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Deposit insurance and market discipline

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ABSTRACT

Limited coverage is a standard feature in deposit insurance schemes. It is used to limit moral hazard, and achieves this objective by reinforcing market discipline: depositors have more incentives to monitor banks' risk-taking if they have skin in the game. In this paper, I study market discipline and coverage levels by analyzing the relationship of funding costs and deposit growth with banks' risk. I use a database of Colombian banks' balance sheets and take advantage of a sudden, significant, and exogenous increase in the coverage level that occurred in April 2017. I find evidence of market discipline throughout the period of analysis and most results are consistent with it not being reduced by the change in the coverage level. The results are nuanced, however. Two variables are impacted: one in the quantity and the other in the price dimension. Furthermore, results also vary when I look at specific groups of banks separately. Market discipline is not present in big banks. Too big-to-fail perceptions seem to limit it. This is also the case for banks concentrated in fully insured deposits, where limited coverage has a less prevalent role.

1. Introduction

Deposit insurance is a guarantee on bank deposits, usually provided by the government. Within the global financial architecture, its role is underscored in the seminal paper by Diamond and Dybvig (1983). If deposits are guaranteed, depositors do not have incentives to withdraw their funds if they believe a run might occur. Deposit insurance thus eliminates an undesirable and costly coordination problem. Guaranteeing deposits might also increase risk in the system, however, by reducing market discipline—one of the three pillars of Basel III. Because of the existence of deposit insurance, depositors have incentives to search for higher rates without paying due attention to risk. Banks might increase risk-taking themselves. Which effect dominates, i.e., what is the net effect of deposit insurance on financial stability, remains an open question in the banking literature.

As detailed in Demirgüç-Kunt et al. (2015), the way DIS are organized varies worldwide. Differing features include the size of the insurance offered—the limit imposed on the guarantee. Limited coverage addresses the possibility of a reduction in market discipline. As presented in Kane (2000), limiting the deposits explicitly covered better aligns banks and depositors' actions with potential consequences. It is a tool broadly used by deposit insurance schemes (DIS) and characterized by the coverage level. This maximum, usually measured per person and per bank, is an important feature of DIS architecture. If set too low, the benefits of the scheme will not materialize. Coverage will not be sufficient to prevent a run on a bank. If set too high, market discipline could disappear. Thus, understanding how coverage levels impact market discipline is central for determining how this lever should be used. This is key for ensuring that DIS support—rather than hinder—financial stability.

This paper studies market discipline and how, if at all, it is impacted by changes in the coverage level in "normal" times. To study this I use a database comprised of all Colombian banks—with data available on a monthly basis—and take advantage of a change in the coverage level that occurred in April 2017. I analyze interest rates paid by banks to depositors and their relationship with a set of banks' risk variables. I also look at the relationship of banks' deposit growth with the same set of risk variables. My interest is answering three questions. Firstly, are depositors demanding higher interest rates from, and supplying less funds to, riskier banks? Secondly, did these relationships change when the coverage level was increased? If so, is there still evidence of market discipline in the data? Thirdly, are these relationships impacted by other characteristics of banks?

The paper's results point to the existence of market discipline within Colombia's banking sector. Furthermore, most of the analyses show that market discipline is still present after the coverage level was increased in 2017. Compared to studies that conclude that changes in coverage levels affect market discipline, results in this paper show that this might not be the case in every setting. This can be the case for situations like the one presented in Colombia in 2017, when deposit insurance already

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exists and the coverage level increase is not conjoined with a financial crisis, a case less studied in the literature.

The results do not imply that deposit insurance and coverage levels have no effect on market discipline in good times. They point to a more complex picture of the relationship between them and highlight the importance of having other levers to support market discipline. In Colombia's case, these additional features include risk-adjusted premiums, a compulsory deposit insurance scheme, high capital levels and sound supervision. Following Anginer et al. (2014), a strong regulatory and institutional framework is most important in good years, such as the ones in which the change in the coverage level analyzed happened. I discuss this in more detail in Section 5. Furthermore, per one of the variables used, the amount of funds provided no longer showed a relationship with banks' risk-taking after the coverage level increased. Thus, the strength of the conclusions might depend on the variable used to study this relationship.

The paper also shows that market discipline is not homogeneous among banks. There is no evidence of market discipline in big banks and in those concentrated in small, fully insured deposits. In the former case, domestic TBTF perceptions seem to limit market discipline. In the latter, depositors that are fully covered have less incentives to monitor banks' behavior. All in all, adding other variables to the analysis underscores the need to look at market discipline through a wider set of lenses.

Compared to previous literature, this paper is novel and interesting in several ways. First, it focuses on a change in the coverage level in the everyday business of DIS—it is not linked to the implementation of a new DIS or to the lifting of a blanket guarantee, which is what previous papers have focused on. It thus targets a relevant issue regarding coverage levels: how to think about them in "peaceful" times. Second, identifying the effect of the increase in coverage on market discipline is more straightforward than in previous analyses since the change was exogenous, unexpected and abrupt. Changes in coverage levels usually occur as a response to a crisis, or gradually, when countries link coverage levels to inflation. Colombia's 2017 increase in its coverage level was sudden and unanticipated, but it was not a response to a particular situation in the financial sector. It followed an administrative decision to restore the purchasing power of coverage. I expand this in Section 4.

Third, notwithstanding that the change in the coverage level is not conjoined with a financial crisis, it is a significant one: coverage increased from COP (Colombian pesos) 20 million to COP 50 million (a 150% increase, roughly from USD 6000 to USD 15,000).[1] This large increase, not common absent a crisis, was a consequence of the insurance threshold not being updated for almost 20 years. Fourth, Colombia is an interesting case study since its DIS has been very active in increasing awareness of deposit insurance and its coverage level. It has worked with banks to achieve this and has had a continuous media presence during the last 10 years. Moreover, this strategy (radio and TV ads, internet flyers, etc.), was modified after coverage was increased to highlight the new coverage level. Fifth, by including other variables in the analyses, the paper shows some of the complexities related to market discipline, which might underlie conflicting evidence from previous literature. These additional dimensions include domestic 'too-big-to-fail'' perceptions and banks' different funding structures—their concentration in fully insured (small) vs. partially insured (large) depositors.

Finally, Colombia's case is particularly relevant for other emerging economies. In particular for those that also face similar challenges, such as building credibility and awareness of their deposit insurance systems within their population. This follows low financial literacy, but also concentrated bank systems where bank failure is thus usually remote. Understanding the dynamics of market discipline in these contexts allows deposit insurance systems to take more informed decisions about coverage levels.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 lays out the methodology used. Section 4 describes Colombia's financial sector, its DIS, the coverage change and the data used in the analysis. Section 5 presents the results, and Section 6 concludes. Additional tables are presented in Appendix.

2. Literature review

Following Berger (1991), market discipline can be understood as a situation where, as banks take additional risks, depositors face increasing costs and take actions to mitigate them.[2] As presented in Flannery (1998), depositors can exercise market discipline through higher interest rates or by providing less funds to banks. Early studies that analyze the former include Hannan and Hanweck (1988) and Cook and Spellman (1994); Goldberg and Hudgins (2002) study the latter, focusing on uninsured depositors. Park (1995), Park and Peristiani (1998) analyze both interest rates and deposit growth. Maechler and McDill (2006) study banks' response to depositor discipline.[3] All in all, these studies support the existence of a relationship between rates paid by banks to depositors, the availability of funds, and banks risk, i.e. the existence of market discipline.[4]

The existence of market discipline curbs banks' incentives to take excessive risks by making it costly for them to do so. A guarantee provided by a third party can affect this, since depositors have incentives to search for higher rates without paying attention to how much risk the banks are taking. This potential reduction in market discipline can translate into increased risk-taking by the banks themselves—a form of moral hazard.[5] Most of the authors that study the relationship between deposit insurance and banking risk document an increase in risk associated with the implementation of deposit insurance or with it being more generous in terms of coverage. Relevant papers include Wheelock and Wilson (1995), Demirgüç-Kunt and Detragiache (2002), Hovakimian et al. (2003), Cull et al. (2005), Hoggarth et al. (2005), Wagster (2007), Anginer et al. (2014), Boyle et al. (2015), Ngalawa et al. (2016), Lambert et al. (2017), Kusairi et al. (2018), and Calomiris and Jaremski (2019). Papers that come to a different conclusion include Karels and McClatchey (1999), Eichengreen and Arteta (2002), Gropp and Vesala (2004), Nier and Baumann (2006) and Liu et al. (2017). Another strand of the literature that builds on theoretical models supports a more complicated relationship between coverage levels and banks' risk.[6] Chiaramonte et al. (2020) argue for a dynamic approach where the optimal coverage level depends on the economic cycle.[7]

Studies that focus directly on deposit insurance and market discipline worldwide start with (Mondschean and Opiela, 1999). They find that, before explicit deposit insurance, interest rates in Poland were significantly related to individual bank characteristics. This effect

[1] All currency conversions are made using the average exchange rate when the change was implemented.

[2] A relevant discussion regarding the term market discipline is presented in Flannery (2001).

[3] Another strand of the literature finds similar conclusions when looking at bank debt. See, for instance, Flannery and Sorescu (1996).

[4] Papers that study market discipline in the Colombian case include Steiner and Barajas (2000) and Márquez (2011). A recent paper that analyzes depositor's behavior following the increase in the coverage level using a survey is De Roux and Limodio (2021).

[5] Calomiris and Jaremski (2016) present a summary of relevant research regarding the risks that can be increased because of deposit insurance both in cross-country and country-specific studies. A good overview of DIS and their implications on moral hazard is presented in McCoy (2008).

[6] Examples of this approach can be found in Angkinand and Wihlborg (2008, 2010), Manz (2009) and Dávila and Goldstein (2020).

[7] Other related papers are Shy et al. (2016) and Iyer et al. (2017).

diminished after deposit insurance implementation. Martinez Peria and Schmukler (2001) evaluate the interaction between market discipline, deposit insurance, and banking crises using data for Chile, Mexico and Argentina during the 1980s and 1990s. They find that depositors discipline banks by withdrawing deposits and by requiring higher interest rates. Deposit insurance does not appear to diminish this. They suggest that this might happen because deposit insurance is not fully credible in the countries studied. Demirgüç-Kunt and Huizinga (2004) analyze the sensitivity of banks interest rates and deposit growth to deposit insurance and several of its features. Per their findings, explicit deposit insurance lowers market discipline; so does higher coverage levels. Imai (2006) studies the impact of deposit insurance on market discipline by examining a reduction of the coverage level in Japan in 2002. The coverage level changed from unlimited to limited at that point in time. He finds that market discipline increased when coverage was limited. Ioannidou and de Dreu (2006) use data from Bolivian banks and find that, when coverage is increased above 60% per bank, market discipline diminishes; it is eliminated when coverage is unlimited.[8] They also find that most market discipline comes from large depositors. On a related paper, Ioannidou and Penas (2010) find that there is a reduction in market discipline following deposit insurance introduction in Bolivia.

Peresetsky (2008) and Chernykh and Cole (2011) study Russian banks and find that market discipline weakened after deposit insurance was established. Hadad et al. (2011) analyze market discipline in Indonesia and the impact of regulatory changes, including the establishment of limited deposit guarantees. They find evidence of market discipline, but that it diminished because of deposit insurance.[9] Distinguin et al. (2013) find that market discipline is effective in countries in Central and Eastern Europe in the presence of explicit deposit insurance. Aysan et al. (2017) study a dual banking system, examining how market discipline operates in an Islamic setting.

Recent papers have studied the effect of the 2008 financial crisis on market discipline.[10] Using data from Russian banks, Pyle et al. (2013) find that the wake-up call effect of a financial crisis on market discipline is diminished in the presence of deposit insurance. Hasan et al. (2013) find weak evidence of market discipline in a set of emerging economies in central European countries and no change in it during the financial crisis. Bennett et al. (2015) investigate market discipline by looking at the dynamics of the liability structure of banks in the US. Their results are consistent with market discipline. Berger and Turk-Ariss (2015) study how measures taken during the 2008 financial crisis, including increases in deposit insurance coverage levels, impacted market discipline in the United States and the European Union. With the exception of small US banks, their results point to a reduction in market discipline after the crisis.

Finally, papers that take too-big-to-fail considerations into account when studying market discipline include Jacewitz and Pogach (2018) and Guo and Prezas (2019). The former finds evidence of too-big-to-fail subsidies captured by large US banks through lower risk premiums on uninsured deposits. The latter analyses US bank holding companies (BHC) and finds that market discipline differs between the largest BHC and others. Beyhaghi et al. (2014) study the extent to which market discipline exists in the Canadian banking sector and if large banks have a funding advantage over smaller ones. Bertay et al. (2013) study an international sample of banks and find that the sensitivity of a bank's interest cost to its capitalization rate rises with the bank's size. Evidence presented in Cubillas et al. (2017), however, is consistent with less market discipline in large banks than in smaller ones for the period before the 2007 global crisis. The effect, however, varies by country and depends on how countries have dealt with banking crises in the past.

Finally, there is agreement about the relevance of coverage levels among practitioners. According to the IADI Core Principles (International Association of Deposit Insurers, 2014), coverage should be limited, credible, and cover the large majority of depositors. A substantial amount of deposits, however, should be left exposed to market discipline. There is less agreement—and guidance for that matter—about how to measure market discipline within the system, or on how to assess the impact that coverage levels or changes in them might have on it. There is also less discussion about when levels should be increased and what considerations to take into account when doing so.

All in all, whereas previous papers have studied market discipline, either by itself, in conjunction with the implementation of deposit insurance, or its effects in relationship with financial crises, less has been said about how market discipline is impacted by coverage changes that happen absent these scenarios—in "peaceful" times. Understanding the sensitivity of market discipline to changes in coverage levels in these instances, however, is the question that DIS face regularly. This study adds relevant elements to this discussion by using a novel data set, a unique and unexplored natural experiment, and a clean methodological approach using several risk variables. By including other considerations, such as the effect of size, and the concentration in partially insured versus fully insured depositors, it further underscores the nuances in the relationship between deposit insurance coverage levels and banks' risk in emerging economies. This further complements studies that have analyzed some of these features in developed ones.

3. Methodology

3.1. Market discipline

In order to study market discipline I follow the literature that simultaneously looks at the relationship between banks' risk and two variables: interest rates paid by banks to depositors, and the amount of deposits offered by these depositors to banks. A correlation between the risk taken by banks and the interest rate they pay depositors could be evidence of market discipline. However, as detailed in Park and Peristiani (1998), this result could also be masking potential demand driven effects. Risky banks, for example, could offer lower rates to reduce their liabilities as a response to regulatory pressures. On the other hand, evidence of a correlation between the risk taken and both the interest rates paid and the quantity of deposits would be consistent with a shift in the supply curve—i.e. with market discipline—but not with a shift in the demand curve. Thus, analyzing both variables helps me rule out potential demand side explanations.

I first study the relationship between funding rates and banks' risk variables. If the market imposes discipline, depositors will need to be rewarded with higher rates by riskier banks. Otherwise they will simply invest their money with less risky competitors. I use the following reduced form equation to explore the existence of market discipline within Colombia's financial sector:

$$r_{it} = \mu_i + \alpha_t + \beta' BankInd_{i,t-j} + \gamma' Controls_{it} + e_{it}, \quad (1)$$

where i corresponds to each individual bank, $i = 1, \ldots, N$, and t corresponds to the time script, $t = 1, \ldots, T$, with T equal to the number of monthly observations in the sample. The dependent variable, r_{it}, is the interest rate paid to depositors by bank i at time t. μ_i and α_t capture fixed effects for bank and time, respectively.

$BankInd_{i,t-j} = [BankInd_{i,t-j,1}, BankInd_{i,t-j,2}, \ldots, BankInd_{i,t-j,k}]'$ are banks' risk variables, where $\beta' = [\beta_1, \beta_2, \ldots, \beta_k]$, and k is the number of variables included in the analysis. e_{it} is the standard error. $BankInd_{i,t-j}$ is included with a lag of $j = 3$ months because data is usually available

[8] According to the authors, the Bolivian system is different to other schemes: coverage limit is per bank rather than per depositor. Thus, 60% corresponds to the maximum amount covered per bank.

[9] Nys et al. (2015) also study Indonesian data. They find that limited coverage increases market discipline but that it is impacted by banks' political connections. A similar analysis for Turkey is presented in Disli et al. (2013).

[10] Cubillas et al. (2012) looks at the effect of earlier banking crises on an international bank data set.

to the public with this lag. Including data with a lag also helps deal with possible endogeneity issues.[11]

The existence of market discipline will be linked to the significance of the β indicators in Eq. (1). There will be evidence of market discipline if these coefficients have the expected sign, and if they are statistically significant. The expected sign will differ depending on the meaning of each of the specific risk variables.

For r_{it} I use an implicit rate calculated by dividing the total interest rate expenses by the total interest-bearing liabilities.[12] Using explicit rates would have been another option but the data was incomplete.

Some previous papers that study country-specific data do not use fixed effects for banks but control using specific bank-related variables (e.g. Mondschean and Opiela, 1999; Chernykh and Cole, 2011). Others, such as Martinez Peria and Schmukler (2001) and Imai (2006), include fixed effects directly and do not include additional control variables at the bank level. I include all relevant fixed effects, but I also include those controls most widely used in the literature ($Controls_{it}$). The first one is a proxy for size, the natural logarithm of the total assets (lACT).[13] The second one captures bank-ownership: it is a dummy variable (FOR) that is equal to 1 for foreign-owned banks and 0 for locally-owned ones.[14] The third one (LIQ) is a proxy for liquidity, and is defined as liquid assets (short cash or equivalents) divided by total assets.[15] Bank fixed effects are captured by μ_i.

α_t accounts for time effects. Some authors use more infrequent time dummies than the periodicity of the data itself—e.g., using quarterly time dummies with monthly data. I use monthly dummies, which match the frequency of my data, but also report results using quarterly data as a robustness check (see Section 5.3).

Regarding $BankInd_{i,t-j}$, the literature uses different indicators for banks' risk variables. For instance, Calomiris and Chen (2018) use metrics that quantify the risk of assets (e.g., loans to assets ratio, % of household loans). Gropp and Vesala (2004) combine values from the asset and the liability side of the balance sheet (e.g., the ratio between retail deposits and total assets or total loans). Another approach is used by Anginer et al. (2014), who use z-scores.[16] Imai (2006) uses ratings from one of the nationally recognized statistical rating organizations. Martinez Peria and Schmukler (2001) use a combination of variables from CAMEL rating systems.[17]

I analyze market discipline including alternatively those proxies of bank risk most frequently found in the recent literature.[18] I use three variables for capturing banks' risk. First, I use a measure of capital adequacy (C), calculated as total capital divided by total assets.[19] Banks with higher values of C should be able to offer lower interest rates. If there is market discipline, the β coefficient for this variable should be negative. My second variable is a proxy for asset quality (Q). I use the ratio of non-performing loans divided by total assets.[20] Higher values of non-performing loans would imply a riskier bank. Thus, a positive β coefficient is associated with market discipline. Finally, I use the z-score (Z), defined previously.[21] In the case of the z-score, higher values of this variable should be associated with a less risky bank. Thus, I expect a negative association with interest rates.[22]

I adjust errors for heteroskedasticity and autocorrelation, and focus on these results in Section 5 in terms of my conclusions. Following Petersen (2009), OLS and White standard errors can be biased when firm and time effects are present. This is a characteristic of panel data in general and of the type of data I am using in particular. Moreover, in the case of panel data heteroskedasticity is less of a problem, but autocorrelation within clusters might be relevant and change results' significance. This is the case with autocorrelation within individual banks in the type of data set used in this paper.[23]

I follow up my initial exploration of market discipline by using growth in real deposits as my dependent variable. To test this I replace r_{it} in Eq. (1) by a new dependent variable:

$$dlDEP_{it} = \mu_i + \alpha_t + \beta' BankInd_{i,t-j} + \gamma' Controls_{it} + e_{it}, \quad (2)$$

where $dlDEP_{it}$ corresponds to the one-quarter difference of the natural logarithm of real deposits.[24] As presented in Ioannidou and de Dreu (2006), however, in the case of deposits finding significance will be harder given the use of growth rates instead of levels—which are used in Eq. (1). The authors suggest using quarterly average growth rates to address this issue. A different approach is taken by Imai (2006), who uses levels instead of growth rates and includes a dummy trend variable. I present results from Eq. (2) using quarterly growth rates, but using other alternatives the results are not very different.

3.2. The coverage change

After examining the presence of market discipline, I look for changes in it due to the 2017 increase in the coverage level. For this I use a modified version of Eq. (1). To account for the change I include a dummy variable, D_t, which is equal to 1 for the period when coverage was increased and 0 elsewhere.[25] I use the following equation:

$$r_{it} = \mu_i + \alpha_t + \beta' BankInd_{i,t-j} + \delta D_t + \theta' D_t \times BankInd_{i,t-j} + \gamma' Controls_{it} + e_{it}, \quad (3)$$

[11] Including banks' risk variables with a 3 month lag does not change the fact that I use data at a monthly frequency. I am only reflecting the fact that these variables are available to the public three months after each month-end.

[12] This value includes the cost of other liabilities, but any impact of this on the results should be minor since Colombia's banks are funded mostly through deposits: for April 2017, the ratio of deposits to other liabilities was about 3 to 1. This ratio is consistent throughout the sample period.

[13] This variable is used in Anginer et al. (2014) and Lambert et al. (2017), among others.

[14] Foreign ownership is used as a control variable by Hasan et al. (2013) and Berger and Turk-Ariss (2015), among others.

[15] This variable is used, for example, in Nys et al. (2015) and Pyle et al. (2013). Some other authors include liquidity as a risk variable. A different possibility for liquidity would have been using the liquidity coverage ratio but data was not available for all the time needed.

[16] z-score is a measure that is linked to the distance to default. It is calculated as the sum of average bank return on assets (net income divided by total assets) and the bank equity to assets ratio, scaled by the standard deviation of the return on assets.

[17] In these models C stands for capital adequacy, A for asset quality, M for management, E for earnings and L for liquidity. CAMEL models have evolved and involve additional parameters in some countries. In the US, for instance, they now include an additional S (CAMELS) that accounts for sensitivity to market risk.

[18] A different approach could have been incorporating all the risk variables simultaneously. Since these are correlated, it is more difficult to study the impact on market discipline of the change in the coverage level.

[19] This is one of the most used variables for capturing risk. It is used, for example, in Berger and Turk-Ariss (2015), Aysan et al. (2017) and Pyle et al. (2013).

[20] This is also a variable commonly used in the literature. Examples include Nys et al. (2015), Hasan et al. (2013) and Cubillas et al. (2012).

[21] Besides Anginer et al. (2014), this is also used in Lambert et al. (2017), among others.

[22] I further tested loans/assets as a risk variable, a metric that quantifies the risk of assets and is proposed by Calomiris and Chen (2018). It did not show a strong relationship with the independent variable. This paper proposes two additional metrics to capture banks' risk: household lending as a percentage of total loans, and the debt/assets ratio. I did not test the first ratio since, as stated by the authors, it is used because of its relationship with systemic risk in the banking system — but it might not by itself be a sign of a riskier bank. The second one is similar to one I am already using (capital adequacy).

[23] I use cluster-corrected errors by bank in the results presented in Section 5. Clustering by both dimensions (time and bank) yielded similar results.

[24] $dlDEP_{it} = ln(DEP_{it}) - ln(DEP_{it-3})$. DEP_{it} corresponds to real deposits of bank i at time t.

[25] Thus, $D_t = 0$ for data up to, and including, March 2017, and $D_t = 1$ for data from April 2017 onward.

which expands Eq. (1) by including the aforementioned dummy and an interaction term between it and the matrix of banks' risk variables.[26] The coefficients of interest are those linked to these interaction terms, which are picked up in the $1 \times k$ vector $\theta' = [\theta_1, \theta_2, \dots, \theta_k]$. They will show if there is a change in the sensitivity of the risk variables due to the change in coverage level. If market discipline declined after the coverage level was increased, these coefficients should be significant and have the opposite sign of the terms in the β vector. Furthermore, the sum of the variables in the θ vector and the corresponding variables in the β vector will give a sense of the market discipline remaining after the change. If variables in the $\beta + \theta$ vector still have the expected sign—as per the original interpretation—market discipline may have been diminished but has not been eliminated.

Likewise, I do the analysis using deposit growth as dependent variable. For this I use a modified version of Eq. (2):

$$dlDEP_{it} = \mu_i + \alpha_t + \beta' BankInd_{i,t-j} + \delta D_t + \theta' D_t \times BankInd_{i,t-j} + \gamma' Controls_{it} + e_{it}, \quad (4)$$

where variables have the same interpretation as in previous equations. Intuition for this equation is similar to that of Eq. (3). Since the relationship between the risk variables and the dependent variable is the opposite, however, the coefficients' expected signs are the opposite as well.

3.3. Including other variables

I expand the analysis by including additional interaction terms in Eqs. (3) and (4). My interest is to understand if other variables impact funding costs, and if results regarding market discipline change when I include them.

First, I study the effect of size. Colombia is a small economy, and none of its banks are systemically important worldwide. However, some of them might still be perceived as too-big-to-fail in a local context. Is there evidence of this when studying market discipline, i.e., can they offer lower rates than smaller banks with similar risk characteristics? Further, is market discipline affected by banks' size?[27] To test this, I include a dummy variable that is equal to 1 for big banks, which I define as those that have more than 5% of total assets within the system.[28]

Secondly, I am interested in examining if there is a link between a higher concentration in fully insured depositors and market discipline. One would expect partially insured depositors to be more sensitive to coverage levels. This would be consistent with evidence presented by Martin et al. (2018), among others. Similar to what I did with size, I include a dummy variable that equals 1 for those banks that have the highest proportion of small, fully insured depositors.[29]

4. The 2017 increase in the coverage level

4.1. Colombia's financial sector

Colombia's financial system is dominated by a handful of domestic conglomerates that link together different participants within the system. As of 2019, there are 45 credit institutions and the banking sector's assets are approximately 65% of the country's GDP. Most of the institutions operating in the country continue to be domestic (60% of them), and local banks are also the biggest players: they hold close to 75% of total assets. Private players are dominant. There is only one public bank, which accounts for approximately 4% of the sector's total assets. The latest developments in the sector involve big institutions expanding into neighboring countries in Central America. Some regional players are also gaining presence in the country.

Loans comprise about 70% of credit institutions' assets (more than 50% of the loans correspond to commercial loans), investments 20% and cash roughly 5%; other assets make up the remaining 5%. On the liability side, deposits account for 65% of total assets, equally distributed among saving accounts and term deposits and with a lower participation of demand deposits. Most deposits are in Colombian pesos (COP). Dollar-denominated deposits are negligible.

4.2. The deposit insurance scheme and the coverage change

The Colombian government created its DIS for financial institutions, Fogafín, following a financial crisis in the early 1980s. One of its main objectives was the development of a deposit insurance scheme; others included participating in resolution mechanisms and providing open bank assistance to credit institutions. Fogafín works in close relationship with the central bank, the financial supervisor—which oversees all financial institutions—and the ministry of finance. These authorities constitute Colombia's main participants in what is usually referred to as its financial safety net.

Deposit insurance is compulsory for all credit institutions. It covers different types of deposit accounts (mainly demand deposits, saving accounts and term deposits). Since the coverage is per institution, in case more than one bank fails simultaneously, effective coverage might be higher. Deposit insurance payment is triggered when the financial supervisor orders the liquidation of an institution. Fogafín claims to be able to pay most of insured depositors within 7 days of the closure of the failing entity.

As discussed earlier, the coverage limit up to 2017 was COP 20 million per person per institution (USD 6000). On April 18th, 2017, Fogafín's Board of Directors increased this coverage level to COP 50 million (USD 15,000). The increase was announced the next day and recorded by the press accordingly. As presented by the head of the institution then, "the decision to update the deposit insurance coverage is only due to the need to maintain its purchasing power, and it is always better to do so in moments of solidity of its institutions and not in times of crisis".[30]

Other potential motives for increasing the coverage level could be the existence of a more robust deposit insurance fund, since it had grown steadily through the years.[31] Alternatively, it could have been increased anticipating potential vulnerabilities in the financial system. But there is nothing in the press or in Fogafín's documents that indicates that these other factors could be behind the increase in the change in coverage. Moreover, the financial system was not particularly at risk, as detailed in the central bank's periodic financial stability report.[32] Finally, there is nothing in the newspapers discussing this increase before it was announced. It thus seems reasonable to think it was indeed abrupt, exogenous, and unanticipated.

[26] In the cases where I use time fixed effects it will not be possible to estimate $\delta for D_t = 1$.

[27] As mentioned in Section 2, this hypothesis would be consistent with evidence presented in Beyhaghi et al. (2014), Cubillas et al. (2017), and Guo and Prezas (2019).

[28] There are five big banks using this threshold; the rest of them are categorized as small. An alternative approach would have been to use some specific percentile to divide the sample, but the emphasis in this case is in comparing big banks versus the rest of them.

[29] I partition the data using the ratio insured deposits/total deposits, and define banks that fund mostly through fully insured deposits as those in the upper quintile of the distribution.

[30] https://www.eltiempo.com/economia/finanzas-personales/seguro-de-depositos-cuentas-bacarias-79496.

[31] See https://www.fogafin.gov.co: "Informe de Gestión 2017".

[32] https://www.banrep.gov.co.

Table 1
Summary statistics of relevant variables.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
IR	5322	0.056	0.016	0.022	0.044	0.055	0.066	0.095
dlDEPR	5199	0.033	0.108	−0.219	−0.014	0.018	0.061	0.477
C	5322	0.183	0.149	0.069	0.106	0.132	0.185	0.846
Q	5322	0.040	0.029	0.000	0.022	0.035	0.054	0.137
Z	5315	2.330	1.064	−0.531	1.800	2.075	2.728	5.392
lACT	5322	21.343	2.130	16.733	19.927	21.030	23.236	25.245
FOR	5322	0.250	0.433	0	0	0	0	1
LIQ	5322	0.165	0.132	0.028	0.087	0.127	0.186	0.680
D	5322	0.331	0.470	0	0	0	1	1

Note: This table reports the summary statistics of the variables used in most of the analyses in the paper. The data set consists of 63 banks and goes from January 2010 to December 2020 (132 months). IR is calculated as total interest rate expenses divided by total interest-bearing liabilities. dlDEPR corresponds to the quarterly difference of the natural logarithm of real deposits. Capital adequacy (C) is calculated as total capital divided by total assets. For asset quality (Q), I use the ratio of non-performing loans divided by total assets. (Z) is the natural logarithm of the z-score, which is calculated as the sum of average bank return on assets (net income divided by total assets) and the bank equity to assets ratio, scaled by the standard deviation of the return on assets. lACT equals the natural logarithm of the total assets. FOR is a dummy variable that is equal to 1 for foreign-owned banks and 0 for locally-owned ones. LIQ is defined as liquid assets (cash or equivalents) divided by total assets. D is a dummy variable that is equal to 1 from April 2017 onward, and 0 otherwise. Data is winsorized at a 98% level.

4.3. The data

I use a database that contains monthly aggregate balance sheet information for each bank from January 2010 until December 2020.[33] The dataset consists of 63 banks and more than 5000 observations. Raw data is available at the bank supervisor's web page.[34]

Summary statistics for the variables used are presented in Table 1.[35]

Implied interest rates (IR) range from roughly 2% to 10%. These figures seem reasonable considering an average annual inflation rate of approximately 3.7% during the period of analysis. Real annual deposit quarterly growth averages almost 3%. Mean values for capital are approximately 18% of equity and 4% for non-performing loans. Foreign-owned banks are about 25% of the sample and liquid assets correspond to 17% of the total assets.

5. Results

Columns 1–3 of Table 2 present regression results on the relationship between funding costs and banks' risk variables per Eq. (1). All columns use clustered-corrected errors by bank and include fixed effects for bank and for time.

Results suggest that there is clear evidence of market discipline in the Colombian banking sector. All risk variables are significant. Furthermore, the sign of all three variables is the expected: stronger banks—those with higher levels of capital and less probability of default per the z-score—face lower rates than their peers. The sign of both C and Z is negative. In contrast, those banks with higher levels of non-performing loans are riskier, and are thus required to pay higher interest rates. This matches the sign of the Q variable, which is positive. Finally, I conducted F tests to test for both time and individual effects, and both were highly significant.[36,37]

Regarding controls, size (lACT) influence rates only in the first regression. Foreign ownership (FOR) and liquidity (LIQ) do in all of them. Higher levels of liquidity are associated with lower interest rates, which is similar to what happens with the capital adequacy variable (C). These variables are highly correlated. Foreign banks seem to pay higher interest rates, all else equal.

Table 2
Results using different risk variables in Eqs. (1) and (2).

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.020*			0.372***		
	(0.011)			(0.144)		
Q		0.052**			−0.753***	
		(0.026)			(0.209)	
Z			−0.002***			0.007
			(0.001)			(0.007)
lACT	−0.004*	−0.001	−0.001	−0.043*	−0.081***	−0.079***
	(0.002)	(0.002)	(0.002)	(0.023)	(0.024)	(0.026)
FOR	0.003***	0.003**	0.003***	−0.003	−0.0004	0.003
	(0.001)	(0.001)	(0.001)	(0.018)	(0.025)	(0.018)
LIQ	−0.014**	−0.019**	−0.018**	−0.390***	−0.315***	−0.317***
	(0.007)	(0.008)	(0.008)	(0.077)	(0.089)	(0.090)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5322	5322	5315	5199	5199	5199
Adjusted R^2	0.016	0.005	0.022	0.040	0.023	0.015

Note: This table reports results for Eqs. (1) and (2). Columns 1–3 present results for Eq. (1) and columns 4–6 for Eq. (2). In both cases, the columns differ in the risk variable used. Capital adequacy (C), is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. Estimators for time dummies, fixed effects and the constant term are not included in the table but were included in the regression.

*Significance is presented as 10%.

**Significance is presented as 5%.

***Significance is presented as 1%.

I present results using real deposit growth as the dependent variable in columns 4–6 of Table 2. Results are similar to what I found using interest rates, although the case for market discipline is not as strong: all variables have the expected sign but only two of the three variables are significant.

Stronger banks—those with higher levels of capital—exhibit higher deposit growth rates, and higher levels of non-performing loans are correlated with lower growth in deposits. However, the z-score has the expected sign but does not come up as statistically significant. This is similar to what other authors have reported (e.g., Demirgüç-Kunt and

[33] I chose monthly data for all my analyses since it is the frequency with which data is made available to the public. As detailed later, I also use quarterly data as a robustness test.

[34] https://www.superfinanciera.gov.co.

[35] There are a few observations that had no value for the z-score (Z); thus, the lower N value for that variable. It happens similarly for the dlDEPR variable. Summary statistics are presented for the variables effectively used in regressions (i.e., for lagged variables, those discarded are not included).

[36] For the model using the C variable, for example, the F-test for two ways effects was 31.38 with df1 = 197 and df2 = 5120 (p-value < 2.2e−16); results are similar for other risk variables.

[37] I also performed the Hausman test to verify the use of fixed vs. random effects; results support using fixed effects in all models (p-value < 2.2e−16).

Huizinga (2004)) since finding significance when studying growth rates is less straightforward than when using levels.[38]

Size (lACT) influences growth rates, with bigger banks seeing less growth in quarterly deposits. This is also the case for foreign banks (although this variable is not significant) and for those with higher liquidity.

All in all, the findings using both dimensions are in line with what has been reported by Martinez Peria and Schmukler (2001), who find that depositors discipline banks by requiring higher rates and by reducing demand. Results in Table 2 are also consistent with other studies that have found evidence of market discipline in countries where deposit schemes are present (e.g., as presented in Park and Peristiani (1998)). They are also in line with authors that have looked at market discipline using different time, variables and a different specification for the Colombian banking sector (e.g., Steiner and Barajas (2000) and Márquez (2011)).

5.1. The coverage change

Having confirmed that there is indeed evidence of market discipline within the data, results using Eqs. (3) and (4) suggest that is still the case after the 2017 increase in coverage. But this is not true for all variables and specifications. Results are presented in Table 3.

Columns 1 to 3 present results for Eq. (3). Most relevant in this table are the interaction terms between the dummy variable and the risk variables. As can be seen in columns 1 through 3, only one of the interaction terms is significant. Still, the sum of the coefficients for this variable is negative, so market discipline did not disappear altogether. The interaction term of the z-score (Z) variable has the opposite sign but is not significant. Interestingly, the Q variable loses significance when the dummy for coverage is included. Hence, there is less evidence of market discipline when using this variable. Results for the control variables do not change from those shown previously (without the interactions).

Results using deposit growth as the dependent variable and Eq. (4) are presented in columns 4 to 6 of Table 3. They are similar to those presented in the first three columns. In this case, however, the interaction with the z-score shows a significant reduction in the expected relationship. Thus, it seems market discipline was indeed present before the change in coverage but has disappeared after it—which was the result presented in Table 2. This change in the market discipline seems to be related to the profitability variable included in the z-score.

When looking at different countries and the characteristics of their DIS, Demirgüç-Kunt and Huizinga (2004) find that coverage levels do impact market discipline. This is also the case in some of the literature that looks at individual countries, for example Imai (2006). Although the evidence is mixed since the findings depend on the risk variable used, most of the results presented in this paper point to a different conclusion. Several reasons might explain why finding evidence of a change in market discipline is less straightforward for the case studied.

First, results presented in the literature in which coverage levels are found to impact market discipline are usually based on levels changing from zero to a specific coverage level, or from unlimited coverage to a concrete level. These changes happen concurrently with the implementation of deposit insurance or when a blanket guarantee is being phased out. The strength of those results might not hold when deposit insurance is already in place and only coverage levels are changing.

Second, the 2017 change in coverage was not motivated by any concern about the health of the financial system. This is a strength of the setting itself, since it insulates results from any effects related to risks within the financial system. But in this scenario depositors might be less sensitive to what is happening in the financial safety net. This seems to be the case even when awareness of the deposit insurance scheme and its coverage level has been actively increasing. As presented in Pyle et al. (2013), the sensitivity of depositors to risk variables increases with the wake-up call of a financial crisis. Awareness of changes to deposit insurance might be heavily influenced by the presence or absence of a crisis and its direct impact on depositor's finances.[39]

A third reason behind these mixed findings could be in line with Angkinand and Wihlborg (2010). They find that the relationship between deposit insurance coverage levels and market discipline depends on country-specific characteristics of bank governance. This is similar to what is also presented by Kane (2000): how much a deposit guarantee undermines bank safety depends on the country's informational and corporate governance environment. In the case of Colombia, other mechanisms can be limiting any reduction in market discipline. Its risk-adjusted premium system and the compulsory nature of the deposit insurance scheme are design features that might make the system less sensitive to changes in the coverage level. The former penalizes banks directly for any additional risks they take, thus making it more costly to do so. The latter levels the playground for all banks since no one can opt out of the system. Following Cooper and Ross (2002), Anginer

Table 3
Results using different risk variables in Eqs. (3) and (4).

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.020*			0.374***		
	(0.011)			(0.145)		
C:D	0.012*			−0.024		
	(0.005)			(0.044)		
Q		0.043			−0.727***	
		(0.032)			(0.245)	
Q:D		0.021			−0.069	
		(0.037)			(0.252)	
Z			−0.002**			0.021**
			(0.001)			(0.010)
Z:D			0.0000			−0.030***
			(0.001)			(0.010)
lACT	−0.004*	−0.001	−0.001	−0.043*	−0.082***	−0.076***
	(0.002)	(0.002)	(0.002)	(0.023)	(0.024)	(0.025)
FOR	0.003***	0.003*	0.003***	−0.004	−0.0002	−0.003
	(0.001)	(0.001)	(0.001)	(0.018)	(0.025)	(0.021)
LIQ	−0.016**	−0.019**	−0.018**	−0.388***	−0.313***	−0.330***
	(0.006)	(0.008)	(0.008)	(0.077)	(0.090)	(0.086)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5322	5322	5315	5199	5199	5199
Adjusted R^2	0.025	0.006	0.022	0.040	0.023	0.025

Note: This table reports results for Eqs. (3) and (4). Columns 1–3 present results for Eq. (3) and columns 4–6 for Eq. (4). In both cases, the columns differ in the risk variable used. Capital adequacy (C) is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. D is a dummy that is equal to 1 for the period when coverage was increased and 0 elsewhere. Interactions between risk variables and the dummy are presented as X:D, where X corresponds to the specific risk variable. Estimators for time dummies, fixed effects, and the constant term, D, were included in the respective models but are not included in the table.
*Significance is presented as 10%.
**Significance is presented as 5%.
***Significance is presented as 1%.

[38] Similarly to what I did with the model with interest rate as dependent variable, I conducted F tests to test for both time and individual effects. Both are highly significant in this model as well.

[39] This premise is in line with results presented in Martinez Peria and Schmukler (2001). Forssbæck (2011), however, does not find evidence of this effect.

et al. (2014) and Lambert et al. (2017), high capital levels and sound supervision might also be reinforcing market discipline. International Association of Deposit Insurers (2014) mentions timely intervention and holding parties at fault responsible for losses as additional levers in this direction.

Of course, results are also limited by the natural experiment itself: a bigger change in the coverage level might be needed for market discipline to diminish more substantially or to find evidence using all variables. The change in the coverage level was economically significant in terms of increasing it to 250% its original level. Yet, it might not be big enough to alter the dynamics of depositors because still a high proportion of deposits remain partially insured (i.e., a large part of deposits are still subject to potential losses if a bank fails). As presented in Demirgüç-Kunt et al. (2015), ratios of coverage/GDP per capita vary widely worldwide. A ratio of 250%, which is approximately Colombia's coverage level following the 2017 increase, is still not high when compared with other countries.

Finally, there is a methodological observation that could be biasing results towards finding significance in previous papers. Some of them seem to be using White standard errors (not clustered ones). This exclusion ignores possible autocorrelation issues within observations of the same entity. Some statistical significance is lost when the possibility of autocorrelation within clusters is allowed.

All in all, the results presented in this paper highlight that increases in coverage during good times have less effects in market discipline, but also that analyzing various variables can give a more nuanced picture. They might also hint that reductions in liquidity risk associated with these changes could be similarly limited. Increases in coverage levels could thus be less disruptive but also less effective absent a crisis scenario.

5.2. Including other dimensions

I present results when including other dimensions in this section. First I present results when including an interaction with size, by using a dummy to differentiate those banks considered to be "big banks" from the rest of them (i.e., small banks). Results are detailed in Table 4.

The results for small banks—first six rows—mimics that of the complete panel. Coefficients for all of the variables come up with the expected signs and most are significant. The change in the coverage level also has a similar impact to the one it has on the complete sample, with two variables being impacted, one in the quantity and the other in the price dimension (column 6).

The results for big banks—those rows interacted with the dummy BIG—are different. There is no evidence of market discipline when looking only at this group. Thus, while market discipline exists in small banks, even if there might be some evidence it was impacted, it seems to be absent in big banks.

This difference in market discipline between big and small banks is in line with what is reported by Berger and Turk-Ariss (2015). They find less market discipline when analyzing large, listed institutions compared to small, unlisted ones. It also follows the results from Cubillas et al. (2017), who find less market discipline in large banks before the 2007 financial crisis. It is different to what is reported by Bertay et al. (2013), however. They find that systemically large banks are subject to greater market discipline since their funding costs have higher sensitivities to risk variables.

The results when including a dummy that captures deposit concentration are shown in Table 5.

Results for banks that are not concentrated in small depositors are similar to those for all banks. These correspond to those in the first six rows—without any interaction with SMALLD in Table 5. There is clear evidence of market discipline among these banks and only one quantity dimension using the z-score might have been impacted because of the increase in coverage.

Results for banks that concentrate in small, fully insured deposits are very different, though (those interacted with SMALLD). There is no evidence of market discipline in this group. Most coefficients are not significant, and those that do have the opposite sign of that expected. For the most part, these relationships did not change following the increase in the coverage level—though one variable appears significant in one dimension.

All in all, there seems to be evidence of market discipline in institutions that have a relevant proportion of their funding coming from big, partially-insured depositors. Evidence of market discipline in banks concentrated in small, fully-insured depositors is mostly absent.

Table 4
Results - Including the size dimension.

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.021*			0.376**		
	(0.011)			(0.147)		
C:D	0.012**			−0.025		
	(0.005)			(0.044)		
Q		0.042			−0.741***	
		(0.033)			(0.248)	
Q:D		0.021			−0.062	
		(0.037)			(0.255)	
Z			−0.002**			0.021**
			(0.001)			(0.010)
Z:D			−0.0001			−0.031***
			(0.001)			(0.010)
C:BIG	0.004			0.008		
	(0.070)			(0.223)		
C:D:BIG	0.010			−0.049		
	(0.008)			(0.053)		
Q:BIG		0.088			−0.363	
		(0.158)			(0.945)	
Q:D:BIG		−0.035			0.342	
		(0.100)			(0.518)	
Z:BIG			0.001			0.012
			(0.001)			(0.008)
Z:D:BIG			0.0003			−0.006
			(0.001)			(0.004)
lACT	−0.004*	−0.001	−0.001	−0.043*	−0.081***	−0.076***
	(0.002)	(0.002)	(0.002)	(0.023)	(0.024)	(0.025)
FOR	0.003***	0.003*	0.003***	−0.004	0.0005	−0.003
	(0.001)	(0.001)	(0.001)	(0.018)	(0.025)	(0.021)
LIQ	−0.015**	−0.019**	−0.018**	−0.390***	−0.311***	−0.331***
	(0.006)	(0.008)	(0.008)	(0.077)	(0.089)	(0.086)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5322	5322	5315	5199	5199	5199
Adjusted R^2	0.040	0.029	0.040	0.041	0.024	0.026

Note: This table reports results for Eqs. (3) and (4), including a dummy BIG that equals 1 for big banks and 0 for other banks. Columns 1–3 present results for Eq. (3) and columns 4–6 for Eq. (4). In both cases, the columns differ in the risk variable used. Capital adequacy (C) is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. D is a dummy that is equal to 1 for the period when coverage was increased and 0 elsewhere. Interactions between risk variables and the dummy are presented as X:D, where X corresponds to the specific risk variable. Double interactions are presented as X:D:BIG where this last variable corresponds to the dummy for size. Estimators for time dummies, fixed effects, and the constant term, D were included in the respective models but are not included in the table.
*Significance is presented as 10%.
**Significance is presented as 5%.
***Significance is presented as 1%.

5.3. Robustness checks

To test the robustness of the results, I perform several checks by changing certain features of the specification. First, following Bottero

Table 5
Results - Including deposit concentration.

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.032***			0.540***		
	(0.010)			(0.112)		
C:D	0.018			−0.043		
	(0.011)			(0.096)		
Q		0.059*			−0.753***	
		(0.035)			(0.266)	
Q:D		0.030			−0.193	
		(0.044)			(0.257)	
Z			−0.003**			0.030**
			(0.001)			(0.013)
Z:D			0.0004			−0.034***
			(0.001)			(0.011)
C:SMALLD	0.030*			−0.397*		
	(0.017)			(0.234)		
C:D:SMALLD	−0.009			0.043		
	(0.009)			(0.082)		
Q:SMALLD		−0.076			0.067	
		(0.058)			(0.367)	
Q:D:SMALLD		0.001			0.236	
		(0.032)			(0.200)	
Z:SMALLD			0.002			−0.016
			(0.001)			(0.012)
Z:D:SMALLD			−0.002*			0.011
			(0.001)			(0.007)
lACT	−0.003	−0.001	−0.001	−0.048**	−0.082***	−0.076***
	(0.002)	(0.002)	(0.002)	(0.024)	(0.024)	(0.025)
FOR	0.003***	0.003*	0.002***	−0.003	0.001	0.0000
	(0.001)	(0.002)	(0.001)	(0.019)	(0.026)	(0.020)
LIQ	−0.016**	−0.018**	−0.018**	−0.391***	−0.322***	−0.336***
	(0.007)	(0.008)	(0.008)	(0.068)	(0.092)	(0.084)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5322	5322	5315	5199	5199	5199
Adjusted R^2	0.086	0.073	0.092	0.054	0.025	0.029

Note: This table reports results for Eqs. (3) and (4), including a dummy SMALLD that equals 1 for banks concentrated in small, fully insured deposits and 0 for other banks. Columns 1–3 present results for Eq. (3) and columns 4–6 for Eq. (4). In both cases, the columns differ in the risk variable used. Capital adequacy (C) is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. D is a dummy that is equal to 1 for the period when coverage was increased and 0 elsewhere. Interactions between risk variables and the dummy are presented as X:D, where X corresponds to the specific risk variable. Double interactions are presented as X:D:SMALLD where this last variable corresponds to the dummy for deposit concentration. Estimators for time dummies, fixed effects, and the constant term, D were included in the respective models but are not included in the table.
*Significance is presented as 10%.
**Significance is presented as 5%.
***Significance is presented as 1%.

et al. (2015), I replace all independent variables by the values they had before the increase in coverage and use these values for the months after the reform. Secondly, I include a timing element for the period after the coverage was increased to reflect a potential fading of the response. Thirdly, I do the analysis using quarterly rather than monthly data. This makes the number of time observations smaller than the number of units (banks), and might show if I have any bias due to the use of monthly data. The results for these analyses are presented in Tables A.6 to A.8 in Appendix. There is some variation in the significance of the coefficients, but the main results hold in all the specifications.

Table A.6
Results using December 2016 values in Eqs. (3) and (4).

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.024**			0.390**		
	(0.011)			(0.157)		
C:D	0.008*			−0.033		
	(0.004)			(0.041)		
Q		0.073**			−0.675**	
		(0.031)			(0.317)	
Q:D		0.038			0.094	
		(0.037)			(0.243)	
Z			−0.002**			0.018*
			(0.001)			(0.010)
Z:D			0.001			−0.038***
			(0.002)			(0.014)
lACT	−0.004*	−0.001	−0.001	−0.043**	−0.081***	−0.075***
	(0.002)	(0.002)	(0.002)	(0.021)	(0.025)	(0.025)
FOR	0.003***	0.002**	0.003***	−0.001	0.003	−0.001
	(0.001)	(0.001)	(0.001)	(0.017)	(0.021)	(0.018)
LIQ	−0.015**	−0.020***	−0.017**	−0.385***	−0.318***	−0.325***
	(0.006)	(0.008)	(0.008)	(0.078)	(0.092)	(0.085)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5322	5322	5315	5199	5199	5199
Adjusted R^2	0.032	0.029	0.014	0.041	0.018	0.026

Note: This table reports results for Eqs. (3) and (4) replacing independent variables by their December 2016 values for all months in 2017 and 2018. Columns 1–3 present results for Eq. (3) and columns 4–6 for Eq. (4). In both cases, the columns differ in the risk variable used. Capital adequacy (C) is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. D is a dummy that is equal to 1 for the period when coverage was increased and 0 elsewhere. Interactions between risk variables and the dummy are presented as X:D, where X corresponds to the specific risk variable. Estimators for time dummies, fixed effects, and the constant term, D, were included in the respective models but are not included in the table.
*Significance is presented as 10%.
**Significance is presented as 5%.
***Significance is presented as 1%.

6. Conclusions

The world has moved toward including DIS as a standard feature of financial safety nets. Hence, learning how to design them effectively will become increasingly important going forward. Coverage levels are one of the key elements in the design of these schemes, so understanding how they relate to market discipline will help keep moral hazard in check. Appropriate coverage levels thus can help insure that the benefits of deposit insurance outweigh its costs.

Most of the literature finds that the introduction of deposit insurance—or its withdrawal—impacts market discipline. Less has been said about the effect that changes in coverage levels have on operating schemes absent a financial crisis. In this paper I find that, for the setting I study and most of the variables analyzed, market discipline was not significantly impacted when coverage levels were increased. I present several hypotheses about why this might be the case, and I discuss how they relate to what other authors have found. Conclusions are nuanced, however, since this is not the case for both dimensions—price and quantity—and all risk variables. I also document that the relationship between coverage levels and market discipline is not homogeneous among banks. First, market discipline is impacted by local too-big-to-fail perceptions within the system: it is not present in big banks. Second, it is mostly absent in banks with a high reliance on small, fully insured depositors.

In terms of policy, the results of this paper provide evidence of the presence of market discipline in emerging markets. They also support

Table A.7
Results using time decay instead of dummy in Eqs. (3) and (4).

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.020*			0.373***		
	(0.011)			(0.144)		
C:D	0.012**			−0.014		
	(0.005)			(0.054)		
Q		0.044			−0.725***	
		(0.032)			(0.236)	
Q:D		0.021			−0.087	
		(0.038)			(0.253)	
Z			−0.002**			0.020**
			(0.001)			(0.010)
Z:D			−0.0002			−0.029***
			(0.001)			(0.010)
lACT	−0.004*	−0.001	−0.001	−0.043*	−0.082***	−0.077***
	(0.002)	(0.002)	(0.002)	(0.023)	(0.024)	(0.025)
FOR	0.003***	0.003*	0.003***	−0.004	−0.0002	−0.002
	(0.001)	(0.001)	(0.001)	(0.018)	(0.025)	(0.021)
LIQ	−0.016**	−0.019**	−0.019**	−0.389***	−0.313***	−0.329***
	(0.006)	(0.008)	(0.008)	(0.077)	(0.089)	(0.086)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5322	5322	5315	5199	5199	5199
Adjusted R^2	0.025	0.017	0.025	0.041	0.023	0.024

Note: This table reports results for Eqs. (3) and (4) but using a time decaying variable instead than a dummy variable after the change in the coverage level. Columns 1–3 present results for Eq. (3) and columns 4–6 for Eq. (4). In both cases, the columns differ in the risk variable used. Capital adequacy (C) is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. D is a dummy that is equal to 1 for the period when coverage was increased and 0 elsewhere. Interactions between risk variables and the dummy are presented as X:D, where X corresponds to the specific risk variable. Estimators for time dummies, fixed effects, and the constant term, D, were included in the respective models but are not included in the table.
*Significance is presented as 10%.
**Significance is presented as 5%.
***Significance is presented as 1%.

Table A.8
Results using quarterly data in Eqs. (3) and (4).

	Dep variable: IR/dlDEPR					
	(1)	(2)	(3)	(4)	(5)	(6)
C	−0.019*			0.345***		
	(0.011)			(0.132)		
C:D	0.012*			0.017		
	(0.006)			(0.048)		
Q		0.045			−0.710***	
		(0.035)			(0.258)	
Q:D		0.010			−0.146	
		(0.038)			(0.252)	
Z			−0.002**			0.018**
			(0.001)			(0.009)
Z:D			0.0001			−0.026***
			(0.001)			(0.009)
lACT	−0.004*	−0.002	−0.001	−0.045**	−0.082***	−0.076***
	(0.002)	(0.002)	(0.002)	(0.021)	(0.023)	(0.024)
FOR	0.003***	0.003**	0.003***	−0.003	−0.001	−0.003
	(0.001)	(0.001)	(0.001)	(0.019)	(0.026)	(0.021)
LIQ	−0.016**	−0.018**	−0.017**	−0.385***	−0.302***	−0.325***
	(0.007)	(0.008)	(0.008)	(0.082)	(0.101)	(0.098)
Bank effects	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1776	1776	1774	1735	1735	1735
Adjusted R^2	−0.008	−0.026	0.002	0.017	0.003	0.0001

Note: This table reports results for Eqs. (3) and (4) using quarterly data. Columns 1–3 present results for Eq. (3) and columns 4–6 for Eq. (4). In both cases, the columns differ in the risk variable used. Capital adequacy (C) is calculated as total capital divided by total assets, (Q) is asset quality, the ratio of non-performing loans divided by assets and (Z) is the natural logarithm of the z-score. The other variables correspond to controls. lACT is the logarithm of assets; FOR, a dummy variable that is equal to 1 for foreign banks and 0 otherwise; LIQ is the ratio of liquid over total assets. D is a dummy that is equal to 1 for the period when coverage was increased and 0 elsewhere. Interactions between risk variables and the dummy are presented as X:D, where X corresponds to the specific risk variable. Estimators for time dummies, fixed effects, and the constant term, D, were included in the respective models but are not included in the table.
*Significance is presented as 10%.
**Significance is presented as 5%.
***Significance is presented as 1%.

that it is robust to changes in coverage levels when fully insured deposits, as a percentage of total deposits, are low. This underscores the importance of having other levers of a well-designed, compulsory system such as risk-adjusted premiums, high capital levels and sound supervision. But they also show that results are sensitive to the variable used, highlighting the complexities of the relationship between market discipline and coverage levels. Finally, Colombia's case is particularly relevant for other emerging economies that face similar challenges in terms of financial literacy and concentrated bank systems. Understanding the nuances of market discipline and coverage levels might help them target policy more effectively.

Data availability

Data will be made available on request.

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Appendix

See Tables A.6–A.8.

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