checks noted in section four are available upon request from the authors.

[Table 6]

Unexpectedly, when analyzing the determinants of real deposit growth ratios, we were not able to identify any stable and statistically significant relationships between the GLR's risk measured by ratings and the strength of market discipline. The relevant results are also

available upon request from authors. We offer an explanation for this interesting phenomenon at the end of this section.

In the strict sense, credit ratings do not constitute market measures of the GLR' risk. They are not determined by the market participants' behaviors; rather, they are assigned by the specialized agencies that suffer from the problem of conflict of interest. This conflict is linked to the credit rating agencies' business model, which consists of collecting fees from their rated issuers. As a consequence, the ratings are inherently prone to being upwardly biased (Kraft 2014). Moreover, Cheng and Neamitiu (2009) documented that credit rating agencies improved their performance only recently when their market power and reputational capital were threatened by the possibility of regulatory intervention. In the past, as noted by Becker and Mibourn (2011), increased completion in the rating industry coincided with a lower quality of ratings from the incumbents. Therefore, CDS and bond yields for sovereigns may provide a more impartial evaluation of the GLR's risk.

In Table 7, we check whether the results concerning the increased role of banks' fundamentals in countries with poor ratings hold when we change the measure of the GLR's ability to pay. In specifications (11) to (13), we employ CDS spreads, while in the remaining specifications, we use spreads for five-year government bonds. Before interacting with the variables for the banks' fundamentals, we transform the market spreads into binary variables. As before, we record the 25%, 33%, and 50% of observations with the highest spreads compared with Germany. Generally, we find that the type of the GLR risk measure is irrelevant. Regardless of the method we use to identify countries and periods for which the GLR creditworthiness is threatened (ratings, CDS and bond spreads), equity seems to play a special role in shaping banks' interest costs. The coefficients for the interaction terms between the variable EQUITY and the dummies WORST25, WORST33, and WORST50 are negative and significant at the 1% level in all specifications in Table 7. Consequently, our results provide rather strong evidence that, all else equal, banks with a solid capital base pay less to attract deposits when the GLR's risk is relatively high. As before, the outcomes regarding current profitability are less conclusive. We observe an increased sensitivity of depositors to the ROA variable in countries and periods characterized by a weakened GLR's ability to pay in all specifications using CDS spreads, but only in one out of three applying bond spreads. The most probable explanation for these discrepancies in the results is linked to the difference in sample sizes. When we base our inference on CDS spreads, the number of observations is less than two-thirds of the observations available for estimation purposes in Table 6 and is

equal to 72% of the observations available when the GLR's risk is approximated by bond spreads. The stability of the results reported in Table 7 was tested similarly to the results based on credit ratings. Namely, we used different estimation procedures, we changed the variables describing the deposit insurance system, and finally we replaced spreads for five-year bonds with spreads for ten-year bonds. None of these modifications materially altered our main findings. Similarly, as in the case of ratings, the GLR's risk approximated by CDS and bond spreads does not influence depositor discipline exercised through deposit volumes.

[Table 7]

So far, we have based our results about changes in interest cost sensitivity to banks' fundamentals only on binary variables that identify countries encountering financial troubles. This approach has two advantages. First, the use of binary variables protects against the possibility that the empirical results are driven by only a few observations. Second, it reduces the problem of high correlation among regressors when the variables describing bank fundamentals are simultaneously introduced into the equations with the interaction terms that include these variables. However, as usual in economics, the chosen solution is not perfect. On the one hand, by discretizing the continuous variables reflecting default rates or spreads, we lose some information. On the other hand, the adoption of the continuous variables enables us to study the potentially non-linear nature of the relationship between interest costs, bank fundamentals and the GLR's risk. Consequently, in Table 8, we report the results obtained when continuous variables (LCU, FCU, CDS and YIELD) are used to illustrate the GLR's risk.

Specifications (17) through (20) in Table 8 are directly comparable by their construction to those contained in tables 6 and 7. However, the evidence in favor of H1 is much less conclusive this time. Although the coefficients for the interaction terms between default rates implied by ratings (LCU or FCU) and the EQUITY variable are still negative and statistically significant, the coefficients for all of the interaction terms, including CDS or bond spreads, are insignificant, and the coefficients for the interaction terms between default rates and the ROA variable are now unexpectedly positive and significant at the 5% level. These results *prima facie* suggest that our previous findings concerning an increased sensitivity to bank fundamentals in countries in distress are partially confirmed only in the case of the capital base. However, specifications (21) through (24) indicate that the relationship between interest costs on the one hand and banks' fundamentals and the measures of the GLR's risk on the other hand is non-linear because the majority of the interaction terms, including the squared

implied default rates ($LCU^2$ or $FCU^2$) and the squared spreads ($CDS^2$ and $YIELD^2$), affect the dependent variable positively and statistically significantly. To facilitate the interpretation of the estimation results presented in the last four columns of Table 8, we plotted the overall interest cost sensitivity to banks' fundamentals against the measures of the GLR's risk. The overall sensitivity to the ROA and EQUITY variables was calculated separately using the coefficients from specifications (21) to (24) obtained for these variables and for the interaction terms including the aforementioned variables. On the x-axis, we present the GLR's risk measures up to their 90th percentile of the real range in our sample. In charts (1) and (2), we apply the default rates implied by ratings, in charts (3) and (4), we use the CDS spreads relative to Germany, and finally, in charts (5) and (6), we use the five-year bond yields again in comparison with Germany.

When we control for the non-linear character of the relationship between the studied variables, our results clearly support H1. All of the charts (1 to 6) show that the overall sensitivity of interest cost to banks' fundamentals (EQUITY or ROA) is limited for low values of the different GLR's risk measures and that this sensitivity surges with increasing values of the default rates, CDS spreads and bond yields. The identified empirical pattern strongly suggests that banks' interest costs and likely depositors' behaviors are influenced by market perceptions of the GLR's risk. The differences between the charts concern only the curvature of the interest cost sensitivity function. For plausible values of the GLR's risk measures, the curvature is sometimes barely visible, yet it is still present, while in other cases, the curvature is clearly evident. Moreover, Chart 2 illustrates one more interesting feature of the characterized relationship. Namely, when we use the coefficients from specification (21) to analyze the overall sensitivity of interest costs to returns on assets as a function of default rates implied by sovereign ratings, it turns out that the sensitivity is initially an increasing function of the GLR's risk, then, for high values of default rates, the sensitivity becomes a decreasing function of the GLR's risk. We observed a similar result in other cases when we performed the robustness checks. Therefore, our research also provides weak evidence that an increase in sensitivity may last only to a certain point where a crisis situation in a given country causes that country's fundamentals to lose their importance in the face of growing systemic risk.

[Table 8]

[Chart 1]

[Chart 2]

[Chart 3]

[Chart 4]

[Chart 5]

[Chart 6]

The last question we address in this sub-section concerns the nexus between the wealth of nations and the importance of the GLR's risk. More specifically, we check whether a weakened position of the GLR influences depositor discipline as exercised through interest costs differently in relatively poor countries than in others. We define the binary variable POOR, which takes the value of one for countries with a GDP *per capita* below the median in the WDI database. Then we construct triple interaction terms including the variables illustrating banks' fundamentals, the POOR variable and the variables describing the market perception of the GLR's risk. However, in contrast to previous empirical tests, we are only able to use the variable WORST50, which identifies countries in a given period with above-median values of a given GLR's risk measure. The reasons for this decisions are different in the case of ratings, on the one hand, and CDS spreads and bond yields on the other hand. First, in the case of ratings, a large majority of the 25% and 33% of countries with the highest implied default rates are also classified as relatively poor according to the WDI database. For example, for the variable WORST25, on average, only 2.9 countries do not belong to the group of poor countries in a given year. Second, when we consider the CDS spreads and bond yields, the problem is linked to the fact that the necessary data are often only available for relatively rich and developed countries. Consequently, the number of countries with non-zero observations for the interaction terms WORST25xPOOR and WORST33xPOOR is low. For example, according to the WDI database, in an average year, less than 3 poor countries are simultaneously situated among the 25% of countries with the highest CDS spreads. We believe that in the described circumstances, valid conclusions pertaining to the nexus between the GLR's risk, countries' wealth and interest cost sensitivity to banks' fundamentals can only be drawn using the broadest variable, WORST50. The relevant empirical results are presented in Table 9. As the table shows, our previous findings are confirmed, and in all of the specifications, the double interaction terms of the WORST50 and EQUITY variables influence the dependent variables negatively and statistically significantly. This result again indicates that the sensitivity of interest costs to the capital base increases with increasing GLR

risk. The evidence concerning the potentially moderating role of the countries' wealth is ambiguous. The triple interaction terms are largely insignificant. Only specification (25) suggests that current profitability is more relevant in poor countries with a weakened GLR, and specification (28) shows that the sensitivity of interest costs to the capital base increases in countries with both a relatively high GLR risk and that are among the group of poor countries.

[Table 9]

*4c. Indirect method of assessing the GLR's risk and its impact on depositor discipline*

To this point, we have tried to directly identify periods of weakened GLR standing by examining risk measures such as ratings, CDS spreads and bond yields. However, we believe that indirect inferences are also possible by using information on banking crises and analyzing the changes in macroeconomic indicators. In this sub-section, we apply both of these indirect approaches to proxy for the GLR's risk.

First, it is reasonable to assume that banking crises usually reduce, especially in the short run, a GLR's ability to withstand subsequent shocks. The literature clearly demonstrates that banking crises are extremely costly both in terms of fiscal outlays and output losses (Hoggarth et al. 2002; Honohan and Klingebiel 2003; Angkinand 2009 and Reinhart and Rogoff 2013). Therefore, we have decided to study the sensitivity of depositors' decisions to banks' fundamentals during crisis periods and the periods following crisis periods. We introduce three binary variables, CRISIS, CRISIS3 and CRISIS5, which take the value of one for crisis periods as determined by Laeven and Valencia (2008; 2010; 2012), three consecutive years after a crisis, and five consecutive years after a crisis, respectively. Then, we interact these dummies with variable describing banks' financial health. Table 10 provides the results. As in the case of direct approaches to measuring the GLR's risk, we were not able to detect any changes in the sensitivity of deposit growth ratios to banks' fundamentals. For this reason, we present only the results regarding interest costs incurred by banks in Table 10. As shown in specifications (29), (31) and (33), crisis phenomena provoke changes in interest cost sensitivity to banks' fundamentals. During three and five years after a crisis, the sensitivity of interest costs to current profitability decreases, and the sensitivity to capital base quality increases. Both effects are highly significant and stable. This result is intuitively appealing and suggests that the behavior of depositors is generally rational. In the post-crisis periods, current profitability constitutes a bad predictor of future performance because it is

strongly affected by the loan-loss provisioning policy and an unstable economic environment. In contrast, banks with a strong capital base are always better prepared to weather difficult times. The situation is slightly different during crisis periods. The coefficient estimated for the interaction term EQUITY x CRISIS maintains a negative sign, but it is no longer statistically significant. In contrast, a reduced sensitivity of interest costs to ROA is also observable during crisis periods.

In specifications (30), (32) and (34), we have checked whether changes in interest cost sensitivity to banks' fundamentals induced by crises are conditional on depositors' losses. We define three binary variables, DEPLOSS, DEPLOSS3, and DEPLOSS5, which identify the crisis episodes during which depositors suffered losses, and the three- and five-year periods following the crises with depositors' losses, respectively. Our results for the subsample of crises provoking depositors' losses are identical in economic terms to those obtained when we control for all systemic banking crises during the period under study. The robustness checks involving the modifications in estimation procedures, the dropping of US banks from the sample and the change in the variables describing the features of the deposit insurance system do not materially alter our findings, as in the previous sub-sections. Therefore, we obtain some support for H3 concerning the existence of the wake-up call effect as generally depositors in our sample at least theoretically pay more attention after a crisis to more relevant indicators of banks' financial health.

[Table 10]

The second indirect method we use to proxy the GLR's standing relies on macroeconomic indicators. We use three such indicators that potentially describe increasing external and internal imbalances. Namely, we calculate three-year growth rates of the current account balance, external debt stocks, and central government debt. The first and the third growth rates are expressed as a percentage of GDP, while the second is expressed as a percentage of GNI. Then, we define binary variables identifying the 25%, 33% and 50% of observations (WEAK25, WEAK33 and WEAK 50, respectively) exhibiting the worst macroeconomic tendencies and interact these variables with EQUITY and ROA. The results of this exercise are shown in Table 11. Despite the differences in sample sizes and methodological approaches, the conclusions closely resemble those drawn previously. It turns out that the sensitivity of interest costs to equity is an increasing function of macroeconomic imbalances and potentially the GLR's risk. We obtain the strongest support for H1 using current account deficit. When central government debt and external debt are considered, the

described phenomenon is limited to the 33% and 25% of countries and years, respectively. Notably, specifications (41) through (43) also indicate that the sensitivity of interest costs to current profitability increases with increasing external macroeconomic imbalances.

[Table 11]

*4d. Why does the GLR's risk influence depositor discipline through prices but not through volumes?*

As documented in the last two sub-sections, the GLR's risk modifies the sensitivity of interest costs to fundamentals in the direction stipulated by the main hypothesis H1. Our evidence concerning this phenomenon is rather strong and is resistant to changes both in the GLR's situational measures and econometric methodologies. However, as previously noted, we were not able to identify any stable pattern regarding the relationship between deposit growth rate sensitivity to fundamentals and the GLR's risk. The first, simplistic explanation for the difference in the results for the two channels of depositor discipline boils down to the fact that the literature describes cases where certain results applied only to discipline through prices but not through volumes (Demirgüç-Kunt and Huizinga 2004, Bertay et al. 2013). However, it would be extremely difficult to regard this explanation as satisfactory.

Therefore, we formulate a sequencing and heterogeneity hypothesis that, in our opinion, may explain the difference in the results pertaining to the impact of the GLR's risk on the sensitivity of volumes and prices to fundamentals. The vast majority of observations we have in our sample concern low and modest values of the GLR's risk. In these circumstances, unsophisticated depositors who are unable to evaluate the GLR's risk and may even be unaware of its existence do not change their behavior; however, sophisticated depositors may require higher yields. Additionally, both groups of depositors face transactional costs when withdrawing funds. Consequently, the influence of the GLR's situation on depositors' sensitivity to fundamentals should be noticeable above all for interest costs. In contrast, redistributing funds more vigorously between banks with stronger and weaker fundamentals becomes rational only when the GLR's risk is high and the risk of double default (of a bank and the GLR) is not trivial. Such cases were relatively scarce during the sample period. As a result, the changing sensitivity of deposit volumes to fundamentals under the influence of the GLR's risk is difficult to detect. In summary, we hypothesize that the difference in the results for interest costs and deposit volumes can be jointly explained by the sequential nature of depositors' reactions when the GLR's risk rises and by the heterogeneity of depositors' ability to evaluate banking risk.

## 5. Conclusions

In our cross-country study of depositor discipline, we positively verified all three hypotheses. With regard to the auxiliary hypothesis H2, we find that both banks' interest costs and deposit growth ratios are associated with bank fundamentals in the expected directions. Therefore, our empirical results confirm the existence of market monitoring by at least some groups of depositors. In line with Martinez Peria and Schmukler (2001), Fueda and Konishi (2007) and Hori et al. (2009), we document that the sensitivity of interest costs to a capital base increases during post-crisis periods. Consequently, our evidence also supports a wake-up call effect described in auxiliary hypothesis H3. However, from the contribution point of view, the most important results are those concerning the main hypothesis H1. For this reason, we now restate them in more detail.

Our investigation provides evidence that the GLR's standing plays a meaningful role in shaping the sensitivity of interest costs to banks' fundamentals. Namely, we demonstrate that this sensitivity is an increasing function of the GLR's risk. The identified regularity is the most stable when we use equity levels to illustrate a bank's ability to withstand financial shocks, as in Berger and Turk-Ariss' (2010) study. In this case, the results are not susceptible to changes in the GLR's risk measures and modifications in the estimation procedures. It should be particularly emphasized that our conclusions are stable despite the fact that we apply several methods to characterize the GLR's standing. Namely, we use local and foreign currency ratings, CDS spreads, bond yields and changes in macroeconomic variables. Additionally, we analyze periods during which a GLR's ability to act is reduced. When we introduce the continuous GLR risk measures into the regressions and allow for non-linearity, we identify one more interesting feature of the studied phenomenon. It turns out that the overall interest cost sensitivity to banks' fundamentals is low for modest values of the GLR's risk measures, and then it increases as the GLR's standing deteriorates. In addition, our study finds weak support for the claim that the sensitivity function is U-shaped because in some cases for high values of the GLR's risk measures, the sensitivity stops increasing. In economic terms, our results indicate that banks' fundamentals gain in significance when the GLR's risk is not trivial; however, this increase in sensitivity persists up to a certain point where generalized instability may eliminate the importance of fundamentals. The last piece of evidence corroborates the previous findings of Levy-Yeyati et al. (2010), who studied the influence of country and currency risk exposures on depositors' decisions and concluded that depositors were responsive to risk in a broader sense than that usually applied in the literature

on market discipline. Finally, we establish that the changes in interest cost sensitivity to banks' fundamentals as a function of the GLR's risk are not conditional on a country's wealth or degree of development.

Is summary, our findings support the main hypothesis H1, which states that the strength of depositor discipline augments with increases in the GLR's risk. Therefore, the results complement the conclusions of Kane (1987) and Cook and Spellman (1991, 1994 and 1996), who showed that in the U.S. economy, depositors considered the standing of the deposit-guaranteeing institutions. However, the phenomenon of the changing strength of depositor discipline only appeared in the case of the interest costs incurred by banks. The lack of a similar regularity for deposit volumes can be jointly explained, as we argued in section four, by the depositors' heterogeneity and the sequential character of disciplinary actions undertaken by depositors.

We believe that our results regarding the impact of the GLR's risk on depositor discipline have important policy implications. First, there is a general opinion that regulatory discipline needs support from market participants to ensure financial stability. However, our empirical results suggest that it will be difficult to strengthen market discipline in countries with low values of GLR risk and ubiquitous beliefs that the GLR will act in the case of a banking crisis. Paradoxically, countries with non-trivial levels of GLR risk are better positioned to strengthen depositor discipline. Second, our findings indicate that it would be unreasonable to rely on depositor discipline when attempting to achieve long-term financial stability during prosperous economic times, i.e., periods when the GLR's risk is low, unless, of course, governments or regulatory bodies are able to credibly eradicate perceptions regarding the existence of GLR guarantees. Third, as expected, depositor discipline seems to be a complex phenomenon. To assess its existence and strength, it is not sufficient to consider the influence of banks' fundamentals and traits of the safety net. Other factors, such as exposure to macroeconomic risks and the GLR's standing, may significantly impact both market monitoring and influences.

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Table 1. **Variables and their definitions**

| Variable | Construction |
|---|---|
| DEP_RGR | the nominal growth ratio of deposits from non-financial entities adjusted for inflation |
| INT_COST | the quotient of interest cost incurred by a bank over total liabilities; the variable is adjusted for inflation |
| LOANS | the ratio of loans to total assets |
| LNA | natural logarithm of assets in constant US$ prices |
| C/I | ratio of overhead to operating income |
| NON_INT | ratio of total non-interest operating income to operating profit |
| ROA | ratio of profit before tax to average assets in a financial year |
| EQUITY | ratio of equity to total assets |
| EXPLICIT | a binary variable that equals 1 if explicit deposit insurance existed in a country in a given year |
| COVERAGE | ratio of the amount of deposit insurance coverage to GDP per capita (in case of full coverage, we assign the maximum coverage observed in a given year in all countries with limited coverage) |
| GDP_PC | GDP per capita in constant US$ prices |
| MAKET_CAP | market capitalization of listed companies (% of GDP) |
| EXT_DEBT | external debt stocks (% of GNI) |
| GOV_DEBT | central government debt (% of GDP) |
| CURR_ACC_BAL | current account balance (% of GDP) |
| POOR | a binary variable that equals 1 if a country in a given year is among the 50% of the poorest countries as measured by GDP per capita in constant US$ prices |
| EXT_DEBT_WEAK25, EXT_DEBT_WEAK33, EXT_DEBT_WEAK50 | a set of three binary variables that equal 1 if a country belongs to the group of 25%, 33% and 50% weakest countries in terms of external debt stocks (% of GNI), respectively |
| GOV_DEBT_WEAK25, GOV_DEBT_WEAK33, GOV_DEBT_WEAK50 | a set of three binary variables that equal 1 if a country belongs in a given year to the group of 25%, 33% and 50% weakest countries in terms of central government debt (% of GDP), respectively |
| CURR_ACC_BAL_WEAK25, CURR_ACC_BAL_WEAK33, CURR_ACC_BAL_WEAK50 | a set of three binary variables that equal 1 if a country belongs in a given year to the group of 25%, 33% and 50% weakest countries in terms of current account balance (% of GDP), respectively |
| LCU | 10-year default rate (in percent) implied by a country's local currency long-term rating (worst S&P rating valid in a given year) |
| FCU | 10-year default rate (in percent) implied by a country's foreign currency long-term rating (worst S&P rating valid in a given year) |
| CDS | ratio of a country's average CDS quotation in a given year to Germany's average quotation in a given year |
| YIELD | ratio of a country's sovereign bond yield to Germany's sovereign bond yield (as measured by year-end generic 5-year yield to maturities) |

| | |
|---|---|
| LCU_WORST50, LCU_WORST33, LCU_WORST25 | a set of three binary variables that equal 1 if the LCU variable belongs to the group of the highest 50%, 33% and 25% values observed in the total sample over the entire time horizon, respectively |
| FCU_WORST50, FCU_WORST33, FCU_WORST25 | a set of three binary variables that equal 1 if the FCU variable belongs to the group of the highest 50%, 33% and 25% values observed in the total sample over the entire time horizon, respectively |
| CDS_WORST50, CDS_WORST33, CDS_WORST25 | a set of three binary variables that equal 1 if the CDS variable belongs to the group of the highest 50%, 33% and 25% values observed in the total sample over the entire time horizon, respectively |
| YIELD_WORST50, YIELD_WORST33, YIELD_WORST25 | a set of three binary variables that equal 1 if the YIELD variable belongs to the group of the highest 50%, 33% and 25% values observed in the total sample over the entire time horizon, respectively |
| CRISIS, CRISIS3, CRISIS5 | a set of three binary variables that take a value of 1 for (a) years of a banking crisis in a given country, (b) years of a banking crisis and three years following each crisis, (c) years of a banking crisis and five years following each crisis, respectively |
| DEPLOSS, DEPLOSS3, DEPLOSS5 | a set of three binary variables that take a value of 1 for (a) years of a banking crisis with depositors' losses, (b) years of a banking crisis and three years following each crisis if the crisis generated depositors' losses, (c) years of a banking crisis and five years following each crisis if the crisis generated depositors' losses, respectively |

Table 2. **The distribution of observations by year and country and the concentration of observations within the biggest banking systems**

The table describes the effective number observations used in our baseline specifications (3) from Table 5. It also presents the number of countries from which the observations are derived as well as the concentration of observations within the largest, the three largest and the five largest banking systems in the world.

| Year | Observations | Countries | Observations in one biggest banking system | Observations in three biggest banking systems | Observations in five biggest banking systems |
|---|---|---|---|---|---|
| 1991 | 267 | 26 | 93 | 130 | 160 |
| 1992 | 563 | 32 | 128 | 295 | 380 |
| 1993 | 708 | 37 | 138 | 324 | 437 |
| 1994 | 1065 | 52 | 167 | 428 | 596 |
| 1995 | 1767 | 60 | 435 | 821 | 1065 |
| 1996 | 2121 | 62 | 565 | 957 | 1222 |
| 1997 | 2286 | 67 | 634 | 1058 | 1327 |
| 1998 | 2768 | 75 | 964 | 1423 | 1689 |
| 1999 | 4018 | 76 | 1410 | 2068 | 2480 |
| 2000 | 4311 | 80 | 1276 | 2222 | 2674 |
| 2001 | 4564 | 80 | 1053 | 2254 | 2920 |
| 2002 | 4559 | 83 | 938 | 2166 | 2820 |
| 2003 | 5028 | 90 | 1118 | 2333 | 3007 |
| 2004 | 5274 | 88 | 1150 | 2366 | 3083 |
| 2005 | 5470 | 90 | 1114 | 2312 | 3097 |
| 2006 | 5885 | 91 | 1135 | 2303 | 3229 |
| 2007 | 6183 | 88 | 1269 | 2480 | 3439 |
| 2008 | 5282 | 89 | 1167 | 2191 | 2861 |
| 2009 | 10360 | 90 | 5454 | 7292 | 7923 |
| 2010 | 10580 | 95 | 5467 | 7337 | 7987 |
| 2011 | 10587 | 95 | 5483 | 7362 | 8027 |
| 2012 | 8811 | 93 | 5446 | 6487 | 6970 |
| Total | 102457 | | 36604 | 56609 | 67393 |

Table 3. **The coverage for the GLR's risk measures**

The table shows the number of countries for which information on the GLR's risk is available. We consider only those countries with non-missing values for the bank-level and country-level control variables. The means are calculated for the period of data availability.

| YEAR | Local currency rating | Foreign currency rating | CDS spreads | Bond yields | Countries in database of systemic banking crises | Countries in crises | Current account balance | External debt | Government debt |
|---|---|---|---|---|---|---|---|---|---|
| 1991 | 0 | 19 | 0 | 0 | 24 | 4 | 0 | 9 | 5 |
| 1992 | 12 | 24 | 0 | 0 | 30 | 5 | 0 | 13 | 6 |
| 1993 | 16 | 29 | 0 | 0 | 34 | 7 | 0 | 14 | 8 |
| 1994 | 21 | 38 | 0 | 14 | 46 | 6 | 0 | 22 | 13 |
| 1995 | 26 | 42 | 0 | 15 | 52 | 6 | 0 | 25 | 26 |
| 1996 | 39 | 46 | 0 | 15 | 56 | 4 | 0 | 28 | 24 |
| 1997 | 50 | 55 | 0 | 17 | 59 | 9 | 0 | 32 | 31 |
| 1998 | 57 | 61 | 0 | 20 | 63 | 16 | 0 | 36 | 35 |
| 1999 | 60 | 62 | 0 | 24 | 66 | 12 | 0 | 37 | 35 |
| 2000 | 66 | 67 | 0 | 24 | 68 | 9 | 0 | 39 | 34 |
| 2001 | 67 | 68 | 9 | 26 | 68 | 7 | 0 | 41 | 37 |
| 2002 | 70 | 71 | 15 | 32 | 70 | 3 | 0 | 43 | 42 |
| 2003 | 75 | 76 | 27 | 35 | 73 | 2 | 0 | 46 | 44 |
| 2004 | 76 | 76 | 36 | 38 | 72 | 1 | 0 | 44 | 41 |
| 2005 | 79 | 79 | 39 | 40 | 73 | 1 | 89 | 45 | 44 |
| 2006 | 81 | 81 | 46 | 43 | 74 | 0 | 90 | 46 | 48 |
| 2007 | 79 | 79 | 46 | 48 | 71 | 2 | 87 | 43 | 50 |
| 2008 | 81 | 81 | 51 | 52 | 71 | 24 | 87 | 43 | 53 |
| 2009 | 82 | 82 | 60 | 52 | 72 | 24 | 88 | 45 | 54 |
| 2010 | 86 | 86 | 60 | 55 | 77 | 25 | 92 | 48 | 55 |
| 2011 | 87 | 87 | 60 | 55 | 77 | 25 | 91 | 48 | 54 |
| 2012 | 86 | 86 | 59 | 59 | 77 | 25 | 89 | 48 | 50 |
| Mean for the period of data availability | 61.71 | 63.41 | 42.33 | 34.95 | 62.41 | 9.864 | 89.13 | 36.14 | 35.86 |

Table 4. **The descriptive statistics for bank-level variables**

The table presents the descriptive statistics for the dependent variables and the bank-level control explanatory variables. All of the statistics were calculated only for the observations effectively used in baseline specification (3) in Table 5 . Both dependent variables are expressed in real terms; therefore, a significant portion of their values is negative.

| Variable name | Average | Standard deviation | Minimum | 5th percentile | Median | 95th percentile | Maximum |
|---|---|---|---|---|---|---|---|
| C/I | 0.545 | 0.212 | 0.000 | 0.258 | 0.524 | 0.947 | 2.000 |
| DEP_RGR | 0.070 | 0.244 | -0.999 | -0.173 | 0.030 | 0.465 | 1.997 |
| EQUITY | 0.102 | 0.087 | -0.493 | 0.032 | 0.085 | 0.223 | 1.000 |
| INT_COST | 0.003 | 0.040 | -0.895 | -0.038 | 0.004 | 0.038 | 0.996 |
| LNA | 6.787 | 1.914 | -3.917 | 4.218 | 6.475 | 10.360 | 14.986 |
| LOANS | 0.590 | 0.196 | 0.000 | 0.196 | 0.617 | 0.873 | 1.000 |
| NON_INT | 1.011 | 1.051 | -1.000 | -0.188 | 0.868 | 3.093 | 5.000 |
| ROA | 0.011 | 0.025 | -0.684 | -0.011 | 0.009 | 0.037 | 0.993 |

Table 5. **The baseline results of the market monitoring hypothesis**

The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is either the real growth ratio of deposits or the real interest cost incurred by banks over total liabilities. The variables testing for market monitoring (ROA and EQUITY) are lagged by one period.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | DEP_RGR | DEP_RGR | INT_COST | INT_COST |
| LOANS | 0.00466 | 0.00575 | 0.0106*** | 0.0143*** |
| | (0.0155) | (0.0159) | (0.00302) | (0.00314) |
| LNA | 0.00521*** | 0.00516*** | 0.00110** | 0.00142*** |
| | (0.00182) | (0.00184) | (0.000429) | (0.000428) |
| C/I | -0.0324** | -0.0337** | 0.00576*** | 0.00568** |
| | (0.0143) | (0.0145) | (0.00221) | (0.00228) |
| NON_INT | 0.00448* | 0.00292 | 0.00106*** | 0.00110*** |
| | (0.00258) | (0.00263) | (0.000392) | (0.000407) |
| INT_COST | 0.215*** | 0.241*** | | |
| | (0.0636) | (0.0657) | | |
| GDP_PC | -0.000172*** | -0.000198*** | 8.79e-06 | 1.45e-05*** |
| | (2.42e-05) | (2.26e-05) | (5.99e-06) | (5.62e-06) |
| MARKET_CAP | 0.0143** | 0.0118* | 0.00186 | 0.00301** |
| | (0.00631) | (0.00644) | (0.00118) | (0.00122) |
| EXPLICIT | -0.0462*** | | 0.00202 | |
| | (0.0127) | | (0.00268) | |
| COVERAGE | | -0.000216 | | -1.32e-05 |
| | | (0.000131) | | (1.84e-05) |
| L.ROA | 0.245** | 0.292** | -0.0655*** | -0.0682*** |
| | (0.122) | (0.123) | (0.0152) | (0.0157) |
| L.EQUITY | 0.334*** | 0.319*** | -0.0100 | -0.00751 |
| | (0.0425) | (0.0429) | (0.00630) | (0.00642) |
| Constant | 0.102*** | 0.0745*** | -0.0219*** | -0.0278*** |
| | (0.0238) | (0.0227) | (0.00469) | (0.00439) |
| No. of observations | 98,573 | 93,158 | 102,457 | 96,555 |
| No. of banks | 16,957 | 16,669 | 17,456 | 17,151 |

***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.

Table 6. **The GLR' risk implied by ratings and the interest cost sensitivity to banks' fundamentals**

The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is the real interest cost incurred by banks over total liabilities. The table contains only the variables and interaction terms relevant from a hypothesis-testing point of view. The models also contain bank-specific variables, country-level variables, and a variable concerning the deposit insurance system in place, all of which are not shown for brevity. The ROA and EQUITY variables are lagged by one period. The full estimation results are available from the authors upon request.

| | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|
| VARIABLES | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST |
| L.ROA | -0.0193 | -0.0397** | -0.0353** | -0.0213 | -0.0389** | -0.0319* |
| | (0.0217) | (0.0186) | (0.0175) | (0.0212) | (0.0196) | (0.0190) |
| L.EQUITY | 0.00194 | -0.0136** | -0.00905 | -0.00499 | -0.00192 | 0.00340 |
| | (0.00683) | (0.00612) | (0.00591) | (0.00708) | (0.00670) | (0.00661) |
| L.ROA x LCU_WORST50 | -0.0104 | | | | | |
| | (0.0286) | | | | | |
| L.EQUITY x LCU_WORST50 | -0.0496*** | | | | | |
| | (0.00854) | | | | | |
| L.ROA x LCU_WORST33 | | 0.0343 | | | | |
| | | (0.0295) | | | | |
| L.EQUITY x LCU_WORST33 | | -0.0262*** | | | | |
| | | (0.00962) | | | | |
| L.ROA x LCU_WORST25 | | | 0.0263 | | | |
| | | | (0.0313) | | | |
| L.EQUITY x LCU_WORST25 | | | -0.107*** | | | |
| | | | (0.0119) | | | |
| L.ROA x FCU_WORST50 | | | | -0.0675** | | |
| | | | | (0.0305) | | |
| L.EQUITY x FCU_WORST50 | | | | -0.0250** | | |
| | | | | (0.0102) | | |
| L.ROA x FCU_WORST33 | | | | | -0.0347 | |
| | | | | | (0.0316) | |
| L.EQUITY x FCU_WORST33 | | | | | -0.0675*** | |
| | | | | | (0.0115) | |
| L.ROA x FCU_WORST25 | | | | | | -0.0622* |
| | | | | | | (0.0322) |
| L.EQUITY x FCU_WORST25 | | | | | | -0.134*** |
| | | | | | | (0.0122) |
| Number of observations | 94,097 | 94,097 | 94,097 | 95,019 | 95,019 | 95,019 |
| Number of banks | 16,871 | 16,871 | 16,871 | 16,950 | 16,950 | 16,950 |

***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.

Table 7. **The GLR's risk implied by CDS and bond spreads vs. the interest cost sensitivity to banks' fundamentals**

The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is the real interest cost incurred by banks over total liabilities. The table contains only the variables and interaction terms relevant from a hypothesis-testing point of view. The models also contain bank-specific variables, country-level variables, and a variable concerning the deposit insurance system in place, which are all not shown for brevity. The full estimation results are available from the authors upon request.

| | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|
| VARIABLES | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST |
| L.ROA | -0.0178 | -0.0250 | -0.0287* | 0.0102 | -0.0108 | -0.0173 |
| | (0.0200) | (0.0189) | (0.0174) | (0.0169) | (0.0154) | (0.0149) |
| L.EQUITY | 0.00419 | 0.00365 | 0.00544 | 0.0242*** | 0.00913* | -0.00493 |
| | (0.00606) | (0.00588) | (0.00576) | (0.00504) | (0.00475) | (0.00476) |
| L.ROA x CDS_WORST50 | -0.0624** | | | | | |
| | (0.0282) | | | | | |
| L.EQUITY x CDS_WORST50 | -0.0310*** | | | | | |
| | (0.00656) | | | | | |
| L.ROA x CDS_WORST33 | | -0.0500* | | | | |
| | | (0.0283) | | | | |
| L.EQUITY x CDS_WORST33 | | -0.0380*** | | | | |
| | | (0.00676) | | | | |
| L.ROA x CDS_WORST25 | | | -0.0547* | | | |
| | | | (0.0303) | | | |
| L.EQUITY x CDS_WORST25 | | | -0.0537*** | | | |
| | | | (0.00718) | | | |
| L.ROA x YIELD_WORST50 | | | | -0.0671*** | | |
| | | | | (0.0237) | | |
| L.EQUITY x YIELD_WORST50 | | | | -0.0685*** | | |
| | | | | (0.00485) | | |
| L.ROA x YIELD_WORST33 | | | | | -0.0396 | |
| | | | | | (0.0243) | |
| L.EQUITY x YIELD_WORST33 | | | | | -0.0611*** | |
| | | | | | (0.00496) | |
| L.ROA x YIELD_WORST25 | | | | | | -0.0327 |
| | | | | | | (0.0274) |
| L.EQUITY x YIELD_WORST25 | | | | | | -0.0299*** |
| | | | | | | (0.00615) |
| Number of observations | 61,486 | 61,486 | 61,486 | 85,460 | 85,460 | 85,460 |
| Number of banks | 14,137 | 14,137 | 14,137 | 15,702 | 15,702 | 15,702 |

***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.

Table 8. **The GLR's risk continuously measured and the interest sensitivity to banks' fundamentals**

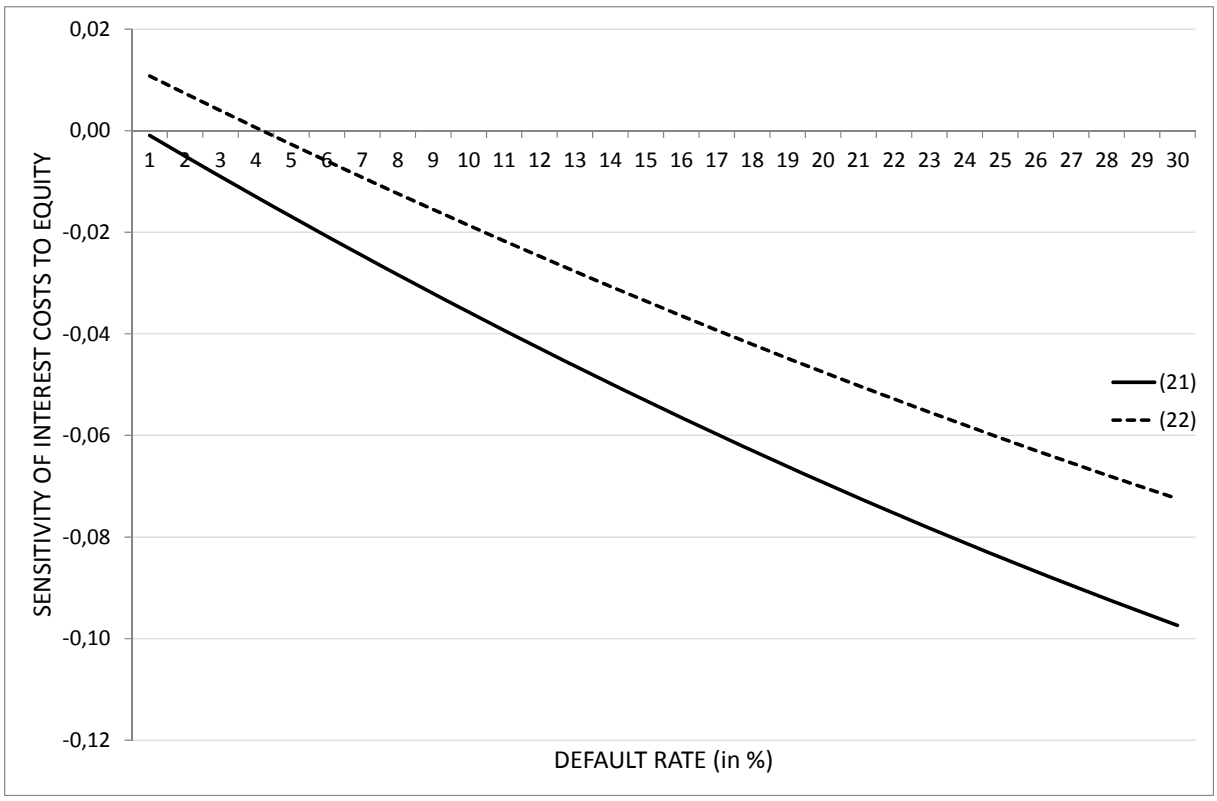
The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is the real interest cost incurred by banks over total liabilities. The table contains only the variables and interaction terms relevant from a hypothesis-testing point of view. The models also contain bank-specific variables, country-level variables, and a variable concerning the deposit insurance system in place, which are all not shown for brevity. The full estimation results are available from the authors upon request.

| | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST | INT_COST |
| L.ROA | -0.0530*** | -0.0837*** | -0.0430*** | -0.0259* | -0.0326* | 0.00418 | -0.0401** | -0.0158 |
| | (0.0174) | (0.0190) | (0.0166) | (0.0148) | (0.0194) | (0.0221) | (0.0177) | (0.0172) |
| L.EQUITY | -0.00406 | 0.00650 | -0.00907 | -0.0107** | 0.00320 | 0.0142* | 0.00435 | 0.00166 |
| | (0.00604) | (0.00680) | (0.00568) | (0.00478) | (0.00640) | (0.00739) | (0.00582) | (0.00516) |
| L.ROA x LCU | 0.00110** | | | | -0.00248 | | | |
| | (0.000518) | | | | (0.00164) | | | |
| L.EQUITY x LCU | -0.00193*** | | | | -0.00416*** | | | |
| | (0.000237) | | | | (0.000649) | | | |
| L.ROA x FCU | | 0.00106** | | | | -0.0120*** | | |
| | | (0.000460) | | | | (0.00183) | | |
| L.EQUITY x FCU | | -0.00187*** | | | | -0.00348*** | | |
| | | (0.000235) | | | | (0.000667) | | |
| L.ROA x CDS | | | -0.000468 | | | | -0.000383 | |
| | | | (0.000358) | | | | (0.000803) | |
| L.EQUITY x CDS | | | 8.86e-05 | | | | -0.00165*** | |
| | | | (9.18e-05) | | | | (0.000212) | |
| L.ROA x YIELD | | | | 0.000433 | | | | -0.00455 |
| | | | | (0.00228) | | | | (0.00508) |
| L.EQUITY x YIELD | | | | -0.000691 | | | | -0.00638*** |
| | | | | (0.000464) | | | | (0.00107) |
| L.ROA x $(LCU)^2$ | | | | | 4.40e-05** | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | (1.74e-05) | | | |
| L.EQUITY x (LCU)² | | | | | 2.69e-05*** | | | |
| | | | | | (6.86e-06) | | | |
| L.ROA x (FCU)² | | | | | | 0.000134*** | | |
| | | | | | | (1.80e-05) | | |
| L.EQUITY x (FCU)² | | | | | | 1.97e-05*** | | |
| | | | | | | (6.70e-06) | | |
| L.ROA x (CDS)² | | | | | | | -7.75e-08 | |
| | | | | | | | (3.86e-06) | |
| L.EQUITY x (CDS)² | | | | | | | 7.79e-06*** | |
| | | | | | | | (8.85e-07) | |
| L.ROA x (YIELD)² | | | | | | | | 7.68e-05 |
| | | | | | | | | (0.000139) |
| L.EQUITY x (YIELD)² | | | | | | | | 0.000207*** |
| | | | | | | | | (3.44e-05) |
| Number of observations | 94,097 | 95,019 | 61,486 | 85,460 | 94,097 | 95,019 | 61,486 | 85,460 |
| Number of banks | 16,871 | 16,950 | 14,137 | 15,702 | 16,871 | 16,950 | 14,137 | 15,702 |

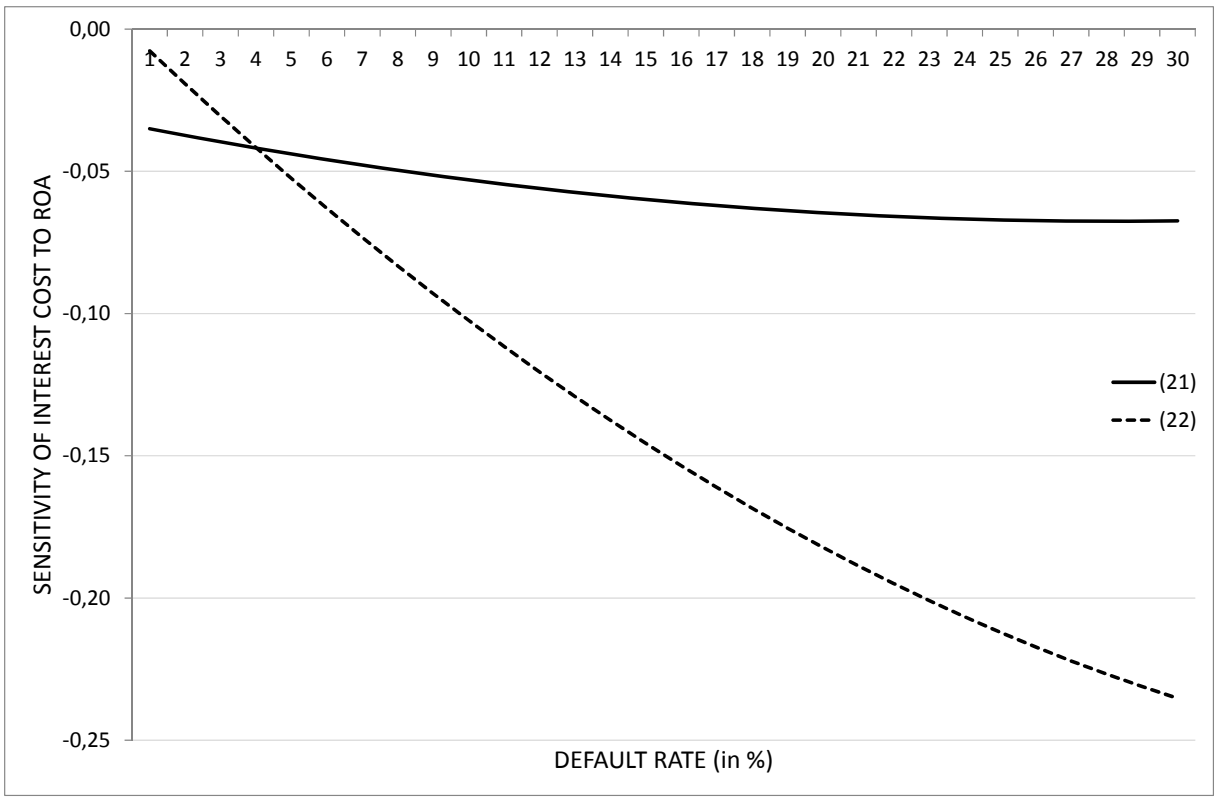
***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.

Chart 1. **The overall sensitivity of interest costs to capital base as a function of the default rates implied by ratings**



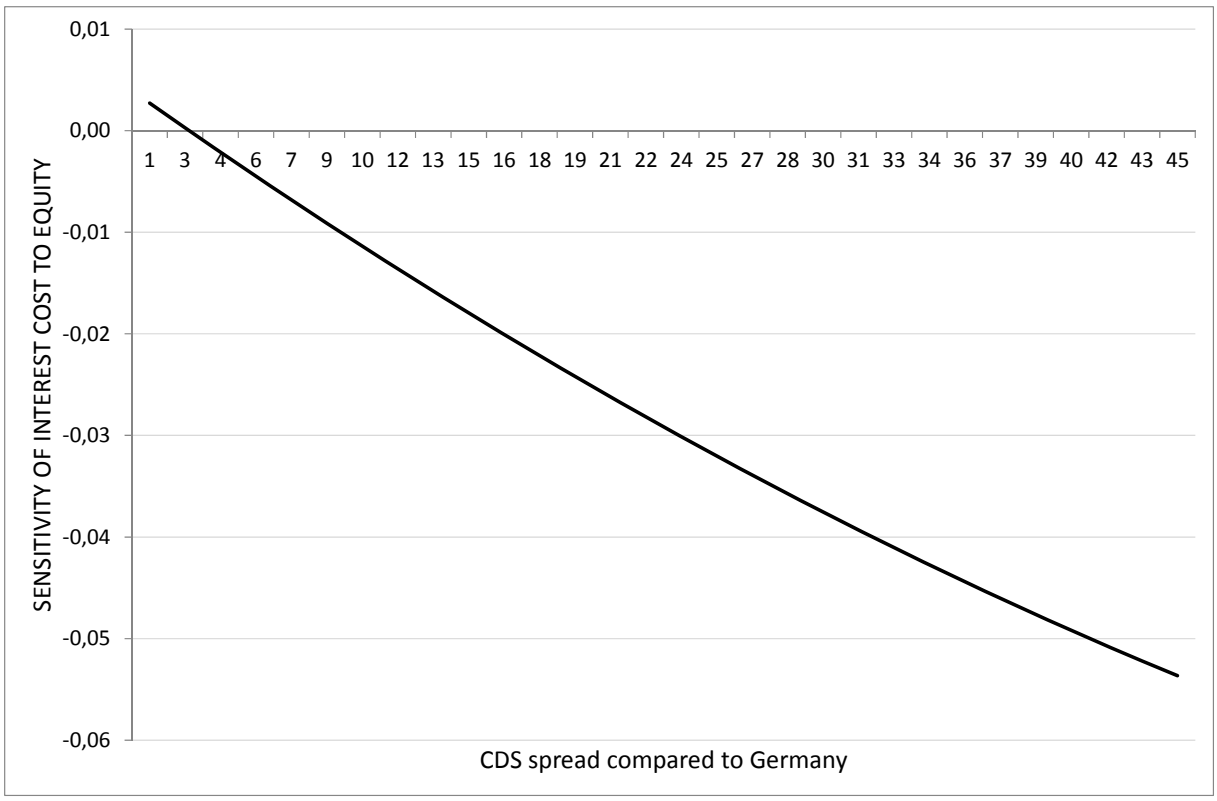

Note: The chart is based on the coefficients from specifications (21) and (22).

Chart 2. **The overall sensitivity of interest costs to return on assets as a function of the default rates implied by ratings**



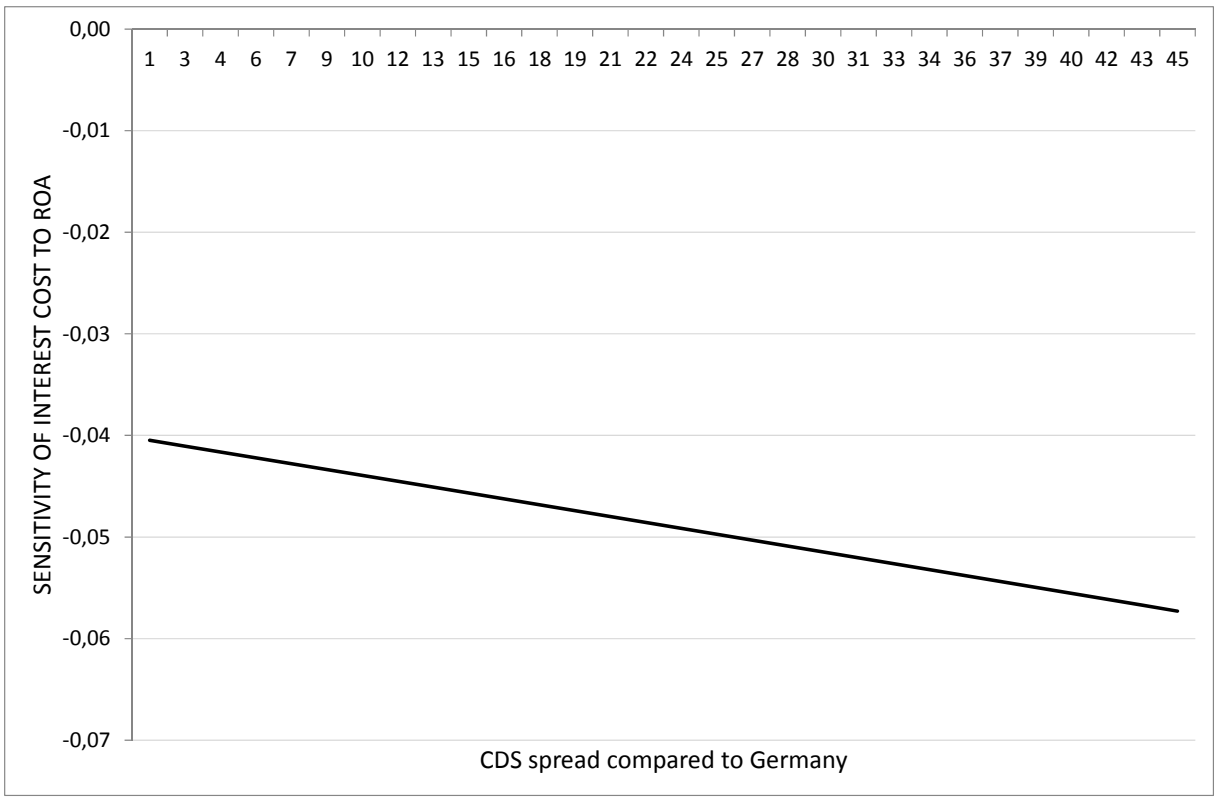

Note: The chart is based on the coefficients from specifications (21) and (22).

Chart 3. **The overall sensitivity of interest costs to capital base as a function of CDS spreads compared with Germany**



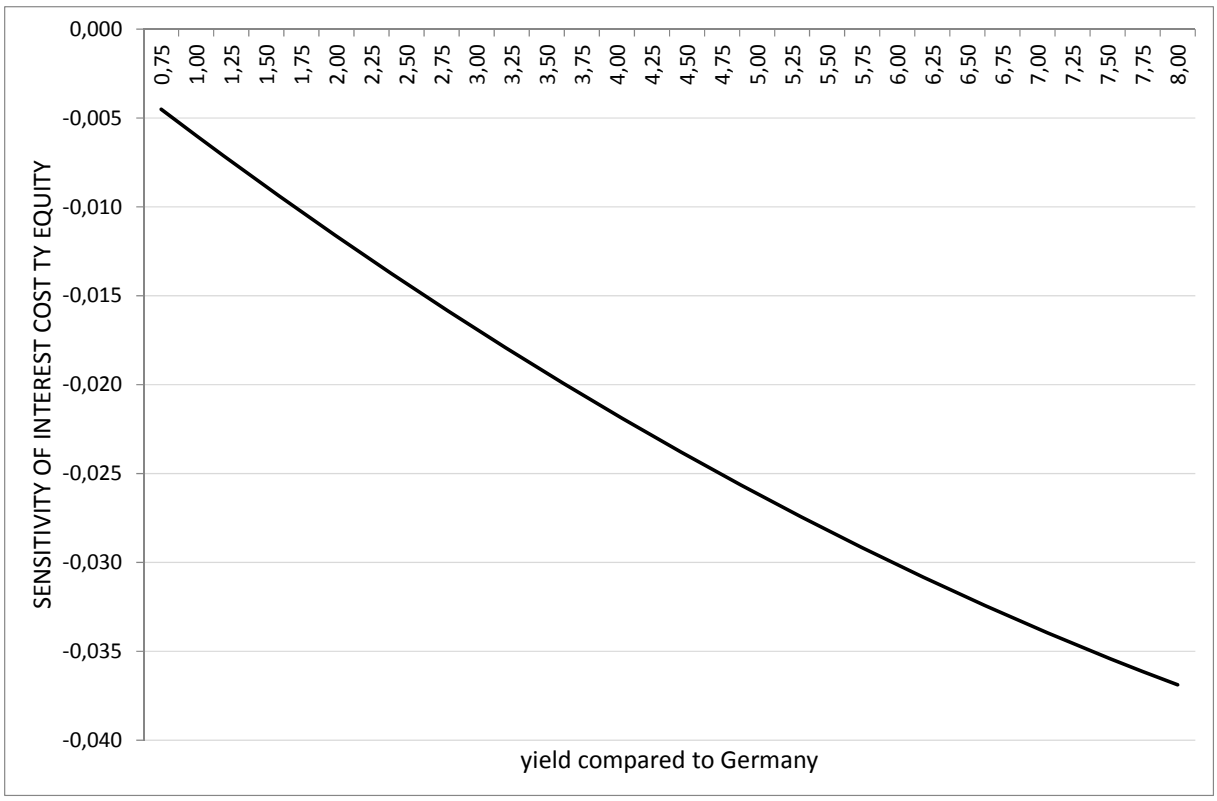

Note: The chart is based on the coefficients from specification (23).

Chart 4. **The overall sensitivity of interest costs to return on assets as a function of CDS spreads compared with Germany**



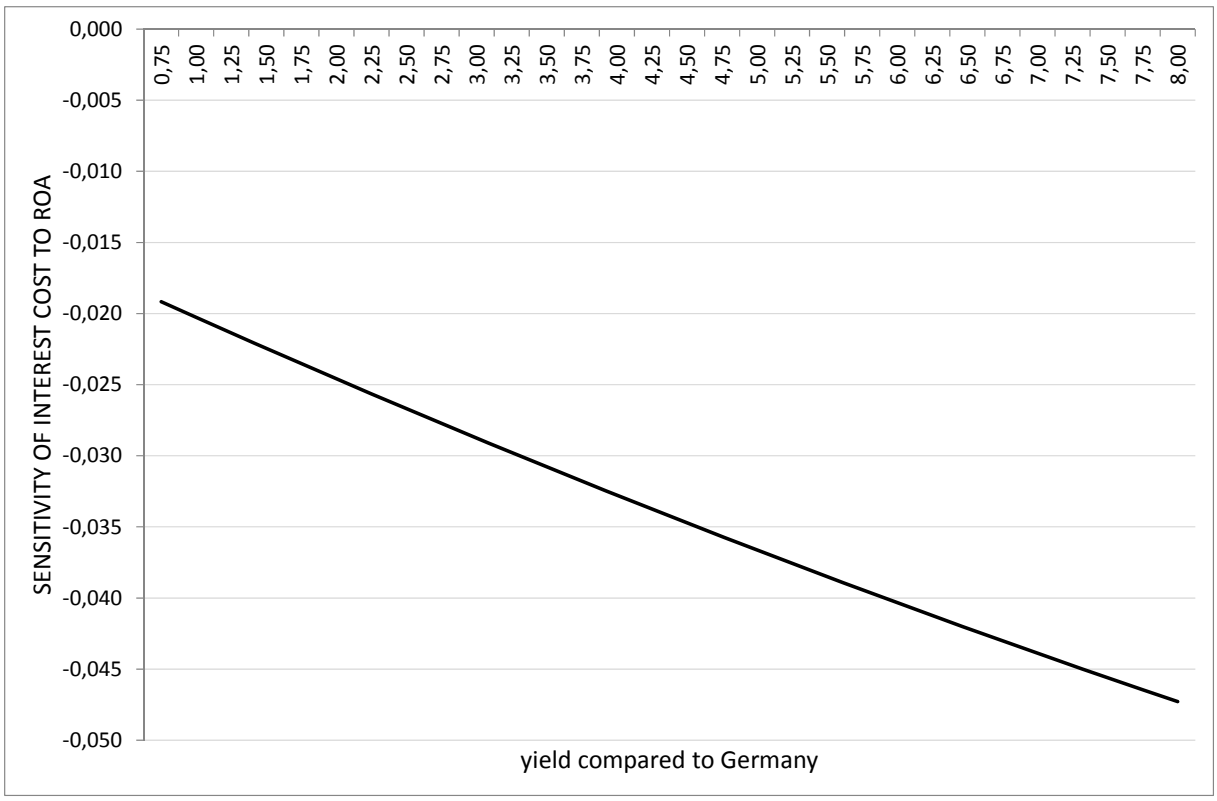

Note: The chart is based on the coefficients from specification (23).

Chart 5. **The overall sensitivity of interest costs to capital base as a function of bond yields compared with Germany**




Note: The chart is based on the coefficients from specification (24).

Chart 6. **The overall sensitivity of interest costs to return on assets as a function of bond yields compared with Germany**




Note: The chart is based on the coefficients from specification (24).

Table 9. **The GLR's risk, relative countries' wealth and interest cost sensitivity to banks' fundamentals**

The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is the real interest cost incurred by banks over total liabilities. The table contains only the variables and interaction terms relevant from a hypothesis-testing point of view. The models also contain bank-specific variables, country-level variables, and a variable concerning the deposit insurance system in place, which are all not shown for brevity. The full estimation results are available from the authors upon request.

| | (25) | (26) | (27) | (28) |
|---|---|---|---|---|
| VARIABLES | INT_COST | INT_COST | INT_COST | INT_COST |
| L.ROA | -0.0162 | -0.0243 | -0.0195 | 0.00961 |
| | (0.0207) | (0.0204) | (0.0202) | (0.0166) |
| L.EQUITY | -0.000325 | -0.00744 | 0.00453 | 0.0242*** |
| | (0.00660) | (0.00694) | (0.00609) | (0.00497) |
| L.ROA x LCU_WORST50 | 0.0213 | | | |
| | (0.0298) | | | |
| L.EQUITY x LCU_WORST50 | -0.0486*** | | | |
| | (0.00890) | | | |
| L.ROA x LCU_WORST50 x POOR | -0.124*** | | | |
| | (0.0429) | | | |
| L.EQUITY x LCU_WORST50 x POOR | -0.0190 | | | |
| | (0.0149) | | | |
| L.ROA x FCU_WORST50 | | -0.0440 | | |
| | | (0.0331) | | |
| L.EQUITY x FCU_WORST50 | | -0.0190* | | |
| | | (0.0113) | | |
| L.ROA x FCU_WORST50 x POOR | | -0.0491 | | |
| | | (0.0473) | | |
| L.EQUITY x FCU_WORST50 x POOR | | -0.0197 | | |
| | | (0.0182) | | |
| L.ROA x CDS_WORST50 | | | -0.0394 | |
| | | | (0.0298) | |
| L.EQUITY x CDS_WORST50 | | | -0.0324*** | |
| | | | (0.00689) | |
| L.ROA x CDS_WORST50 x POOR | | | -0.0458 | |
| | | | (0.0479) | |
| L.EQUITY x CDS_WORST50 x POOR | | | 0.00558 | |
| | | | (0.0140) | |
| L.ROA x YIELD_WORST50 | | | | -0.0605** |
| | | | | (0.0245) |
| L.EQUITY x YIELD_WORST50 | | | | -0.0643*** |
| | | | | (0.00490) |
| L.ROA x YIELD_WORST50 x POOR | | | | -0.00516 |
| | | | | (0.0442) |
| L.EQUITY x YIELD_WORST50 x POOR | | | | -0.0344*** |
| | | | | (0.0120) |

| | | | | |
|---|---|---|---|---|
| Number of observations | 99,390 | 100,881 | 61,961 | 87,683 |
| Number of banks | 17,170 | 17,253 | 14,152 | 15,860 |

***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.

Table 10. **The crisis phenomena, the GLR's standing and the sensitivity of interest costs to banks' fundamentals**

The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is the real interest cost incurred by banks over total liabilities. The table contains only the variables and interaction terms relevant from a hypothesis-testing point of view. The models also contain bank-specific variables, country-level variables, and a variable concerning the deposit insurance system in place, which are all not shown for brevity. The full estimation results are available from the authors upon request.

| VARIABLES | (29) INT_COST | (30) INT_COST | (31) INT_COST | (32) INT_COST | (33) INT_COST | (34) INT_COST |
|---|---|---|---|---|---|---|
| L.ROA | -0.105*** | -0.0992*** | -0.144*** | -0.120*** | -0.147*** | -0.122*** |
| | (0.0206) | (0.0186) | (0.0232) | (0.0192) | (0.0241) | (0.0194) |
| L.EQUITY | -0.00308 | 0.000217 | 0.00496 | 0.00452 | 0.00353 | 0.00647 |
| | (0.00736) | (0.00727) | (0.00760) | (0.00735) | (0.00780) | (0.00740) |
| CRISIS | -0.00721*** | | | | | |
| | (0.00143) | | | | | |
| L.ROA x CRISIS | 0.0707** | | | | | |
| | (0.0303) | | | | | |
| L.EQUITY x CRISIS | -0.00643 | | | | | |
| | (0.0101) | | | | | |
| DEPLOSS | | 0.0111 | | | | |
| | | (0.0110) | | | | |
| L.ROA x DEPLOSS | | 0.283*** | | | | |
| | | (0.0653) | | | | |
| L.EQUITY x DEPLOSS | | -0.0697 | | | | |
| | | (0.0457) | | | | |
| CRISIS3 | | | -0.00494*** | | | |
| | | | (0.00133) | | | |
| L.ROA x CRISIS3 | | | 0.126*** | | | |
| | | | (0.0300) | | | |
| L.EQUITY x CRISIS3 | | | -0.0265*** | | | |
| | | | (0.00962) | | | |
| DEPLOSS3 | | | | -0.0218*** | | |
| | | | | (0.00708) | | |
| L.ROA x DEPLOSS3 | | | | 0.270*** | | |
| | | | | (0.0480) | | |
| L.EQUITY x DEPLOSS3 | | | | -0.115*** | | |
| | | | | (0.0297) | | |
| CRISIS5 | | | | | -0.00469*** | |
| | | | | | (0.00129) | |
| L.ROA x CRISIS5 | | | | | 0.125*** | |
| | | | | | (0.0303) | |
| L.EQUITY x CRISIS5 | | | | | -0.0216** | |
| | | | | | (0.00944) | |
| DEPLOSS5 | | | | | | -0.0108* |
| | | | | | | (0.00629) |
| L.ROA x DEPLOSS5 | | | | | | 0.271*** |
| | | | | | | (0.0471) |
| L.EQUITY x DEPLOSS5 | | | | | | -0.119*** |
| | | | | | | (0.0276) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Number of observations | 94,010 | 81,680 | 94,010 | 81,402 | 94,010 | 81,151 |
| Number of banks | 16,680 | 16,385 | 16,680 | 16,371 | 16,680 | 16,364 |

***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.

Table 11. **The macroeconomic imbalances and the sensitivity of interest costs to banks' fundamentals**

The table presents random effects estimates when observations are weighted in the following way: each observation is given a weight that equals 1 divided by the natural logarithm of the total number of observations from a given country. The dependent variable is the real interest cost incurred by banks over total liabilities. The table contains only the variables and interaction terms relevant from a hypothesis-testing point of view. The models also contain bank-specific variables, country-level variables, and a variable concerning the deposit insurance system in place, which are all not shown for brevity. The full estimation results are available from the authors upon request.

| VARIABLES | (35) INT_COST | (36) INT_COST | (37) INT_COST | (38) INT_COST | (39) INT_COST | (40) INT_COST | (41) INT_COST | (42) INT_COST | (43) INT_COST |
|---|---|---|---|---|---|---|---|---|---|
| L.ROA | -0.109** | -0.110** | -0.0864 | -0.0291 | -0.0396* | -0.0577** | -0.0461** | -0.0488*** | -0.0370* |
| | (0.0514) | (0.0558) | (0.0665) | (0.0202) | (0.0211) | (0.0237) | (0.0183) | (0.0184) | (0.0220) |
| L.EQUITY | 0.0119 | 0.0118 | 0.00653 | -0.00567 | -0.00258 | -0.0142** | 0.0137** | 0.0194*** | 0.0260*** |
| | (0.0208) | (0.0214) | (0.0229) | (0.00591) | (0.00598) | (0.00642) | (0.00616) | (0.00632) | (0.00672) |
| L.ROA x EXT_DEBT_WEAK25 | 0.00655 | | | | | | | | |
| | (0.0725) | | | | | | | | |
| L.EQUITY x EXT_DEBT_WEAK25 | -0.0395** | | | | | | | | |
| | (0.0201) | | | | | | | | |
| L.ROA x EXT_DEBT_WEAK33 | | 0.00940 | | | | | | | |
| | | (0.0715) | | | | | | | |
| L.EQUITY x EXT_DEBT_WEAK33 | | -0.0267 | | | | | | | |
| | | (0.0187) | | | | | | | |
| L.ROA x EXT_DEBT_WEAK50 | | | -0.0267 | | | | | | |
| | | | (0.0763) | | | | | | |
| L.EQUITY x EXT_DEBT_WEAK50 | | | -0.00808 | | | | | | |
| | | | (0.0186) | | | | | | |
| L.ROA x GOV_DEBT_WEAK25 | | | | -0.00908 | | | | | |
| | | | | (0.0304) | | | | | |
| L.EQUITY x GOV_DEBT_WEAK25 | | | | -0.0284*** | | | | | |
| | | | | (0.00644) | | | | | |
| L.ROA x GOV_DEBT_WEAK33 | | | | | 0.0158 | | | | |
| | | | | | (0.0294) | | | | |
| L.EQUITY x GOV_DEBT_WEAK33 | | | | | -0.0313*** | | | | |
| | | | | | (0.00589) | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L.ROA x GOV_DEBT_WEAK50 | | | | | | 0.0503 | | | |
| | | | | | | (0.0309) | | | |
| L.EQUITY x GOV_DEBT_WEAK50 | | | | | | 0.00153 | | | |
| | | | | | | (0.00610) | | | |
| L.ROA x CURR_ACC_BAL_WEAK25 | | | | | | | -0.165*** | | |
| | | | | | | | (0.0433) | | |
| L.EQUITY x CURR_ACC_BAL_WEAK25 | | | | | | | -0.0450*** | | |
| | | | | | | | (0.00897) | | |
| L.ROA x CURR_ACC_BAL_WEAK33 | | | | | | | | -0.128*** | |
| | | | | | | | | (0.0395) | |
| L.EQUITY x CURR_ACC_BAL_WEAK33 | | | | | | | | -0.0432*** | |
| | | | | | | | | (0.00753) | |
| L.ROA x CURR_ACC_BAL_WEAK50 | | | | | | | | | -0.0666** |
| | | | | | | | | | (0.0309) |
| L.EQUITY x CURR_ACC_BAL_WEAK50 | | | | | | | | | -0.0380*** |
| | | | | | | | | | (0.00626) |
| Number of observations | 12,342 | 12,342 | 12,342 | 72,274 | 72,274 | 72,274 | 45,422 | 45,422 | 45,422 |
| Number of banks | 2,014 | 2,014 | 2,014 | 14,451 | 14,451 | 14,451 | 13,659 | 13,659 | 13,659 |

***, **, * indicate statistical significance at 1%, 5% and 10%, respectively. Standard errors are shown in parentheses.