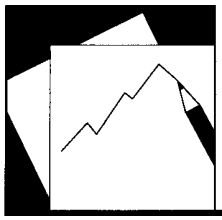

IMF Working Paper

Depositor Behavior and Market Discipline in Colombia

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INTERNATIONAL MONETARY FUND

IMF Working Paper

IMF Institute

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Authorized for distribution by Enzo Croce

November 2000

Abstract

This study examines how depositors decide among different banks and over time in Colombia, with particular attention to the issue of market discipline. By controlling for a more comprehensive set of risk/return factors, the study strengthens the conventional test for market discipline, and addresses two sets of questions of particular interest: (1) How do banks gain or lose market share? Which specific return or risk factors are the most important in explaining a bank's deposit growth? (2) How well do depositors discriminate between well and poorly managed banks? Panel data estimations for the 1985-99 period show that deposit growth is related to bank fundamentals, even after controlling for other risk-return factors. There is also evidence that depositors' choices effectively discipline banks; following "fundamental" deposit losses, banks tend to improve their fundamentals. Finally, banks with strong fundamentals appear to benefit from lower interest costs and higher lending rates, thus leading to the conclusion that market discipline exists in Colombia – perhaps complemented by "regulatory discipline" – and that moral hazard stemming from deposit insurance is limited, perhaps a consequence of certain design features of the insurance scheme.

JEL Classification Numbers: G21

Keywords: banking system, market discipline, deposit insurance, Colombia

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I. INTRODUCTION

With the recent outbreak of high-profile financial and currency crises throughout the world and in emerging market economies in particular, the issue of proper regulation of the banking system has become critical to the policy discussion. On the one hand, it is recognized that less government interference and hence greater operation of market forces are conducive to more rapid development of the financial system which, in turn, tends to generate substantial economic benefits resulting in higher economic growth (Levine, 1997). On the other hand, it is also increasingly apparent that as financial systems are liberalized and rely more and more on market forces, they also become more vulnerable and subject to greater instability (Demirguc-Kunt and Detragiache, 1998; Caprio and Honohan, 1999). For this reason, regulation and supervision of financial institutions must be stronger and more carefully designed in order to reduce the instability of the system and minimize the probability of crisis.

One crucial issue in banking system regulation is whether the government should provide a safety net for depositors, and if so, what form it should take. Starting with the classic work by Diamond and Dybvig (1983), there is a strong argument in favor of establishing a liquidity insurance scheme for depositors in order to prevent the disruptive and costly effects of the types of depositor runs that are endemic to a fractional reserve banking system. Of course, the cost of such a scheme is moral hazard, as insured depositors no longer have a strong incentive to monitor the behavior of banks where they hold their deposits, and thus banks may also have an incentive to assume greater risks. Therefore, the design of a deposit insurance scheme faces a tradeoff between the reduction of risk coming from bank runs and the additional risk induced by moral hazard.

Recently there has been significant interest in the literature in examining how depositors choose among different banks, and whether this choice reflects market discipline, whereby depositors would effectively monitor bank management and reward well-managed banks for good behavior while punishing poorly managed banks for bad

behavior. If depositor behavior is found to be consistent with market discipline, then this suggests that there is limited moral hazard in the system, an indication that depositors do not perceive their deposits to be fully protected.

In this paper we use Colombia as a case study to explore depositor behavior and market discipline, and to address an apparent contradiction that has arisen in the empirical literature. On the one hand, cross-country analysis (Demirguc-Kunt and Detragiache, 1999) finds that countries with explicit and more extensive deposit insurance tend to be more fragile and, hence, more prone to banking crises, which is consistent with deposit insurance leading to an increase in moral hazard and a corresponding breakdown in market discipline. On the other hand, individual country studies of depositor behavior have been generally supportive of market discipline, even in cases of explicit and relatively extensive deposit insurance.

Although some explanations related to the design and/or credibility of the deposit insurance system may account partially for the results of the individual country studies, we also argue that the tests conducted to date have tended to be relatively weak and perhaps have biased the results in favor of finding market discipline. Thus, we set out to strengthen the traditional market discipline test by including a set of controls that may reflect more completely the set of criteria used by depositors to choose one bank over another. Also, as argued by Calomiris and Powell (2000), a true test for market discipline should also involve a second test in which it is determined whether banks effectively respond to the signals provided by depositors. We also build on this idea, showing how this test may be developed further.

Colombia constitutes an interesting case study for analyzing both market discipline and depositor behavior in general. Throughout our period of analysis (1985-99) Colombia had an explicit deposit insurance system, with several design features that might have limited moral hazard, but others that may have increased it. Anecdotal evidence of a deposit run on an individual bank that occurred in mid-1999 raises questions about the incentives of depositors and the quality of the information they use to

assess bank performance. Thus, whether Colombian depositors discipline their banks is an open question. Furthermore, throughout the 1990s Colombia underwent rapid change starting with a liberalization program at the beginning of the decade that increased flexibility of interest rates and opened the financial system to greater competition. A significant number of new banks, both foreign and domestic, entered the market and quickly acquired market share (Barajas, Steiner, and Salazar, 2000). However, after several years of extremely high growth and profitability, the banking system began to show signs of fragility and distress toward the end of the decade, as numerous banks and other financial institutions encountered mounting non-performing loans and diminishing solvency. Therefore, it is crucial to understand depositor behavior during the initial expansion, when new banks entered the market, and whether depositors played a positive role in disciplining banks.

As we will show in greater detail, our empirical analysis finds strong evidence that deposit growth depends on bank performance fundamentals, even after strengthening the test by incorporating a more complete set of bank-specific controls. Furthermore, we also find that banks respond to signals from depositors in a manner consistent with market discipline. Interestingly, the response from banks seems to be asymmetric, occurring only when they perceive they are being punished by depositors. This disciplining behavior does not appear to extend to the cases in which fundamentals are the weakest. That is to say, the most troubled banks tend to perpetuate their problems rather than to correct them.

These results suggest the existence of market discipline, with depositors taking into account bank fundamentals and sending signals to banks, who then adjust key fundamentals accordingly. Thus, moral hazard appears to be limited in spite of having an explicit deposit insurance system. This may be due to some design features of Colombia's insurance scheme, which is compulsory, has co-insurance and risk-weighted premiums, and with relatively small coverage which is declining continuously in real terms. We also suggest that the observed appropriate response of banks could also be the result of effective regulatory oversight rather than market discipline per se. It may be the

case that banks are simply adjusting their fundamentals in order to comply with the regulations, rather than as a response to deposit outflows.

The paper is divided into six sections, including this introduction. In the second section we review the current literature regarding depositor behavior in the presence of deposit insurance. In the third section we discuss the Colombian context, describing its deposit insurance scheme and briefly discussing the case of a recent rumor-induced bank run, a good example that depositors may react not non-fundamental news. In the fourth section we present our estimation approach, showing how we build upon the standard tests for market discipline. We also discuss the idea that disciplining cannot be detected exclusively through the behavior of depositors, as it is also important to assess how banks react to the actions of depositors. In the fifth section we present the results of three sets of econometric estimations. The first one looks at the determinants of the rate of growth of deposits, the second at the determinants of interest rates, and the third at the reaction of banks to changes in depositor behavior. In the sixth section we conclude.

II. DEPOSIT INSURANCE AND DEPOSITOR BEHAVIOR

When deciding on a deposit insurance system, policymakers face a tradeoff between two types of risk: (1) the risk of non-fundamental or inefficient deposit runs (Diamond and Dybvig, 1983), vs. (2) moral hazard. If policymakers believe that deposit runs are not a significant source of instability[2], and that moral hazard is the predominant risk, then they should opt to eliminate deposit insurance, as in the extreme case of New Zealand, where depositor protection is explicitly denied and therefore the system relies entirely on market discipline and transparency (García, 1999 and 2000). If, on the contrary, policymakers believe that deposit runs are extremely dangerous and likely, and

[2] Or that deposit runs are only of the efficient type, they fully reflect the fundamentals of the banks (see Freixas and Rochet, 1997).

that moral hazard is not significant, then they should choose the opposite extreme, a full explicit guarantee. In practice, both extremes are very rare, with the majority of countries in the world adopting some limited form of deposit insurance, and therefore assuming a certain level of additional moral hazard in exchange for greater protection against bank runs. They also may incorporate certain design features into the scheme that limit the propensity for moral hazard and thus risk-taking by banks (Demirguc-Kunt and Huizinga, 1999).

In the end, which type of risk dominates? A recent study (Demirguc-Kunt and Detragiache, 1999) sought to answer this question for a broad sample of countries exhibiting varying extents of coverage in their deposit insurance systems. Using the capacity to predict financial crisis as the prime criterion, the authors investigate what happens to bank fragility when the extent and coverage of deposit insurance increases. Based on a sample of 61 countries for 1980–97, they find that bank fragility increases as the deposit insurance scheme becomes more explicit and extensive, an indication that moral hazard may be dominating over whatever stabilizing effects deposit insurance has on the risk of bank runs[3].

However, recent empirical studies of depositor behavior in individual countries have given support for the opposite result: the presence of market discipline in different countries and with varying types of deposit insurance systems. Using panel data estimation on individual bank balance sheet information, these studies examine market discipline by testing whether a significant relationship arises between depositor behavior and bank performance and management indicators, or "fundamentals." Park and

[3] This result is particularly noteworthy if one considers that, in some countries, the establishment of an explicit deposit insurance system may constitute a *reduction* in the perceived coverage, to the extent that a more extensive implicit insurance had been in place previously. In fact, Gropp and Vesala (2000) find that moral hazard was *reduced* after explicit deposit insurance was established in the EU, since depositors had previously held expectations of a much more extensive implicit safety net.

Peristiani (1998) show evidence of market discipline in the U.S. thrift industry throughout the 1980s, as depositors were shown to demand a higher interest rate and deposit growth was shown to be lower as banks' activities became riskier. Regarding developing countries, Martínez Pería and Schmukler (1999) consider the banking systems of Argentina, Chile, and Mexico, and find support for market discipline in all three cases, as the level of deposits was significantly related to bank fundamentals, once controlling for systemic and macroeconomic variables also affecting demand for deposits. This result is shown to hold even in the case of small, insured depositors. Schumacher (1996, 2000) finds evidence of market discipline in Argentina during the 1994–95 "Tequila" crisis. Finally, for Argentina during the 1990s, Moore (1997) finds depositor growth to be significantly linked to bank fundamentals[4], and Calomiris and Powell (2000) find deposit interest rates as well as deposit growth to be significantly related to bank fundamentals.

Considering the theoretical backing for moral hazard when deposit insurance is in place, this strong support for market discipline is somewhat puzzling. In fact, it has been argued that, even in the absence of *explicit* deposit insurance, depositors and bank managers may often tend to behave *as if* their deposits were insured, expecting a rescue if their bank were to experience serious difficulties. However, the results from country studies suggest the opposite, that even though deposits are *explicitly* insured, depositors behave *as if* they were not, refusing to trust the deposit guarantee fully. Furthermore, from the Demirguc Kunt-Detragiache (1999) study, the Mexican and Chilean deposit insurance systems exhibit some of the characteristics making them even more prone to fragility and hence, to moral hazard[5]: both systems are explicit and un-funded but

[4] It must be noted that the Moore (1997) study also finds the banking system in Mexico to exhibit *lack* of market discipline, as bank fundamentals do not explain deposit growth during the 1990s. However, the sample period is relatively small (only 16 observations) and the specification does not include many relevant systemic and macroeconomic variables (such as those used by Martínez Pería & Schmukler, 1999), so the test cannot be considered a strong finding of lack of market discipline.

[5] Demirguc-Kunt and Detragiache (1999) express these factors as dummy variables explaining the probability of banking crises. For example, if a deposit insurance system is

(continued…)

callable, they cover foreign-currency deposits, and are government-managed. Additional risk elements are introduced in Mexico by having unlimited coverage, and in Chile by being funded entirely by the government. Argentina, on the other hand, appears to be a case in which market discipline would be more plausible, as there is no explicit safety net for depositors, and the currency board arrangement practically rules out any scope for the central bank to serve as a lender of last resort.

There are three possible explanations that may account for the empirical results supporting market discipline even in the presence of extensive safety nets for depositors. First, if the tests have been properly specified, then they would suggest that the moral hazard problem in depositor behavior is not very important. This may be because deposit insurance is not credible, or because it is designed in such a way to limit moral hazard. However, this conflicts with the cross-country results indicating greater fragility, and it is not clear how fragility can increase if market discipline is left intact.

A second possibility is that deposit insurance *reduces* but *does not eliminate* market discipline. A recent cross-country study by Demirguc-Kunt and Huizinga (1999) conducts market discipline tests for a number of developed and developing countries, and then pools the bank and country-specific data in order to test whether there is an impact of deposit insurance on market discipline. They find some evidence that the existence of deposit insurance lowers the responsiveness of deposit interest rates to changes in bank liquidity, an indication that market discipline is weakened. However, the study was not successful in finding significant market discipline effects in regressions explaining the growth of deposits. Therefore, if market discipline does exist, then it is most likely operating through the level of interest rates rather than through the demand for deposits.

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explicit, the respective dummy variable takes on a value of one. Since this variable is shown to be a significant predictor of financial crisis, then a country with explicit deposit insurance is more likely to exhibit moral hazard.

Although the first two explanations may partly account for why market discipline is not rejected in countries with deposit insurance, we consider a third possibility as well: that the individual country tests have not been very strong, and therefore may be biased in favor of finding market discipline. We explore this in the present study, with particular reference to Colombia, by strengthening the test and incorporating control variables that reflect the direct return to depositors as well as other non-fundamental characteristics which may lead depositors to prefer a certain type of bank over another.

Finally, as argued in Calomiris and Powell (2000), even if there is evidence that depositors choose banks according to their fundamentals, it does not necessarily follow that market discipline exists. It must also be true that banks are effectively "disciplined", in that they react appropriately by adjusting their fundamentals in response to the signals provided by depositors. Calomiris and Powell suggest an indirect test based on the behavior of deposit interest rates, and we build upon it by testing the direct response of individual fundamental variables to what we define as "fundamental" deposit withdrawals.

III. DEPOSIT INSURANCE IN COLOMBIA AND A CASE OF A NON-FUNDAMENTAL BANK RUN

Following the financial crisis of the early 1980s, FOGAFIN (Fondo de Garantiás de Instituciones Financieras, or Financial Institutions Guarantee Fund) was created in 1985 (Law 117), and one of whose key obligations was to develop a deposit insurance scheme, whose *current* main features are (see Table 1):

(i) A guarantee that depositors will receive their funds when a financial institution intervened by the Banking Superintendency is unable honor its obligations to them. All financial institutions registered in FOGAFIN and under the tutelage of the Banking Superintendency are required to purchase deposit insurance: commercial banks, savings and loans (CAV's), financial corporations, commercial finance companies, leasing companies and capitalization societies.

(ii) Insured liabilities are demand deposits, CD's, savings accounts, UPAC accounts[6], receipts payable, tax collection services and capitalization titles. FOGAFIN will cover 75% of the amount deposited up to a maximum coverage of col$10'000.000 per account, regardless of the number of persons owning the account. In each institution, and regardless of the number of accounts, one person is only insured up to col$10.000.000, while accounts in different institutions are insured separately. Insurance only covers deposits payable in Colombia, and regarding interest-earning liabilities, insurance covers principal, monetary correction and regular interests.

(iii) Yearly premiums amount to 0.3% of all liabilities (and 0.3% of reserves in the case of capitalization societies), paid quarterly, and are differential among institutions, through a system of reimbursements based on efficiency and solvency indicators. At the end of each year, financial institutions are reimbursed 50% of premiums paid if their CDs and Time Savings Deposits have been granted "Investment Grade" by a specialized grading agency, and 25% if they have been awarded a "Good Grade[7]."

One particular issue to be highlighted is the effective coverage of the scheme. The bottom portion of Table 1 describes qualitative and quantitative aspects of deposit insurance coverage in Colombia. Almost all financial system accounts – just under 98% in 1999 – are smaller than the maximum coverage of col$10 million and are thus fully

[6] UPAC, or "constant purchasing power", accounts were created in the early seventies as a means to ensure that depositors would receive a positive real return. Their yield thus incorporates an inflationary or "monetary" correction component plus a "regular" or pure interest component.

[7] In the event that several agencies grade a financial institution, FOGAFIN will take into account the lowest grading. Financial institutions are not entitled to reimbursement if during the previous year they have received guarantee capital from FOGAFIN or special credit from the central bank.

covered[8]. Also, almost all accounts –just over 98% in 1999 – were of types covered by the insurance scheme. However, in terms of value, overall coverage much smaller – 35% in 1999 – owing to the existence of a small number of very large accounts. Furthermore, this percentage has been declining continuously throughout the nineties reflecting the fact that the coverage limit has been fixed in nominal terms while annual inflation has been between 10 and 15%. Therefore, over time we may expect value coverage to continue to decline as well as the percentage of accounts under the coverage limit.

The effective coverage can also be analyzed on an ex post basis. In Table 2 we can observe actual payments made by FOGAFIN in 1996–2000, following a period of enormous financial distress. Payments are expressed as a percentage of insured liabilities. The enormous variance among different institutions partly reflects the different composition of deposits (by size and type) across institutions. In one case, deposit insurance covered as little as 4% of an institution's liabilities, while in another it covered almost 53%.

In Table 3, we compare the main characteristics of the Colombian deposit insurance scheme with those of several industrialized countries and a world average (Beck, 2000). According to the Demirguc-Kunt and Huizinga (1999) analysis, there appear to be several features of Colombian deposit insurance that would increase the likelihood of moral hazard: the system is explicit, funded, and managed by the government. On the other hand, there are features that may work in the opposite direction: the coverage limit is relatively small (below the world average of 3 times GDP per capita) and declining in real terms, it is privately funded, membership is compulsory, there is co-insurance by depositors (25% of the amount covered), and premiums are risk-adjusted (through the system of reimbursements). Whether or not deposit insurance has prevented depositors from exerting market discipline in Colombia is therefore an open question, one that has to be addressed empirically.

[8] Of course, excluding the deductible amount of 25%.

On a more anecdotal level, an incident in mid-1999 involving a deposit run on a relatively sound bank raises questions on both sides of the market discipline/moral hazard question. On May 26th, an unfounded rumor that a large private bank was on the brink of bankruptcy was spread through the internet. This provoked a depositor panic, and in one day the bank's deposits fell by 5% of total liabilities in net terms, with an even larger gross loss as some government entities that had withdrawn their deposits early in the day returned them late in the afternoon. The net deposit loss was covered, in almost equal parts, through credit from the central bank, other financial institutions, and real sector corporations. Deposits gradually came back, but were not fully restored until the end of October. The person who spread the rumor was eventually caught and criminally charged with having provoked an economic panic.

This incident illustrates on the one hand, the willingness of the public to move quickly and withdraw their deposits in response to perceived increased risk of bankruptcy. This suggests that depositor risk has not been completely eliminated by the insurance scheme, and therefore depositors have an incentive to monitor banks. On the other hand, the large response to unfounded and even blatantly incorrect news suggests that depositors do not have very reliable information, and this may prevent them from monitoring bank behavior effectively. In other words, it may be the case that depositors have the incentive but not the means to impose market discipline.

IV. EXTENDING THE TESTS FOR MARKET DISCIPLINE

In this section we present our estimation approach, describing first how we extend the conventional test for market discipline on the depositor side, and then how we develop a more direct and flexible test for the behavior of banks in response to depositors' signals.

A. Depositor response to fundamental and non-fundamental variables

As developed in Park and Peristiani (1998), there are two ways in which market discipline may be tested in the market for bank deposits, through the price (the interest rate) or through quantities (level, or growth of deposits):

$$r_{ti} = \alpha_0 + \hat{p}_{t+1,i}\alpha_1 + z_{ti}\alpha_2 + \varepsilon_{ti} \quad (1)$$

$$D_{ti} = \beta_0 + \hat{p}_{t+1,i}\beta_1 + w_{ti}\beta_2 + v_{ti} \quad (2)$$

The variables *r* and *D* represent the deposit interest rate and the level of deposits, respectively, and sub-indices *t* and *i* denote the time and individual bank dimensions, respectively. The expected probability of default or failure of bank *i* in the following period is defined as $\hat{p}_{t+1,i}$; it represents the risk or expected loss assumed by depositors. Finally, the equations include vectors of other control variables, which may have an effect on the deposit rate (*z*) or on the level of deposits (*w*).

In short, equations (1) and (2) test for the existence of market discipline by testing for the significance of α_1 and/or β_1. If depositors demand a higher interest rate from banks with a higher probability of default (i.e., higher risk), then α_1 will be positive and significant, and one may conclude that depositors are exerting discipline over banks. Likewise, if depositors tend to demand fewer deposits from riskier banks, then β_1 should be negative and significant, also signaling the existence of market discipline.

Two issues arise in the specification of equations (1) and (2). First, there is the question of how to measure the probability of default *p*. Park and Peristiani (1998) follow

a two-step procedure, estimating this probability using a logit model as a function of bank performance indicators or fundamentals (percentage of bad loans, profitability, equity ratios, portfolio composition, operational costs, among others) and using the estimated probability directly as an explanatory variable in equations (1) and (2). While this procedure appears to be reasonable, it may not always be possible to estimate the probability accurately, especially in a period when there are not many actual observations of bank failures. Also, as Martínez Pería and Schmukler (1999) point out, by including the probability of default directly, it is not possible to determine which of the bank indicators may be providing the strongest signals to depositors that banks are in fact taking on high risks. Therefore, it may make sense to include the bank fundamentals themselves as explanatory variables in the market discipline equations (1) and (2), and to test for market discipline by testing for their joint significance.

A second specification issue is what to include as the control variables *z* and *w*, which are expected to exert influence on depositor behavior. Park and Peristiani (1998) include two macro variables indicating overall size of the market[9] (state-wide deposit growth), bank-specific controls relating to market share and size (total assets), and a number of regulatory dummy variables. Demirguc-Kunt and Huizinga (1999) include two controls in their individual country estimations: bank overhead (the non-interest cost to asset ratio) and size (deflated by the GDP deflator). Martínez Pería and Schmukler (1999) include two sets of controls: systemic and macroeconomic variables, both of which vary over time but not across individual banks[10]. The systemic variable was the cash (outside banks) to deposit ratio, capturing overall preference for bank deposits, and the macroeconomic variables were the ratio of international reserves to M2, the stock market index, and the external interest rate differential, the latter to control for the expected rate

[9] In the case of U.S. Savings and Loan institutions, the relevant market is the respective state.

[10] They also control for individual bank size, but do not include it within the set of bank fundamental variables, since it is not considered to be directly linked to riskiness.

of devaluation. Finally, Calomiris and Powell (2000) include period effects as time-varying controls.

The main shortcoming of the specifications used in these studies is that, while they may control for the effects of mostly economy-wide factors, they do not incorporate additional individual bank variables that should play a key role, in particular the return to deposits. While risk is partially accounted for by the bank fundamental variables (reflecting the probability of default), the tests do not incorporate the returns to depositors nor do they incorporate non-fundamental variables that may affect *perceived risk* to depositors. We suggest including returns to depositors in a broad sense, encompassing both direct financial return (the interest rate) as well as benefits in terms of easing transaction costs, to the extent that bank deposits are used for payments purposes. Therefore, a full specification of deposit demand should incorporate these as well as non-fundamental variables related to perceived risk.

By not including these additional controls, the above studies do not provide a satisfactory alternative hypothesis regarding depositor behavior in the absence of market discipline. That is, if market discipline is rejected – all bank specific variables do not explain deposit levels – then there is no explanation for why depositors choose one bank over another or why deposits may grow more rapidly in one type of bank than in another. In this sense, the test may be considered too weak; if only bank fundamentals are permitted to explain how deposits vary from bank to bank, then the hypothesis of market discipline will tend to be accepted more often than is true. We propose strengthening the market discipline test by incorporating return variables *x* and non-fundamental risk variables *y* in addition to fundamental variables (*FUND*) and macro controls *z* and *w*:

$$r_{ti} = \alpha_0 + FUND_{ti}\alpha_1 + z_t\alpha_2 + x_{ti}\alpha_3 + y_{ti}\alpha_4 + \varepsilon_{ti} \qquad (1')$$

$$D_{ti} = \beta_0 + FUND_{ti}\beta_1 + w_t\beta_2 + x_{ti}\beta_3 + y_{ti}\beta_4 + \nu_{ti} \qquad (2')$$

To capture the return to depositors we include the interest paid on deposits *r* (bank-specific) in the deposit growth equation, and we proxy the level of bank transaction services by the number of branch offices (*BRANCH*). As for non-fundamental risk factors, we include a dummy variable for state ownership (*STATE*) to test whether depositors perceive that state-owned banks are more likely to be bailed out; and for foreign ownership (*FOREIGN*) to test whether these banks possess any advantages in terms of reputation over their domestic counterparts. As in other studies, we also control for bank size (*ASSETS*) to test whether depositors respond to a "too big to fail" effect.

B. Response of banks to disciplining behavior by depositors

As discussed earlier, whether depositors are sensitive to bank fundamentals is only the first step in determining whether there is market discipline. A second step should involve understanding whether banks respond positively to the signals provided by depositors. Calomiris and Powell (2000) explore this issue by testing whether there is a tendency for individual banks' deposit rates to revert to their mean, a behavior consistent with market discipline; if interest rates rise too much (i.e., fundamentals fall out of line) then banks must take corrective action to ensure that interest rates may fall again (i.e., improving their fundamentals). The authors not only accept the hypothesis of mean reversion for Argentina but also provide evidence that the speed at which interest rates revert to their mean has increased, which they attribute to improvements in accounting and supervision standards.

We develop the test further, along three major lines. First, rather than focusing exclusively on interest rates as the dependent variable, we test directly whether bank *fundamentals* react to changes in deposits. Second, since changes in deposits may be caused by non-fundamental as well as fundamental variables, we zero in on those changes that are attributable to an individual bank's performance fundamentals in relation to those of other banks. Therefore, we define a "fundamental" deposit growth as the key explanatory variable for bank response. Third, we allow for a possible asymmetry in this

response. Market discipline implies that a bank should improve its fundamentals following a deposit withdrawal, but it does not necessarily follow that a bank should let its fundamentals deteriorate if deposits are growing rapidly. Therefore, we allow for the possibility that banks only respond on the downside.

V. ESTIMATION RESULTS

We perform estimations on semi-annual data for 1985–1999 based on individual bank balance sheets and income statements, which yield a set of bank-specific variables which are defined below. Except for some dummy variables, all have both a time (t) and a cross-section dimension (i), which we suppress for notational simplicity. The fundamental variables that explain the probability of default are defined as follows[11]:

NPL = non-performing loans/total loans
NPLASS = non-performing loans/assets
PROV = loan loss provisions/assets
KASS = capital/assets
COVGE = *KASS* + *PROV* – *NPLASS*
ROE = return on equity
LIQUIDITY = total reserves/assets

Based on the analytical framework discussed above, we want to test whether depositors react to changes in fundamentals. In particular, depositors should react

[11] González-Hermosillo (1999) provides an estimation of the probability of bank failure during the 1982-1985 Colombian banking crises, much in the same manner as in the Park and Peristiani study of the U.S. savings and loan market. In particular, González-Hermosillo proposes a "bank distress" variable, the coverage ratio (the ratio of equity plus loan reserves minus non-performing loans to total assets) as a good predictor of bank failures. Both bank failures and bank distress were explained to a large extent by such bank fundamental variables as non-performing loans, the deposit-asset ratio (measuring liquidity risk), deposit and lending interest rates, and the net income-asset ratio (indicating profitability).

negatively to increases in non-performing loans (*NPL* and *NPLASS*), and positively to increases in provisions (*PROV*), in the capital-asset ratio (*KASS*), in the coverage of non-performing loans (*COVGE*), and in the return-to-equity (*ROE*).

Though most of the empirical literature considers higher liquidity as an indication of a lower probability of default, in this paper we allow for differences in depositors' assessment of liquidity depending on the business cycle. In particular, while in "bad times" (i.e., a sharp recession) holding liquid assets might make a bank less vulnerable and depositors more confident, in "normal times", higher liquidity implies a lower return on assets, with little offsetting positive effect. We classify each time observation as being "normal" or "bad times" according to the real growth rate in relation to its trend growth rate for the 1970–1996 period[12], and produce a time-varying dummy variable, *BADTIMES*. The product of this variable with *LIQ* results in *BTLIQ*, which captures whether there are indeed different effects of liquidity during "bad times". If our priors are correct, depositors should view liquidity negatively, except during "bad times."

As we discussed in Section IV, we control for other non-fundamental variables that might affect both the rate of growth of deposits and the level of interest rates. Total real assets (*ASSETS*) allow us to test whether depositors believe that larger banks are "too big to fail", and therefore that deposits held there are safer. Our two controls for the return to deposits are the number of branches (*BRANCH*), and (in the deposit growth equation) the deposit interest rate (*r*). We expect the number of branches to reflect the quality of payments services offered by the banks; all else constant, deposits should grow faster in those banks that lower transaction costs or offer more payments services by providing more branches. We measure the interest rate implicitly from the balance sheets

[12] The trend growth rate for Colombian real GDP was 4.1 percent throughout this period. We defined periods where the growth rate was more than a full percentage point below this level (i.e., below 3.1 percent) as "bad times". This yielded 9 of 30 observations classified as "bad times".

and income statements, as the ratio of interest paid to the average stock of deposits over a given six-month period[13].

In addition, we control for the effect of macroeconomic shocks that affect all banks equally, such as changes in GDP growth and interest rates on government securities. Our best results were obtained using period effects, but our estimations using specific macroeconomic controls yielded similar overall results[14]. Finally, we included dummy variables in order to distinguish between private and state-owned banks (*STATE*) and between domestic and foreign-owned institutions (*FOR*).

Our regression analysis was done using semi-annual panel data for the 1985–99 period, with a sample encompassing virtually the entire commercial banking system (25-33 banks, depending on the period), excluding only a few smaller banks for which there was missing information. We allowed for different bank-specific intercepts by using fixed effects (*FE*) and random effects (*RE*) estimation, and chose which to report according to the Hausman test. In all cases differences in bank-specific intercepts were overwhelmingly accepted, as was the existence of common period effects.

A. Deposit growth equation

As we expected, deposit growth depends positively and significantly on the interest rate and on the number of branches, thus showing that return is an important factor in choosing among banks. In all estimations bank size appears with a positive

[13] In future estimations, we intend to use a more detailed, monthly data set available for the more recent post-1990 period. This will allow use to use the more precise marginal posted interest rates rather than those obtained implicitly from balance sheets and income statements.

coefficient, in line with the "too big to fail" argument. However, this coefficient is significant only in about half of the estimations.

With respect to the dummy variables that account for ownership, whether banks are foreign or domestically owned seems to make no difference, thus showing that foreign banks do not appear to possess any reputational advantages in attracting deposits. However, in several estimations state-owned banks exhibit a significantly higher rate of growth of deposits. Since we are already controlling for fundamental variables capturing quality of bank management, we interpret the positive coefficient on *STATE* as an indication that, other things constant, depositors perceive state-owned banks as less likely to default, presumably because they are expected to be bailed out by the government in case of distress[15].

Regarding the fundamental variables, Table 4A shows estimations in which they are introduced one by one, and Table 4B shows the estimations when more than one are included at a time. The results reported in Table 4A give evidence of market discipline. Though deposit growth does not appear to depend on the level of non-performing loans (*NPL*) nor on the return to equity (*ROE*)[16], it does depend, and with the expected sign, on the other three fundamental variables. In particular, deposits grow faster in banks with a higher capital base (*KASS*) and in banks in which non-performing loans are better covered by both capital and provisions (*COVGE*). As for liquidity, our results give support to our suspicion that depositors' attitudes toward liquidity differ according to the macroeconomic environment. In normal times depositors tend to have a negative view of liquidity, as reflected in the negative significant

[15] In the reported FE and RE estimations, the ownership variables *STATE* and *FOREIGN* reflect only time variation in ownership for each bank rather than differences across groups of banks. In order to capture the latter effects, we reestimated the regressions using OLS (excluding bank-specific intercepts), and found the same result, namely that *FOREIGN* was not significant but *STATE* was significant in about half of the regressions.

[16] This is a common result in the country studies surveyed.

coefficient of *LIQ*. During an economic downturn, on the other hand, depositors' view of liquidity changes, presumably as the bank becomes better equipped to withstand a draining of resources. This is shown by the positive coefficient of *BTLIQ*.

Most of these results carry on to Table 4B, where now we include more than one fundamental variable at a time. Regarding the "too big to fail argument", we always obtain a positive coefficient for the level of assets, although the coefficient is only significant, and at the 90% level, in one of the regressions. The results on a bank's interest rates and the number of branches continue to hold and have the expected signs. Regarding ownership, once again we observe that the rate of growth of deposits is higher for state-owned banks, and this coefficient is statistically significant in two out of the four specifications. Again, whether a bank is domestically or foreign-owned seems to have no effect on the rate of growth of deposits.

Turning to the fundamental variables, there is evidence that depositors are sensitive to these variables, as shown by their overwhelming joint significance. Individually, however, not all fundamentals appear to matter to depositors. Once again the percentage of non-performing loans and the return-on-equity (*ROE*) do not appear to have any effect on depositor behavior. On the other hand, the coverage ratio (*COVGE*), which a previous study (González-Hermosillo, 1999) found to be a good leading indicator for bank failure during the 1980s banking crisis, does have a positive and significant effect on deposit growth. When we decompose this variable into its three components: provisions (*PROV*), *KASS*, and the ratio of non-performing loans to assets (*NPLASS*), we find that the first two have the expected positive sign and are significant at the 95% level, whereas *NPLASS* has the expected negative sign but is not statistically significant.

Finally, in all four regressions a higher level of liquidity (*LIQ*) is associated in a statistically significant manner with a lower rate of growth of deposits during normal times, while *BTLIQ* is associated with the a higher rate of growth of deposits. In the final column of Table 4B we test for the linear restriction that the sum of the coefficients on

LIQ and on *BTLIQ* is equal to zero, which is not rejected. Thus, our final reading on this is as follows. In "normal times" (i.e. when the rate of growth of GDP is not considerably below trend), the bad news coming out of a high level of liquidity (i.e. a low return on assets) dominates the good news (i.e. the bank will more easily accommodate a deposit withdrawal). On the other hand, in "bad times" depositors perceive that the level of liquidity is irrelevant – the negative effect associated with a low return on assets appears to be offset by the positive effect stemming from a better ability to cope with a deposit withdrawal.

B. The interest rate equation

We also estimated the equation for the interest rate on deposits, the results of which are shown in Table 5. As was discussed above, this interest rate is measured implicitly, and therefore is only an approximate and average measure of a bank's interest rate behavior. The implicit interest rate is highly dependent on the types of deposits held by a bank (a significant portion of which are demand deposits, which do not pay interest), and, by the same token, if deposits are of a long-term maturity, it is a deficient proxy for a bank's marginal response to a change in the attitudes of depositors. Our future work will focus on taking advantage of a shorter monthly database currently being constructed in which we be able to use more direct measures of marginal and shorter term interest rates.

In the analytical framework discussed above, it was argued that depositors discipline banks by withdrawing deposits as the probability of default increases. Of course, it could well be the case that as the probability of default increases, we do not observe a decline in the rate of growth of deposits, only because banks compensate the increased probability of default with a hike in the interest rate paid on deposits. That being the case, depositors discipline banks either by withdrawing deposits or by demanding higher interest rates on deposits as "fundamentals" deteriorate. One should not necessarily expect to observe both a fall in deposits and an increase in interest rates as a result of an increase in the likelihood of default. Thus, since we have just shown that market discipline is not rejected for a key subset of fundamental variables in the deposit

growth equation, we need not observe any particular relationship between interest rates and these fundamentals, as all market discipline may be operating through the quantity of deposits.

In the interest rate equation, the results for non-fundamental variables are mixed. We find additional support for the "too big to fail" argument, since, after controlling for all other variables, larger banks appear to be able to attract deposits at a lower interest rate. Again we find that whether a bank is private or state-owned matters, and whether it is domestic or foreign-owned does not. Once again, we interpret this result as evidence that, other things constant, state-owned banks have an advantage over private institutions, presumably because depositors perceive a higher probability of government bailout. The result on *BRANCH*, however, is puzzling, since we expect the number of branches to be a good proxy for services rendered by banks to their clients, services that should substitute, rather than complement, the interest rate paid on deposits.

Regarding our fundamental variables, we also obtain mixed and sometimes contradictory results. The capital-asset ratio, the coverage ratio, and the level of liquidity all perform in a manner consistent with market discipline, that is, significantly lowering the interest rate that banks need to pay to attract deposits. However, other fundamental variables do not fare as well. Increases in provisions or profitability, or improvements in loan quality (declines in nonperforming loans) are shown to *increase* the interest rate that depositors demand from banks. Furthermore, the distinction between liquidity in "normal times" and in "bad times" (*BTLIQ*) does not seem to be relevant in the case of interest rates.

C. Extensions to the estimations for depositor behavior

In this section we examine three extensions to our empirical analysis of depositor behavior, focusing on the deposit growth regressions, which yielded the best and most theoretically plausible results.

First, we address the possible endogeneity between deposit interest rates and fundamentals (in fact, in the following section deposit interest rates are shown to respond significantly to prior changes in fundamentals), employing a 2SLS procedure and including as instruments for the deposit interest rate the lending interest rate, the required reserve ratio (which may be viewed as an exogenous policy variable), and the ratio of noninterest expenses to assets (which reflects the individual product mix chosen by the bank as well as its level of efficiency). We then enter the predicted value for the deposit interest rate as a regressor in the deposit growth equation, using the specification in which only coverage and liquidity are included as fundamental variables. The previous results hold; the interest rate and number of branches continue to be positively and significantly related to deposit growth, the respective fundamentals continue to be significant and in the expected direction, and state banks appear to have an advantage in attracting deposits.

Secondly, we examine whether market discipline, as measured by the sensitivity of deposit growth to bank fundamentals, has changed over time. Given that coverage has been declining in real terms, and that depositors may have undergone a learning process in which their assessment of banks performance has improved, we might expect to observe some increase in market discipline. Table 6 presents results of estimations in which we include interaction terms between a time variable and each of the fundamentals, and find that depositor sensitivity has increased for those fundamentals which performed best in the previous regressions, *COVGE*, *KASS*, and *PROV*. For *NPLASS* however, which did not perform well in the previous estimations, we find that depositor sensitivity has declined over time. Finally, for *LIQ* and *ROE* we do not detect a significant change in sensitivity. Thus, we find some evidence of increasing market discipline throughout the sample period.

Thirdly, we re-ran the regressions using explicit macroeconomic controls rather than common period effects, the detailed results of which are available upon request. While the principal results reported in Tables 4A and 4B continue hold, this is not the

case for the liquidity variables *LIQ* and *BTLIQ*, which continue to be significant, but change sign. Two macro controls performed well in all regressions: the growth rate of aggregate bank deposits, and the real interest rate on government paper. A third variable, a liberalization dummy for 1991, was positive and significant in some of the deposit growth equations, thus suggesting that the liberalization program may have increased the attractiveness of bank deposits above and beyond the return or risk characteristics of banks.

D. Response of banks to changes in deposit growth

In the previous sections we showed that depositor behavior appears to be broadly consistent with market discipline, particularly as seen in the deposit growth regressions; depositors tend to prefer banks with stronger fundamentals. Now we turn to the question of whether banks respond once depositors have revealed their preferences. Thus, we measure to what extent bank fundamentals change in response to past changes in deposits, and we zero in on the component of deposit growth that is directly attributable to an individual bank's fundamentals, which we term the "fundamental" deposit growth, (*DRDFUND*). We define *DRDFUND* as the real growth of deposits explained by fundamental variables from regression (8) in Table 4B. Note that this variable is bank-specific, but below we drop the *i* subscript for simplicity.

$$DRDFUND_t = -0.547 NPLASS_{t-1} + 1.427 PROV_{t-1} + 2.396 KASS_{t-1} - 0.416 LIQ_{t-1} + 0.617 BTLIQ_{t-1}$$

The first test therefore consists of regressing each fundamental variable on lagged *DRDFUND*, to determine whether this period's fundamentals are sensitive to depositors' preference for strong fundamentals in the previous period. If market discipline holds, we should expect negative coefficients on *DRDFUND* in the equations for *KASS*, *COVGE*, *PROV*, and *LIQ*, and a positive coefficient in the case of *NPLA*. For instance, if depositors punished a bank last period for weak fundamentals (*DRDFUND* falls), then it should react today by improving its fundamentals, increasing the capital base or reducing

the level of non-performing loans. The results of this test are not very encouraging, however, as shown in the top portion of Table 7. Only *PROV* clearly appears to behave in a manner consistent with market discipline, where a previous deterioration leads to an increase today in provisions. Liquidity responds with the expected sign but the coefficient is not statistically significant. All other variables appear to exhibit the opposite behavior: if fundamentals deteriorate (improve) in the previous period, and therefore depositors withdraw (increase) deposits, then today fundamentals tend to deteriorate (improve) even more.

One possible explanation for this behavior is that banks may respond asymmetrically to signals by depositors. On the upside it may be that a virtuous cycle is encountered whereby an initial improvement in fundamentals leads to further improvements, whereas on the downside bank managers would not allow a vicious cycle to ultimately doom the bank, so they would be likely to react by improving the fundamentals. Thus, in a second group of tests we allow for this type of asymmetry, whereby the bank only reacts when it perceives a deposit *loss* stemming from weak fundamentals.

We define two types of deposit losses, one in absolute and one in relative terms. The first occurs when the fundamental deposit growth rate of a given bank is negative, so it defines an absolute loss of deposits owing to weak fundamentals. The second defines a deposit loss as any situation when a bank exhibits a fundamental growth rate below the banking sector average, thus indicating that this bank could increase deposits by moving its fundamentals closer to the sector average. Formally we define two dummy variables for each bank *i* and period *t* as shown below:

$$DLOSS1_{it} = \begin{cases} 1, DRDFUND_{it} < 0 \\ 0, otherwise \end{cases} \qquad DLOSS2_{it} = \begin{cases} 1, DRDFUND_{it} < \overline{DRDFUND}_t \\ 0, otherwise \end{cases}$$

We must note that these variables constitute two extremes in deposit losses[17]. In the total sample of 709 observations, *DLOSS1* defines only 15 observations as having been of fundamental deposit losses, therefore it captures only the most extreme cases of individual banks being out of line in their fundamentals. On the other hand, *DLOSS2* encompasses a much greater number of observations (420) in which individual banks were simply exhibiting sub-par fundamentals in relation to the rest of the banking sector.

We now test the response of the fundamental variables to deposit *losses* only, using the two definitions. In the case of *DLOSS1*, the more extreme observations of weak fundamentals, two minor changes in results occur with the respect to the symmetric estimation, as shown in the second portion of Table 6. First, the capital-asset ratio is now simply unresponsive to deposit losses, rather than being responsive in the wrong direction. Second, liquidity has the correct sign and now approaches statistical significance, with a p-value of just over 10 percent. Therefore, in these most extreme cases, the banks that suffer the strongest deposit withdrawals appear to be unlikely to respond in any desirable way other than by increasing their loan loss provisions. Their level of nonperforming loans deteriorates even more and coverage falls even further, reflecting a type of vicious cycle of deteriorating fundamentals.

For *DLOSS2*, a wider sample including less extreme cases of deposit losses, bank behavior appears to be more consistent with market discipline. Banks now tend to improve their coverage and capital-asset ratios when depositors have discriminated against them in the previous period, they continue to adjust their provisions upward, but do not appear to adjust their nonperforming loans or their liquidity levels.

[17] We also conducted tests on two intermediate definitions: when deposit growth is below the sector average minus two standard deviations, and when it fell below the average minus one standard deviation. We excluded their results from Table 7 since the two extremes (*DLOSS1* and *DLOSS2*) illustrated the main properties of this type of analysis.

In another set of tests, we investigated whether, in addition to changes in fundamental variables, banks adjusted their interest rates following fundamental-driven changes in deposit demand. We might expect a negative relationship for deposit interest rates, as banks could counteract the (absolute or relative) deposit outflow without having to resort to improving their fundamentals. In other words, they could attract deposits either by lowering risk (i.e., improving fundamentals) or by increasing return (the interest rate). We estimate the interest rate equation described in Table 5 but replace all fundamental variables with *DRDFUND* as well as its cross-product with each of the deposit loss variables. The results show that deposit rates do exhibit the expected behavior symmetrically, thus they not only increase in response to a deposit loss, but also tend to fall when the fundamentals are above-par and deposits are growing rapidly. Furthermore, the asymmetric estimation does not seem to hold, thus indicating that the adjustment seems to be occurring primarily on the upside. However, a final exercise estimated the interest equation using *DLOSS2 itself* rather than its cross-product with *DRDFUND* and found that, on average, banks that suffered from sub-par fundamentals tended to pay higher interest rates, although these rates did not depend on the magnitude of the deposit loss.

Finally, we analyzed the response of bank lending rates to changes in fundamental deposit growth. The behavior of lending rates may signal a bank's level of risk-taking, which may eventually lead to changes in asset quality. For example, if a bank's fundamentals deteriorate and it suffers a subsequent deposit loss, it may attempt to increase risk to recover profits (i.e., "gamble for resurrection") or it may reduce risk in order to improve its fundamentals. Thus, an upward adjustment in lending rates may reflect increased risk-taking while a downward adjustment would reflect the contrary, a lower level of risk.

We find that lending rates do not appear to adjust symmetrically nor on the extreme downside in response to changes in fundamental deposit growth. However, in the case of moderate deposit losses, lending rates tend to be adjusted downward, thus suggesting that banks with sub par fundamentals tend to react by lowering risk. We also

find that on average this group of banks charges lower lending rates. This prudent behavior comes at the cost of lower profits, since we found earlier that the deposit interest rates of these banks tended to be higher on average.

VI. CONCLUSIONS

In this study we have asked two types of questions: (1) What determines depositor behavior? and (2) do banks respond correctly to depositor's signals regarding their performance? With regard to the first question, our strongest answers come from the estimations for real deposit growth, which showed that Colombian depositors respond to both risk and return factors. Banks attract deposits either by offering high interest rates (return), providing a large number of branches (return), or by exhibiting strong fundamentals, which presumably lowers the risk of default. Furthermore, state banks appear to have an inherent advantage in attracting deposits, possibly due to depositors' expectation that policymakers will not allow these institutions to fail. On the other hand, although foreign banks have been highly successful in attracting deposits in recent years, they do not appear to have any advantage in terms of reputation, as their deposit growth is explained entirely by the return they offer and their fundamentals. Finally, there appears to be some limited evidence of a "too big to fail" perception by depositors, most noticeably in the interest rate equation, where larger banks were able to pay a lower interest rate.

Fundamentals appear to matter to depositors. Coverage and two of its components, the capital-asset ratio and loan-loss provisions, tend to exert a positive influence on deposit growth, and the joint significance of fundamental variables was overwhelmingly accepted in all regressions. However, neither profitability (as measured by the return to equity), nor nonperforming loans, nor liquidity ratios appear to be associated with declines in depositors' perceived risk of losses. As we discussed earlier, the poor performance of the profitability variable is a common finding in the literature, but it remains puzzling that a bank's nonperforming loans do not seem to affect deposit demand. Finally, we showed that depositor's attitudes toward liquidity varied depending

on whether the macroeconomic environment was normal or one of particularly low growth. During normal times, greater liquidity was associated with less active intermediation, but with very little benefit in terms of lower risk of default. Only in difficult or "bad times" did the benefits of greater liquidity become apparent.

As for the second question, we obtained evidence that banks responded to depositors' signals in a manner consistent with market discipline, as evidenced by the responsiveness of some of the fundamental variables that were relevant to depositors: coverage, capitalization, and provisions. Our results also gave support to the hypothesis that this response was asymmetric, occurring only when the banks perceived that they were being punished by depositors. However, this disciplining behavior did not appear to extend to the cases in which fundamentals were the weakest, as these banks tended to perpetuate their problems rather than try to correct them. Finally, we found that positive signals from depositors tended to allow banks to lower their interest costs subsequently and that, on average, banks that received negative signals from depositors tended to have higher interest costs and lower interest receipts than the rest of the banking system, thus suffering a profit squeeze as a result of attempting to limit the deposit outflow and the level of risk.

These results point to the existence of market discipline in Colombia, as depositors take into account bank fundamentals, send signals to the banks, who then adjust their behavior accordingly. In other words, moral hazard appears to be limited, even though there is an explicit deposit insurance system throughout our sample period. This may be due to one or several design features, such as its compulsory nature, or the co-insurance, risk-weighted premiums, and the existence of a coverage limit that is continuously declining in real terms. With regard to the latter variable, we note that the recent cross-country study by Demirguc-Kunt and Detragiache (1999) finds evidence that the less extensive the coverage, the less moral hazard and greater market discipline is observed. Furthermore, the steady decline in coverage is consistent with the observed increase over time in depositors' sensitivity to fundamentals, an indication that market discipline may be increasing.

Our results also have implications regarding the nature of market discipline in Colombia, in particular with regard to the behavior of loan-loss provisions. Indeed, we found this to be the only fundamental variable that responded symmetrically (and in the expected direction) to depositors' signals. This finding is consistent with the level of provisions being largely an automatic or "endogenous" response of banks in order to comply with regulation. While depositor behavior may play an important role in disciplining banks in Colombia, there may also be an element of "regulatory discipline" which imposes appropriate adjustments by banks when their fundamentals deteriorate, most notably observed in the level of provisions[18].

Finally, although depositor behavior appears to exhibit market discipline and moral hazard seems to be limited, there still are two principal causes for concern. First, it is unclear why nonperforming loans do not play an important part either in depositors' decisions nor in banks' responses, especially when this variable has a proven empirical track record in predicting bank failures, both in Colombia's mid-1980s crisis as well as in other countries (González-Hermosillo, 1999). Second, market discipline is certainly weakened by the preference for state-owned banks and a possible "too big to fail" mentality on the part of depositors, and indication that some degree of moral hazard still remains.

[18] In future work, also based on more detailed monthly bank data, we will investigate to what extent depositor behavior is driven by large government deposits in the banking system, perhaps another instance of "government-driven" market discipline.

Table 1. Colombia's Deposit Insurance Scheme

	1994	1995	1996	1997	1998	1999
Characteristics:						
Premium (% of insured deposits)	0.15	0.15	0.15	0.15	0.15	0.30
Refund for "Investment Grade"					50%	300%
Refund for "Good Grade"					25%	25%
Coverage limit (col$mill)	10	10	10	10	10	10
Deductible	25%	25%	25%	25%	25%	25%
Coverage indicators:						
	(Percentage of total financial system)					
Eligibility						
By size: Number of accounts smaller than the coverage limit	98.61%	98.33%	98.00%	97.79%	97.58%	97.87%
By type: Number of eligible accounts		98.56%	92.70%	95.15%	97.95%	98.12%
Value covered						
Total insured deposits	48.16%	45.07%	41.51%	40.19%	37.72%	34.63%

Source: Superintendencia Bancaria de Colombia

Table 2. Colombia: Actual Insurance Payments to Depositors (1996-2000)

Intervened Institution	Amount paid/Insured liabilities
COMMERCIAL BANKS	
BANCO SELFIN S.A	9.9%
BANCO ANDINO	5.9%
BANCO PACIFICO S. A.	5.7%
FINANCIAL CORPORATIONS	
CORFIPACIFICO	10.6%
COMMERCIAL FINANCE COMPANIES	
LA FORTALEZA S.A.	40.6%
BERMUDEZ Y VALENZUELA S.A.	32.8%
C.F.C.PACIFICO	19.6%
FINDESARROLLO	16.7%
LEASING COMPANIES	
LEASING SELFIN S.A	20.0%
LEASING FINANCIERA CAUCA S.A. (FINANCAUCA)	16.2%
LEASING PATRIMONIO	9.2%
FINANCIERA ARFIN	4.4%
CAPITALIZATION SOCIETIES	
CAPITALIZADORA GRANCOLOMBIANA	52.8%

Source: Fogafin

Table 3. Cross-country comparison of deposit insurance schemes

	Germany	EU*	US	World average (68 countries)	Colombia
Coverage limit	30% of equity	ECU$20000	US$100000	3 times per capita GDP	col$10 million**
Coinsurance	No	10%	No	Yes, in 17	25%
Foreign currency deposits covered	Yes	Can be excluded	Yes	Yes, in 48	n.a.***
Interbank deposits Covered	No	No	Yes	Yes, in 18	No
Funding	Funded, but additional funds callable	Not regulated	Funded	Funded, in 58 cases	Funded
Sources of Funding	Banks only	Not regulated	Joint	Private: 15 Joint: 51 Public: 1	Private
Management	Private	Not regulated	Public	Private: 11 Joint: 24 Public: 33	Public
Membership	Voluntary	Compulsory	Compulsory	Compulsory in 55 cases	Compulsory
Risk adjusted Premiums	Yes	Not regulated	Yes	Yes, in 21 cases	Yes

* Minimum requirements.

** As of July 2000, this is around USD4600, or 2 to 3 times per capita GDP.

*** Colombia's financial system does not allow for foreign currency deposits.

Source: Beck (2000).

TABLE 4A. DETERMINANTS OF THE RATE OF GROWTH OF REAL DEPOSITS (*DRD*)
(Period and bank-specific effects, semi-annual data, 1985(1)-1999(2))

	(1)	(2)	(3)	(4)	(5)
Estimation method:	FE	FE	FE	FE	FE
Constant	-0.126 (2.28)**	-0.436 (8.541)**	-0.139 (2.571)**	-0.332 (6.675)**	-0.100 (1.577)
Return on deposits					
r	0.694 (2.774)**	1.184 (5.421)**	0.763 (3.025)**	0.996 (4.510)**	0.687 (2.753)**
BRANCH	0.677E-03 (1.584)	0.609E-03 (1.646)*	0.646E-03 (1.512)	0.673E-03 (1.788)*	0.712E-03 (1.670)*
Probability of default: bank size and lagged fundamentals					
ASSETS	3.52E-08 (1.802)*	2.93E-08 (1.738)*	0.340E-07 (1.748)*	0.346E-07 (2.013)**	0.313E-07 (1.597)
NPL(-1)	-0.138 (1.020)				
KASS (-1)		2.332 (14.742)**			
COVGE(-1)				1.963 (13.666)**	
LIQ(-1)					-0.503 (-1.962)**
BTLIQ(-1)					0.897 (2.308)**
ROE(-1)			-0.017 (1.485)		
Sector dummies					
STATE	.026 (0.461)	.099 (2.116)**	.009 (0.179)	0.117 (2.437)**	.017 (0.319)
FOR	.007 (0.138)	-0.025 (0.561)	0.007 (0.139)	-0.048 (-1.049)	.016 (0.313)
Hypothesis tests					
Bank effects	105.87	99.19	106.02	97.41	110.37
p-value	0.00	0.00	0.00	0.00	0.00
Period effects	119.34	183.27	121.78	186.11	116.12
p-value	0.00	0.00	0.00	0.00	0.00
Hausmann test	27.02	23.24	23.55	29.31	31.67
p-value	0.00	0.00	0.00	0.00	0.00
No. of observations	709	709	709	709	709
R^2	0.293	0.470	0.294	0.451	0.299

t-ratios in parentheses; (*) significant at 90%; (**) significant at 95%

TABLE 4B. DETERMINANTS OF THE RATE OF GROWTH OF REAL DEPOSITS (*DRD*)
(Period and bank-specific effects, semi-annual data, 1985(1)-1999(2))

	(6)	(7)	(8)[1]	(9)[2]
Estimation method:	FE	FE	FE	FE-2SLS
Constant	-0.273 (4.745)**	-0.419 (6.891)**	-0.400 (6.549)**	-0.133 (1.222)
Return on deposits				
r	0.947 (4.253)**	1.154 (5.228)**	1.126 (5.136)**	1.019 (4.336)**
BRANCH	0.732E-03 (1.947)*	0.645E-03 (1.746)*	6.83E-04 (1.858)*	0.001 (4.514)**
Probability of default: bank size and lagged fundamentals				
ASSETS	0.302E-07 (1.753)*	0.249E-07 (1.467)	0.240E-07 (1.420)	-0.836 (1.222)
NPL(-1)		0.166 (1.391)		
NPLASS(-1)			-0.547 (1.402)	
PROV(-1)			1.427 (2.587)**	
KASS (-1)		2,404 (14.657)**	2.396 (14.882)**	
COVGE(-1)	1.980 (13.609)**			1.919 (12.871)**
LIQ(-1)	-0.605 (2.672)**	-0.430 (1.926)*	-0.416 (1.852)*	-0.852 (3.079)**
BTLIQ(-1)	0.702 (2.049)**	0.614 (1.822)*	0.617 (1.839)*	0.740 (2.156)**
ROE(-1)	0.005 (0.500)	0.012 (1.197)		
Sector dummies				
STATE	0.133 (2.747)**	0.086 (1.727)*	0.076 (1.540)	0.092 (1.740)*
FOR	-0.044 (0.961)	-0.014 (0.307)	-0.023 (0.513)	-0.042 (0.922)
Hypothesis tests				
Bank effects	102.15	103.54	103.41	
p-value	0.00	0.00	0.00	
Period effects	179.29	172.36	179.39	
p-value	0.00	0.00	0.00	
Hausmann test	36.67	24.93	29.08	
p-value	0.00	0.01	0.00	
Joint significance of fundamentals				
F-statistic	49.15	0.00	45.66	
p-value	0.00	0.00	0.00	
No. of observations	709	709	709	709.00
R^2	0.458	0.478	0.482	0.456

t-ratios in parentheses; (*) significant at 90%, (**) significant at 95%

[1] Also ran this specification restricting the coefficients for LIQ and BTLIQ to be equal in absolute value. This restriction yields an F-statistic of 0.4408 and a p-value of 0.503.

[2] Two-stage least squares estimation using the lending rate, the required reserve ratio, and the ratio of noninterest expenses to assets as instruments for the deposit interest rate.

TABLE 5. DETERMINANTS OF THE NOMINAL RATE OF INTEREST (r)
(Period and bank-specific effects, semi-annual data, 1985(1)-1999(2))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation method:	FE	FE	FE	FE	FE	FE	FE	FE	RE
Constant	0.156	0.164	0.151	0.158	0.164	0.163	0.174	0.180	0.188
	(25.165)**	(25.040)**	(25.158)**	(25.123)**	(21.311)**	(20.668)**	(20.613)**	(21.357)**	(17.917)**
BRANCH	0.159E-03	0.156E-03	0.161E-03	0.155E-03	0.161E-03	0.163E-03	0.167E-03	0.166E-03	0.633E-04
	(2.367)**	(2.347)**	(2.422)**	(2.319)**	(2.403)**	(2.456)**	(2.544)**	(2.515)**	(1.159)
Probability of default: bank size and lagged fundamentals									
ASSETS	-0.853E-08	-0.840E-08	-0.864E-08	-0.875E-08	-0.956E-08	-0.925E-08	-0.853E-08	-0.869E-08	-0.528E-08
	(2.791)**	(2.781)**	(2.863)**	(2.879)**	(3.120)**	(3.051)**	(2.828)**	(2.872)**	(1.927)*
NPL(-1)	-0.029						-0.050		
	(1.352)						(2.342)**		
NPLASS(-1)								-0.220	-0.217
								(3.159)**	(3.204)**
PROV(-1)								0.243	0.236
								(2.460)**	(2.423)**
KASS(-1)		-0.107					-0.098	-0.111	-0.118
		(3.805)**					(3.371)**	(3.857)**	(4.257)**
COVGE(-1)				-0.062		-0.043			
				(2.446)**		(1.682)*			
LIQ(-1)					-0.076	-0.063	-0.075	-0.086	-0.122
					(1.875)*	(1.573)	(1.875)*	(2.138)**	(3.533)**
BTLIQ(-1)					-0.003	-0.004	0.009	0.009	0.071
					(0.046)	(0.072)	(0.144)	(0.157)	(1.784)*
ROE(-1)			0.007			0.006	0.005		
			(3.839)**			(3.351)**	(3.022)**		
Sector dummies									
STATE	-0.022	-0.030	-0.027	-0.029	-0.023	-0.027	0.020	-0.024	-0.020
	(2.459)**	(3.575)**	(3.235)**	(3.481)**	(2.748)**	(3.132)**	(2.252)**	(2.706)**	(2.401)**
FOR	0.002	0.005	0.005	0.005	0.003	0.006	0.004	0.002	0.007
	(0.245)	(0.588)	(0.629)	(0.611)	(0.382)	(0.763)	(0.545)	(0.226)	(1.066)
Hypothesis tests									
Bank effects	443.34	449.63	442.26	438.95	378.38	390.56	410.63	402.70	402.70
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Period effects	256.56	267.29	274.75	268.97	223.04	228.47	220.53	225.60	225.60
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hausmann test	17.48	14.67	19.45	16.27	15.54	16.32	14.66	12.02	12.02
p-value	0.00	0.01	0.00	0.01	0.02	0.04	0.10	0.21	0.22
Joint significance of fundamentals									
F-statistic						5.36	6.95	5.83	
p-value						0.00	0.00	0.00	
No. of obs.	709	709	709	709	709	709	709	709	709
R^2	0.692	0.698	0.698	0.694	0.694	0.701	0.707	0.705	0.287

t-ratios in parentheses; (*) significant at 90%, (**) significant at 95%

Table 6. Changes Over Time in the Responsiveness to Bank Fundamentals:
Rate of Growth of Real Deposits (DRD)[1]
(Period and bank-specific effects, semi-annual data, 1985(1)-1999(2))

Specification	(6)	(7)	(8)
Estimation method:	FE	FE	FE
Probability of default: bank lagged fundamentals			
NPL(-1)		0.428 (2.237)**	
*NPL(-1)*Time*		-0.042 (2.171)**	
NPLASS(-1)			0.935 (1.528)
*NPLASS(-1)*Time*			-0.132 (3.031)**
PROV(-1)			-0.357 (0.364)
*PROV(-1)*Time*			0.128 (2.109)**
KASS (-1)		1.775 (4.084)**	1.558 (3.310)**
*KASS (-1)*Time*		0.036 (1.608)[2]	0.047 (1.893)*
COVGE(-1)	0.560 (1.822)*		
*COVGE(-1)*Time*	0.088 (5.275)**		
LIQ(-1)	-0.214 (0.530)	-0.298 (0.741)	-0.245 (0.613)
*LIQ(-1)*Time*	-0.003 (0.143)	0.009 (0.403)	0.003 (0.162)
ROE(-1)	0.008 (0.458)	0.013 (0.688)	
*ROE(-1)*Time*	-0.001 (0.086)	0.000 (0.212)	
Bank effects	109.451	112.595	116.596
p-value	0.000	0.00	0.00
Period effects	185.999	171.513	178.862
p-value	0.000	0.00	0.00
Hausmann test	26.100	19.3	20.69
p-value	0.006	0.114	0.079
No. of obs.	709	709	709
R2	0.478	0.487	0.493

t-ratios in parentheses; (*) significant at 90%, (**) significant at 95%

[1] For simplicity we present only the coefficients for the fundamentals.
[2] Significant at 89%.

Table 7. Response of Banks to Fundamental Growth of Deposits
(Period and bank-specific effects, semi-annual data, 1985(2)-1999(2))

	Response in fundamental variables					Response in deposit rate [1]		Response in lending rate [1]	
	COVGE	*KASS*	*PROV*	*NPLA*	*LIQ*	*r*	*r* [2]	r_L	r_L [2]
No. of observations:	678	678	678	678	678	678	678	678	678
Symmetric response									
Estimation method:	RE	RE	RE	RE	FE	FE		FE	
DRDFUND(-1)	0.215	0.162	-0.038	-0.143	-0.114	-0.041		-0.005	
	(14.592)**	(13.228)**	(4.135)**	(6.145)**	(0.829)	(3.400)**		(0.317)	
Constant	0.0274	0.061	0.028	0.124	0.139	0.161		0.365	
	(3.880)**	(11.932)**	(6.920)**	(9.225)**	(45.42)**	(24.903)**		(40.227)**	
Hausman test p-value	0.623	0.672	0.792	0.514	0.006	0.001		0.000	
R2	0.003	0.003	0.025	0.090	0.691	0.702		0.638	
Asymmetric response: Banks only respond to deposit "losses"									
Case 1: Banks only respond when their fundamental deposit growth is negative									
Estimation method:	RE	RE	FE	FE	RE	FE	FE	FE	FE
*DRDFUND(-1)*DLOSS1(-1)*	0.404	0.078	-0.407	-1.160	-0.133	0.048	-0.001	0.005	-0.019
	(5.167)**	(1.19)	(9.505)**	(11.035)**	(1.566)	(0.872)	(0.005)	(0.069)	(1.319)
Constant	0.074	0.096	0.0185	0.0862	0.125	0.153	0.153	0.364	0.364
	(5.167)**	(14.092)**	(18.503)**	(35.12)**	(15.206)**	(25.176)**	(25.123)**	(43.057)**	(43.119)**
Hausman test p-value	0.110	0.576	0.000	0.000	0.272	0.001	0.001	0.000	0.000
R2	0.049	0.006	0.463	0.632	0.005	0.697	0.696	0.638	0.639
Case 2: Banks only respond when their fundamental deposit growth is below the banking sector average									
Estimation method:	RE	RE	FE	FE	FE	FE	FE	FE	FE
*DRDFUND(-1)*DLOSS2-(1)*	-0.091	-0.101	-0.032	-0.045	0.017	0.079	0.007	-0.074	-0.01
	(3.707)**	(5.093)**	(2.130)**	(1.211)	(0.831)	(0.448)	(2.253)**	(3.039)**	(2.382)**
Constant	0.080	0.103	0.022	0.093	0.135	0.153	0.149	0.370	0.37
	(10.392)**	(17.632)**	(13.851)**	(23.176)**	(63.312)**	(24.356)**	(23.253)**	(42.871)**	(41.777)**
Hausman test p-value	0.180	0.582	0.077	0.000	0.000	0.001	0.004	0.000	0.000
R2	0.022	0.051	0.389	0.560	0.691	0.696	0.699	0.643	0.641

t-ratios in parentheses; (*) significant at 90%; (**) significant at 95%

[1] Regressions included non-fundamental controls: *ASS*, *BRANCH*, *STATE*, *FOR*.
[2] In this case regressors are *DLOSS1* and *DLOSS2* rather than their products with *DRDFUND*.

References

Barajas, Adolfo, Roberto Steiner, and Natalia Salazar, 2000, "The Impact of Liberalization and Foreign Investment in Colombia's Financial Sector," *Journal of Development Economics*, Vol. 63, pp. 157-96.

Beck, Thorsten, 2000, "Deposit Insurance as a Private Club: The Case of Germany", (Unpublished).

Calomiris, Charles, 1999, "Building an Incentive-Compatible Safety Net," *Journal of Banking and Finance*, Elsevier Science, B.V., pp. 1-21.

Calomiris, Charles and Andrew Powell, 2000, "Can Emerging Market Bank Regulators Establish Credible Discipline? The Case of Argentina, 1992–1999," (Unpublished, Buenos Aires: Central Bank of Argentina).

Caprio, Gerard and Patrick Honohan, 1999, "Restoring Banking Stability: Beyond Supervised Capital Requirements," *Journal of Economic Perspectives*, Vol. 13 (4), pp. 43-64.

Claessens, Stijn, Asl1 Demirguc-Kunt and Enrica Detragiache, 1998, "How Does Foreign Entry Affect the Domestic Banking Market?," World Bank Policy Research Working Paper No. 1918 (Washington: World Bank)

Demirguc-Kunt, Asl1 and Enrica Detragiache, 1998, "Financial Liberalization and Financial Fragility," IMF Working Paper No. WP/98/83 (Washington: International Monetary Fund).

Demirguc-Kunt, Asl1 and Enrica Detragiache, 1999, "Does Deposit Insurance Increase Banking System Stability?: An Empirical Investigation," World Bank Policy Research Working Paper No. 2247 (Washington: World Bank).

Demirguc-Kunt, Asl1 and Harry Huizinga, 1999, "Market Discipline and Financial Safety Net Design," CEPR Discussion Paper No. 2311 (London: Center for Economic Policy Research).

Diamond, D.W. and P.H. Dybvig, 1983, "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy*, Vol 91 (3), pp. 749-61.

Flannery, Mark J.,1998, "Using Market Information in Prudential Bank Supervision: A Review of the U.S. Empirical Evidence,"*Journal of Money,Credit and Banking*, Vol. 30, pp. 273-305.

Freixas, Xavier and Jean-Charles Rochet, 1997, *Microeconomics of Banking* (Cambridge, Massachussetts: The MIT Press).

García, Gillian, 1999, "Deposit Insurance: Actual and Best Practices," IMF Working Paper No. WP/99/54 (Washington: International Monetary Fund).

García, Gillian, 2000, "Deposit Insurance and Crisis Management," IMF Working Paper No. WP/00/57 (Washington: International Monetary Fund).

González-Hermosillo, Brenda, 1999, "Determinants of Ex-Ante Banking System Distress: A Macro-Micro Empirical Exploration of Some Recent Episodes," IMF Working Paper No. WP/99/33 (Washington: International Monetary Fund).

Gropp, Reint and Jukka Vesala, 2000, "Deposit Insurance and Moral Hazard: Does the Counterfactual Matter?", (unpublished; Frankfurt: European Central Bank).

Gruben, 1998, "Financial Reforms and Monetary Systems in Latin America: The Cases of Argentina and Mexico," (unpublished; Dallas: Federal Reserve Bank of Dallas).

Levine, Ross, 1997, "Financial Development and Economic Growth: Views and Agenda," *Journal of Economic Literature*, Vol. XXXV (June 1997), pp. 688-726.

Martínez Pería, María Soledad and Sergio Schmukler, 1999, "Do Depositors Punish Banks for Bad Behavior?: Examining Market Discipline in Argentina, Chile, and Mexico," World Bank Policy Research Working Paper No. 2058 (Washington: World Bank).

Mishkin, Frederic, 1998, "Financial Consolidation: Dangers and Opportunities," NBER Working Paper No. 6655 (Cambridge: National Bureau of Economic Research).

Moore, Robert R., 1997, "Government Guarantees and Banking: Evidence from the Mexican Peso Crisis," *Financial Industry Studies*, December, pp. 13-21.

Park, Sangkyun and Stavros Peristiani, 1998, "Market Discipline by Thrift Depositors," *Journal of Money, Credit and Banking*, Vol. 30 (3), pp. 347-364.

Schumacher, Liliana, 1996, "Bubble or Depositor's Discipline? A Study of the Argentine Banking Panic (December 1994/May 1995)," Ph.D. Dissertation, University of Chicago.

Schumacher, Liliana, 2000, "Bank Runs and Currency Run in a System without a Safety Net: Argentina and the 'Tequila' shock," *Journal of Monetary Economics*, forthcoming (March).