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# **THE RESOLUTION OF BANKING CRISES AND MARKET DISCIPLINE: INTERNATIONAL EVIDENCE**

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## **Abstract**

This paper analyzes the effect of banking crises on market discipline in a sample of 101 banking crises over the 1989-2007 period. We control for unobservable bank, country, and time specific effects using an international panel data set of 3,254 banks from 87 countries. We also evaluate how bank regulation, supervision, institutions, and crisis management policies shape the effect of banking crises on market discipline. Our results suggest that on average market discipline diminishes after a banking crisis. The reduction of market discipline is, moreover, higher in countries where bank regulation, supervision, and institutions promote market discipline before the banking crisis, and where a more accommodating kind of intervention is used. Specifically, forbearance and recapitalizations are the two kinds of interventions that have the most negative effect on market discipline.

*Key words:* Market discipline, banking crisis, crisis resolution, regulation, supervision, institutions.

*JEL Classification:* E43, G01, G21, G28.

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## 1. Introduction

Market discipline is one of the three pillars generally accepted by regulators and scholars to limit the bank risk-shifting incentives exacerbated by financial safety nets. Basel II explicitly emphasizes the strengthening of market discipline (Pillar 3) as well as official supervision (Pillar 2) and regulation (Pillar 1) as tools to increase bank stability. The accommodating intervention policies usually adopted by national governments during banking crises, however, open a debate on the incentives of depositors to discipline bank managers after the crisis. This paper addresses this issue trying to answer three main questions: How do banking crises modify the strength of the market discipline imposed by bank creditors to control bank risk-taking? How does the variation in a country's market discipline after banking crises depend on its bank regulation, supervision, and institutions? How do the intervention and resolution policies that governments adopt during banking crises affect market discipline?

We aim to respond to these questions by providing empirical evidence on changes in market discipline after 101 banking crises in 87 countries over the 1989-2007 period. Using an international data base allows us to analyze how bank regulation, supervision, institutions, and crisis management policies shape such changes after banking crises.

The literature on market discipline primarily focuses on whether market discipline exists in a particular country during a given period. Most of the papers focus on the U.S. commercial banking industry. They usually provide support for the existence of some market discipline showing that bank risk is positively related to yields on deposits (Baer and Brewer, 1986; Hannan and Hanweck, 1988; Ellis and Flannery, 1992; and Cook and Spellman, 1994), interest rates for uninsured deposits (Flannery and Sorescu, 1996; Hancock and Kwast, 2001), and risk premia on subordinated notes and debentures (Avery *et al.*, 1988; Gorton and Santomero, 1990; and Flannery and Sorescu, 1996). Other papers provide evidence on market discipline by concentrating on the level of deposits (Goldberg and Hudgins, 1996; and Calomiris and Wilson, 2004) or capital buffers held by banks (Flannery and Rangan, 2008). Park (1995) and Park and Peristiani (1998) combine several of the above approaches.

Cross-country data, however, are necessary to see whether the extent of market discipline in a country is affected by its bank regulation, supervision, and quality of institutions. To our knowledge, four empirical papers analyze market discipline across countries. Sironi (2003) obtains evidence of market discipline analyzing bank issues of subordinated debt in 14 European countries. Demirgüç-Kunt and Huizinga (2004) use an international database of

banks from 51 countries to show that the presence of explicit deposit insurance lowers market discipline. They also show that higher explicit coverage, broader coverage, and the existence of earmarked insurance funds, government provision of funds, and public management of deposit insurance lower market discipline.

Nier and Baumann (2006) and Fonseca and González (2010) provide evidence that market discipline has a positive influence on capital buffers in an international bank level database. They also find that market discipline varies across countries depending on the extent of the government safety net, the proportion of banks' uninsured liabilities, accounting disclosure, restrictions on bank activities, official supervision, and institutional quality.

None of these papers, however, have analyzed whether market discipline changes after a banking crisis. We intend to offer empirical evidence on this. Theoretically, banking crises do not have a clear effect on market discipline. On the one hand, following bank interventions and failures, depositors may become more aware of the risk of losing deposits, so they start exercising stricter market discipline. On the other hand, governments usually respond to banking crises with containment and resolution policies that increase bank safety nets and the protection of depositors (Honohan y Klingebiel, 2003). As a consequence, depositors may be more relaxed if a new banking crisis occurs and have fewer incentives to exercise discipline. Since both types of relations are possible, empirical evidence becomes the key issue.

To our knowledge, only Martinez Peria and Schumukler (2001) analyze if the sensitivity of investors to bank risk was affected as a result of the experiences of Argentina, Chile, and Mexico during the 1980s and 1990s. They find that depositors punish banks for risky behavior, by both withdrawing their deposits and requiring higher interest rates. Their results also indicate that the relative importance of market discipline increases after crises and that deposit insurance does not appear to diminish the extent of market discipline. Their data, however, include only a few crises in a small set of countries, so there is some concern regarding degrees of freedom. They do not analyze the impact of any bank regulations apart from deposit insurance. Nor do they analyze the impact of institutions and intervention policies on changes in market discipline after crises.

We make several contributions to this literature. First, we include more crises and countries than previous studies. We analyze 101 banking crises in 87 countries using bank-level data from 3,254 banks over the 1989-2007 period. The availability of an international panel data set allows us to control for unobserved bank, country, and time specific effects.

Second, we provide systematic evidence on the influence of regulation, supervision, and institutions on variations in market discipline after crises. We consider how bank entry requirements, generosity of deposit insurance, official and private supervision, government and private bank ownership, rule of law, and economic freedom of a country modify such variations. We argue that in countries where bank regulation, supervision, and institutions enhance market discipline, a banking crisis would have a larger impact on market discipline. In countries where bank regulation and institutions do not favor market discipline, we do not expect a banking crisis to lead to significant changes in market discipline.

Finally, we examine how crisis management policies influence market discipline after banking crises. We explicitly consider the influence of blanket depositor protection, prolonged and extensive liquidity provision to banks, forbearance, recapitalizations, and nationalizations. We expect a reduction (increase) in market discipline after a banking crisis to be positively (negatively) related to the accommodating policies adopted to manage the crisis.

Our results indicate that on average market discipline diminishes after banking crises. The reduction of market discipline, however, varies across countries. It is greater in countries where bank regulation, supervision, and institutions enhance market discipline before the crisis so the margin for reduction is greater. A banking crisis, however, does not change market discipline in countries where discipline hardly exists before the crisis. In particular, we find a larger reduction of market discipline in countries with less stringent foreign entry restrictions, lower official supervisory power, more private supervision, more private ownership of banks, and better-quality institutions. Our results also show that intervention and resolution tools adopted during a banking crisis affect the variation in market discipline. Specifically, forbearance and recapitalizations are the two resolution policies that contribute most to reducing the sensitivity of deposit interest rates and deposit growth to bank risk after a crisis. Our results are robust to using different country samples and estimation techniques, including instrumental variables and variations in country controls.

The remainder of this paper is organized as follows. Section 2 describes the database, methodology, and variables used in the study. Section 3 discusses the results. Section 4 concludes.

## 2. Data, methodology, and variables

We use bank-specific and country-specific data from a variety of sources. We take the information from Caprio *et al.* (2003) on 168 banking crises of 138 countries since the 1970s. We define the post-crisis period as  $[t+3, T]$  where  $t$  is the crisis inception year reported in Caprio *et al.* (2003) and  $T$  is the end of the sample period, (2007). Kroszner *et al.* (2007) and Dell’Ariccia *et al.* (2008) use a similar definition of the post-crisis period to analyze the real effects of banking crises. We use  $[t, t+2]$  as the crisis period and  $[t_1, t-1]$  as the pre-crisis period, where  $t_1$  is the first year of the sample period (1989). When a country suffers multiple crises, we estimate a single crisis. So, we define the crisis period as  $[t_a, t_b+2]$ , where  $t_a$  and  $t_b$  are the crisis year corresponding to the first and the last crisis, respectively. Consequently, we define the pre-crisis period as  $[t_1, t_a-1]$  and the post-crisis period as  $[t_b+3, T]$ . We check that results do not vary when we use alternative definitions of the crisis period, such as  $[t-3, t+3]$  and  $[t-5, t+5]$ .

Bank-level information comes from Fitch-IBCA Ltd. BankScope Database. Whenever available, we use consolidated bank balance-sheet and income-statement data. All data are expressed in US dollars and in real prices. As BankScope Database provides information since 1989 we refer our analysis to the 1989-2007 period. The proxies for the regulatory and supervisory variables come from the World Bank’s Bank Regulation and Supervision Database and are defined following Barth *et al.* (2004). As proxies of countries’ institutional quality, we use the “Index of Economic Freedom” from the Heritage Foundation and the Rule of Law indicator from the International Country Risk Guide. Information on crisis management policy is obtained from Laeven and Valencia (2008). Macroeconomic data are obtained from the International Financial Statistics of the International Monetary Fund (IMF).

Our final sample includes 101 banking crises and a panel data set of 3,254 banks from 87 countries. Table 1 reports the banking crises analyzed in the paper.

**Table 1**  
**Episodes of Systemic and Borderline Financial Crises**

Albania	1992	Ethiopia	1994	Nigeria	1991, 1997
Algeria	1990	Finland	1991	Norway	1990
Angola	1991	France	1994	Papua New Guinea	1989
Argentina	1989, 1995, 2001	Gabon	1995	Paraguay	1995, 2001
Armenia	1994	Georgia	1991	Philippines	1998
Australia	1989	Ghana	1997	Poland	1992
Azerbaijan	1995	Greece	1991	Romania	1990
Belarus	1995	Guatemala	1990	Russian Fed.	1995, 1998
Bolivia	1994	Guinea	1993	Rwanda	1991
Bosnia Herzeg.	1992	Hong Kong	1998	Sierra Leone	1990
Botswana	1994	Hungary	1991	Slovakia	1991
Brazil	1990, 1994	Iceland	1993	Slovenia	1992
Bulgaria	1996	India	1993	South Africa	1989
Burundi	1994	Indonesia	1994, 1997	Sri Lanka	1989
Cameroon	1995	Italy	1990	Swaziland	1995
Cape Verde	1993	Jamaica	1994, 1996	Sweden	1991
Central African	1995	Japan	1991	Tajikistan	1996
Chad	1992	Jordan	1989	Thailand	1997
China People's	1990	Kenya	1992, 1993, 1996	Togo	1993
Congo, Dem. Rep.	1991, 1994	Korea Rep. of	1997	Tunisia	1991
Costa Rica	1994	Kyrgyzstan	1990	Turkey	1994, 2000
Croatia	1996	Laos	1990	Uganda	1994
Czech Republic	1989	Latvia	1995	Ukraine	1997
Djibouti	1991	Liberia	1991	Uruguay	2002
Ecuador	1996, 1998	Lithuania	1995	Venezuela	1994
Egypt	1991	Malaysia	1997	Vietnam	1997
El Salvador	1989	Mauritius	1996	Yemen	1996
Eritrea	1993	Mexico	1994	Zambia	1995
Estonia	1992, 1998	Myanmar	1996	Zimbabwe	1995

## 2.1. Methodology

Market discipline can be described as a situation in which depositors can penalize riskier banks by requiring higher interest rates or by withdrawing their deposits. We therefore focus on the relationship between bank risk and the cost and growth of bank deposits. We use a standard panel-data approach to control for unobservable bank-specific, country-specific, and time-specific effects. The basic model is:

$$\begin{aligned}
 Y_{i,j,t} = & \beta_0 + \beta_1 \text{Risk}_{i,j,t-1} + \beta_2 (\text{Risk}_{i,j,t-1} \times \text{Crisis}_{j,t}) + \beta_3 \text{Bank}_{i,j,t-1} + \beta_4 \text{Macro}_{j,t} + \\
 & + \beta_5 \sum_{j=1}^{87} \text{Country}_j + \beta_6 \sum_{t=1989}^{2007} \text{Year}_t + \mathcal{V} + \varepsilon_{i,j,t}
 \end{aligned} \tag{1}$$

where  $Y$  is  $\text{Costdep}$  or  $\text{GrowthD}$  and  $i, j, t$  refer to the bank, country and year respectively. We follow Demirgüç-Kunt and Huizinga (2004) to define our two dependent variables.  $\text{Costdep}_{i,j,t}$  is



the cost of deposits for bank  $i$  in country  $j$  in year  $t$ . We measure it as the ratio of interest expense to interest-bearing debt of the bank minus the government interest rate. The government rate is the Treasury bill rate where available; otherwise, it is the discount rate.  $\text{GrowthD}_{i,j,t}$  is the growth of deposits for bank  $i$  in country  $j$  in year  $t$ . We measure it as the growth rate of banks' customer deposits, after dividing by the GDP deflator.

$\text{Risk}_{i,j,t-1}$  is a set of three proxies of risk of bank  $i$  in country  $j$  in year  $t-1$ . We control for the potential endogeneity of risk variables using one lag. Market discipline would imply a positive relation between bank risk and the cost of deposits, and a negative one between bank risk and the growth of deposits.

$\text{Crisis}_{j,t}$  is a dummy variable that takes a value of one for years after the banking crisis and zero for the pre-crisis period. In our specification, the coefficient  $\beta_2$  of the interaction between  $\text{Risk}_{i,j,t-1}$  and  $\text{Crisis}_{j,t}$  would capture the variation in market discipline after the banking crisis, with  $\beta_1$  measuring the importance of market discipline in the pre-crisis period. We check that basic results do not change when we include the crisis period in a separate dummy variable.

$\text{Bank}_{i,j,t-1}$  is a vector of control bank variables potentially affecting bank interest rate and growth in bank deposits. It includes bank size and overhead costs. Like Martínez Peria and Schmukler (2001) and Demirgüç-Kunt and Huizinga (2004), all bank explanatory variables are included with a lag to account for the fact that balance sheet information is available to the public with a certain delay.

$\text{Macro}_{j,t}$  is a vector of macroeconomic variables to control for inflation, real GDP growth, and real GNP per capita in country  $j$ .  $\sum_{t=1989}^{2007} Y_t$  is a set of dummy time variables for each year capturing any unobserved bank-invariant time effect not included in the regression. Finally,  $\mu_i$  is a bank-specific effect, which is assumed to be constant for bank  $i$  over  $t$  and  $\eta_{i,j,t}$  is a white-noise error term.

We estimate regressions using both fixed and random effects. In the random effect estimations we additionally include a set of country dummies ( $\sum_{j=1}^{87} \text{Country}_j$ ) to control for other unobservable country-specific effects apart from those captured by the macroeconomic variables. In the fixed effects estimation we cannot include country dummy variables because they are time invariant. The inclusion of country dummies only in the random effects estimations means that the two

estimations differ not only in the nature of the unobserved bank effects. The Breusch and Pagan (1980) Lagrange multiplier test (LM test) rejects the null hypothesis that errors are independent within banks, i.e., the individual effects are relevant and OLS estimations would be biased. For that reason, we report results with fixed and random effects.

To analyze the influence of both regulation and institutions and intervention policies on variation in market discipline, we sequentially include an interaction term for our proxies of bank regulation, supervision, institutions, and intervention policies in a country ( $RegInt_{j,t}$ ) with the variable capturing the variation in market discipline after the banking crisis ( $Risk_{i,j,t-1} \times Crisis_{j,t}$ ). The model is:

$$Y_{i,j,t} = \beta_0 + \beta_1 Risk_{i,j,t-1} + \beta_2 (Risk_{i,j,t-1} \times Crisis_{j,t}) + \beta_3 (Risk_{i,j,t-1} \times Crisis_{j,t} \times RegInt_{j,t}) + \beta_4 Bank_{i,j,t-1} + \beta_5 Macro_{j,t} + \beta_6 \sum_{j=1}^{87} Country_j + \beta_7 \sum_{t=1989}^{2007} Year_t + \nu + \varepsilon_{j,t} \quad [2]$$

We apply the random effects in this specification given that there is no within-variation in the legal origin variables.<sup>1</sup> As we are interested in the influence of  $RegInt$  on the variation in market discipline, the inclusion of country dummies in the random effects specification also allows us to omit the specific regulatory and institutional variables and focus on the interaction between the regulatory and institutional variables with bank risk and crisis dummy variables.

A major stumbling block when empirical analysis includes regulatory and institutional variables is separating out the effects and the correlated outcomes. Such interrelations and the potential endogeneity of country-level variables make it difficult to tease out the specific effect of each variable and to know which of them plays the major role. Our empirical analysis uses a number of instruments for the observed values of each country variable to identify the exogenous component of the variable and control for potential simultaneity bias. The instruments are defined following Barth *et al.* (2004): four binary variables indicating an English, German, French or Scandinavian legal origin, a country's latitudinal distance from the equator, and three religious composition dummy variables. Religious composition is measured as the percentage of population in each country that is Roman Catholic, Protestant, Muslim or other. This methodology allows us to focus on the influence of the exogenous component of each country

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<sup>1</sup> La Porta *et al.* (2000, 2002) use a random effects specification with the same type of database and legal origin variables.

variable included in  $\text{RegInt}_{j,t}$ .<sup>2</sup>

## 2.2. Bank risk

As in Demirgüç-Kunt and Huizinga (2004) we use three different proxies for bank risk: Equity, liquidity and profit. Equity  $_{i,j,t-1}$  is the book value of bank capital divided by total bank risk-weighted assets. Bank capital is total assets minus total bank liabilities. Liquidity  $_{i,j,t-1}$  is the ratio of liquid assets to total risk-weighted assets. Profit  $_{i,j,t-1}$  is before-tax profit divided by total bank risk-weighted assets. Higher values of Equity, Liquidity, and Profit are expected to indicate lower levels of bank risk. Market discipline would imply a negative coefficient for these variables when the dependent variable is cost of deposits and a positive one when the dependent variable is growth in deposits. A weakening (enhancement) of market discipline after banking crises would imply a positive (negative) coefficient for the interaction between the risk and the crisis dummy variables when the dependent variable is cost of deposits and a negative (positive) one when the dependent variable is growth in deposits.

## 2.3. Bank-level controls

We include in the regressions, as bank-specific characteristics potentially affecting the cost and the growth of bank deposits, the bank's Asset Size and Overhead costs. We use the natural logarithm of total bank assets as a measure of bank size. We control for the influence of size for several reasons. On the one hand, big banks might be thought to have lower cost of deposits if, as the "too-big-to-fail" hypothesis suggests, depositors believe they will receive support from the regulator in the event of difficulties or if they have lower risk as a consequence of the enhanced diversification of their asset portfolio. These arguments might also explain a positive relation between size and growth in bank deposits. On the other hand, larger banks may have higher deposit rates than small banks if they have better investment options or compete more intensively than smaller banks. Larger banks may also have access to more non-deposit sources of liabilities that might lead to a negative relation between size and growth in deposits. Empirical evidence is not conclusive. Most of the empirical studies, using US data, show that

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<sup>2</sup> Results are robust to alternative definitions of the set of instruments. For instance, we check that results do not vary when we use as instruments only the country's legal origin as in La Porta *et al.* (1998), Beck *et al.* (2000), and Levine *et al.* (2000), when we use its legal origin and an index for the efficiency of its legal system produced by the Business International Corporation as in Rajan and Zingales (1998), or when we use the country's legal origin, rule of law, total GDP, and population as in Cetorelli and Gambera (2001).

large banks have lower deposit rates than small banks (Park and Peristani, 1998). Rosen (2007), however, finds that the effect of bank size on deposit rates has evolved over time in the US, with mega-banks recently becoming more aggressive competitors and having higher deposit rates than small banks.

Overhead is defined as non-interest bank expenses divided by assets. Differences in overhead may capture differences in employment or wage levels as well as banks' product mixes and quality of service. Higher expenditures may be associated to less efficient banks. Higher expenditures to total assets, however, may also be associated to better services to customers. If we could control for quality of service, we would expect an increase in noninterest expenditures to have a negative effect on deposits and a positive impact on interest rates. In our case, given that we cannot control for the quality of bank services, the effect of this variable is indeterminate.

Table 2 reports descriptive statistics and correlations for bank and macroeconomic variables. Correlations are consistent with the presence of market discipline: higher values of Equity, Liquidity, and Profit are negatively associated with cost of deposits and positively with growth in deposits.

**Table 2**  
**Descriptive statistics and correlations**

Interest is the ratio of interest expense to interest paying debt. GrowthD is the percentage growth in real customer deposits. Equity is book value of equity (assets minus liabilities) to total assets. Liquidity is defined as liquid assets to total bank risk-weighted assets. Profit is given by before tax profits divided by total bank risk-weighted assets. Asset Size is the natural logarithm of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Data source is the BankScope data base of Fitch IBCA.

Panel A: Descriptive statistics										
	Interest	GrowthD	Equity	Liquidity	Profit	AssetSize	Overhead	Inflation	GrowthGDP	GNP
Mean										
Pre-crisis	0.0824	0.1014	0.2115	0.8110	0.0332	13.7712	0.0895	0.2850	-0.0295	0.0265
Crisis	0.0921	0.0830	0.2897	0.9452	0.0358	12.9969	0.0764	0.3214	-0.0892	0.0128
Post-Crisis	0.0519	0.1684	0.2919	0.9340	0.0345	13.5041	0.0512	0.0784	0.0399	0.0108
Overall	0.0599	0.1505	0.2873	0.9295	0.0346	13.4306	0.0575	0.1312	0.0139	0.0120
Median	0.0467	0.0399	0.1598	0.4843	0.0199	13.2539	0.0364	0.0481	0.0300	0.0038
Minimum	0.0000	-0.9308	0.0059	0.0039	-0.2865	-0.2231	-0.2844	-0.1779	-0.9600	1.91e-08
Maximum	1.2911	6.2622	5.3944	21.2738	0.6917	24.2825	27.1226	24.7715	0.5400	1.0996
Std. Deviation	0.0562	0.6136	0.4378	1.6468	0.0770	2.4377	0.2359	0.8255	0.1661	0.0286
N of obs.	18534	23462	25931	26218	25906	26609	26609	26609	26609	26609

  

Panel B: Correlations										
	Costdep	GrowthD	Equity	Liquidity	Profit	AssetSize	Overhead	Inflation	GrowthGDP	GNP
GrowthD	-0.0013									
Equity	-0.1664***	0.1216***								
Liquidity	-0.0842***	0.0318***	0.5243***							
Profit	-0.2634***	0.0200***	0.4037***	0.3405***						
Asset Size	0.2927***	-0.1281***	-0.3602***	-0.1398***	-0.1764***					
Overhead	-0.1299***	0.0090	0.0927***	0.0334***	0.0904***	-0.1119***				
Inflation	-0.2406***	-0.0876***	0.0312***	0.0297***	0.1272***	0.0114*	0.2270***			
GrowthGDP	0.2611***	0.1560***	-0.0080	-0.0239***	-0.0755***	0.0164***	-0.1018***	-0.4128***		
GNP	0.1730***	-0.0565***	-0.0652***	-0.0306***	0.0532***	0.2359***	-0.0073	0.1964***	-0.1053***	

#### *2.4. Bank regulation, supervision, and institutions variables*

We use a set of proxy variables for regulation, supervision, and institutions in country  $j$  in year  $t$ . These variables include restrictions on bank entry, restrictions on foreign bank entry, the degree of generosity of deposit insurance, official supervisory power, private monitoring, government ownership of banks, private ownership of banks, rule of law, and economic freedom. As these variables may influence the extent of market discipline before the crisis, they may also be expected to affect the change in market discipline after a banking crisis. In particular, we expect more changes in market discipline in environments in which market discipline is more important. However, when regulation and institutions in a country do not promote market discipline before a crisis, we expect changes in market discipline to be less likely following it.

We measure entry restrictions by the number of documents required to obtain a license to operate a bank (Entry). This variable is based on whether or not the following information is required of applicants for a banking license: (1) Draft by-laws; (2) Intended organizational chart; (3) Financial projections for first three years; (4) Financial information on main potential shareholders; (5) Background/experience of future directors; (6) Background/experience of future managers; (7) Sources of funds to be used to capitalize the new bank; and (8) Market differentiation intended for the new bank. Each of these types of submissions is assigned value 1 if it is required and 0 otherwise. Thus, higher values indicate greater restrictiveness. We also check that basic results do not vary when we measure entry restrictions by the fraction of rejected entry applications.

We also include the extent to which foreign banks may own domestic banks and enter a country's banking industry (ForeignEntry). We measure it by adding a value of one for each positive answer to these three questions: 1) Are foreign entities prohibited from entering through acquisition? 2) Are foreign entities prohibited from entering through subsidiaries? 3) Are foreign entities prohibited from entering through branches? Thus, higher values indicate greater restrictiveness to foreign entry.

Entry restrictions may increase banks' charter value and provide incumbent banks with incentives to behave prudently (Keeley, 1990). It would reduce depositors' incentives to monitor banks. We can therefore expect higher barriers to bank entry to diminish the extent of market discipline. We also expect a smaller variation in market discipline after a banking crisis in countries with higher barriers to entry.

We measure the generosity of deposit insurance (Insurance) as the size of the deposit insurance fund relative to total bank assets. Higher values of this variable indicate a greater generosity of deposit insurance in a country.

Since the presence and generosity of deposit insurance lowers market discipline (Demirgüç-Kunt and Huizinga, 2004), we expect a smaller impact of banking crises on market discipline in countries with higher degree of generosity of their deposit insurance system.

We measure a country's official supervisory power (Official) by adding a value of one for each affirmative answer to 14 questions intended to gauge the power of supervisors to undertake prompt corrective action, to restructure and reorganize troubled banks, and to declare a deeply troubled bank insolvent. This variable may range from 0 to 14, and higher values indicate more official supervisory power.

Official supervision can prevent banks from engaging in excessive risk-taking behavior and may thus weaken market discipline. This means we can expect a smaller variation in market discipline after a banking crisis in countries with more official supervisory power.

We measure the intensity of private monitoring by the index given in Barth *et al.* (2004), which captures whether an external audit is required of a bank's financial statements and whether or not there is an explicit deposit insurance scheme. Regarding bank accounting, it indicates whether the income statement includes accrued though unpaid interest or principal on performing and nonperforming loans, whether banks are required to produce consolidated financial statements and whether bank directors are legally liable if information disclosed is erroneous or misleading. It also indicates if banks must disclose risk management procedures to the public, if subordinated debt is allowable as part of regulatory capital and if formal enforcement actions are made public. Higher values for this index mean more private oversight.

Pillar 3 of the Basel II Accord encourages greater bank disclosure to strengthen market discipline. Empirical evidence is consistent with this view, showing that investor monitoring of banks requires the development of accounting systems and information disclosure mechanisms to provide information on the value of banks' claims (Qian and Strahan, 2007; Fernández and González, 2005; Nier and Baumann, 2006). Therefore, if private monitoring enhances market discipline, we can expect a greater variation in market discipline after banking crises in countries with higher values for the private monitoring index.

We measure the influence of bank ownership type by using two variables which indicate the

extent to which the banking system's assets are government or privately owned. These are percentages for Government and Privately-Owned banks respectively. We forecast that depositors will exert less market discipline in countries where much of the banking system is government-owned, since depositors anticipate that the government will rescue the bank in the event of bankruptcy. Therefore, in such countries, the effect of a banking crisis on market discipline should be less than in countries where most banks are privately-owned.

Finally, our indicator of the quality of a country's legal and institutional environment is the Index of Economic Freedom published by the Heritage Foundation (Freedom). This index measures ten components of economic freedom (Business Freedom, Trade Freedom, Fiscal Freedom, Government Size, Monetary Freedom, Investment Freedom, Financial Freedom, Property rights, Freedom from Corruption, Labor Freedom), assigning a grade in each using a scale from 0 to 100, where 100 represents maximum freedom. The ten component scores are then averaged to give an overall economic freedom score for each country. Demirgüç-Kunt *et al.* (2004) and Beck *et al.* (2006) use this index for purposes similar to ours. We also report results measuring the quality of a country's legal environment by the Rule of Law indicator from the International Country Risk Guide.<sup>3</sup>

A growing number of recent papers highlights that well-functioning markets and financial development rely on contracts and their legal enforceability (La Porta *et al.*, 1997, 1998). As the enforceability of contracts is the prime reason why investors have incentives to monitor and why markets develop and progress, market discipline by depositors will be strengthened with the quality of the legal and institutional environment. Therefore, we expect a greater variation in market discipline after banking crises in good-quality contracting environments.

## 2.5. Crisis intervention policy variables

To analyze how the variation in market discipline depends on the forms of intervention during the crisis we use the data on intervention policies compiled by Laeven and Valencia (2008). We differentiate between the containment and resolution phases in crisis policy responses. In the containment phase, we consider two types of intervention using the following variables: 1)

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<sup>3</sup> We check the robustness of our results by including alternative measures of the quality of the legal and institutional environment: (1) We use the Kaufman *et al.* (2006) KKZ index. This is calculated as the average of six indicators: voice and accountability in the political system; political stability; government effectiveness; regulatory quality; rule of law; and control of corruption, and (2) the property rights index from the Economic Freedom index used initially by La Porta *et al.* (1998). Results are not significantly different from those reported.



Blanket Guarantee is a dummy variable which takes on value 1 in cases where governments either issue an explicit blanket guarantee to depositors and creditors after the initial onset of the crisis or in cases where market participants are implicitly protected from any losses if public banks' market share exceeds 75%; 2) Liquidity Support is a dummy variable which takes value 1 if the government provides emergency liquidity support. Our definition of "emergency" support is when claims from monetary authorities on deposit money banks to total deposits are at least 5 per cent and at least twice as much as the year before the crisis.

In the resolution phase, we consider three types of intervention using the following variables: 1) *Forbearance* is a dummy variable which takes value 1 if some banks are permitted to continue functioning despite being technically insolvent or if prudent banking regulations such as loan classification and loan loss provisioning standards are suspended or not fully applied during the first three years of the crisis. 2) *Recapitalization* is a dummy variable which takes value 1 if banks are recapitalized during the first three years of the crisis and 0 otherwise, and 3) *Nationalization* is a dummy which takes value 1 if banks are nationalized during the first five years of the crisis.

We define a new variable (*Total Interventions*) as the sum of all the previous dummy variables. It can take values from 0 to 5. We also consider separately the influence of what are considered resolution interventions (*Resolution*) by adding only the last three dummies (*Forbearance*, *Recapitalization*, and *Nationalization*). These may range from 0 to 3.

We obtain information on crisis resolution policies for 32 systemic banking crises in 29 countries using growth in deposits as the dependent variable. The sample is reduced to 26 crises in 25 countries when we use cost of deposits as the dependent variable.

Honohan and Klingebiel (2003) find that accommodating policies such as blanket deposit guarantees, open-ended liquidity support, repeated partial recapitalizations, debtor bail-outs and regulatory forbearance all tend to add significantly and sizably to the fiscal costs of banking crises. There is, however, no evidence on the effects of crisis intervention policies on market discipline. We expect a more accommodating intervention policy will have negative effects on market discipline because depositors become more relaxed regarding bank supervision if they anticipate similar interventions in future banking crises.

### 3. Results

#### 3.1. Banking crises and market discipline

We now empirically analyze variations in market discipline after banking crises. Table 3 reports the results of model [1] when the dependent variable is the cost of bank deposits. Table 4 reports the results using the growth of bank deposits as dependent variable. Results are reported using both fixed effects and random effects with country dummies.

The results are consistent with the presence of market discipline in our sample of banks during the pre-crisis period. Our three measures of bank risk (Equity, Liquidity, and Profit) are negatively associated with the cost of bank deposits and positively with growth in bank deposits. All the coefficients of bank risk variables in Table 3 are statistically significant at the one percent level. Only profit in column (3) and liquidity in column (5) of Table 4 have no statistically significant coefficients when we use growth in bank deposits as the dependent variable. These results corroborate those found by Demirgüç-Kunt and Huizinga (2004) in a database of 30 countries, with and without banking crises, indicating that riskier banks pay higher interest rates and attract fewer deposits.

The coefficients of interactions between each proxy of bank risk variables and the crisis dummy have the opposite sign to those of the bank risk variables, i.e., the coefficients of the interaction terms are positive when in Table 3 we use the cost of bank deposits as the dependent variable and negative when in Table 4 we use the growth of deposits. Moreover, ten of the twelve coefficients are statistically significant at the 0.05 level or higher. This indicates that market discipline diminishes after a banking crisis, i.e., we observe that the negative (positive) influence that greater capital ratios, liquidity, or bank profitability exert on the cost (growth) of bank deposits decreases after banking crises.

Our finding is consistent with depositors being more relaxed after banking crises because they anticipate that governments are more likely to protect them if a new crisis occurs. The economic magnitude of this effect is substantial. Using, for instance, the results in column (1) of Table 3, a variation of one standard deviation in Equity (0.4378) would reduce the cost of deposits before banking crisis on average by 0.13 times its standard deviation. After a banking crisis, however, the reduction in the cost of deposits is 0.10 times its standard deviation.

**Table 3**  
**Deposit Interest Rates, Market Discipline and Crises**

Results of fixed and random regressions. The dependent variable is the ratio of interest expense to interest paying debt minus Treasury bill rate. Equity, Profit and Liquidity are entered as alternative risk measures. Equity is book value of equity (assets minus liabilities) to total bank risk-weighted assets. Liquidity is defined as liquid assets to total bank risk-weighted assets. Profit is defined as before tax profits to total bank risk-weighted assets. Asset Size is the natural logarithm of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Crisis is a dummy variable that takes a value of one during the post-crisis period and zero during the pre-crisis period. Bank data are from the BankScope data base of Fitch IBCA, macro data are from the IMF's International Financial Statistics and crises episodes are classified by Caprio and Klingebiel (2003). The sample period is 1989-2007. t statistics are given in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1, 5, and 10 percent, respectively.

Dependent Variable: Costdep						
	Fixed Effects			Random Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Equity	-0.0202*** (-4.25)			-0.0224*** (-5.26)		
Liquidity		-0.0055*** (-5.29)			-0.0039*** (-4.53)	
Profit			-0.1484*** (-7.68)			-0.1668*** (-9.71)
Asset Size	0.0078*** (10.92)	0.0097*** (14.33)	0.0088*** (13.48)	0.0005 (1.48)	0.0014*** (4.82)	0.0015*** (5.08)
Overhead	-0.0147** (-2.13)	-0.0189*** (-2.77)	-0.0016 (-0.46)	-0.0207*** (-3.54)	-0.0273*** (-4.74)	-0.0014 (-0.50)
Inflation	0.0029* (1.79)	0.0038** (2.35)	-0.0360*** (-10.62)	0.0048*** (3.27)	0.0057*** (3.86)	-0.0305*** (-9.74)
Growth GDP	0.0330*** (10.13)	0.0327*** (10.11)	0.0204*** (6.20)	0.0377*** (11.84)	0.0370*** (11.70)	0.0250*** (7.73)
GNP	-0.2253*** (-3.14)	-0.1757** (-2.52)	-0.1438** (-2.10)	-0.1596*** (-7.67)	-0.1551*** (-7.48)	-0.1394*** (-6.74)
Equity x Crisis	0.0109** (2.32)			0.0119*** (2.82)		
Liquidity x Crisis		0.0042*** (3.95)			0.0026*** (2.92)	
Profit x Crisis			0.1209*** (6.16)			0.1279*** (7.28)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	No	No	No	Yes	Yes	Yes
R <sup>2</sup> within	11.38%	11.31%	12.07%			
F-test	66.34***	68.27***	72.98***			
R <sup>2</sup> overall				67.65%	67.55%	67.83%
Wald-test				11,525.05***	11,579.13***	11,417.82***
LM test				1,192.61***	1,104.70***	1,236.84***
# observations	15,289	15,375	15,290	15,289	15,375	15,290
# banks	2,493	2,506	2,501	2,493	2,506	2,501
# countries	77	77	77	77	77	77

**Table 4**  
**Deposit Growth, Market Discipline and Crises**

Results of fixed and random regressions. The dependent variable is the percentage growth in real customer deposits. Equity, Profit and Liquidity are entered as alternative risk measures. Equity is book value of equity (assets minus liabilities) to total bank risk-weighted assets. Liquidity is defined as liquid assets to total bank risk-weighted assets. Profit is defined as before tax profits to total bank risk-weighted assets. Asset Size is the natural logarithm of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Crisis is a dummy variable that takes a value of one during the post-crisis period and zero during the pre-crisis period. Bank data are from the BankScope data base of Fitch IBCA, macro data are from the IMF's International Financial Statistics and crises episodes are classified by Caprio and Klingebiel (2003). The sample period is 1989-2007. t statistics are given in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1, 5, and 10 percent, respectively.

Dependent Variable: GrowthD						
	Fixed Effects			Random Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Equity	0.2477*** (3.49)			0.3608*** (6.39)		
Liquidity		0.0513*** (3.15)			0.0201 (1.58)	
Profit			0.3774 (1.48)			0.7391*** (3.30)
Asset Size	-0.2151*** (-20.24)	-0.2289*** (-22.45)	-0.2244*** (-22.11)	-0.0488*** (-11.55)	-0.0617*** (-15.03)	-0.0606*** (-15.03)
Overhead	-0.0785 (-0.71)	-0.0105 (-0.10)	-0.0470 (-0.94)	0.1441 (1.60)	0.2565*** (2.87)	0.0017 (0.04)
Inflation	-0.0582*** (-2.69)	-0.0545** (-2.52)	-0.0838*** (-2.95)	-0.0761*** (-3.77)	-0.0656*** (-3.25)	-0.1085*** (-4.01)
Growth GDP	0.4091*** (8.49)	0.4128*** (8.60)	0.3860*** (7.88)	0.4158*** (8.90)	0.4320*** (9.29)	0.3946*** (8.29)
GNP	-0.5182 (-1.05)	-0.6056 (-1.23)	-0.6605 (-1.34)	-0.4450 (-1.41)	-0.5261* (-1.65)	-0.5438* (-1.72)
Equity x Crisis	-0.1237* (-1.75)			-0.2232*** (-3.93)		
Liquidity x Crisis		-0.0490*** (-2.97)			-0.0191 (-1.47)	
Profit x Crisis			-0.2906 (-1.11)			-0.6561*** (-2.84)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	No	No	No	Yes	Yes	Yes
R <sup>2</sup> within	4.33%	4.05%	3.82%			
F-test	30.04***	28.25***	26.36***			
R <sup>2</sup> overall				5.98%	5.40%	5.22%
Wald-test				832.45***	736.81***	692.83***
LM test				28.27***	31.99***	28.53***
# observations	19,207	19,323	19,220	19,207	19,323	19,220
# banks	3,241	3,254	3,247	3,241	3,254	3,247
# countries	87	87	87	87	87	87

Regarding the coefficients of the bank control variables, Size has positive and statistically significant coefficients when we use the cost of deposits as the dependent variable. This positive coefficient is not consistent with a lower risk expected for larger banks due to, for instance, greater asset portfolio diversification or the anticipation of support from the regulator in the event of difficulties (the Too-big-to-fail hypothesis). It is, however, consistent with larger banks having better investment options or competing more intensively than smaller banks. Size has negative coefficients in Table 4 when we use growth in deposits as the dependent variable. These negative coefficients might be consistent with larger banks having more access to more non-deposit sources of liabilities.

The negative coefficients of Overhead in the regressions in Table 3 suggest that banks which have less administrative and personnel expenses, will probably have to pay higher deposit interest rates to make up for their poorer services to customers. This variable becomes positive and significant in column (5) of Table 4 since customers of banks with higher personnel expenses and better service will be more satisfied, promoting growth in deposits.

Finally, among the macro variables, we see that Inflation has positive coefficients in Table 3 and negative ones in Table 4. This indicates, respectively, that bank interest rates tend to reflect inflation to a higher extent than Treasury bill rates and that higher inflation is associated to lower growth in deposits. GDP growth becomes positive in most specifications whereas GNP per capita is negatively associated to the cost and growth of bank deposits.

### *3.2. Bank regulation, supervision, institutions, and variations in market discipline*

We now analyze whether changes in market discipline after banking crises vary across countries depending on the exogenous component of regulation, supervision, and institutions. We report the results using as the dependent variable the cost of deposits in Table 5 and growth in bank deposits in Table 6. To save space, we present results only using Equity as the risk variable and applying random effects with country dummies. Random effects is the most suitable specification given that there is no within variation in the legal and institutional variables. Results do not change when we use Liquidity and Profit as proxies of bank risk or when we apply fixed effects.

The results confirm a greater reduction in market discipline after banking crises in countries where regulation, supervision, and institutions promote market discipline before the banking

crisis. The triple interaction term capturing the influence of the restriction on foreign bank entry ( $\text{Equity} \times \text{Crisis} \times \text{ForeignEntry}$ ) becomes positive and significant in Table 5 when the dependent variable is the cost of deposits. The interaction between equity and crisis is positive. This indicates that the reduction in market discipline after banking crises is greater in countries with less stringent restrictions on foreign bank entry. The results of Table 6, using growth in bank deposits as the dependent variable, confirm this conclusion. We do not, however, obtain significant coefficients for the triple interaction term capturing the influence of entry restrictions (both domestic and foreign) in Table 5 or Table 6. This suggests that it is restrictions on foreign bank entry, rather than on domestic banks, that have the greater influence on market discipline.

We do not obtain statistically significant coefficients for the triple interaction term between Equity, Crisis and our proxy of the generosity of deposit insurance system, whatever the dependent variable. This result is probably due to the reduction of our sample when we introduce this variable because it is only available for a small set of countries.

The results for Official supervision in Table 5 confirm a smaller reduction in market discipline in countries with more official supervisory power. In column (4), we obtain a positive coefficient for  $\text{Equity} \times \text{Crisis}$  and a negative one for the triple interaction between Equity, Crisis, and Official. Both are statistically significant. This suggests that greater power of official supervisors limits the reduction in market discipline after banking crises indicated by the positive coefficient of the interaction  $\text{Equity} \times \text{Crisis}$ . In Table 6, although the coefficients suggest the same conclusion, they are not statistically significant. This result might indicate that official supervision is a stand-in for private supervision, reducing market discipline before a crisis. Therefore, when a banking crisis emerges, the variation in weak market discipline is also smaller.

The results for the private supervision index are the opposite to those found for official supervision. In column (5) of Table 6, the triple interaction term  $\text{Equity} \times \text{Crisis} \times \text{Monitor}$  has a negative and statistically significant coefficient. This indicates that a banking crisis has a greater reducing effect on the positive relation between bank capital and growth in bank deposits the higher the level of private supervision in the country. We even find a positive coefficient for the interaction between Equity and Crisis, indicating that there is no reduction in a country's market discipline after banking crises when there is no private supervision there. Again, our results indicate that the reduction in market discipline after banking crises is related to the level of market discipline before the crisis. Results for Monitor in Table 5 are in the same vein, although the coefficients are not statistically significant.

Results for bank ownership indicate that the reduction in market discipline after banking crises is greater the larger the private bank ownership and the lower the government bank ownership. The negative coefficient of  $Equity \times Crisis \times State$  in Table 5 decreases the reduction in market discipline after banking crises indicated by the positive coefficient of  $Equity \times Crisis$ . Similarly, the interaction term of  $Equity \times Crisis \times Private$  has a positive coefficient in the cost of deposits equation (Table 5) and a negative one in the growth in deposits equation (Table 6). Both coefficients indicate a greater reduction in a country's market discipline after banking crises the larger the bank ownership there. These results are consistent with a higher percentage of private ownership of banks or a lower percentage of government ownership of banks enhancing market discipline. Once the crisis emerges, the reduction in market discipline is also greater in these countries.

Finally, the results in columns (8) and (9) of Tables 5 and 6 suggest a greater reduction in market discipline after banking crises in countries with more economic freedom and the rule of law. The positive coefficients of  $Equity \times Crisis \times Freedom$  and  $Equity \times Crisis \times Law$  in Table 5 lower the negative relation between bank capital and cost of deposits before the crisis. The reduction is, moreover, greater the greater the economic freedom and the rule of law. In Table 6, the negative coefficients of  $Equity \times Crisis \times Freedom$  and  $Equity \times Crisis \times Law$  lower the positive relation between bank capital and growth in bank deposits before the crisis. This means there is a greater reduction in a country's market discipline after banking crises the greater the economic freedom and the rule of law there. Again, this result suggests a greater reduction in market discipline after a banking crisis in countries where better institutional quality enforces market discipline before the crisis.

**Table 5**

**Deposit Interest Rates, Market Discipline, and Regulatory and Institutional Environment**

Results of random effects regressions. The dependent variable is the ratio of interest expense to interest paying debt minus Treasury bill rate. Equity is book value of equity (assets minus liabilities) to total bank risk-weighted assets. Asset Size is the natural logarithm of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Crisis is a dummy variable that takes a value of one during the post-crisis period and zero during the pre-crisis period. Entry measures the requirements for a banking license, ForeignEntry measures limitations on foreign bank entry and ownership, Insurance measures the generosity of deposit insurance, Official measures official supervisory power, Monitor is the private monitoring index, State is the percentage of banks that are government-owned, Private is the percentage of banks that are privately-owned, Freedom is the Index of Economic Freedom, Law is the component of rule of law of World Governance Indicator. Bank data are from the BankScope data base of Fitch IBCA, macro data are from the IMF's International Financial Statistics, crises episodes are classified by Caprio and Klingebiel (2003) and finally, regulation and institutional variables are derived from Barth et al. (2004). The sample period is 1989-2007. t statistics are given in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1, 5, and 10 percent, respectively.

		Dependent Variable: Costdep								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equity		-0.0202*** (-4.56)	-0.0205*** (-4.57)	-0.0730*** (-5.07)	-0.0198*** (-4.41)	0.0007 (0.11)	-0.0184*** (-4.13)	-0.0225*** (-3.59)	-0.0218*** (-5.12)	-0.0217*** (-5.10)
Asset Size		0.0008** (2.29)	0.0009*** (2.69)	-0.00004 (-0.07)	0.0009*** (2.65)	0.0002 (0.46)	0.0009** (2.56)	0.0002 (0.48)	0.0005* (1.65)	0.0005* (1.65)
Overhead		-0.0164*** (-2.83)	-0.0167*** (-2.84)	-0.0623*** (-5.18)	-0.0166*** (-2.84)	-0.0302*** (-3.55)	-0.0170*** (-2.93)	-0.0107* (-1.66)	-0.0213*** (-3.64)	-0.0217*** (-3.71)
Inflation		0.0007 (0.37)	0.0007 (0.38)	-0.2066*** (-18.42)	0.0008 (0.42)	0.0103*** (5.03)	0.0006 (0.31)	0.0023 (1.18)	0.0048*** (3.28)	0.0049*** (3.30)
Growth GDP		0.0263*** (8.07)	0.0255*** (7.59)	-0.0192*** (-3.45)	0.0246*** (7.32)	0.0127*** (3.44)	0.0249*** (7.53)	0.0320*** (8.50)	0.0374*** (11.73)	0.0373*** (11.70)
GNP		-0.1586*** (-7.68)	-0.1599*** (-7.61)	0.1340 (0.92)	-0.1621*** (-7.81)	-0.1489*** (-7.18)	-0.1612*** (-7.76)	-0.1473*** (-6.53)	-0.1637*** (-7.86)	-0.1618*** (-7.76)
Equity x Crisis		0.0040 (0.22)	0.0149*** (3.26)	0.0654*** (4.45)	0.0204*** (3.06)	-0.0335 (-1.44)	0.0123*** (2.69)	0.0049 (0.72)	-0.0477*** (-4.39)	0.0115*** (2.71)
Equity x Crisis x Entry		0.0008 (0.32)								
Equity x Crisis x ForeignEntry			-0.0180*** (-4.91)							
Equity x Crisis x Insurance				-0.0056 (-1.38)						
Equity x Crisis x Official					-0.0011** (-2.06)					
Equity x Crisis x Monitor						0.0027 (0.98)				
Equity x Crisis x State							-0.0002*** (-2.97)			
Equity x Crisis x Private								0.0001* (1.67)		
Equity x Crisis x Freedom									0.0010*** (5.97)	
Equity x Crisis x Law										0.0058*** (4.17)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup> overall		66.81%	66.91%	53.54%	67.42%	71.41%	66.84%	67.96%	67.70%	67.66%
Wald-test		9,987.17***	9,555.27***	3,637.78***	9,753.32***	8,497.47***	9,841.69***	8,629.13***	11,460.50***	11,442.53***
LM test		1,327.37***	1,282.39***	278.35***	1,169.41***	580.86***	1,323.95***	545.89***	1,189.73***	1,192.68***
# observations		14,207	13,666	5,688	13,484	9,226	13,963	11,051	15,204	15,216
# banks		2,293	2,197	885	2,164	1,430	2,258	1,840	2,476	2,480
# countries		62	60	22	60	45	56	52	74	75



**Table 6**  
**Deposit Growth, Market Discipline, and Regulatory and Institutional Environment**

Results of random effects regressions.. The dependent variable is the growth of bank deposits. Equity is book value of equity (assets minus liabilities) to total bank risk-weighted assets. Asset Size is the natural logarithm of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Crisis is a dummy variable that takes a value of one during the post-crisis period and zero during the pre-crisis period. Entry measures the requirements for a banking license, ForeignEntry measures limitations on foreign bank entry and ownership, Insurance measures the generosity of deposit insurance, Official measures official supervisory power, Monitor is the private monitoring index, State is the percentage of banks that are government-owned, Private is the percentage of banks that are privately-owned, Freedom is the Index of Economic Freedom, Law is the component of rule of law of World Governance Indicator. Bank data are from the BankScope data base of Fitch IBCA, macro data are from the IMF's International Financial Statistics, crises episodes are classified by Caprio and Klingebiel (2003) and finally, regulation and institutional variables are derived from Barth et al. (2004). The sample period is 1989-2007. t statistics are given in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1, 5, and 10 percent, respectively.

Dependent Variable: GrowthD									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equity	0.3930*** (6.52)	0.3959*** (6.51)	0.9726*** (5.01)	0.3906*** (6.45)	0.5823*** (7.91)	0.3945*** (6.51)	0.5031*** (6.82)	0.3569*** (6.32)	0.3570*** (6.32)
Asset Size	-0.0458*** (-10.56)	-0.0462*** (-10.33)	-0.0626*** (-10.32)	-0.0456*** (-10.11)	-0.0579*** (-10.62)	-0.0453*** (-10.37)	-0.0554*** (-11.19)	-0.0496*** (-11.65)	-0.0500*** (-11.65)
Overhead	0.1431 (1.56)	0.1438 (1.56)	0.2383 (1.44)	0.1416 (1.53)	0.5273*** (4.13)	0.1424 (1.55)	0.0913 (0.95)	0.1514* (1.67)	0.1548* (1.71)
Inflation	-0.1027*** (-3.88)	-0.0975*** (-3.65)	-0.5362*** (-5.85)	-0.1024*** (-3.86)	-0.3115*** (-4.09)	-0.1018*** (-3.82)	-0.0935*** (-3.44)	-0.0693*** (-3.29)	-0.0697*** (-3.31)
Growth GDP	0.3921*** (7.76)	0.4006*** (7.78)	0.3269*** (4.42)	0.3920*** (7.62)	0.2660*** (4.66)	0.3882*** (7.55)	0.4208*** (7.67)	0.4204*** (8.98)	0.4209*** (9.00)
GNP	-0.4004 (-1.26)	-0.4017 (-1.25)	-0.6778 (-0.34)	-0.3841 (-1.20)	-0.4337 (-1.45)	-0.4066 (-1.27)	-0.6295* (-1.86)	-0.4316 (-1.36)	-0.4373 (-1.38)
Equity x Crisis	-0.5992* (-1.88)	-0.1680*** (-4.98)	-0.8797*** (-4.44)	-0.2521** (-2.41)	0.8373** (2.35)	-0.2609*** (-4.03)	-0.2172** (-2.44)	0.1618 (1.01)	-0.2220*** (-3.91)
Equity x Crisis x Entry	0.0479 (1.09)								
Equity x Crisis x ForeignEntry		0.1680*** (3.37)							
Equity x Crisis x Insurance			0.0290 (0.49)						
Equity x Crisis x Official				0.0004 (0.04)					
Equity x Crisis x Monitor					-0.1541*** (-3.61)				
Equity x Crisis x State						-0.0001 (-0.12)			
Equity x Crisis x Private							-0.0031*** (-2.82)		
Equity x Crisis x Freedom								-0.0066** (-2.56)	
Equity x Crisis x Law									-0.0488** (-2.20)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup> overall	5.46%	5.56%	8.11%	5.56%	8.86%	5.35%	6.30%	5.97%	5.95%
Wald-test	717.22***	709.74***	482.91***	696.76***	762.62***	686.85***	670.23***	834.49***	833.66***
LM test	25.89***	22.11***	18.32***	26.91***	26.60***	24.95***	17.65***	29.61***	29.79***
# observations	17,971	17,429	7,065	17,245	10,717	17,700	14,772	19,097	19,105
# banks	3,031	2,935	1,030	2,906	1,594	2,993	2,582	3,221	3,224
# countries	69	67	28	67	51	62	58	83	84

### *3.3. Crisis intervention policies and variations in market discipline*

We now analyze how intervention policies during banking crises shape post-crisis variations in market discipline. In the estimations in Table 7 we introduce a triple interaction term between bank risk, the crisis dummy variable, and variables capturing the exogenous component of the types of intervention implemented during the crisis. We define *TotalInt* as the sum of five dummy variables indicating whether or not blanket guarantee, liquidity support, forbearance, recapitalizations, and nationalization measures are adopted during the crisis. We separate in a new variable (*Resolution*) the influence of the last three interventions that are more related to the resolution of the crisis than its containment. To save space, we only report the results that use cost of deposits as the dependent variable. The results are similar when we use growth in bank deposits as the dependent variable. The information on intervention policies comes from Laeven and Valencia (2004). The lack of information on intervention policies reduces the analysis to 26 crises in 25 countries.

The interaction of bank risk, the crisis dummy variable, and *TotalInt* does not have statistically significant coefficients whatever the risk variable we use in columns (1) to (3). The results are different when we only focus on intervention variables related to resolving the crisis. The interaction between bank risk, the crisis dummy, and *Resolution* has positive and statistically significant coefficients in columns (4) and (6) when equity and profit are, respectively, the proxies of bank risk. These positive coefficients for the triple interaction term reduce in the post-crisis period the negative relation between bank risk and cost of deposits in the pre-crisis period suggested by the negative coefficients for *Equity* and *Profit*. Moreover, the non-significant coefficients for *EquityxCrisis* and *ProfitxCrisis* indicate that market discipline does not diminish after banking crises if any of the three types of resolution policies (forbearance, recapitalization, and nationalizations) are not adopted.

**Table 7**  
**Deposit Interest Rates, Market Discipline and Interventions**

Results of random effects regressions. The dependent variable is the ratio of interest expense to interest paying debt minus Treasury bill rate. Equity, Profit and Liquidity are entered as alternative risk measures. Equity is book value of equity (assets minus liabilities) to total bank risk-weighted assets. Liquidity is defined as liquid assets to total bank risk-weighted assets. Profit is defined as before tax profits to total bank risk-weighted assets. Asset Size is the natural logarithm of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Crisis is a dummy variable that takes a value of one during the post-crisis period and zero during the pre-crisis period. TotalInt is the sum of five variables dummy capturing containment and resolution policies (blanket guarantee, liquidity support, forbearance, recapitalizations, and nationalizations). Resolution is the sum of the only three policies that are considered resolution interventions (forbearance, recapitalizations, and nationalizations). Bank data are from the BankScope data base of Fitch IBCA, macro data are from the IMF's International Financial Statistics, crises episodes are classified by Caprio and Klingebiel (2003) and information on policy interventions is obtained from Laeven y Valencia (2008). The sample period is 1989-2007. t statistics are given in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1, 5, and 10 percent, respectively.

Dependent Variable: Costdep						
	(1)	(2)	(3)	(4)	(5)	(6)
Equity	-0.0240*** (-3.62)			-0.0250*** (-3.78)		
Liquidity		-0.0056*** (-2.97)			-0.0057*** (-3.00)	
Profit			-0.1993*** (-6.96)			-0.2025*** (-6.99)
Asset Size	0.0006 (1.07)	0.0017*** (3.30)	0.0019*** (3.85)	0.0006 (1.13)	0.0017*** (3.36)	0.0020*** (4.08)
Overhead	0.0006 (0.08)	-0.0041 (-0.55)	0.0035 (1.13)	0.0012 (0.17)	-0.0040 (-0.54)	0.0033 (1.07)
Inflation	0.0061** (2.44)	0.0072*** (2.86)	-0.1670*** (-14.26)	0.0058** (2.34)	0.0071*** (2.83)	-0.1669*** (-14.27)
Growth GDP	0.0201*** (3.79)	0.0210*** (3.96)	-0.0188*** (-3.29)	0.0197*** (3.72)	0.0210*** (3.97)	-0.0186*** (-3.25)
GNP	-0.1477*** (-6.27)	-0.1418*** (-6.03)	-0.0574** (-2.44)	-0.1475*** (-6.27)	-0.1414*** (-6.02)	-0.0583** (-2.49)
Equity x Crisis	0.0249** (2.45)			-0.0179 (-1.45)		
Liquidity x Crisis		0.0049* (1.92)			0.0012 (0.37)	
Profit x Crisis			0.1563** (2.54)			-0.0449 (-0.62)
Equity x Crisis x TotalInt	-0.0032 (-1.47)					
Liquidity x Crisis x TotalInt		-0.0003 (-0.63)				
Profit x Crisis x TotalInt			0.0024 (0.17)			
Equity x Crisis x Resolution				0.0125*** (3.03)		
Liquidity x Crisis x Resolution					0.0011 (1.06)	
Profit x Crisis x Resolution						0.0817*** (3.18)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup> overall	66.43%	66.04%	67.75%	66.46%	66.04%	67.76%
Wald-test	5,205.42***	5,182.39***	5,621.28***	5,219.93***	5,184.50***	5,623.60***
LM test	363.23***	367.90***	365.80***	365.73***	368.95***	368.46***
# observations	6,069	6,134	6,029	6,069	6,134	6,029
# banks	1,143	1,153	1,148	1,143	1,153	1,148
# countries	25	25	25	25	25	25

In Table 8, we report the results separately for each of the resolution policies. We obtain positive and statistically significant coefficients for the triple interaction term for Forbearance and Recapitalization. In column (1),  $Equity \times Crisis \times Forbearance$  has a positive coefficient indicating that the negative relation between bank capital and cost of deposits before the crisis is reduced after the crisis when forbearance measures are adopted. Similarly, the triple interaction terms with the recapitalization dummy in columns (4) and (6) have positive and statistically significant coefficients. This indicates that the negative relation between cost of deposits and, respectively, bank capital and profit before the crisis is reduced after it when recapitalizations programs take place. We do not, however, obtain statistically significant coefficients for the interaction terms of Nationalization with bank risk and the crisis dummy.

**Table 8**  
**Deposit Interest Rates, Market Discipline, and Resolution Interventions**

Results of random effects regressions. The dependent is the ratio of interest expense to interest paying debt minus Treasury bill rate. Equity, Profit and Liquidity are entered as alternative risk measures. Equity is book value of equity (assets minus liabilities) to total assets. Liquidity is defined as liquid assets to total assets. Profit is defined as before tax profits to total assets. Asset Size is log transformation of total assets. Overhead is personnel expenses and other non-interest expenses over total assets. Inflation is the annual inflation rate from the GDP deflator. Growth GDP is the annual growth rate of real GDP per capita. GNP is the real GNP per capita in \$1,000. Crisis is a dummy variable that takes a value of one during the post-crisis period and zero during the pre-crisis period. Resolution is the sum of the scores of three zero-one dummy variables of resolution interventions: Forbearance indicates whether or not banks were permitted to continue functioning despite being technically insolvent, and whether or not prudential regulations (such as for loan classification and loan loss provisioning) were suspended or not fully applied during the first three years of the crisis. Recapitalization denotes whether or not banks were recapitalized by the government during the first three years of the crisis, and Nationalizations denotes whether or not banks were nationalized during the five three years of the crisis. Bank data are from the BankScope data base of Fitch IBCA, macro data are from the IMF's International Financial Statistics, crises episodes are classified by Caprio and Klingebiel (2003) and information on policy interventions is obtained from Laeven y Valencia (2008). The sample period is 1989-2007. t statistics are given in parentheses. \*\*\*, \*\* and \* indicate statistical significance at 1, 5, and 10 percent, respectively.

Dependent Variable: Costdep									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Equity	-0.0161** (-2.24)			-0.0164** (-2.27)			-0.0165** (-2.28)		
Liquidity		-0.0036* (-1.73)			-0.0036* (-1.73)			-0.0036* (-1.74)	
Profit			-0.1750*** (-5.61)			-0.1753*** (-5.62)			-0.1754*** (-5.62)
Asset Size	-0.0006 (-1.07)	0.0008 (1.36)	0.0009* (1.67)	-0.0006 (-0.96)	0.0008 (1.38)	0.0010* (1.84)	-0.0006 (-1.03)	0.0008 (1.38)	0.0009* (1.68)
Overhead	0.0004 (0.05)	-0.0042 (-0.53)	0.0031 (0.94)	0.0002 (0.02)	-0.0040 (-0.50)	0.0030 (0.92)	-0.0002 (-0.02)	-0.0042 (-0.53)	0.0031 (0.94)
Inflation	0.0062** (2.29)	0.0070** (2.56)	-0.1726*** (-13.34)	0.0060** (2.22)	0.0069** (2.55)	-0.1729*** (-13.37)	0.0061** (2.27)	0.0070** (2.58)	-0.1726*** (-13.34)
Growth GDP	0.0167** (2.58)	0.0177*** (2.75)	-0.0318*** (-4.49)	0.0162** (2.49)	0.0177*** (2.75)	-0.0320*** (-4.51)	0.0164** (2.53)	0.0178*** (2.75)	-0.0319*** (-4.49)
GNP	-0.1382*** (-5.20)	-0.1186*** (-4.48)	-0.0353 (-1.33)	-0.1244*** (-4.72)	-0.1190*** (-4.52)	-0.0362 (-1.38)	-0.1260*** (-4.79)	-0.1195*** (-4.54)	-0.0361 (-1.38)
Equity x Crisis	-0.0234** (-2.32)			-0.0021 (-0.26)			0.0127 (1.40)		
Liquid x Crisis		0.0020 (0.73)			0.0008 (0.37)			0.0023 (0.96)	
Profit x Crisis			0.1623*** (2.75)			0.0824** (2.12)			0.1107** (2.24)
Equity x Crisis x FORBEARANCE	0.0311*** (3.93)								
Liquidity x Crisis x FORBEARANCE		-0.0004 (-0.20)							
Profit x Crisis x FORBEARANCE			-0.0257 (-0.46)						
Equity x Crisis x RECAPITALIZATION				0.0076* (1.72)					
Liquidity x Crisis x RECAPITALIZATION					0.0011 (0.97)				
Profit x Crisis x RECAPITALIZATION						0.0703*** (2.65)			
Equity x Crisis x NATIONALIZATION							-0.0113 (-1.58)		
Liquidity x Crisis x NATIONALIZATION								-0.0009 (-0.52)	
Profit x Crisis x NATIONALIZATION									0.0376 (0.78)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup> overall	65.06%	64.43%	66.23%	64.98%	64.43%	66.23%	65.00%	64.42%	66.22%
Wald-test	4,353.52***	4,299.21***	4,642.54***	4,333.50***	4,290.94***	4,640.99***	4,354.57***	4,288.98***	4,638.75***
LM test	266.45***	274.69***	267.39***	266.54***	274.67***	273.26***	265.14***	274.40***	271.63***
# observations	5170	5233	5126	5170	5233	5126	5170	5233	5,126
# banks	979	990	985	979	990	985	979	990	985
# countries	24	24	24	24	24	24	24	24	24

#### **4. Conclusions**

This paper analyzes the effect of banking crises on market discipline in a sample of 101 banking crises over the 1989-2007 period. Using an international bank dataset allows us to evaluate how the variation in market discipline depends on regulation, supervision, institutions, and the crisis management policies. We use an international panel data set of 3,254 banks from 87 countries to control for unobservable bank, country and time specific effects.

We find that banking crises weaken market discipline. The reduction in market discipline, however, varies across countries. The reduction is larger in environments in which regulation and institutions enhanced market discipline before the crisis. In particular, we find a larger reduction in market discipline in countries with less stringent foreign entry restrictions, lower official supervisory power, more private supervision, more private ownership of banks, and better-quality institutions. We also find that the reduction in market discipline after banking crises is positively related to the accommodation policies applied to resolve the crisis. Forbearance and recapitalization programs are the two kinds of intervention that have the most negative effect on market discipline. We do not observe that two of the usual measures to contain bank crises, such as blanket guarantee and bank liquidity support, have a specific negative effect on market discipline after the crisis.

Finally, in terms of policy implications, our paper suggests that regulation, supervision, institutions, and interventions during banking crises are complements to enhance market discipline. Our paper provides empirical evidence on the contradiction between enhancing market discipline by, for instance, increasing accounting and auditing requirements, and adopting the intervention policies that are usually devised for solving banking crises. The results suggest that the resolution interventions increasing safety nets and depositor protection that are usually adopted by governments to resolve banking crises, make depositors more relaxed regarding future banking crises and reduce their incentives to exercise discipline. Therefore, although market discipline has gained importance as an instrument for controlling bank behavior in Basel II, doubts arise as to its effectiveness for controlling risk-taking by banks in the years following the financial crises.

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