The Impact of Explicit Deposit Insurance on Market Discipline

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Abstract

This paper examines the interaction between market discipline and explicit or implicit deposit insurance using the experiences of Bolivia during the period 1998:1 to 2003:12. The country-specific circumstances during this period allow us to investigate the effect of explicit deposit insurance on market discipline in a setup that resembles a controlled experiment. Contrary to other studies on developing countries, we find a strong link between bank fundamentals and the supply of deposits, which is consistent with the hypothesis that market discipline is at work. The results also suggest that most of the market discipline comes from large depositors. More importantly, we find that the introduction of an explicit deposit insurance system (as opposed to implicit guarantees) caused a significant reduction in market discipline, especially from large depositors. These findings are in line with the characteristics of the deposit insurance system and with the bailout practices of the Bolivian Central Bank before the introduction of deposit insurance. Finally, the results also suggest that foreign banks are subject to less market discipline than domestic banks and that depositors "run" more from domestic banks than from foreign banks during episodes of political instability.

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1. Introduction

During the last twenty years, both developed and developing countries have suffered significantly from systemic banking crises.[1] To reduce the likelihood of such crises and to limit their costs when they occur, policymakers around the world rely almost exclusively on bank regulation and supervision and on the introduction of financial safety nets. The latter includes implicit or explicit deposit insurance, lender-of-last-resort facilities, procedures for resolving bank failures, and procedures for obtaining emergency financial assistance from international organizations, such as the IMF and the World Bank.

In recent years, the introduction of explicit deposit insurance systems became very popular. For example, from 1974 to 1999, the number of countries with explicit deposit insurance increased from 12 to 71 (Demirgüç-Kunt and Sobaci, 2001). In fact, establishing explicit deposit insurance has become one of the main policy recommendations that outside experts give to developing countries.[2] Their popularity relies not only on the common wisdom that they may reduce or eliminate financial panics, but also on the hope that they may limit the open-ended implicit guarantees that are common in developing countries. Local governments, however, often use them to promote other political objectives (e.g., protect small, unsophisticated depositors or help small banks compete with large banks).[3]

Academics are increasingly concerned with possible adverse effects from deposit insurance. Depending on the generosity of the deposit insurance system and the efficacy of the bank regulatory and supervisory system, deposit insurance may actually increase financial fragility. In particular, deposit insurance is expected to reduce the incentives of insured depositors to monitor and discipline their banks (i.e., by requiring higher interest rates and/or by withdrawing their deposits) and thus increase the incentives of banks for excessive risk taking. "Overly generous" deposit insurance systems or open-ended implicit guarantees may completely eliminate market discipline. If this situation is coupled with

[1] Caprio and Klingebiel (2003) report 117 episodes of systemic banking crises in 93 countries since the late 1970s. In many cases the fiscal costs are more than 30 percent of GDP.
[2] See Folkerts-Landau and Lindgren (1998), and Garcia (1999).
[3] See Demirgüç-Kunt and Kane (2002).

weak regulatory and supervisory systems, it could lead to huge costs, both for taxpayers and for the economy more generally from exacerbating and prolonging crises.[4]

This paper investigates the interaction between market discipline and explicit deposit insurance. To explore how deposit insurance affects market discipline, we first examine whether and how depositors discipline their banks and then how explicit deposit insurance, as opposed to implicit guarantees, affects market discipline. For both cases, we also examine whether large and small depositors behave differently. The analysis focuses on the experiences of Bolivia between 1998:1 and 2003:12. The country-specific circumstances during this period allow us to investigate the effect of explicit deposit insurance on market discipline in a setup that resembles a controlled experiment.

In particular, during this period depositors had reasons to worry about the safety of their deposits given that a recession that started in 1998 weakened significantly the health of the Bolivian banking sector. More importantly, apart from the introduction of a deposit insurance system in December 2001, there were no major regulatory reforms during this period. This makes it possible to construct consistent time-series and to compare the behavior of depositors before and after the new system was introduced. The comparison is between implicit and explicit deposit insurance, since before December 2001, the Bolivian Central Bank bailed out depositors of failed institutions. Detailed knowledge of the practices of the Bolivian Central Bank and the characteristics of the deposit insurance system allows us to link the results to the institutional setting.

A crucial ingredient for the analysis is information on the current cost of funds (i.e., the current cost of existing deposits or the cost of new deposits). For most countries, the only available information is an implicit interest rate on deposits, calculated as the ratio of interest expenses to total deposits. However, this is only a rough indicator of current interest rates, since it is an aggregate of various types of deposits with interest rates that have been adjusted to market conditions at different points in time. The data from Bolivia allow us to improve upon this measure. In particular, the interest rate on deposits is constructed by the Bolivian Central

[4] The U.S. Savings and Loans debacle in the mid-1980s is a classical example of such situations (see Kane, 1989). More recently, evidence from 61 developed and developing countries indicates that the existence of explicit deposit insurance, as opposed to implicit insurance and/or no insurance at all, increases the likelihood that a country will experience a banking crisis. This effect is more pronounced for generous deposit insurance systems and for countries with poor institutional settings (see Demirgüç-Kunt and Detragiache, 2002).

Bank as a weighted average of the interest rate on all deposits outstanding at the end of each month and it is constructed separately by type of deposits and by currency denomination.

The results are consistent with the hypothesis that market discipline is at work. We find that an increase in bank risk leads to higher interest rates on deposits and lower volume of deposits (i.e., we find evidence both on prices and quantities). The results also suggest that most of the market discipline comes from large depositors. Nevertheless, small depositors are also found to respond to bank risk. This result is important, since deposit insurance systems are often motivated or designed to protect small unsophisticated depositors that are not able, or find it too expensive, to monitor their banks (e.g., Dewatripont and Tirole, 1994).

The results with respect to deposit insurance indicate that the introduction of an explicit deposit insurance system caused a significant reduction in market discipline. Moreover, most of the reduction in market discipline came from large depositors. This is not surprising, since before the introduction of deposit insurance there were cases where the Bolivian Central Bank bailed out only small depositors. Instead, the deposit insurance system that was introduced in 2001 made no distinction between small and large depositors (i.e., in the event of bankruptcy all depositors would receive the same percentage of their deposits).

This paper contributes to a small but growing literature that investigates empirically the effects of deposit insurance on market discipline. In particular, drawing from the U.S. Savings and Loans crisis, the evidence shows that even fully insured depositors will discipline their banks if the deposit insurer faces serious financial difficulties (e.g., Kane, 1987; Cook and Spellman, 1991 and 1994; and Park and Peristiani, 1998). More recently, Martinez Peria and Schmukler (2001) examined the effect of deposit insurance on market discipline using data from developing countries. In particular, using data from Argentina, Chile, and Mexico during the 1980s and 1990s, they found that both insured and uninsured depositors discipline their banks, and the degree of market discipline increases right after a financial crisis, even if a deposit insurance system has been just introduced. The authors argue that these results highlight the lack of credibility of deposit insurance in developing countries.

Finally, using data from 31 developed and developing countries, Demirgüç-Kunt and Huizinga (2003) found that market discipline is lower in countries with explicit deposit insurance, and the degree to which it is lower depends positively on the generosity of the

deposit insurance system. It should be pointed out, however, that this study found evidence consistent with market discipline only on prices, not on quantities. As emphasized by Park (1995)—and explained later in the section on methodology— finding evidence on both prices and quantities is crucial in order to distinguish market discipline from alternative hypotheses.

The remainder of the paper is organized as follows. Section two reviews the empirical literature and provides a critical evaluation of the existing evidence. Section three describes the deposit insurance system in Bolivia. Section four discusses the methodology and the data used in the empirical analysis. Section five describes and evaluates the paper's main results. Section six provides sensitivity analysis, and Section seven concludes.

2. Literature Review

Since the mid-1980s, a number of studies have examined whether uninsured (or partially insured) debt holders in the United States respond to bank risk by requiring higher interest rates and/or by withdrawing their deposits. These studies can be divided into two groups, depending on the instrument used. The first group uses large certificates of deposit (over $100,000), which are only partially insured by the U.S. deposit insurance system.[5] The second group uses subordinated notes and debentures (SNDs), which are expected to enjoy a less secure conjectural guarantee than certificates of deposit (CDs). In particular, SNDs are debt-contracts that are not covered by deposit insurance and are subordinate to the claims of depositors. Hence, many researchers have regarded SNDs as an attractive instrument for evaluating the potential effectiveness of market discipline.

Although the results are not unanimous, both groups of studies found evidence consistent with the hypothesis that market discipline is at work. Studies using CDs found that the interest rate on large CDs responds positively to indicators of bank risk (e.g., Baer and Brewer, 1986; James, 1988, 1990; Hannan and Hanweck, 1988; Cargill, 1989; Keeley, 1990; and Ellis and Flannery, 1992). However, the early studies using debentures found no relationship between the interest rate on SNDs and indicators of bank risk (e.g., Avery, Belton, and Goldberg, 1988 and Gorton and Santomero, 1990). Given the evidence from the CD market, this result was quite surprising, if not disturbing.

[5] The U.S. deposit insurance system provides insurance on deposits up to $100,000 per account.

A more recent study by Flannery and Sorescu (1996) showed that the inability to detect market discipline was due to the conjectural guarantee of "too-big-to-fail" policies in the early 1980s, the sample period for the two early studies on SNDs. For the period 1988-1991, when the too-big-to-fail policies receded, Flannery and Sorescu (1996) found that bank risk explains a high proportion of the cross-sectional variation in the risk premium of SNDs. Hence, they concluded that investors can evaluate the credit quality of individual banks, but they will do so only when they feel that their funds are at risk.

A related branch of the literature has shown that even fully insured depositors will respond to bank risk if the deposit insurer faces financial difficulties (e.g., Kane, 1987; Cook and Spellman, 1991 and 1994; Park and Peristiani, 1998). These studies focused on S&Ls in the United States during the period that the Federal Savings and Loan Insurance Corporation (the deposit insurer of S&Ls at the time) was insolvent. When the deposit insurer is insolvent, there are reasons to believe that the guarantee could be repudiated (in whole or in part) or that insured depositors could incur indirect costs if their bank fails (e.g., waiting for a long time to collect their funds). In that case, even fully insured depositors might find it optimal to withdraw their funds from a risky bank or to require a higher risk premium.

Although market discipline seems to be at work in the United States, it is not entirely clear that it is present in developing countries. In particular, banks in the United States might be subject to more market discipline than in developing countries since they are subject to more stringent reporting requirements and their debt holders might be more sophisticated. On the contrary, one could argue that corruption, weak regulatory and supervisory systems, and the recurrence of banking crises in developing countries may actually increase debt holders' incentives to monitor their banks.

There are a few studies investigating market discipline in developing countries, most of which emerged in the late 1990s and focused on the experiences of a particular country (e.g., Valdes and Lomakin, 1988; D'Amato et al., 1997; Calomiris and Powell, 2000; Schumacher, 2000; Barajas and Steiner, 2000; Martinez Peria and Schmukler, 2001). In general, these studies provide evidence consistent with the hypothesis that market discipline is at work. In most cases, however, the evidence is not very strong. Many indicators of bank risk are not

statistically significant and the results (sign and significance) are often sensitive to the particular specification of the estimated regression.

An even smaller set of studies examined the interaction between market discipline and deposit insurance in developing countries. Martinez Peria and Schmukler (2001) examined the effect of deposit insurance on market discipline using data from Argentina, Chile, and Mexico during the 1980s and 1990s. They found that both insured and uninsured depositors discipline their banks, and the degree of market discipline increases right after a financial crisis, even if a deposit insurance system has been just introduced. The authors argue that these results highlight the lack of credibility of deposit insurance in developing countries. More recently, a cross-sectional study by Demirgüç-Kunt and Huizinga (2003) found that market discipline is lower in countries with an explicit deposit insurance system in place and the degree to which it is lower depends on the characteristics of the deposit insurance system (i.e., the more generous the deposit insurance system, the lower the market discipline).

Having reviewed the literature on market discipline, it is important to highlight some differences across the various studies with respect to data and methodology. These differences have important implications for the quality of the empirical analysis.

In many cases, data availability limits the quality of one of the most important variables for the analysis: the interest rate on the debt instrument used. In particular, to examine whether debt holders respond to an increase in bank risk by requiring a higher risk premium, it is necessary to have information on the bank's current cost of existing funds or the cost of new funds. This is often a problem for studies that use deposits as their debt instrument, since the only available information on the current cost of deposits is an implicit interest rate, which is calculated as the ratio of interest rate expenses to total deposits. This measure is only a rough indicator of current interest rates, since it is an aggregate of various types of deposits with interest rates that have been adjusted to market conditions at different points in time. It should be pointed out that this is not a problem for studies that use SNDs, since a large proportion of outstanding SNDs is traded in the secondary market, and thus current interest rates can be computed from their prices.

With respect to methodology, it should be emphasized that a positive relationship between interest rates and bank risk is not sufficient evidence of market discipline (Park,

1995). For example, an increase in bank risk could lead to an increase in the demand for deposits if risky banks are expanding more aggressively. In this case, the interest rate on deposits may depend positively on bank risk, even if depositors are indifferent about the riskiness of their banks. This possibility suggests that higher interest rates may result from debt holders' aversion to risky banks (a leftward shift of the supply curve), higher demand for funds by risky banks (a rightward shift of the demand curve), or both.

To draw more convincing conclusions, one should examine whether bank risk is also inversely related to the amount of debt (i.e., examine both prices and quantities). Nonetheless, many studies in this literature do not pursue this strategy. Notable exceptions are Park (1995), Park and Peristiani (1998), Calomiris and Powell (2000), Schumacher (2000), Martinez Peria and Schmuckler (2001) and Demirgüç-Kunt and Huizinga (2003). We will discuss this issue further in the methodology section.

3. The Deposit Insurance System in Bolivia

Bolivia introduced an explicit deposit insurance system on December 20, 2001, with the passage of the law for Financial Restructuring (2297). In particular, a deposit insurance fund was created in order to assist in the resolution of failing financial institutions. All financial institutions operating in Bolivia are *required* to contribute to this fund. The insurance *premiums* are proportional to the institution's private sector deposits. When fully capitalized, the fund will be 5 percent of the total deposits in the financial system. Full capitalization is expected in 2005. Until 2005, Central Bank is responsible for deposit insurance. After 2005, the fund will be used.

The deposit insurance coverage is *limited*: before 2005, it covers only up to 50 percent of a bank's "total privileged obligations" (TPOs), while after 2005 it covers only up to 30 percent. Total privileged obligations are divided into first and second order obligations, where second order obligations are subordinate to first order obligations. First order obligations include: private sector deposits, foreign trade prepayments, tax collections and withholdings, and judicial deposits. Second order obligations include: public sector deposits and obligations to the Central Bank, foreign financial entities, tax authorities, and other entities that provide services to financial intermediaries. It should be pointed out, that

private sector deposits do not include *interbank deposits*. The law states specifically that interbank deposits are not insured. Instead, *foreign denominated deposits* are treated the same way as deposits in Bolivianos.[6]

Insert Table 1 here

Table 1 provides some information regarding the average bank's sources of finance before and after the introduction of deposit insurance. In particular, the most important category of total privileged obligations is deposits from the private sector: they are, on average, more than 78 percent of total privileged obligations. More importantly, they are almost always more than 50 percent of total privileged obligations, which implies that not all deposits to the private sector are covered by deposit insurance, and that after 2001 all second-order obligations are effectively uninsured.

Given that not all deposits are insured, one would expect that even if the deposit insurance system were fully credible, it would not lead to a complete elimination of market discipline (assuming of course that there is market discipline in the first place). Moreover, given that second-order obligations are effectively uninsured after 2001, while previously they were implicitly insured, one would expect a significant reduction in this type of obligations.[7] In fact, deposits from foreign financial entities decreased significantly after the introduction of deposits insurance. This finding is consistent with the hypothesis that foreign banks know that their deposits are effectively uninsured and reduce their supply of deposits. On the contrary, domestic institutions do not seem to be concerned with the safety of their deposits. In particular, obligations to the public sector, the Central Bank, and government-owned financial entities increase significantly after the introduction of deposit insurance, while interbank deposits remained constant.

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[6] The Bolivian economy is highly dollarized (i.e., more than 90 percent of deposits and credits are denominated in U.S. dollars). This high degree of dollarization is one of the longer lasting effects of the hyperinflation of the 1980s. Because of the high degree of dollarization, the exchange rate policy follows a crawling peg with the U.S. dollar. The depreciation rate is determined annually, but is not announced. In response to internal developments, the Central Bank can decide on short-term variations in the exchange rate. During the sample period, the exchange rate has been depreciating at a roughly constant rate of 6.5 percent per annum, with a peak of 9.7 percent in 2002.

[7] Billet, Garfinkel, and O'Neal (1998) argue that if the costs of regulatory discipline are lower than the costs of market discipline, banks should replace uninsured funds with insured funds. Using U.S. data, the authors show that banks that have been downgraded by Moody's experience smaller declines in equity value and increase their absolute and relative reliance on insured deposits, indicating that bank managers perceive the cost of insured deposits to have increased less than the cost of uninsured deposits.

Although the descriptive statistics in Table 1 might be suggestive about the effect of deposit insurance on market discipline (i.e., a leftward shift in the supply of a debt instrument), the observed patterns could also be due to demand effects. To distinguish between the two, it is necessary to also use interest rate information and to control for other factors that may affect the demand and supply of a debt instrument. Since we have interest rate information only for private sector deposits, the empirical analysis in the remainder of the paper will focus on deposits from the private sector.

4. The Empirical Analysis

4.1. Methodology

To examine whether depositors impose market discipline on banks, ideally one should estimate a *simultaneous equations model* specifying demand and supply equations. In practice, however, this is very difficult, since it is hard to find exogenous variables that strongly affect either the supply or the demand equation. Hence, the empirical literature has tried to infer whether market discipline is present using *reduced-form equations* for the *equilibrium* interest rates and deposits. In particular, market discipline implies that an increase in bank-risk leads to a decrease in the supply of deposits. Thus, everything else equal, it leads to higher interest rates and lower deposits.[8]

Using reduced-form equations, however, is more complicated than it may seem at first sight, since the demand function could also depend on bank risk. For example, an increase in bank risk could be associated with an increase in the demand for deposits, if risky banks are expanding more aggressively. At the same time, an increase in bank risk could be associated with a decrease in the demand for deposits, if banks respond to regulatory discipline by shrinking their operations. For example, banks may respond to

[8] Whether an increase in bank risk leads to a change in interest rates *and* deposits, depends on the elasticities of the two curves (e.g., if the demand curve is perfectly inelastic we should expect only a change in interest rates, while if it is perfectly elastic, we should expect only a change in deposits). However, it is more likely that the demand curve is downward sloping and the supply curve is upward sloping. In particular, a bank's demand for deposits is determined by its loan supply. Hence, if a bank has finite lending opportunities due to geographic and regulatory restrictions or limited expertise with certain types of loans, then its marginal revenue curve for loans is downward sloping, which implies that its demand for deposits will be downward sloping (see Klein, 1971). Similarly, an upward sloping supply curve is consistent with a limit on the amount of deposits per depositor and a finite number of potential depositors or, alternatively, with higher search costs for deposits outside the bank's local market (see Flannery, 1982).

regulatory pressures on their capital ratios by reducing their assets and, consequently, their liabilities.[9] Thus, risky banks may lower their interest rates to reduce their deposits.

Since both the demand and the supply functions may depend on bank risk, it is possible that market discipline occurs, but it is not strong enough (compared to the demand effect) to be reflected in the equilibrium interest rates and deposits. Figure 1 illustrates this argument graphically. Assuming that the supply curve is upward sloping and the demand curve is downward sloping, an increase in bank risk could lead to four possible cases. In general, the presence of market discipline is most convincing in the first case, most doubtful in the second case, and inconclusive in the third and fourth case (see Park, 1995). Figure 1 also highlights that a positive relationship between interest rates and bank risk *and* a negative relationship between deposits and bank risk is a sufficient, but not a necessary, condition for market discipline. We argue, however, that finding both effects would provide the most convincing evidence.

Insert Figure 1 here

To examine how equilibrium interest rates and deposits respond to changes in bank risk, we estimate the following reduced-form equations:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \varepsilon_{i,t} \qquad (1)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \eta_{i,t} \qquad (2)$$

where $i = 1,...,N$ and $t = 1,...,T$, and N is the number of banks and T is the number of observations per bank. The panel is unbalanced, which implies that T varies across banks. $InterestRate_{i,t}$ is the interest rate on deposits in bank i at time t, while $\Delta Deposits_{i,t}$ is the growth rate of deposits in bank i at time t.[10] $BankRisk_{i,t-k}$ is a vector of bank risk

[9] In the United States, formal regulatory interventions in banks with serious financial problems have been found to have an immediate negative impact on new lending (e.g., Peek and Rosengren, 1995).

[10] Following the literature, the growth rate of deposits is used instead of the level because the latter is expected to depend more on bank characteristics, such as bank size and business orientation (retail versus wholesale), than on supply and demand conditions in a given month. However, regressing the growth rate of deposits on the level of bank risk makes it a lot more difficult to find statistically significant coefficients for β_2, since even if bank risk affects the level of deposits, it may not affect its growth rate.

characteristics and $Controls_{i,t-k}$ is a vector of control variables. These vectors are included with a lag (i.e., k = 0,1,2,… n), since this information is available to the public with a 20 to 30 day lag, and because it takes some time before changes in the independent variables lead to changes in the dependent variables. The specific variables included in each vector are explained in detail in the next section. A positive estimate for β_1 and a negative estimate for β_2 would indicate the existence of market discipline. In terms of their economic interpretation, $\hat{\beta}_1$ and $\hat{\beta}_2$ should be viewed as either a *lower bound* or an *upper bound* of the degree to which depositors discipline their banks. In particular, one of the two estimates is a lower bound and the other an upper bound, depending on whether the demand for deposits depends positively or negatively on bank risk.[11]

To examine whether the introduction of an explicit deposit insurance system affects market discipline, we estimate the following model:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \delta_1 DI_{t-k} + \phi_1 BankRisk_{i,t-k} DI_{t-k} + \varepsilon_{i,t} \quad (3)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \delta_2 DI_{t-k} + \phi_2 BankRisk_{i,t-k} DI_{t-k} + \eta_{i,t} \quad (4)$$

where DI_{t-k} is a dummy variable that equals one when an explicit deposit insurance system is in place, and equals zero otherwise. A negative estimate for ϕ_1 and a positive estimate for ϕ_2 would indicate that an explicit deposit insurance reduces market discipline. In addition, a positive estimate for $\beta_1 + \phi_1$ and a negative estimate for $\beta_2 + \phi_2$ would indicate that deposit insurance reduces, but does not eliminate, market discipline.

A few comments are in order. First, to estimate the model, we use only *savings deposits denominated in U.S. dollars*. Focusing on U.S. dollar denominated deposits does not involve a significant loss, since they represent more than 90 percent of total deposits. The reason we focus on savings deposits instead of demand deposits or time deposits is a little more complicated and deserves some explanation. For the purposes of the current

[11] For example, if the demand for deposits depends positively on bank risk (i.e., the gambling for resurrection hypothesis is true), $\hat{\beta}_1$ would overestimate the degree of market discipline, while $\hat{\beta}_2$ would underestimate it.

analysis, savings deposits have clear advantages over the other two types of deposits. Demand deposits do not pay interest. Hence, it is impossible to examine whether a supply effect is present by estimating only one of the two equations. Although time deposits pay interest, these interest rates do not reflect current market conditions as clearly as savings deposits. In particular, time deposits are grouped into various "maturity buckets" (e.g., 90 days, 180 days, etc). Within each bucket, there are deposits issued at different points in time, with the interest rate being determined when the deposit is issued. Hence, like the implicit interest rate, the interest rate on time deposits is only a rough measure of current market conditions. On the contrary, saving deposits pay the same interest rates for all their accounts regardless of time of initiation.

Second, equations (1) to (4) are estimated separately using ordinary least squares on pooled bank-level data. In the sensitivity analysis we experiment with alternative estimation techniques, such as seemingly unrelated regression estimation and fixed effect estimation.

4.2. The Data

The paper makes use of a detailed and reliable dataset on the Bolivian banking sector during the period of 1998:1-2003:12. The data and all information that was necessary to create consistent time series (e.g., definitions of variables, changes in laws and regulations, bank mergers, bank failures, etc.) were provided by the Bolivian Superintendent of Banks and Financial Entities (SBEF). This agency is responsible for the regulation and supervision of all financial institutions in Bolivia.

To ensure comparability of the financial institutions in our sample, we focus on commercial banks. This does not involve any significant loss, since commercial banks capture a dominant part of the market (e.g., 86 percent of total loans). Table 2 provides an overview of all banks in our sample. At the beginning of the sample period, there are sixteen banks. Instead, at the end of the sample period, there are twelve banks. During the sample period, one bank failed, another bank was taken over, a foreign bank left the Bolivian market, and one bank was sold after intervention by the SBEF. The five largest banks have a market share of 70 percent of total assets, and two of these banks are foreign.

During the sample period, there are no government-owned banks (the last one, Banco del Estado, was liquidated in 1994), and there are no de novo banks.

Insert Table 2 here

As of December 2003, six out of twelve banks are foreign, accounting for 33 percent of the market.[12] It should be pointed out that as of 1993, foreign banks in Bolivia have the same rights as domestic banks (i.e., they are subject to the same regulation), and as of December 2001, both foreign and domestic banks are covered by the deposit insurance system in Bolivia. Moreover, as mentioned in Table 2, none of the foreign banks in our sample is subject to explicit deposit insurance from its home country.[13]

4.2.1 Indicators of Bank Risk and Control Variables

The independent variables can be grouped into two categories: indicators of bank risk and control variables. To capture bank risk we use variables that resemble the indicators used in the CAMEL rating system. The CAMEL abbreviation stands for capital adequacy, asset quality, management, earnings, and liquidity. If market discipline is at work, deteriorating CAMEL indicators reflect higher risk, and thus are expected to have a positive impact on interest rates and a negative impact on deposits.

The leverage ratio, measured as equity to total assets, is used as an indicator of capital adequacy. The ratio of nonperforming loans to total loans and the ratio of loan loss reserves to total assets are used as indicators of assets quality. Nonperforming loans are defined as loans that are overdue for more than 30 days plus loans in liquidation. Hence, nonperforming loans are expected to capture problems with credit risk. Instead, loan loss reserves are funds set aside to absorb expected losses from nonperforming loans and thus, everything else equal, are expected to reduce problems with credit risk. The ratio of overhead expenses to total assets is used to measure bank efficiency, which may depend on management competence. We expect banks with higher overhead expenses to total assets to be less efficient. However, to compare bank efficiency, one needs to control for the types of

[12] Following the literature on foreign banks, a bank is defined as foreign if more than 50 percent of its shares is owned by foreigners. We consider Banco BISA as an exception to this rule. Although, more than 50 percent of its shares is owned by foreigners, this bank is considered a domestic bank, given that a Bolivian investor has majority ownership in the foreign companies that own the bank.

[13] This information was obtained from direct contact with the supervisory authority in each country.

loans offered (e.g., micro loans, commercial credit, etc.) and for the level of extra services. Given that we cannot control for service quality, the effect of this variable is ambiguous.

The return on total assets is used to measure bank profitability. If the other variables do not adequately control for bank risk, higher profitability would indicate lower risk. If, instead, the other variables do control adequately for risk, this variable is expected to capture a demand effect, and thus would enter with a positive sign in both equations. Finally, the ratio of liquid assets to total assets is used to measure liquidity, where liquid assets include cash plus temporary investments. In general, liquid banks are more able to meet sudden deposit withdrawals, and thus are more likely to be perceived as safer.

We also include a number of bank characteristics that may or may not capture bank risk. For example, bank size—measured as the log of total assets— could be capturing market power and reputation, but it could also be capturing a lower probability of failure (e.g., due to too-big-to-fail policies, better access to funds, better diversification of risk, etc.). In both cases, bank size is expected to enter with a negative sign in the interest rate equation and with a positive sign in the deposit equation. We also include a dummy variable for foreign banks to capture possible fixed-effect differences between domestic and foreign banks. In the sensitivity analysis, we also interact the bank risk indicators with the foreign bank dummy variable to examine whether foreign banks are subject to different degrees of market discipline compared to domestic banks.

The control variables can be grouped into two main categories: i) indicators that control for general macroeconomic conditions, and ii) a number of dummy variables that control for episodes of political instability. The macroeconomic variables include the growth rate of real GDP in Bolivia and the inflation rate in the United States. The U.S. inflation rate is included in the interest rate equation to deflate the interest rate on U.S. dollar denominated deposits. Including the inflation rate in the equation, instead of using real interest rates, allows for the estimated coefficient on the inflation rate to be different than one, indicating the degree to which banks compensate depositors for the inflation tax.

Finally, during the sample period there were several episodes of political instability that induced uncertainty in financial markets (e.g., violent confrontation between the police and the public, resignation of the president after he was diagnosed with cancer, and severe

uncertainty during the election period). To capture these events we created a (0,1) dummy variable—called the political instability dummy— that equals one whenever each one of these events takes place. The specifics of each event are described in the appendix.

5. Estimation Results

The estimation results are organized as follows. First, we examine whether there is any market discipline in Bolivia during the sample period. Second, we examine how the introduction of a deposit insurance system affected market discipline. In both cases, we also examine whether small and large depositors behave differently.

5.1. Do Depositors Discipline their Banks?

The first panel of Table 3 reports estimation results for equations (1) and (2) using a benchmark specification. It includes bank-level indicators of bank risk and a number of control variables, such as bank size, a foreign bank dummy, the growth rate of real GDP in Bolivia, the U.S. inflation rate, and the political instability dummy.

Insert Table 3 here

The results provide strong evidence that market discipline is at work. In particular, the leverage ratio, the nonperforming loans ratio, the loan loss reserves ratio, and the overhead expenses ratio are statistically significant in both equations and enter with signs that are consistent with the hypothesis that market discipline is at work (i.e., the higher the risk, the higher the interest rate and the lower the growth rate of deposits). The liquid assets ratio enters with signs that are consistent with market discipline, but is not statistically significant in the deposits equation. The only variable that is not statistically significant and does not show any signs of market discipline is the returns on total assets. This variable seems to be capturing a demand effect, since it enters with a positive sign in both equations (i.e., the higher a bank's profitability, the higher its demand for deposits, and thus the higher the equilibrium interest rate and deposits).

Most control variables enter with the expected sign. In particular, the log of total assets enters in both equations with a negative sign, indicating that, everything else equal, bigger banks demand less deposits, either because they have access to other sources of

finance or because they are expanding less than smaller banks. The foreign bank dummy variable enters in both equations with a negative sign indicating that, everything else equal, foreign banks demand less deposits than domestic banks.

As expected, the U.S. inflation rate enters with a positive sign in the interest rate equation and a negative sign in the deposit equation, which indicates that, ceteris paribus, the higher the U.S. inflation rate the lower the supply of deposits denominated in U.S. dollars. The growth rate of real GDP in Bolivia is included to control for the business cycle. The results suggest that the higher the growth rate of real GDP, the lower the demand for deposits. To some extent, this result is surprising, since one would expect that the better the state of the economy, the better the lending opportunities of banks, and thus the higher their demand for deposits; unless there is a substitution effect towards other sources of finance. This last explanation seems quite plausible, since the ratio of savings deposits to total assets is negatively correlated with the growth rate of real GDP.[14]

Finally, the dummy variable for political instability is statistically significant in both equations and enters with a positive sign in the interest rate equation and a negative sign in the deposits equation. This result implies that political instability makes depositors worry about the safety of their deposits and thus, everything else equal, they reduce their supply of deposits, regardless of the health of an individual institution.[15] These findings are in line with a recent paper by Levy-Yeyati, Martinez Peria, and Schmukler (2004) that emphasizes the importance of systemic risk factors for developing countries.

Given the rather surprising sign on the estimated coefficient of GDP, we re-estimate the model by replacing the macroeconomic variables with quarterly time dummies. The

[14] To further examine this possibility, the ratio of savings deposits to total assets was regressed on the growth rate of real GDP after controlling for bank risk and bank fixed-effects. The results, which are available upon request, indicate that the higher the growth rate of real GDP, the lower the ratio of savings deposits to total assets. This result is statistically significant at the 1 percent level. The same result is obtained using the ratio of total deposits to total assets, which implies that there might be a more general substitution from deposits to other sources of finance.

[15] Since the role of political instability is not a central point to our analysis, we only present results using one dummy variable for all episodes of political instability in our sample. However, we also experimented with separate dummies for each event. This exercise highlighted that the two most important events are the uncertainty before and during the elections of July 2002 (i.e., the period from May to July 2002) and the resignation of president Banzer in July 2001.

results, presented in the second panel of Table 3, show that our main results with respect to bank risk are unaffected by the inclusion or exclusion of the GDP variable.

5.1.1. Do large depositors behave differently than small depositors?

In general, there might be some difference between large and small depositors with respect to market discipline. For example, large depositors are often more sophisticated than small depositors, and since they have a significant value at risk they may find it optimal to discipline their banks, while small depositors might find it prohibitively expensive. On the contrary, although small depositors have a smaller value at risk, this amount is often a larger proportion of their total wealth. In addition, the cost of evaluating the risk profile of a bank might not be very high, since a vast amount of information is available to the public in a timely fashion (e.g., the website of the supervisory authority, mass media, etc.). For example, during the sample period, the balance sheet and income account statements of each financial institution in Bolivia, as well as indicators of bank risk (similar to those used in this paper), were available on the web page of the SBEF with less than a one-month lag.

Equation (2) is estimated separately for "small" and "large" depositors, where small depositors are defined as those with $30,000 or less in their accounts.[16] The results, presented in the third panel of Table 3, show that both large and small depositors discipline their banks. To examine whether the $\hat{\beta}_2$'s are statistically different between small and large depositors, we re-estimate equation (2) using interaction terms between the indicators of bank risk and a (0,1) dummy variable that equals 1 when an account has $30,000 or less. The estimation results, which are available upon request, confirm that the observed differences between small and large depositors are statistically significant at 1 percent.

Finding that small depositors impose some market discipline is important, since deposit insurance systems are often motivated or designed to protect small unsophisticated depositors that are either not able, or find it too expensive, to monitor and discipline their

[16] The data for the dependent variable of equation (2) are available by size (e.g., below US$500, between US$501-US$1,000, etc). In total, there are 14 size categories, where the largest category includes accounts with more than US$2,000,000. Hence, in order to compare the behavior of small and large depositors, we construct two series, one for "small" depositors and another for "large" depositors. In this case, equation (2) is estimated using a $30,000 threshold for small depositors.

banks (e.g., Dewatripont and Tirole, 1994). In the sensitivity analysis, we experiment with alternative thresholds for small depositors, and we show that the transition between imposing or not imposing market discipline occurs somewhere between $1,000 and $5,000.

5.2. Did the introduction of deposit insurance affect market discipline?

To examine whether the introduction of explicit deposit insurance affected the extent to which depositors discipline their banks, we estimate equations (3) and (4) using our benchmark specification presented in the first panel of Table 3. In this case, the deposit insurance dummy, DI_{t-k}, is set equal to one as of January 2002.[17]

The results, presented in first panel of Table 4, indicate that the introduction of explicit deposit insurance caused a significant reduction in market discipline. In particular, all indicators of bank risk that were previously found to reflect market discipline (i.e., leverage ratio, nonperforming loans to total assets, loan loss reserves to total assets, and overhead expenses to total assets) are again found to indicate market discipline (i.e., $\hat{\beta}_1 > 0$, $\hat{\beta}_2 < 0$, and they are each statistically significant). In all cases, the interaction terms (between these variables and DI_{t-k}) enter with signs that indicate a reduction in market discipline (i.e., $\hat{\varphi}_1 < 0$ and $\hat{\varphi}_2 > 0$), and in most cases they are statistically significant.

Insert Table 4 here

To examine whether there is market discipline after the introduction of deposit insurance, we test whether the combined coefficients ($\hat{\beta}_1 + \hat{\varphi}_1$ and $\hat{\beta}_2 + \hat{\varphi}_2$) are statistically significant, and whether they enter with the expected signs (i.e., $\hat{\beta}_1 + \hat{\varphi}_1 > 0$ and $\hat{\beta}_2 + \hat{\varphi}_2 < 0$). We find that in all cases the signs are consistent with market discipline. However, the combined coefficients are not always statistically significant. In particular, we find that the leverage ratio and the nonperforming loans ratio are statistically significant in both equations, while the ratio of loan loss reserves to total assets is significant only in the interest rate equation. All in all, these results suggest that the introduction of deposit insurance caused a significant reduction in market discipline. Although, the coefficients of

[17] In the sensitivity analysis, we experiment with alternative timings.

some indicators are still statistically significant, they are much smaller, suggesting an almost complete elimination of market discipline after deposit insurance.

5.2.1 Were large and small depositors affected differently by deposit insurance?

Before the introduction of an explicit deposit insurance system, the Bolivian Central Bank covered the depositors of failed financial institutions.[18] In more recent years, however, these bailout policies tended to favor only "small" depositors. For example, when a savings and loan cooperative failed in 1996, the Central Bank covered private sector deposits up to U.S. $5,000. In contrast, when Banco Internacional de Desarrollo failed in 1997, the Central Bank covered deposits up to U.S. $200,000. Although there is a trend in limiting coverage to "small" deposits, the definition of small is quite ambiguous.[19]

The intentions of limiting coverage to only small depositors is also reflected in the first draft of the deposit insurance law, since it included a coverage limit of $10,000 per account. However, after pressure from financial institutions, this limit was lifted and the deposit insurance system that was introduced in 2001 made no distinction between small and large depositors. In the event of bankruptcy all depositors will receive the same percentage of their deposits, regardless of their size. Hence, the introduction of explicit deposit insurance is expected to have a bigger effect on large depositors.

To examine this possibility, we estimated equation (4) separately for small and large depositors. Given the policies described above, it is not clear ex-ante what is the relevant definition of small and large depositors. Hence, we experimented with all available thresholds in our data: $1,000, $5,000, $10,000, $15,000, $20,000, $30,000, $50,000, $100,000, $200,000, $500,000, $1,000,000, and $2,000,000. The results show that for any threshold between $1,000 and $15,000, small depositors are not affected by the introduction of the deposit insurance system. Although the interaction terms enter with the

[18] For example, when Banco Sur and Banco Cochabamba failed in 1994 the Bolivian Central Bank covered 100 percent of their deposits to the private sector.

[19] Part of the difference between the two limits (U.S. $5,000 vs. U.S. $200,000), is probably due to differences in the composition of deposits between commercial banks and savings and loan cooperatives. The deposits of commercial banks are usually composed of larger accounts than the deposits of savings and loan cooperatives. Hence, although the coverage limits per account are very different, the total coverage per bank might be similar (i.e., the percentage of accounts covered and/or the percentage of deposits covered).

expected signs, they are not statistically significant.[20] For any threshold above $15,000, we find that the introduction of deposit insurance reduced market discipline (i.e., the interaction terms enter with the expected signs and are statistically significant). In the third panel of Table 4, we present results using the $15,000 threshold; the results from the other thresholds are available upon request.

6. Sensitivity Analysis

The sensitivity analysis is organized as follows. First, we examine whether the results with respect to market discipline change using alternative estimation techniques. Second, we examine how the results with respect to size change if we use different thresholds or if we correct for a "pollution bias" in the two size categories. Third, we provide some sensitivity analysis with respect to the sample period and the timing of deposit insurance. Finally, we examine whether there are differences in market discipline between foreign and domestic banks, and between foreign subsidiaries and branches.

6.1. Alternative Estimation Techniques

In order to make our results comparable to other studies, the interest rate equation was estimated separately from the deposits equation, ignoring the fact that the two are jointly determined. In this case, the underlying assumption is that the error terms $\varepsilon_{i,t}$ and $\eta_{i,t}$ are independent. To examine how the results change if we relax this assumption, we re-estimate the benchmark specification of Table 3 using seemingly unrelated regression estimation (SURE). The results, presented in Table 5, show that SURE yields very similar results to those presented in Table 3, even if $\varepsilon_{i,t}$ and $\eta_{i,t}$ are not independent (the Breusch-Pagan test statistic appears at the bottom of Table 5).

Insert Table 5 here

We also estimate equations (1) and (2) using fixed effects. In general, fixed effects estimators highlight the variation of deposits over time, using deviations from each bank's

[20] In some cases, the interaction term between the deposit insurance dummy variable and the ratio of loan loss reserves to total assets is statistically significant at the 10% level. However, it is never the case that the four key indicators (leverage, nonperforming loans, loan loss reserves, and overhead expenses) are jointly significant.

mean. The estimation results, presented in the second panel of Table 5, show that the results with respect to the interest rate equation are qualitatively the same as the pooled estimates presented in Table 3. However, the results with respect to the deposits equation are weaker. Although most variables enter with the expected sign, only two of the estimated coefficients are statistically significant. This implies that the growth rate of deposits is relatively constant over time and can be explained either by bank fixed effects or by various bank risk indicators, but not by both at the same time (i.e., the estimated coefficients in the deposit equation are mostly picking up cross-sectional variation).

6.2. Small vs. Large Depositors

To examine the sensitivity of our results with respect to size, we try alternative thresholds for defining small deposits. The specification presented in the third panel of Table 3 is re-estimated using the following thresholds: $1,000, $5,000, $10,000, $15,000, and $20,000. In general, we find that depositors with more than $10,000 in their account impose market discipline on their banks, while depositors with $1,000 or less do not. The results using the $5,000 threshold are mixed. For depositors with $5,000 or less, we find some market discipline (i.e., from the six indicators of bank risk, only two are statistically significant; the leverage ratio and the ratio of nonperforming loans to total assets). Hence, the transition between imposing or not imposing market discipline happens somewhere between $1,000 and $5,000. In the first and second Panel of Table 6, we report estimation results using the $1,000 and the $10,000 thresholds.[21]

Insert Table 6 here

It should be pointed out that our results with respect to size are subject to a possible "pollution bias". If we assume that there is market discipline, then when a bank's financial condition deteriorates, its depositors are likely to withdraw their deposits. In principle, they could withdraw all their funds and close their account or they could withdraw only part of their funds. The latter case is problematic, since they could fall into the small size category. Hence, by construction, our data would show that large accounts drop by the total amount (i.e., the amount they withdraw and the amount that falls into the small size category). This

[21] The estimation results using the other thresholds are available upon request.

implies that our estimates in Table 3 tend to *overestimate* market discipline for large depositors and *underestimate* it for small depositors.

To examine the potential size of this bias, we collected data on the number of accounts. Using the $30,000 threshold, we find that on average (across banks and time) there are 46,617 small accounts and 207 large accounts. Since the number of large accounts is only 0.44% of small accounts, one could argue that the bias is likely to be small. However, if all large depositors were to drop into the small accounts, the maximum amount they would transfer would be 20% of the total deposits in the small size category, which is not so small.[22] Hence, to further examine how our results are affected from this bias, we reconstruct our series for small and large depositors by removing the *maximum possible* "pollution" from the original series:

$$Large\ Deposits\_Adjusted_{i,t} = Large\ Deposits\ \_Original_{i,t} + \$30{,}000(N^{L}_{i,t-1} - N^{L}_{i,t}) \qquad (5)$$

$$Small\ Deposits\_Adjusted_{i,t} = Small\ Deposits\_Original_{i,t} - \$30{,}000(N^{S}_{i,t-1} - N^{S}_{i,t}) \qquad (6)$$

where $N^{L}_{i,t}$ and $N^{S}_{i,t}$ are the number of large and small accounts, respectively.

Using the adjusted series, we re-estimate equation (2). The results, presented in Table 6, show that both large and small depositors discipline their banks, but small depositors impose less market discipline. As expected, the difference between small and large depositors is smaller using the adjusted series than with the original series (see Table 3 for comparison). It should be pointed out that these estimates do not measure the actual degree of market discipline, but simply provide a *lower bound* for large depositors and an *upper bound* for small depositors. Given that we still find that small depositors impose less market discipline, we can conclude that regardless of the actual degree of market discipline, small depositors impose less market discipline than large depositors.

6.3. Deposit Insurance

[22] The average dollar value of small deposits is $31.7 million and the maximum amount that each large depositor could transfer in the small size category is $30,000.

Although the results, presented in Table 4, are consistent with the hypothesis that the introduction of deposit insurance reduced market discipline, they are also consistent with an alternative hypothesis. In particular, the ratio of foreign banks to domestic banks increased during the sample period. Hence, to the extent that foreign banks are subject to less market discipline, our results could be simply due to the increase of foreign banks in the sample.[23] To examine this possibility, we estimated equations (3) and (4) using a sub-period for which the number of foreign banks in the sample is equal to the number of domestic banks, and they are exactly the same during the whole period.[24] The results, presented in Table 7, and are very similar to those presented earlier in Table 4. This implies that the deposit insurance dummy variable is not picking up the relative increase of foreign banks in the sample.

Insert Table 7 here

We also examine the sensitivity of the results with respect to the timing of deposit insurance (i.e., we re-estimate the model using alternative definitions of DI_t).[25] First, we start by setting the introduction of deposit insurance earlier than January 2001 by one month at a time. At the beginning, the results improve. We reach the peak of improvement in October 2001, i.e., three months earlier than the effective date. After October 2001, the results start to deteriorate, and they break down completely if deposit insurance is timed six months earlier than the effective day or at any time earlier than six months (i.e., we do not find any statistically significant difference between before and after deposit insurance). We also examine how the results change if we introduce deposit insurance later than January 2002. In this case, the results start to deteriorate right away. In fact, they completely break down if deposit insurance is introduced three months after the effective date or later.

[23] A growing literature on foreign bank entry argues that foreign banks in developing countries might be more efficient and less corrupted than domestic banks. Hence, depositors might trust foreign banks more than domestic banks. Foreign banks may also enjoy implicit deposit insurance from the home country, and thus they may be subject to less market discipline. In the next section, we provide evidence that foreign banks in our sample are indeed subject to less market discipline than domestic banks.

[24] From April 1999 till the end of the sample, the number of banks in our sample is unchanged. During that period it happens that the number of domestic banks is equal to the number of foreign banks and that each banks is present for the whole period.

[25] The results are not presented, but are available upon request.

Overall, these results suggest that the reduction in market discipline during the sample period is due to a *structural break* around the date that the deposit insurance system was introduced, and not to a constant reduction in market discipline during the sample period. In addition, it seems that there was an *anticipation effect* i.e., market participants starting to adjust three months before the law was implemented.

6.4. Foreign vs. Domestic Banks

Despite the fact that domestic and foreign banks in Bolivia are subject to the same regulation and that foreign banks do not have explicit deposit insurance from the home country, the market might still perceive them differently. For example, a growing literature on foreign bank entry argues that foreign banks in developing countries might be more efficient and less corrupted than domestic banks. Hence, depositors might trust foreign banks more than domestic banks. In addition, foreign banks may enjoy implicit deposit insurance from their home country. Thus, they may be subject to less market discipline, depending on the credibility of the deposit insurance system in the home country.

To investigate whether the degree of market discipline differs between foreign and domestic banks, the indicators of bank risk in equations (1) and (2) are interacted with the foreign bank dummy. The estimation results, presented in the first panel of Table 8, show that foreign banks are subject to less market discipline overall. However, diagnostic tests using variance inflation factors indicate that there is multicollinearity among the various bank risk indicators and the interaction terms.[26]

Insert Table 8 here

Hence, as an extra robustness test, we re-estimate the model using principal components, using two principal components. The first principal component is constructed using the leverage ratio, the loan loss reserves to total assets, the return on total assets, and the liquidity ratio. The second component is constructed using the ratio of nonperforming loans to total assets and the ratio of overhead expenses to total assets. By separating the indicators in this way, we were able to obtain principal components for which we know the

[26] This problem is due to the fact that most the variance in our data is cross-sectional (i.e., most of it comes from differences across banks at each point in time). Hence, when the sample of banks is divided between foreign and domestic banks the collinearity between the various indicators of bank risk increases.

economic meaning of the estimated coefficients. Specifically, all variables in the first component enter with a positive sign, which implies that the higher the first principal component the lower the risk. Similarly, all variables in the second component enter with a positive sign, which implies that the higher the second principal component the higher the risk. The estimation results, presented in the second panel of Table 8, clearly suggest that foreign banks are subject to less market discipline.

Finally, there might be differences between branches and subsidiaries of foreign banks. Subsidiaries are separate legal entities, and thus they could fail even if the parent company does not. In contrast, branches are integral parts of the parent company. Thus, they can fail only if the parent company does. To examine whether the degree of market discipline differs between foreign branches and subsidiaries, we estimate the model only on the foreign banks sample with the principal components used above interacted with a subsidiary dummy. The results, which are available upon request, show that there is no statistically significant difference between the branches and subsidiaries in our sample.

7. Conclusions

This paper examines the interaction between market discipline and deposit insurance using the experiences of Bolivia between 1998 and 2003. The country-specific circumstances allow us to investigate the effect of explicit deposit insurance, as opposed to implicit guarantees, on market discipline in a setup that resembles a controlled experiment. The sample period is characterized by a recession, which provides reasons for depositors to worry about the safety of their deposits. Moreover, during the sample period, there are no major regulatory reforms apart from the introduction of an explicit deposit insurance system in December 2001. This makes it possible to investigate the effect of explicit deposit insurance on market discipline by comparing the behavior of depositors before and after the introduction of deposit insurance. Detailed knowledge of the practices of the Bolivian Central Bank and the characteristics of the deposit insurance system allows us to link the results to the institutional setting.

The methodology and the data employed improve upon previous studies in at least three ways. First, data availability with respect to interest rates and our focus on savings deposits provide us with a much more accurate indicator of a bank's current cost of funds

than those employed by previous studies (e.g., Demirgüç-Kunt and Huizinga, 2003 and Martinez Peria and Schmukler, 2001). Second, we provide evidence both on prices and quantities, which is important in order to distinguish market discipline from alternative hypotheses (e.g., regulatory discipline, more aggressive expansion of riskier banks, etc.). Finally, the analysis compares the behavior of small and large depositors, which has been largely unexplored by the empirical literature. We examine whether the degree of market discipline differs between large and small depositors, and whether the introduction of explicit deposit insurance affected them differently.

In contrast to other studies on developing countries we find a strong link between bank fundamentals and the supply of deposits, consistent with the hypothesis that market discipline is at work. We find that an increase in bank risk leads to higher interest rates and lower deposits. The results also suggest that most of the market discipline comes from large depositors. Nevertheless, small depositors (with at least $5,000 in their account) are also found to respond to bank risk. Moreover, as shown in the sensitivity analysis, these results are not due to a possible "pollution bias" across the two size categories. More importantly, we find that the introduction of explicit deposit insurance reduced market discipline significantly, especially for large depositors. These findings are in line with the characteristics of the deposit insurance system and with the bailout practices of the Bolivian Central Bank before the introduction of explicit deposit insurance.

The results also suggest that the degree of market discipline differs between domestic and foreign banks. Foreign banks are subject to less market discipline than domestic banks. In addition, we find that depositors "run" more from domestic banks than from foreign banks whenever there are episodes of political instability. These results are consistent with the hypothesis that foreign banks are trusted more than domestic banks, either because they are more efficient or because they are perceived to have implicit guarantees from their home country or their parent company.

Appendix

Episodes of Political Instability

During the sample period, there were several episodes of political instability that induced uncertainty in the financial markets. After pressure from the United States, the Bolivian government initiated an aggressive plan to eradicate coca plantations, known as the "zero-coca" policy. This policy caused considerable political and social unrest and put the government under strong pressure from the opposition. This pressure was intensified in July 2001 after president Banzer was diagnosed with cancer. The news gave an excuse to the opposition to force the president to resign. President Banzer resigned in the last week of July 2001, only one year before the next presidential elections. The vice president was sworn in for the remainder of the term.

The period before the elections was characterized by severe uncertainty, since Evo Morales— the leader of the coca-growers and a congressman— decided to run for president in order to overturn the zero-coca decision. His candidacy caused considerable uncertainty, since his victory would have meant a major movement in the political and economic system towards socialism. The elections in July 2002, however, did not eliminate the uncertainty, since none of the candidates received more than 50 percent of the votes. The two front-runners, Gonzalo Sanchez de Lozada and Evo Morales, obtained only 22.5 and 20.9 percent of the votes, respectively. The new Congress had to choose between the two front-runners. It chose Gonzalo Sanchez de Lozada. This seemed like a "recipe for trouble", since it gave the presidency to a free-market conservative, while the leftist coca growers and the Andean Indian protesters had a large share of the congressional seats.

In fact, it was not long before new problems started. In February 2003, there were violent protests against the presidents' austerity measures and coca eradication plans. Finally, in September and October 2003, plans for gas exports to the United States triggered massive protests, roadblocks, and strikes, which resulted in a severe disruption of economic activity and the death of over 70 people. After mounting pressure, President Sanchez de Lozada was forced to resign and was replaced by the Vice President.

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Table 1: The introduction of explicit deposit insurance and the sources of finance for the average bank in the sample

	Before Deposit Insurance	After Deposit Insurance
Private sector deposits to total privileged obligations	78.3	83.7
	(9.1)	(12.3)
Observations	523	263
Observations for which this ratio is less than 50 percent	11	10
Private sector deposits to total assets	61.8	61.6
	(10.1)	(12.1)
Deposits from foreign financial entities to total assets	11.7	4.3
	(8.0)	(8.4)
Obligations to the public sector, Central Bank, and government owned financial entities to total assets	5.3	7.5
	(3.6)	(6.2)
Interbank deposits to total assets	4.0	4.5
	(3.3)	(3.0)
Observations	523	263

Notes: The averages have been constructed using only the banks that were active from the beginning until the end of the sample. This avoids possible variations due to the exit of banks with characteristics that may be different from those of the average bank in the sample. Standard errors are included in the parentheses.

Table 2: Overview of commercial banks in Bolivia during the period 1998:1-2003:12.

Bank Name	Market Share[a] January, 1998	Market Share[a] December, 2003	Ownership[b]	Country of Parent Bank	Explicit Deposit Insurance from the Home Country
Banco Santa Cruz	22.1	11.2	Foreign Subsidiary (17-07-98)	Spain	No
Banco Nacional de Bolivia	12.9	16.2	Domestic		
Banco Industrial[c]	11.2	16.0	Domestic		
Banco Mercantil	11.2	15.1	Domestic		
Banco de la Unión	9.5	8.3	Domestic		
Banco de Crédito de Bolivia	7.7	11.7	Foreign Subsidiary (30-12-92)	Peru	No
Banco Boliviano Americano	5.8		Domestic		
Banco Económico	5.5	6.3	Domestic		
BHN Multibanco	4.3		Domestic		
Banco de La Paz	3.7		Domestic		
Banco Ganadero	2.0	4.9	Domestic		
Banco Solidario[d]	1.5	3.0	Foreign Owned (15-03-99)	Mix[d]	No
Citibank	1.3	5.8	Foreign Branch (10-10-66)	United States	No
Banco de la Nación Argentina	0.8	0.4	Foreign Branch (28-04-58)	Argentina	No
Banco Real / ABN Amro	0.4		Foreign Branch	Brazil/Netherlands	No
Banco do Brasil	0.2	1.2	Foreign Branch (01-07-61)	Brazil	No

[a] Market Share is calculated in terms of total assets.

[b] Foreign subsidiary: a bank operating in Bolivia for which more than 50 percent of its shares is owned by a foreign company; Foreign owned: a bank operating in Bolivia for which more than 50 percent of its shares are owned by foreign companies; Foreign branch: a bank operating in Bolivia that is an integral part of a foreign bank (i.e., it is not a separate legal entity). The dates in parentheses indicate when a bank changed from domestic to foreign or the date a foreign branch started its operations in Bolivia.

[c] Banco Industrial is not considered a foreign bank although, more than 50 percent of this bank is owned by foreign companies. It is viewed as a domestic bank because a Bolivian investor has a majority share in some of these foreign companies.

[d] Banco Solidario has the legal status of a bank, but it focuses mainly on micro-credit lending. Hence, this bank is more comparable to micro-credit institutions rather than commercial banks. In terms of ownership, 24 percent of the shares of this bank is owned by a Costa Rican company, 22 percent is owned by a British company, and 22 percent in owned by an American company.

Table 3: Do depositors in Bolivia discipline their banks?

	Panel 1		Panel 2		Panel 3	
	Interest Rates	Deposits	Interest Rates	Deposits	Big Deposits	Small Deposits
Leverage ratio (t-k)	-0.07***	1.12**	-0.05***	0.95**	1.95**	0.18**
	(0.01)	(0.57)	(0.01)	(0.48)	(0.97)	(0.09)
Nonperforming loans to total assets (t-k)	0.05***	-1.91***	0.04***	-2.16***	-2.37***	-0.29***
	(0.2)	(0.40)	(0.01)	(0.48)	(0.57)	(0.07)
Loan loss reserves to total assets (t-k)	-0.18***	1.84***	-0.06***	2.66**	1.99***	0.11
	(0.03)	(0.55)	(0.02)	(1.14)	(0.80)	(0.14)
Overhead expenses to total assets (t-k)	1.91***	-27.19***	1.42***	-30.17***	-29.73***	-2.95***
	(0.32)	(6.70)	(0.21)	(9.07)	(9.71)	(1.14)
Return to total assets (t-k)	0.00	0.21	0.00	0.18	0.15	0.02
	(0.01)	(0.14)	(0.01)	(0.14)	(0.17)	(0.03)
Liquid assets to total assets (t-k)	-0.03***	0.25	-0.02***	0.12	0.40	0.00
	(0.01)	(0.22)	(0.01)	(0.21)	(0.33)	(0.04)
Log of total assets (t-k)	-0.61***	-7.53***	-0.59***	-8.43***	-8.97***	1.32***
	(0.08)	(2.28)	(0.06)	(2.61)	(2.87)	(0.43)
Foreign Bank Dummy	-1.03***	-2.58	-1.16***	-2.41	-6.89	-1.78***
	(0.11)	(2.78)	(0.09)	(3.47)	(5.48)	(0.70)
U.S. inflation rate (t-k)	0.19**	-0.39			-1.51	-0.35
	(0.08)	(1.15)			(1.58)	(0.40)
Growth rate of real GDP in Bolivia (t-k)	-0.13***	-1.82			-2.18	-0.12
	(0.04)	(1.30)			(2.30)	(0.28)
Political instability dummy	0.61***	-7.04**			-10.10**	-4.12***
	(0.24)	(3.11)			(4.33)	(0.85)
Constant	9.49***	57.45***	9.31***	54.33***	65.83***	12.16***
	(0.73)	(18.39)	(0.45)	(16.98)	(23.00)	(3.77)
Quarterly dummies	Not Included	Not Included	Included	Included	Not Included	Not Included
Observations	866	819	890	830	645	649
Adjusted R-Square	0.39	0.14	0.68	0.17	0.15	0.19

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. For the interest rate equation k equals 1, while for the deposit equation k equals 3. The standard errors have been corrected for heteroscedasticity. Small deposits are those with $30,000 or less, per account.

Table 4: Did the introduction of explicit deposit insurance affect the extent to which depositors impose market discipline?

	Panel 1				Panel 2			
	Interest Rates		Deposits		Big Deposits		Small Deposits	
		DI effect		DI effect		DI effects		DI effects
Leverage ratio (t-k)	-0.06***	0.02*	1.45*	-0.61	2.94*	-1.72	0.22*	-0.05
	(0.01)	(0.01)	(0.84)	(0.69)	(1.57)	(1.19)	(0.12)	(0.11)
Nonperforming loans to total assets (t-k)	0.10***	-0.08***	-2.74***	1.56***	-3.50***	2.22***	-0.35**	0.17
	(0.02)	(0.03)	(0.73)	(0.63)	(1.11)	(1.00)	(0.17)	(0.14)
Loan loss reserves to total assets (t-k)	-0.12***	0.04	4.53***	-3.98***	6.36***	-5.55***	0.37	-0.45
	(0.03)	(0.03)	(1.68)	(1.51)	(2.54)	(2.26)	(0.39)	(0.41)
Overhead expenses to total assets (t-k)	1.84***	-1.78***	-37.62***	30.59*	-52.94***	54.71**	-2.45	3.50
	(0.26)	(0.47)	(12.37)	(17.77)	(19.23)	(28.01)	(1.92)	(2.77)
Return to total assets (t-k)	0.06***	-0.08***	0.54	-0.47	0.01	0.08	0.10	-0.10
	(0.02)	(0.02)	(0.47)	(0.46)	(0.73)	(0.73)	(0.13)	(0.14)
Liquid assets to total assets (t-k)	-0.02	-0.01	0.36	-0.40	0.53	-0.57	0.09	-0.20***
	(0.01)	(0.02)	(0.27)	(0.26)	(0.39)	(0.37)	(0.06)	(0.07)
Log of total assets (t-k)	0.60***		-6.76***		-6.51**		-0.34	
	(0.07)		(2.45)		(3.27)		(0.55)	
Foreign bank dummy	-1.07***		-3.69		-10.13		-1.42**	
	(0.12)		(3.89)		(7.12)		(0.70)	
U.S. inflation rate (t-k)	-0.09		-2.68		-7.44*		-0.18	
	(0.08)		(2.29)		(4.41)		(0.41)	
Growth rate of real GDP in Bolivia (t-k)	-0.22***		-1.85		-1.50		-0.52	
	(0.04)		(1.40)		(2.20)		(0.39)	
Political instability dummy	0.76***		-5.92***		-7.85***		-3.60***	
	(0.21)		(2.46)		(3.07)		(0.87)	
Constant	12.08***	-2.46***	39.76*	26.75***	30.05	33.96***	8.27	-3.24
	(0.61)	(0.33)	(22.69)	(8.25)	(31.46)	(12.23)	(6.69)	(2.07)
Observations	866		819		645		649	
Adjusted R-Square	0.52		0.15		0.17		0.15	

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. For the interest rate equation k equals 1, while for the deposit equation k equals 3. The standard errors have been corrected for heteroscedasticity. The "DI effect" columns show the coefficients of the interaction terms between the DI dummy and indicators of bank risk. Small deposits are those with $15,000 or less per account.

Table 5: Alternative estimation techniques

	Panel 1		Panel 2	
	Interest Rates	Deposits	Interest Rates	Deposits
Leverage ratio (t-k)	-0.05***	1.23**	-0.05***	1.14***
	(0.01)	(0.34)	(0.01)	(0.45)
Nonperforming loans to total assets (t-k)	0.06***	-1.77***	0.04***	-0.51
	(0.2)	(0.49)	(0.01)	(0.52)
Loan loss reserves to total assets (t-k)	-0.13***	1.94**	-0.05**	0.09
	(0.02)	(0.94)	(0.02)	(0.64)
Overhead expenses to total assets (t-k)	1.65***	-26.47***	1.09***	-10.69
	(0.21)	(7.37)	(0.36)	(10.00)
Return to total assets (t-k)	0.004	0.20	0.002	0.17
	(0.01)	(0.24)	(0.01)	(0.25)
Liquid assets to total assets (t-k)	-0.03***	0.26	-0.03***	0.34
	(0.01)	(0.27)	(0.01)	(0.30)
Log of total assets to total assets (t-k)	-0.52***	-5.48**	-2.06***	-5.90
	(0.08)	(2.50)	(0.27)	(3.71)
Foreign bank dummy	-0.95***	-3.84	-1.41***	-4.28
	(0.12)	(3.88)	(0.29)	(6.10)
U.S. inflation rate (t-k)	0.17**	-0.31	0.17***	-0.69
	(0.07)	(2.33)	(0.06)	(2.45)
Growth rate of real GDP in Bolivia (t-k)	-0.14***	-2.33	-0.36***	-0.56
	(0.05)	(1.49)	(0.05)	(1.60)
Political instability dummy	0.67***	-5.80	0.82***	-8.29*
	(0.51)	(4.61)	(0.15)	(4.69)
Observations	791	791	852	819
Adjusted R-Square	0.37	0.13		
Breusch-Pagan test for independence	Chi2=4.49, P=0.034			
Hausman test			Chi2=4.45, P=0.0	Chi2=132.82, P=0.0

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. For the interest rate equation k equals 1, while for the deposit equation k equals 3. The standard errors have been corrected for heteroscedasticity. Panel 1 shows SUR estimates. Panel 2 shows fixed effect estimates (since random effects are rejected – see Hausman test at the bottom of Panel 2).

Table 6: Alternative size thresholds and "pollution bias"

	Panel 1		Panel 2		Panel 3	
	Big Deposits	Small Deposits	Big Deposits	Small Deposits	Big Deposits	Small Deposits
Leverage ratio (t-k)	1.63**	0.45	1.67**	0.29***	0.92*	0.40***
	(0.78)	(0.31)	(0.82)	(0.10)	(0.51)	(0.16)
Nonperforming loans to total assets (t-k)	-2.03***	-0.35	-2.12***	-0.19**	-1.54***	-0.75***
	(0.47)	(0.25)	(0.49)	(0.08)	(0.43)	(0.22)
Loan loss reserves to total assets (t-k)	1.66***	-0.39	1.77***	0.01	1.48***	0.45
	(0.65)	(0.32)	(0.69)	(0.16)	(0.60)	(0.29)
Overhead expenses to total assets (t-k)	-27.12***	-7.47**	-27.7***	-2.36**	-18.48***	-11.56***
	(7.70)	(3.50)	(8.14)	(1.23)	(5.82)	(2.98)
Return to total assets (t-k)	0.10	0.004	0.11	0.01	0.09	-0.03
	(0.13)	(0.09)	(0.14)	(0.04)	(0.11)	(0.08)
Liquid assets to total assets (t-k)	0.27	0.15	0.31	0.01	0.07	-0.13*
	(0.26)	(0.12)	(0.28)	(0.05)	(0.17)	(0.08)
Log of total assets to total assets (t-k)	-7.37***	-3.71**	-7.91***	-0.23	-4.54***	2.72***
	(2.43)	(1.78)	(2.54)	(0.46)	(1.58)	(0.4)
Foreign bank dummy	-5.64	-1.64	-5.73	-2.72***	-4.82	0.52
	(4.40)	(1.91)	(4.61)	(0.70)	(3.21)	(0.88)
U.S. inflation rate (t-k)	-1.46	-2.48***	-1.40	0.01	-0.28	-2.07**
	(1.31)	(0.75)	(1.38)	(0.40)	(1.10)	(0.98)
Growth rate of real GDP in Bolivia (t-k)	-1.62	0.11	-1.68	-0.45*	-3.47**	-1.46**
	(1.88)	(0.82)	(1.97)	(0.24)	(1.47)	(0.63)
Political instability dummy	-8.02**	-4.60***	-8.78**	-3.22***	-5.97**	-3.83***
	(3.53)	(1.63)	(3.70)	(0.89)	(2.98)	(1.16)
Observations	6.45	642	645	649	625	625
Adjusted R-Square	0.15	0.14	0.15	0.13	0.09	0.22

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The standard errors are corrected for heteroscedasticity. k equals 3. Panel 1: equation (2) is estimated using a $1,000 threshold for small deposits; Panel 2: equation (2) is estimated using a $10,000 threshold for small deposits; and Panel 3: equation (2) is estimated using the adjusted series constructed using equations (5) and (6) in order to examine the size of the "pollution bias" in the two size categories.

Table 7: The effect of deposit insurance on market discipline using a sub-sample for which the percentage of foreign banks in the sample is constant

	Panel 1				Panel 2			
	Interest Rates		Deposits		Big Deposits		Small Deposits	
		DI effect		DI effect		DI effects		DI effects
Leverage ratio (t-k)	-0.07***	0.04***	2.45**	-0.94	3.96**	-2.09	0.18*	-0.03
	(0.01)	(0.01)	(1.15)	(0.90)	(2.00)	(1.48)	(0.15)	(0.14)
Nonperforming loans to total assets (t-k)	0.11***	-0.08***	-2.77***	1.91**	-3.81***	2.81**	-0.49**	0.29
	(0.02)	(0.03)	(0.91)	(0.86)	(1.39)	(1.33)	(0.22)	(0.19)
Loan loss reserves to total assets (t-k)	-0.11***	0.05*	5.28***	-5.37***	7.70***	-7.48***	0.33	-0.45
	(0.03)	(0.03)	(2.02)	(1.89)	(2.99)	(2.77)	(0.41)	(0.42)
Overhead expenses to total assets (t-k)	2.21***	-1.40***	-46.74***	55.60**	-65.76***	81.70**	-2.81	3.49
	(0.38)	(0.48)	(16.14)	(23.05)	(23.85)	(35.53)	(2.37)	(2.88)
Return to total assets (t-k)	0.06**	-0.07***	0.71	-0.70	0.21	-0.20	0.10	-0.09
	(0.03)	(0.03)	(0.61)	(0.61)	(0.81)	(0.82)	(0.16)	(0.16)
Liquid assets to total assets (t-k)	-0.02	-0.00	0.41	-0.56**	0.54	-0.75*	0.13*	-0.23***
	(0.01)	(0.02)	(0.32)	(0.27)	(0.44)	(0.41)	(0.08)	(0.08)
Log of total assets (t-k)	0.62***		-1.75		-1.29		-0.54	
	(0.09)		(2.20)		(3.32)		(0.61)	
Foreign bank dummy	-1.33***		-6.67		-12.85*		-1.23	
	(0.12)		(4.44)		(7.79)		(0.88)	
U.S. inflation rate (t-k)	0.30***		-2.27		-7.60		-0.66	
	(0.10)		(2.62)		(5.31)		(0.66)	
Growth rate of real GDP in Bolivia (t-k)	-0.87***		-1.93		-1.70		-1.16	
	(0.08)		(1.94)		(2.72)		(0.81)	
Political instability dummy	0.62***		5.91***		-7.83***		-3.70***	
	(0.21)		(2.34)		(3.85)		(0.88)	
Observations	662		635		553		649	
Adjusted R-Square	0.54		0.17		0.19		0.15	

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. For the interest rate equation k equals 1, while for the deposit equation k equals 3. The standard errors have been corrected for heteroscedasticity. The "DI effect" columns show the coefficients of the interaction terms between the DI dummy and indicators of bank risk. Small deposits are deposits less than $15,000.

Table 8: Are foreign banks subject to different degrees of market discipline than domestic banks?

	Panel 1				Panel 2			
	Interest Rates		Deposits		Interest Rates		Deposits	
		Foreign		Foreign		Foreign		Foreign
Leverage ratio (t-k)	-0.02	-0.06*	1.41**	-1.65				
	(0.03)	(0.03)	(0.68)	(1.06)				
Nonperforming loans to total assets (t-k)	0.18***	-0.15***	2.30***	1.76***				
	(0.04)	(0.04)	(0.48)	(0.44)				
Loan loss reserves to total assets (t-k)	-0.49***	0.37***	1.93***	-1.14				
	(0.06)	(0.07)	(0.72)	(0.73)				
Overhead expenses to total assets (t-k)	1.98***	-0.37***	-31.00***	23.26*				
	(0.34)	(0.44)	(8.71)	(13.53)				
Return to total assets (t-k)	0.02	-0.02	0.22	-0.14				
	(0.02)	(0.02)	(0.19)	(0.23)				
Liquid assets to total assets (t-k)	-0.06***	0.05***	0.25	-0.22				
	(0.01)	(0.02)	(0.36)	(0.39)				
Principal component 1 (t-k)					-1.37***	0.71***	8.50**	-5.78
					(0.13)	(0.16)	(4.20)	(4.55)
Principal component 2 (t-k)					0.69***	-0.27**	-15.5***	9.55***
					(0.10)	(0.13)	(4.03)	(3.12)
Foreign bank dummy	1.22***		1.50		-1.00***		-2.15*	
	(0.36)		(11.69)		(0.12)		(1.33)	
Log of total assets (t-k)	-0.69***		-5.66**		-0.39***		12.51***	
	(0.08)		(2.52)		(0.04)		(2.97)	
U.S. inflation rate (t-k)	0.19**		0.27		0.25***		0.64	
	(0.08)		(1.15)		(0.08)		(1.12)	
Growth rate of real GDP in Bolivia (t-k)	-0.15***		-1.62		-0.12***		-2.00	
	(0.05)		(1.72)		(0.04)		(1.61)	
Political instability dummy	1.05***	-0.75*	-12.55**	9.73*	0.89***	-0.70	-14.8**	11.84**
	(0.33)	(0.46)	(5.61)	(5.30)	(0.34)	(0.47)	(6.22)	(5.78)
Observations	866		819		866		819	
Adjusted R-Square	0.43		0.15		0.36		0.13	

Notes: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. For the interest rate equation k equals 1, while for the deposit equation k equals 3. The standard errors have been corrected for heteroscedasticity. The columns "Foreign" show the coefficients of the interaction terms between the Foreign bank dummy and the independent variables.

Figure 1: Market discipline and reduced-form models on equilibrium interest rates and deposits