

Marcia P. Romera (Brazil), Benjamin M. Tabak (Brazil)

## Testing for market discipline in the Brazilian banking industry

### Abstract

This paper investigates the effectiveness of depositor discipline for the Brazilian banking industry within the 1994-2004 period. The study shows that depositors are able to discriminate between well and poorly managed banks. Evidence of market discipline is found, both via quantity (withdrawal of deposits) and prices (increases in interest rates). However, the former is more pronounced in crisis periods while the latter is more relevant in tranquil periods. Therefore, in crisis depositors discipline banks by withdrawing deposits while in non-crisis periods charging higher interest rates. The macroeconomic environment and systemic effects are shown to be important. Furthermore, the “too big to fail” hypothesis is also confirmed for the Brazilian economy.

**Key words:** market discipline, banking system, Basel Accord, emerging markets.

**JEL Classification:** G21, G28.

### Introduction

The debate regarding market discipline focuses on the ability of private agents (depositors, creditors and rating agencies) to identify the risk assumed by banks, and if they are capable of pricing such risk. Evidence of market discipline, in the banking industry, is verified when investors make decisions based on information about the risk taken by a certain institution, demanding a higher risk premium, or withdrawing their deposits if they consider the institution too risky. Martinez-Peria and Schmukler (2001) have shown that depositors, who are exposed to bank risk taking, may penalize riskier banks by requiring higher interest rates or by withdrawing their deposits<sup>1</sup>. Furthermore, banks are nowadays operating in different industries and failure in one industry may impact financial stability of banks (see for example the recent failure of AIG (large insurance company in the US) that needed government intervention as it has sold insurance for a large part of the US banking system using credit derivatives).

Market discipline is an important mechanism of control and supervision over risk, and has recently been introduced as the third pillar in the second Basel Accord. Bank monitoring is promoted by the market and, with the adequate incentives and information, will induce transparency and influence the management of risk by banks. The future model of capital adequacy, based on the risk measures proposed by the Basel Committee, increases the importance of market discipline<sup>2</sup>.

Besides promoting a decrease in risk assumed by banks, worried with possible negative consequences, other advantages of market discipline include: the constitution of a mechanism that promotes transparency, avoiding instabilities in the financial system and bank runs; the increase of

banks efficiency, considering that the less efficient ones will be pressured by the market; and a decrease in the social cost of supervision, since the responsibility of supervisors will diminish because bank managers will have the obligation of demonstrating to the market the low risk of their organization.

The governmental control over the banking industry, in most countries around the world, is designed to preserve the payment system and the stability of the banking system. The banking crises in the 1980s and 1990s led many countries in the world to introduce, for example, explicit deposit insurance schemes (Demirguc-Kunt and Kane, 2002). A banking crisis is capable of affecting the entire economy, making agents withdraw from the financial system and apply their resources in other assets<sup>3</sup>. To avoid instabilities, the maintenance of credibility in the financial system is crucial. A method to promote security in the market is to reinforce the market discipline imposed over banks<sup>4</sup>.

This study intends to examine the existence of market discipline in the Brazilian market. We analyze if Brazilian depositors identify the risk of a banking institution and use such information in the decision-making. In addition, we evaluate if the existence of deposit insurance, safety nets and a significant participation of the government in the industry, inhibit the incentives of monitoring risk of institutions and, consequently, the capability of promoting discipline amongst banks. With this purpose, panel data of banking deposits and a group of indicators of the financial condition of institutions will be used. Additionally, the research intends to verify if macroeconomic, institutional and systemic aspects are important in explaining depositor's behavior.

It is worth mentioning that we employ interest rates charged on deposits as a main dependent variable in our regressions. These interest rates are the result of

© Marcia P. Romera, Benjamin M. Tabak, 2010.

<sup>1</sup> See also Park and Peristiani (1998), Flannery (1998), Barajas and Steiner (2000), and Bundevech and Franken (2003).

<sup>2</sup> See Basel (2000, 2003).

<sup>3</sup> Hoggarth et al. (2002) finds that cumulative output losses incurred during banking crisis are large, 15-20%, on average, of annual GDP.

<sup>4</sup> See Hoggarth et al. (2005) for a discussion on safety nets and its impacts on market discipline.

the interaction of demand and supply in equilibrium. If a bank is riskier and on average it pays higher interest rates we interpret this as the result of charging a higher "risk premium" by depositors. This should be true for uninsured depositors that deposit large amounts of cash in these banks, such as institutional investors, pension funds and alike.

Although Brazilian banks are adapting their risk management models and capital allocation to meet the terms of the new Basel Accord, and besides intense academic debate in countries of Latin America, there is no previous study about this subject for Brazil. Certain aspects make Brazil an interesting country for the study of market discipline: a) crisis and restructuring of the sector initiating in 1994; b) important transformation in the regulatory system; c) the existence of deposit insurance; d) changes in the exchange rate regimes and in monetary policies; e) intense participation of the government in the system and its interventions to avoid banking failures (PROER)<sup>1</sup>; f) low participation level of banks in the equity and debt market; and g) elevated market concentration.

The experience of the 1994-2004 period, with the banking crisis in 1995, the failure of medium sized banks and a currency crisis in 2002 constitutes an unique period in which banks have had a high volatile environment to operate. In the recent global crisis that started in September 2008 after the failure of Lehman Brothers, Brazilian banks have shown to be resilient, which in part may be due to a long period of learning on how to respond to crisis.

In this paper we try to contribute to the literature in three ways. First, by examining market discipline for crisis and non-crisis periods for the Brazilian financial system, which is the largest financial system in Latin America. Brazilian banks have been issuing substantial amounts of subordinated debt in developed economies in the past years, which makes it a particularly interesting country to pursue such studies. Our results suggest that the macroeconomic environment and systemic effects are important in explaining market discipline. Second, we study the impact of ownership (state-owned versus private banks) on market discipline. Our evidence suggest that government control of banks is not highly significant. Finally, we test the "too big to fail" hypothesis and find evidence that it seems to be present in the Brazilian financial system.

In the next Section, a brief review of the literature regarding market discipline will be presented. Section 2 will present the major characteristics of

the Brazilian banking industry, with a special focus on the aspects that influence market discipline. Finally, Section 3 presents the empirical model used and major results. The last Section concludes the paper.

## 1. Literature review

The debate regarding market discipline focuses on the ability of private agents (depositors, creditors and rating agencies) to identify the risk assumed by banks, and if they are capable of pricing such risk. Flannery and Sorescu (1996) define market discipline as the process in which informed market investors obtain and evaluate information about the activity of financial institutions and incorporate them in their negotiated debts. The most valuable market discipline is the one in which investors are able to anticipate future risk changes in banks and incorporate this information in assets instantaneously. The anticipation of the increase of debt would be capable of promoting discipline of managers, who would anticipate changes in the risk exposure, diminishing costs.

Berger et al. (2000) in a study inside the American banking industry compared the capability of the market to evaluate bank risk with the estimations performed by regulators. They found that the government, rating agencies and other market participants all produce valuable, and complementary, information about the conditions of the financial institution, promoting improvement in the management of banks.

An important aspect to consider is the weakening of market discipline, and of the financial system, due to the existence of safety nets. Deposit insurances contribute to the protection of depositors, but also incentive the presence of moral hazard in the financial system. Recently Hoggarth et al. (2005) study this trade-off and concludes that design of the safety net is important. The authors suggest that limited depositors protection schemes reduce the likelihood of a banking crisis.

Flannery and Sorescu (1996) demonstrated that a decrease in governmental intervention, in order to avoid bank failure, reinforced market discipline in America and private agents started to monitor and punish risky banks. Nonetheless, many countries have implemented explicit or implicit deposit insurance systems, which protects small depositors. The question that arises in this context regards the impact of these systems on market discipline. Demirguc-Kunt and Huizinga (2004) studied the various deposit insurance systems established in thirty countries and concluded that the insurance has the capability of reducing interest rates required in deposits and, at the same time, diminish market discipline

<sup>1</sup> PROER stands for Program of Incentives to the Restructuring of the National Financial System.

over banks through prices<sup>1</sup>. It hasn't been verified, in this study, any evidence that market discipline, in terms of growth rates and volume of deposits, is depreciated due to the existence of deposit insurances.

An aspect also discussed in the market discipline and safety nets literature is the "too big to fail" policy. The idea is that if a large banking institution goes bankrupt, a financial instability of great proportions and a contagion effect that would impact the entire system would be more likely to happen. Therefore, in case banks and depositors believe that large financial institutions are secured, there could be an increase in risk by banks and, additionally, depositors wouldn't be likely to monitor and punish them by withdrawing their deposits.

The literature that tests for market discipline uses different instruments (equity, stocks, subordinated debt and deposits) and distinctive measures of risk (book and market value) of banks. Currently, there is a large focus on the utilization of subordinated debt to obtain market discipline in developed countries<sup>2</sup>. Most of the studies try to confirm if investors are capable of distinguishing the risk of different banks. Therefore, econometric models have been developed to study the relation between risk spreads and different risk measures of banks<sup>3</sup>.

According to Calomiris (1997), non-secured depositors hold the incentive to monitor and penalize banks that assume risky asset positions, increasing depositor's risk. As a result, the mechanism of subordinated debt, as a non-secured funding, would have the advantage of allowing the creation of desired incentives in a reduced group of regulatory mechanisms, without recurring to supervisors to analyze the situation of a bank's assets.

Some authors severely criticize the practical value of using subordinated debt to obtain market discipline by revealing the solvency risk of institutions. According to Rivera and Nickerson (2003), the secondary market of subordinated debt is decentralized, being formed by independent dealers. Consequently, the historical data of prices are difficult to be accessed and hardly illustrate the variety of influences related to the risk of default performed by a bank.

<sup>1</sup> In this study Brazil was not included, but other developing nations such as Argentina, Mexico, Bolivia, Colombia, Chile, Haiti and Guatemala were part of the sample.

<sup>2</sup> See Goyal (2005), Nivorozhkin (2005) and Herring (2004).

<sup>3</sup> In the event of default, subordinated creditors will only receive costs after all the other creditor's debt have been liquidated. The resources obtained by issuing subordinated debt, form capital level II in the bank's base capital. These resources are normally a long-term (at least ten years) investment and allow larger volume of funding than other types of allocation. Because it forms capital level II, this instrument allows leveraging new credit operations without the necessity of allocating more money with an increase of traditional capital, which would reduce the investor's returns.

Sironi (2001) verified by analyzing European banks, that private investors might discriminate between risk of different banks by using corporate bonds spreads. A conclusion of the study was that public banks, or those with government participation, didn't have spreads sensible to the bank's risk, differently from private ones. Other debt instruments tested were bank deposit certificates and deposits in general. Ellis and Flannery (1992) verified that interests paid in certificate of deposits (CDs) by major American banks are able to illustrate the bank's risk, paying significant default risk premia<sup>4</sup>.

The importance of using equity to promote and confirm market discipline is controversial in most of the studies analyzed. Signals based on equity may not be considered appropriate for the purpose of supervision and market discipline. The main problem is that the relation between equity prices and a bank's risk is still not clear. For Hancock and Kwast (2001) information from the debt market and equity market, combined with the information from supervisors, may be useful to diminish the time to identify changes in risk conditions, and allow forecasts of the variation of a bank's risk.

When analyzing the capability of emerging markets to promote market discipline, some aspects may be more important than bank's specific financial characteristics. Yeyati et al. (2004) affirm that institutional, systemic and macroeconomic factors of emerging economies are capable of substantially affecting market discipline. In this case, using market reactions as an "alert" is highly questionable, as macroeconomic factors affect such reactions and these factors are not variables controlled by banks.

Santos (2004) presented a study about how the market disciplines different banks. While studying exclusively the American market, the author demonstrated, by means of an empirical test, that the risk spread, besides the issuer's risk, depends on the circumstances of the economy (recession or expansion). He also demonstrated that risky banks were relatively more punished than others, meaning that the market disciplines banks in different ways. Therefore, in moments of recession, investors demand higher risk premiums, but this impact isn't uniform amongst banks, being larger in those less safe. For emerging markets this result would be more severe, once they are susceptible to higher fluctuations in the economy.

The major empirical results for Chile, Argentina, Mexico, Costa Rica, Colombia and India demonstrate the existence of market discipline in these countries, even though in an incipient way. The

<sup>4</sup> The risk premium embedded in CDs rates compensates depositors for their expected default losses.

empirical evidence concentrates on market discipline by depositors, due to the low development of the private debt and equity markets. Mostly, accounting information such as risk measurements of banks are used in these areas. Martinez-Peira and Munoz (2002) in an evaluation of Costa Rica, during the period from 1995 to 2001, concluded that macroeconomic factors, and financial factors of institutions, didn't present great significance. Martinez-Peria and Schmukler (2001) studied the existence of market discipline in Mexico, Chile and Argentina during the decades of 80 and 90. They focused on the impact of macroeconomic and systemic variables and also those that illustrate bank's foundation, concluding that market discipline does exist in these countries, despite the existence of deposit insurance.

Studying Colombia during the period of 1985-99 and using semester data, Bajas and Steiner (2000) included in their analysis alternative methods to illustrate bank's foundations, such as the number of agencies, interest paid in deposits and a dummy for government control and another for foreign control. They concluded that, besides the market discipline hypothesis being verified, banks also reacted to depositor's punishment. Bundeich and Franken (2003) proved, using funding interest rates and deposit volumes, that there is evidence of market discipline in Chile for the period of 1994-2001.

Hess and Feng (2006) study non-bank financial institutions for New Zealand and find that although more risky financial institutions have to offer higher interest premiums, investors do not appear to reward for disclosure by accepting lower interest rates for better transparency.

Ashcraft (2008) has shown that bank debtholders are able to influence the behavior of distressed banks. Davenport and McDill (2006) examine the disciplinary behavior of both uninsured and insured depositors and find that risk monitoring may shift from normal to crisis times. Furthermore, De Jonghe (2010) has shown that the recent move to non-traditional banking activities within the European banking sector have increased systemic instability within the European banking sector.

There is an ongoing debate on how better to promote market discipline. Several authors such as Van Hoose (2007) and Tarulo (2008) suggest mandatory periodic issuance of subordinated debt as a way to promote market discipline. Besides, Gatev et al. (2009) have shown the importance of accounting for liquidity in assessing for bank risk.

Overall, it is not clear whether market discipline is in work in different countries due to different institutional arrangements and perhaps cultural

differences. In most of the studies for emerging markets, it is possible to realize that there wasn't a weakening of market discipline related to the existence of deposit insurance. The Brazilian banking system was not object of these studies. However, the Brazilian banking system is an interesting case as it has an explicit deposit insurance scheme, which has been put in place after the banking crisis in 1995. The next section will focus in the Brazilian banking industry.

## 2. The Brazilian banking industry

Some aspects like the existence of deposit insurance and safety nets, the high participation of the state owned banks, the interventions of the Central Bank to not allow bankruptcy of institutions, macroeconomic shocks, the regulatory environment and the transparency of the market may change the form and intensity of the manifestation of market discipline, once they are capable of affecting incentives and the information available to agents who will respond to bank risk. This section will present a brief overview of how these aspects manifest in the Brazilian banking industry.

**2.1. Macroeconomic environment and banking activity after Plano Real.** The development of the Brazilian financial system during the years that preceded Plano Real was characterized by a strong inflationary process that dominated the Brazilian economy. Because of the expressive earnings, linked with inflationary transfers, the inefficiency of the banking industry wasn't noticed. In this case, the period of high profitability allied with low competition and transparency, didn't represent a propitious environment for the manifestation of market discipline<sup>1</sup>.

The year of 1994 was the beginning of important transformations in the Brazilian economic history, once, after several non-successful stabilization plans, Plano Real manages to stabilize the price level. As the inflation diminished, a restructuring process of the Brazilian economy initiated and contributed to the appearance of systemic problems in the banking industry. The opening of the economy revealed the low profitability and inefficiency of some industrial and commercial sectors, which illustrated the incapability of recovering loans conceived by banks. In addition, the restrictive monetary and "fiscal" policies beginning with Plano Real contributed to the reduction of the credit available for some sectors of the economy.

Other consequence of the stabilization period was the stimulation of monetization and demand for

<sup>1</sup> See Baer and Nazmi (2000) and Ness (2000).

credit, which enlarged the financial intermediation market. In the second semester of 1994, the demand and time deposits increased 165,4% and 40%, respectively, accompanied by the elevation of loans in 58,7% (Rocha, 2001). This aspect shows that the elevation of deposits was influenced by the favorable macroeconomic conditions.

Together, these facts changed the scenario in which financial institutions worked. They elevated the volume of credit operations, increased the costs of banking operations and initiated a process of cutting costs, in order to achieve higher productivity. Many banks didn't resist to the new reality of the Brazilian financial system. By the end of 1994, seven small banks were liquidated.

In early 1995 larger banks started being affected by the new macroeconomic measures, this initiated the restructuring and strengthening of the financial system's safety net, with special liquidity lines like the PROER. More power was given to the Central Bank in the determination of transfers of share hold control of banks with solvency problems, advances in the supervision and banking regulation, and an incentive to the promotion of fusions and acquisitions<sup>1</sup>. At the end of 1996 five liquidations were performed by the Central bank. In 1997 the situation deteriorated after the liquidation of a large, private and national bank, "Bamerindus". Also at this time, the federal deposit insurance system – Credit Guarantee Fund (FGC) – was created to promote security amongst depositors.

The preventive measures discussed above avoided a systemic crisis of greater proportions, once large healthy institutions weren't troubled. Besides, depositors also weren't affected. The financial cost was estimated in 4% of GDP, which is a small cost compared to banking restructuring in other countries (Rocha, 2001). However, if PROER avoided a possible systemic crisis, it also made clear to depositors that the government is willing to stop bank failure amongst large institutions, which could influence the perception of risk by agents and create a moral hazard problem. After the crisis and all the liquidations, interventions, fusions and acquisitions the Brazilian banking system now had a new configuration.

The period of 1994-1997 was of great difficulty to the Brazilian economy in general and to the banking sector in particular. The year of 1998 emerged with a new reality, being defined a scenario of stability and failures became less expressive. Stabilization of prices, appreciation of domestic cur-

rency, monetization, increase of credit, high nominal and real interest rates and high bankruptcy rates were factors that changed the economy and the banking industry.

The period of restructuring, accompanied by the larger participation of foreign banks, and reduction of public participation, shaped a solid and efficient system concentrated on a smaller number of banks. Financial institutions no longer relied on inflation, but on banking spreads. The enlargement of the intermediation market and the end of inefficient institutions influenced banks to become more efficient and transparent.

A post-stabilization period initiated, with management adjustment in banks and a period of acquisitions, and incorporations, focused on scale gains, which increased the concentration inside the system. This tendency is still verified today.

Another characteristic of the reorganization period in the banking system was the raise of foreign investments and participation. The diversification of operations was combined with larger network coverage, reduction of costs and larger opportunities of growth for financial groups, substantially increasing competitiveness inside the market (BCB, 2003).

In April, 2002, the new Brazilian payment system (SPB) was implemented to reduce the possibility of contagion and systemic crisis. The new system diminished the time between payment instruction and final liquidity, which reduced the credit risk and liquidity of participants.

The analysis of the macroeconomic aspects that influenced the Brazilian economy from the second semester of 1994 until the beginning of 2004, allow the identification of two very specific periods. First, the period that will here be classified as the restructuring of the sector, or crisis period, comprehending the years from 1994 to 1997. Second, the period from 1998 until today, which is a period of larger stability. Therefore, in order to analyze the empirical model in the next chapter, the behavior of depositors in both separate periods will be tested, to prove if the manifestation of market discipline is higher during crisis periods.

**2.2. Governmental participation.** The participation of the government as a bank owner is a factor that may influence market discipline. This is justified by the fact that agents will fall under the impression that they are secured by the government, not only because of the size of the bank, but also because of the bank's function as part of the governmental loan conceiving policy. In Brazil there is a tendency of privatizing public banks. However, the participation of public banks in the market is still high.

<sup>1</sup> The PROER spent around 20 billion reais to transfer businesses from liquidated banks to healthy institutions.

In 1996 a period of privatizing public banks initiated because of PROES<sup>1</sup>. Out of the 25 state controlled banks existent in 1996, only 2 didn't participate in the program and a total of 10 were privatised<sup>2</sup> (Salviano Junior, 2004).

Public banks started loosing, since the implementation of PROES, participation in this segment. In 1997, public banks (Banco do Brasil, Caixa Economica Federal, State banks and State savings banks) were responsible for 32.34% of the net worth in the banking segment; by 2003 they only held 12.53%. Nevertheless, when analyzing the participation of State controlled banks in the total number of deposits, it is possible to realize that, despite the downward trajectory, this participation is still expressive. In 2003, public banks held 42.43% of deposits<sup>3</sup>.

When analyzing the existence of market discipline, it is possible to realize that almost half of the deposits are concentrated in public banks. This implies that, if depositors believe they are secured by governmental guarantees, the manifestation of market discipline will be disturbed. This aspect will be tested in the next section.

According to Lundberg (1999) the problem known as "too big to fail" occurs in Brazil. Thus, only small financial institutions are liquidated when presenting insolvency problems while large banks are restructured. In the Brazilian PROER, the efficient parts of the distressed banks were sold, and the inefficient parts liquidated. This aspect could negatively influence market discipline in Brazil, once depositors of large institutions won't monitor their risk.

The restructuring process of the Brazilian banking industry occurred in a scenario of reduction in the number of institutions in the market. One third of the banks were terminated only in the period from 1994 to 2000, as shown in the Table below.

Table 1. Evolution of the banking system by capital structure

Banks	State-owned	Private	Total
Dec-94	38	210	248
Dec-95	32	210	242
Dec-96	32	198	230
Dec-97	27	190	217
Dec-98	22	182	204
Dec-99	19	175	194
Dec-00	17	175	192
Dec-01	15	167	182
Dec-02	15	152	167
Dec-03	14	150	164

Note: This table shows the number of state-owned and private banks for the period of 1994-2003.

**2.3. Safety nets and transparency.** The Brazilian Central Bank disposes of several instruments due to its supervisory function. The Brazilian safety net can be characterized by: the capability if ordering interventions and liquidations; last resort credit loaner; the competence of regulating deposit insurance mechanisms (existence of the Credit Guarantee Fund, FGC); the licensing of new financial institutions; prudent rules to guarantee larger risk management by banks, like imposing limits of leverage and supervising banks to assure that rules are being obeyed.

The Credit Guarantee Fund (FGC) was created in August, 1995 by Resolution CMN 2.197. It's a federal deposit insurance system, maintained by banks, with the purpose of functioning as a banking insurance for investors, which allows recovering deposits after an institution has been liquidated<sup>4</sup>. The characteristics of this insurance are: explicit protection, compulsory acceptance, limited coverage, private funding *ex-ante* and private administration.

After evaluating the characteristics of the Brazilian deposit insurance, and revising the literature regarding the impact of insurance in the manifestation of market discipline, it is possible to conclude that, besides reducing the burden on the government with the coverage of deposits, the limited coverage and the funding from private resources may cause a positive effect over market discipline, since depositors believe that only minor deposits are guaranteed in case of bankruptcy.

Summarizing, the regulatory focus used to control risk decurrently of banking operations, in Brazil, has been the strengthening of the prudential regulation systems and the establishment of deposit insurance. In Brazil, the banking regulation and supervision is

<sup>1</sup> The PROES – Program of Incentives to the Reduction of the State-Level Public Sector in the bank activity – was created by Medida Provisoria 1.514 (A Medida Provisoria is a decree issued by the president that must be approved by vote of the Brazilian Congress. If congressionally approved, the Medida Provisoria becomes law within 120-day period. If the Congress does not approve the Medida Provisoria, the decree has no effect. Instead, the Brazilian Congress is required to issue new measures regulating those transactions that were conducted during the period in which the Medida Provisoria was "in force") and intended to create lines of financing for states that would allow the extinction, privatization, acquisition by the Federal Government or restructuring of 100% of the adjustment cost in case the state signs the plan or 50% if the state decides to keep controlling the institution (Salviano Junior, 2004).

<sup>2</sup> Amongst the privatized banks, some large institutions were between the twenty largest in assets in the financial system, such as Banespa (third largest in assets), Nossa Caixa, Banrisul, Credireal, Banerj and Banestado.

<sup>3</sup> See Nakane and Weintraub (2005) and Beck et al. (2005).

<sup>4</sup> The maximum insurance, since it has been created, is of R\$20,000,00. Several financial applications are secured, like CDBs (bank deposit certificates), RDBs (bank deposit receipts), demand deposits, savings account, mortgage, exchange and real estate letters.

developing and getting better with time, and the Central Bank now possesses several instruments that constitute a safety net. The period after the Plano Real is characterized by the adoption of more restrictive prudential measures.

**2.4. Stock market and subordinated debt.** In Brazil, just about 20 banks have equity negotiated in stock markets<sup>1</sup>. However, it is important to notice that although it is a small number of banks, their assets form 60% of the total assets of banks in the financial system, in June 2004.

Other important source of information of the market comes from the rating agencies. In Brazil, the number of rating agencies, and the number of banks rated, is considerably small. Published information and evaluations aren't easily accessible for depositors. The Brazilian Central Bank by the communicate 12.746 from December, 2004, about the proceedings to the implementation of the new capital requirements, Basel II, established that it will not use ratings published by external credit risk classification agencies for calculating capital requirements. Therefore, most banks have their own internal credit risk models that are used to assess the credit risk of their loans portfolio.

The first subordinated debt emissions in Brazil initiated in 2001. The utilization of subordinated debt as a base capital component, although regulated since 1998, wasn't being used, until then, because the capital requirements were more flexible. In 1999 rules became more specific to the types of exposure (exchange, interest rate and tax credit) and, consequently, started demanding higher capital allocation.

Since then, Itau, Unibanco, Bradesco and Banco do Brasil performed many emissions. The participation of this instrument in these banks base capital developed considerably since the beginning of 2001. In 2003 this participation achieved, in average, 25% of the base capital according to the accounting balances of these institutions. Despite the gradual increase in the emissions of subordinated debt, there is not enough frequency, and number of emissions, that enables studying the impact of these emissions on market discipline.

Testing for market discipline requires substantial amounts of data and it seems unlikely that using data on bank equity prices or subordinated debt would be satisfactory due to the limitations described above. Therefore, we will focus on tests that employ balance sheet accounts from individual banks. The methodology is explained in more detail in the next section.

<sup>1</sup> Data obtained by Bovespa in the sector classification of companies and funds negotiated in Bovespa during June, 2004.

### 3. Empirical tests

**3.1. Methodology.** We employ a panel data estimation technique to evaluate the response of time and total deposits and interest rates paid for deposits on bank risk characteristics. This methodology allows testing for market discipline. We test for two effects: quantity and price. If market discipline is exerted via quantity then depositors reallocate their deposits from riskier to safer banks. Market discipline via prices suggests that riskier banks would pay higher interest rates on their deposits than safer banks.

Our baseline panel specification to analyze the quantity effect is as follows:

$$\Delta Dep_{i,t} = \mu_i + d_t + \beta' Fund_{i,t-1} + \epsilon_{i,b} \epsilon_{i,t} \sim N(0, \sigma_{i,t}^2), \quad (1)$$

where  $i = 1, \dots, N$  is the bank identifier and  $t = 1, \dots, T$  is the period identifier.

The  $Dep_{i,t}$  variable represents the time deposits level in real terms, where  $i$  represents each bank and  $t$  represents time. Two specifications will be tested: the first will use the first logarithmic difference (growth rates) of these deposits; the second will employ, as a dependent variable, the logarithm of the time deposits balance.

The same two regressions will be estimated using the variable total deposits (savings account, demand and time deposits and so on). It is expected that time deposits have larger capability of manifesting market discipline, since they have defined maturity, and pay taxes, they reach a more specialized public.

The  $Fund_{i,t-1}$  variable represents a vector of indicators of the economic and financial condition of banks (fundamentals). This vector presents one lag to capture the time between the publication of the information and the absorption by the market. The utilization of one lag also diminishes the potential occurring of endogeneity. In the next section, the accounting variables used will be detailed.

The  $\mu_i$  term represents the effects of fixed nature of each bank. They affect each studied unit in a different way. As an example, the level of experience of a bank may increase his level of deposits. This is a specific characteristic of the institution, which affects the depositor's decision and is not directly related to the institution's risk.

The  $d_t$  represents time effects. This will control the effects of the evolution of macroeconomic and systemic aspects that vary with time, but not between study units. The variable must capture all the influence that isn't related to the evaluation of banks by depositors. In this case, the variable will affect all the studied units. The error vector is represented by  $\epsilon_{i,t}$ .

Thus, the model postulates that a bank's volume of deposits is determined by its risk, individual characteristics, macroeconomic and systemic conditions.

To analyze market discipline using prices the model to be estimated is as follows:

$$I_{i,t} = \mu_i + d_t + \beta Fund_{i,t-1} + \omega_{i,t}, \omega_{i,t} \sim N(0, \sigma^2_{\omega_{i,t}}), \quad (2)$$

where  $i = 1, \dots, N$  is the bank identifier and  $t = 1, \dots, T$  is the period identifier.

In this case,  $I$  represents the interest rate paid by banks to depositors. The implicit interest rate represents the volume of interest rate expenses paid by banks in all their deposits, divided by the total number of deposits. This variable does not allow separating secured from non-secured deposits, nor if it's a time or demand deposit. Therefore, it is not possible to identify differences in market discipline by value trenches, which would be ideal.

In order to exclude the scale effects and test the "too big to fail" hypothesis, it has been included a logarithmic variable of each banks assets, with the intention of testing if large banks are considered more safe and, consequently, attract more deposits. It has also been included a dummy to test if state banks are considered safer by agents. So, if the parameter is significant, it is possible to conclude that these banks have the capacity to interfere in market discipline and attract deposits.

The estimators within and between will be calculated. The estimators between will be regressed from the mean of deposits (during the time of study) of each bank against the mean of the explicative variables. In this case, the time effects will not be included. Within estimators focus the change of deposits during time, while the between explores the differences between banks. The within estimation method studies the deviation from the average of each bank. It indicates how the deviation from the average of fundamentals affect the deviation of deposits of their means. They are obtained by including a dummy for each bank.

The deviations corrected by heteroskedasticity will be calculated in both estimations (White correction). The test of joint significance of bank fundamentals will be presented. It will also be included tests of joint significance of time effects in order to determine if macroeconomic effects and shocks are important, and a test for the joint significance of fixed effects. A Hausman test will evaluate the inclusion of fixed effects instead of estimating the model of random effects. In case the test indicates a hypothesis of random effects, these results will be indicated<sup>1</sup>.

<sup>1</sup> The random effects model considers that individual effects aren't independent between them, but randomly distributed around a certain value. Here, the GLS method was used. The Hausman test uses a chi-squared test with the null hypothesis: the random effects model is the one that best describes the relation between the dependent and explicative variables.

The estimation will also be done for different time periods: during the crisis and stable period. As said in the precedent section, during the period from the beginning of Plano Real until 1997, there was a crisis and reorganization of the banking sector, caused by macroeconomic, and systemic aspects, and by structural characteristics of the sector, which culminated in the bankruptcy of several institutions. Since 1998, a second period of more stability was initiated, with increased prudential regulation where bank failure occurred less often and with little magnitude.

**3.2. Description of the data base.** With the purpose of verifying the market discipline hypothesis, accounting data from balance sheet and income reports from the Austin rating database will be used<sup>2</sup>. Quantitative measures of banks, supplied by this agency, will also be used.

The base is composed with non-balanced panel data (by semester) from July, 1994 to July, 2004 and contemplates all banks with active commercial portfolio<sup>3</sup>. A total number of 2639 observations were made during this period. An average number of 146 banks can be observed in the period. Banks without time or demand deposits during the period, or with incomplete information, were excluded from the sample.

**3.3. Explicative variables used in the model.** The variables chosen to represent banks fundamentals were obtained by accounting balances provided by Austing database.

In general, the literature regarding the subject uses a group of indicators that summarize an institutions financial condition, based on the five categories of the CAMEL methodology, in which financial indicators are used to evaluate capital adequacy, asset quality, management quality, profitability and liquidity risk. In this study, the variables used to represent the risk of Brazilian banks, will also have these five dimensions.

For the capital adequacy dimension, three variables were used: capital/assets ratio, an immobilization index and a working capital measure. It is expected that better working capital indexes, and capital/assets ratio, have a positive effect over deposits, while high immobilization indexes will negatively influence them. As to the effect over interest rates, we expect the opposite. As a proxy for an immobilization index we employ the non-earning assets variable.

The variables current liquidity and interbanking dependence will represent the liquidity dimension. In this case, it is expected that banks with higher liquidity pay smaller interest rates and attract more

<sup>2</sup> Austin rating is a Brazilian credit risk-rating agency. It was the first national company to publish ratings in Brazil and has been in the market for over 20 years.

<sup>3</sup> The BNDES, and other development banks and cooperatives don't make part of the sample. Caixa Economica (large state-owned bank) is a part of the database.



deposits. Considering interbanking resources, we expect a negative effect over deposits and an increase in rates required by the market towards these banks.

The size of a bank's constituted provision, in relation to its total volume of credit, will be the indicator of the quality of its assets. An elevated provisioning index tends to present a negative effect over deposits and a positive one over interest rates. As a profitability indicator, a measure of return on assets was used. As an institution becomes more profitable, the lower will be its funding rates, while its total number of deposits increases.

Finally, to indicate quality of management, the operational cost was the variable chosen. In this case, banks with larger administrative and personnel expenses in relation to their assets will be considered inefficient and, therefore, attract less deposits. However, it is possible to argue that banks with higher indices are investing in the quality of

their services, possibly attracting more deposits. Therefore, the sign (positive or negative) of this variable isn't determined.

**3.4. Discussion of empirical results.** *3.4.1. Quantity analysis.* Tables 2 and 3 indicate the estimation results, using, as a dependent variable, the growth rate of time deposits and the level of time deposits, respectively. The specifications in equation (1) were ran for both distinctive periods: crisis and post-crisis and, also, for the total period.

When analyzing the results in Tables 2 and 3, it is possible to notice the presence of market discipline in both within and between estimations. The F-tests demonstrate that the risk characteristics are significant in most of the estimations, which is a favorable sign of market discipline. However, some coefficients of some bank risk variables are, individually, not different from zero. This aspect is more strongly verified in the second period.

Table 2. Response of growth of time deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	1998:1 to 2004:1 Between	Within	Random T.	1994:2 to 2004:1 Between	Within
Lag (non-earning assets)	0.0240 (1.1284)	0.0342** (2.2179)	-0.0042* (-2.7496)	-0.0169 (-1.3923)	-0.0095 (-0.9801)	-0.0021 (-0.0814)	-0.0052 (-0.4205)
Lag (interbanking dependence)	-0.0423* (-2.8252)	0.0107** (2.2910)	-0.0039 (-1.5591)	0.0050 (1.2240)	-0.0002 (-0.0915)	-0.0361** (-2.3496)	0.0056** (2.0517)
Lag (working capital)	0.0216 (1.0087)	0.0328** (2.1462)	-0.0044* (-2.8997)	-0.0169 (-1.3957)	-0.0095 (-0.9844)	-0.0015 (-0.0583)	-0.0052 (-0.4246)
Lag (current liquidity)	0.0053* (3.1871)	0.003* (5.3917)	-0.0014** (-2.3148)	0.0010 (1.4570)	0.0001 (0.1748)	0.0056*** (1.8911)	0.0019* (3.4116)
Lag (provisioning)	0.0480** (2.1710)	-0.0001 (-0.0176)	-0.0169* (-3.4071)	-0.0047 (-0.9517)	-0.0079** (-1.9735)	0.0849* (3.1230)	-0.0045 (-1.1468)
Lag (returns/assets)	0.0002 (1.3579)	-0.0001*** (-1.8880)	-0.0001 (-1.0591)	0.0000 (0.2126)	0.0000 (0.1652)	0.0002 (1.3737)	0.0000 (0.3693)
Lag (operational costs)	-0.0249*** (-1.7969)	0.0104*** (1.9068)	0.0075*** (1.6409)	0.0031 (0.7582)	0.0028 (1.0720)	-0.0432** (-2.2530)	0.0052*** (1.8870)
Lag (capital/assets)	-0.0305** (-2.0748)	0.0103*** (1.9592)	0.0034 (0.8744)	0.0017 (0.3795)	0.0002 (0.0787)	-0.0312*** (-1.6626)	0.0000 (-0.0067)
Log (deflated assets)	-0.3230* (-3.0357)	0.0590 (0.4883)	0.0034 (0.2989)	0.0473 (0.5200)	-0.0028 (-0.2494)	-0.3009* (-2.7684)	-0.0026 (-0.0485)
Government control (dummy)		0.2677 (1.3706)		0.2646** (2.4912)	0.0983 (1.4971)		0.1998** (2.3716)
Adjusted R <sup>2</sup>	0.1802	0.9349	0.1859	0.0392	0.0163	0.1916	0.8577
F-test fixed effects		0.6613		0.7912	0.7912		0.7582
F-test time effects		32.8143*		6.8775	6.8775*		72.6528*
F-test joint effects (fixed and time)		16.1066*		1.2493	1.2493**		35.4019*
F-test fundamentals	5.2016*	7.9232*	4.6795*	0.9961	0.9961	0.8037	2.9471*
Hausman cross-section effects		551.4380*		28.1923	28.1923*		947.0137*
Hausman time effects				4.5527	4.5527		1886.0916*
Number of banks	173	173	146	146	146	183	183
Number of observations	173	1036	146	1603	1603	183	2639

Notes: This table shows the regression results of the growth of time deposits on bank risk characteristics. Between and within estimators (fixed effects) are reported. Estimators for time dummies, fixed effects and the constant term are not reported in the table, even though they are included in the regressions. T-statistics are in parentheses. Robust standard errors using the White correction for heteroskedasticity are obtained. F-tests for fixed effects, time effects and bank fundamentals test the null hypothesis that the corresponding group of variables is equal to zero. Random T. stands for Random Time. The \*\*\*, \*\* and \* stand for statistical significance at the 1%, 5% and 10% level, respectively.

Table 3. Response of time deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	1998:1 to 2004:1 Between	Within	Random T.	1994:2 to 2004:1 Between	Within
Lag (non-earning assets)	0.0087 (0.5768)	0.0308*** (1.8897)	0.0062 (0.8956)	-0.0101** (-2.4110)	-0.0009 (-0.3434)	0.0033 (0.2366)	0.0005 (0.0656)
Lag (interbanking dependence)	-0.0201** (-2.4378)	-0.0039 (-1.0557)	-0.0180** (-2.0790)	-0.0155* (-3.5645)	-0.0170* (-4.4088)	-0.0260* (-3.2939)	-0.0125* (-4.2665)
Lag (working capital)	0.0077 (0.5123)	0.0312*** (1.9211)	0.0055 (0.8107)	-0.0102** (-2.4323)	-0.0010 (-0.3949)	0.0036 (0.2614)	0.0005 (0.0661)
Lag (current liquidity)	0.0022** (2.2913)	0.0005 (0.9842)	-0.0032 (-1.1156)	-0.0038* (-4.8991)	-0.0051* (-5.8217)	0.0007 (0.2414)	-0.0015*** (-1.9295)
Lag (provisioning)	0.0248 (1.3484)	-0.0060 (-0.9101)	-0.0177 (-1.2783)	-0.0060 (-1.0893)	-0.0138* (-2.8492)	0.0268 (1.3315)	-0.0065*** (-1.6262)
Lag (returns/assets)	0.0003** (2.2227)	0.0000 (0.8552)	0.0000 (0.0678)	0.0000 (0.9395)	0.0000 (0.6693)	0.0003*** (1.8461)	0.0000** (2.2421)
Lag (operational costs)	0.0149 (1.5581)	0.0059 (1.0438)	0.0475** (2.5188)	0.0081 (1.0346)	0.0302* (3.8319)	0.0166 (1.2088)	0.0046 (1.0568)
Lag (capital/assets)	-0.0241** (-2.4147)	-0.0119** (-2.0376)	-0.0071 (-0.4959)	-0.0059 (-0.9573)	0.0009 (0.1957)	-0.0200 (-1.3540)	-0.0141* (-3.6513)
Log (deflated assets)	0.7132* (13.3404)	0.2917** (2.5302)	0.8692* (15.4864)	0.5994* (4.3743)	0.8267* (42.3586)	0.7657* (12.9087)	0.4655* (6.7745)
Government control (dummy)		-0.0362 (-0.1457)		0.4682* (3.1132)	0.3133* (3.6091)		0.4081* (3.5815)
Adjusted R <sup>2</sup>	0.7518	0.8860	0.7502	0.8204	0.6593	0.7186	0.8184
F-test fixed effects		8.4590*		10.9575*	10.9575*		11.8467*
F-test time effects		8.5547*		3.3474*	3.3474*		14.7753*
F-test joint effects (fixed and time)		23.9413*		10.5170*	10.5170*		29.1952*
F-test fundamentals	59.5756*	1.6218***	49.7313*	7.4456*	10.7561*	52.6366*	6.3590*
Hausman cross-section effects		266.3375*		31.4964*	31.4964*		308.3203*
Hausman time effects				8.6186	8.6186		1461.8209*
Number of banks	175	174	147	146	146	183	183
Number of observations	175	1039	147	1607	1607	183	2646

Notes: This table shows the regression results of time deposits on bank risk characteristics. Between and within estimators (fixed effects) are reported. Estimators for time dummies, fixed effects and the constant term are not reported in the table, even though they are included in the regressions. T-statistics are in parentheses. Robust standard errors using the White correction for heteroskedasticity are obtained. F-tests for fixed effects, time effects and bank fundamentals test the null hypothesis that the corresponding group of variables is equal to zero. Random T. stands for Random Time. The \*\*\*, \*\* and \* stand for statistical significance at the 1%, 5% and 10% level, respectively.

In the first period, the variables of the liquidity dimension (current liquidity) and capital adequacy (working capital) seem to be those with largest influence over depositor's decisions. The significance of the liquidity variable is justified by the bank failures experienced since 1994. In the period analyzed, the variables demonstrated their significance and the expected theoretical sign. This result was also verified in the study performed by Martinez-Peria and Schmukler (2001), where the liquidity component was highly significant in the analysis done for Chile, Mexico and Argentina.

It is worth noting that bank fundamentals explain better the behavior of deposits during the crisis period, than during the period of stability. A possible explanation is that depositors changed the focus on bank monitoring, which, during the crisis period, was directed to the solvency of financial institutions and, therefore, more focused on liquidity and capital

adequacy, and during the stability period, depositors started monitoring, with more concern, credit quality and management efficiency. It is also possible to argue that the governmental measure of restructuring of banks, and a reinforced safety net, made depositors diminish the focus on monitoring financial institution's risk and care more about less technical aspects, such as the coverage network and personnel, reflecting operational cost.

In relation to depositor's response in crisis events, its noticeable that time effects are significant in all regressions for all periods. This means that shocks and systemic variables are significant to explain the behavior of deposit holders, besides the risk variables.

In relation to the size control variable, in regressions for level of deposits and growth rates, this variable was significant in both periods. This result makes sense in the Brazilian banking sector context, previously knowing that, besides the large number of

banks, deposits are concentrated in a small number of large banks. In addition, the result is a favorable indicative of the “too big too fail” hypothesis. This implies that depositors believe that large banks tend to be safer, or that the government wouldn’t allow their bankruptcy, so they reduce their focus on monitoring bank risk.

Governmental control only demonstrated any significance when explaining the behavior of deposit holders during the period of stability. This indicates that the elevated state participation in the industry until 1997 didn’t influence the decisions of depositors, or didn’t suggest any implicit guarantee by the government. A possible explanation for this variable being significant during the period of stability is the fact that, since 1996, many measures of privatizing and restructuring of public banks took place, in-

creasing the confidence of depositors towards these banks. It is also important to mention that, besides the reduction in the number of public banks, most of the deposits are still concentrated in large public banks, such as Banco do Brasil and Caixa Economica Federal.

Tables 4 and 5 present the results using the total number of deposits as a dependent variable. Results are quite similar to those using time deposits. However, differently from expected, little evidence of manifestation of market discipline was found. Even though testing for market discipline in value trenches was not possible (this would demonstrate the behavior of small and large depositors), these results allow concluding that small depositors, or depositors in general, also monitor the risk of financial institutions.

Table 4. Response of growth of total deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	1998:1 to 2004:1 Between	Within	Random T.	1994:2 to 2004:1 Between	Within
Lag (non-earning assets)	0.0262 (1.2828)	0.0346** (2.2869)	-0.0035 (-1.4703)	-0.0170 (-1.3965)	-0.0090 (-0.9227)	-0.0013 (-0.0513)	-0.0035 (-0.2847)
Lag (interbanking dependence)	-0.0394* (-2.6074)	-0.0187* (-5.0189)	-0.0002 (-0.1178)	-0.0126* (-3.9001)	-0.0067* (-3.3253)	-0.0305** (-2.1079)	-0.0130* (-5.5510)
Lag (working capital)	0.0228 (1.1058)	0.0336** (2.2324)	-0.0038 (-1.5594)	-0.0170 (-1.3985)	-0.0090 (-0.9253)	-0.0005 (-0.0209)	-0.0035 (-0.2880)
Lag (current liquidity)	0.0095* (5.5583)	0.0019* (3.2940)	-0.0021** (-2.5982)	0.0009 (1.4145)	0.0003 (0.5084)	0.0067** (2.3055)	0.0020* (2.9393)
Lag (provisioning)	0.0594* (2.7697)	-0.0035 (-0.6140)	-0.0125** (-2.3428)	0.0010 (0.4064)	-0.0026 (-1.1620)	0.095* (3.5199)	-0.0010 (-0.4452)
Lag (returns/assets)	0.0002*** (1.6771)	-0.0001*** (-1.9136)	0.0000 (-0.3743)	0.0000 (0.4225)	0.0000 (-0.0604)	0.0002 (1.4325)	0.0000 (-0.1424)
Lag (operational costs)	-0.0286** (-2.1263)	0.0024 (0.6062)	0.0063*** (1.8441)	-0.0023 (-0.9419)	0.0021 (1.0994)	-0.0472** (-2.4405)	0.0007 (0.3753)
Lag (capital/assets)	-0.0381* (-2.6671)	0.0078 (1.5079)	0.0041 (1.1799)	0.0013 (0.4610)	0.0020 (0.9384)	-0.0344*** (-1.8665)	0.0020 (0.8744)
Log (deflated assets)	-0.3233* (-3.0458)	-0.2779* (-2.8840)	0.0006 (0.0509)	-0.1006 (-1.4035)	0.0017 (0.1776)	-0.3092* (-2.9347)	-0.0989** (-2.2633)
Government control (dummy)		0.2159 (0.9370)		0.2638 (1.2797)	0.0397 (1.1068)		0.2271 (1.4390)
Adjusted R <sup>2</sup>	0.3120	0.9607	0.0767	0.0607	0.0202	0.1980	0.8839
F-test fixed effects		1.3314*		1.2464**			1.1704***
F-test time effects		33.9118*		3.9177*			78.7504*
F-test joint effects (fixed and time)		27.4947*		1.4627*			44.8440*
F-test fundamentals	9.7178*	8.5808*	2.3467*	4.1595*	3.3585*	6.0210*	7.3739*
Hausman cross-section effects		627.3639*		54.7531*			994.5599*
Hausman time effects				4.4665			2910.69*
Number of banks	174	174	147	147	147	184	184
Number of observations	174	1043	147	1636	1636	184	2679

Notes: This table shows the regression results of the growth of total deposits on bank risk characteristics. Between and within estimators (fixed effects) are reported. Estimators for time dummies, fixed effects and the constant term are not reported in the table, even though they are included in the regressions. T-statistics are in parentheses. Robust standard errors using the White correction for heteroskedasticity are obtained. F-tests for fixed effects, time effects and bank fundamentals test the null hypothesis that the corresponding group of variables is equal to zero. Random T. stands for Random Time. The \*\*\*, \*\* and \* stand for statistical significance at the 1%, 5% and 10% level, respectively.

Table 5. Response of total deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	1998:1 to 2004:1 Between	Within	Random T.	1994:2 to 2004:1 Between
Lag (non-earning assets)	0.0128 (0.8926)	0.0329* (2.0894)	0.0008 (0.1206)	-0.0099* (-2.2962)	0.0024 (0.1556)	0.0013 (0.1610)
Lag (interbanking dependence)	-0.0057 (-0.7281)	-0.0035 (-1.0251)	0.0169* (3.4726)	0.0057 (1.4526)	-0.0026 (-0.2909)	0.0040 (1.5387)
Lag (working capital)	0.0115 (0.8046)	0.0328* (2.0928)	-0.0004 (-0.0550)	-0.0099* (-2.2995)	0.0023 (0.1540)	0.0013 (0.1621)
Lag (current liquidity)	-0.0014 (-1.2559)	0.0000 (-0.0807)	-0.0076* (-3.1812)	-0.0043* (-4.9186)	-0.0009 (-0.3187)	0.0020* (-2.5765)
Lag (provisioning)	0.0254 (1.4058)	-0.0089 (-1.4080)	-0.0164 (-1.3632)	-0.0013 (-0.4771)	0.04589* (2.2244)	-0.0037 (-1.3937)
Lag (returns/assets)	0.0001 (1.2934)	0.0000 (0.2844)	-0.0002* (-1.5723)	0.0000 (1.0511)	0.0002 (1.1179)	0.0000 (0.8427)
Lag (operational costs)	0.0195* (2.0507)	0.0027 (0.6380)	0.0601* (4.7262)	0.0030 (0.5843)	0.0238 (1.6154)	0.0014 (0.4879)
Lag (capital/assets)	-0.0111 (-1.1052)	-0.0101* (-1.9997)	0.0125 (1.2537)	-0.0032 (-0.8951)	-0.0102 (-0.7232)	-0.0069* (-2.4380)
Log (deflated assets)	0.8167* (14.1177)	0.1585* (1.8330)	1.0244* (28.2744)	0.5823* (5.9876)	0.8801* (14.8877)	0.5317* (9.8740)
Government control (dummy)		-0.0295 (-0.1760)		0.5332* (2.0136)		0.3356* (1.7422)
Adjusted R <sup>2</sup>	0.7992	0.9345	0.8686	0.8737	0.7609	0.8771
F-test fixed effects		9.566*		9.3733*		10.7995*
F-test time effects		13.4576*		2.6174*		27.8039*
F-test joint effects (fixed and time)		40.8747*		9.0173*		43.7060*
F-test fundamentals	77.9579*	3.0632*	108.9801*	6.0835*	65.6924	4.9050*
Hausman cross-section effects		378.1683		79.7907*		510.9939*
Hausman time effects				30.1075*		2567.489*
Number of banks	175	174	148	147	184	184
Number of observations	175	1043	148	1636	184	2679

Notes: This table shows the regression results of total deposits on bank risk characteristics. Between and within estimators (fixed effects) are reported. Estimators for time dummies, fixed effects and the constant term are not reported in the table, even though they are included in the regressions. T-statistics are in parentheses. Robust standard errors using the White correction for heteroskedasticity are obtained. F-tests for fixed effects, time effects and bank fundamentals test the null hypothesis that the corresponding group of variables is equal to zero. The \*\*\*, \*\* and \* stand for statistical significance at the 1%, 5% and 10% level, respectively.

3.4.2. *Price Analysis.* The analysis of market discipline using prices demonstrated the existence of market discipline, although in a weak form. Differently from the behavior of depositors, the market discipline using prices manifested more strongly during the period of stability. Results using interest rates paid on deposits

are available in Tables 6 and 7, respectively. In the first period, the only variables statistically significant, and with an appropriate theoretical sign, were: current liquidity, working capital and profitability on equity. As expected, the risk indicators presented contrary signs than those presented for deposits.

Table 6. Response of interest rates paid on deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	1998:1 to 2004:1 Between	Within	Random T.	1994:2 to 2004:1 Between
Lag (non-earning assets)	0.1740 (0.3709)	0.1587 (0.9407)	-0.0665 (-1.4770)	-0.0110 (-0.3429)	0.1140 (0.1816)	0.0557 (1.2991)
Lag (interbanking dependence)	1.1496 (1.1436)	-0.1608 (-0.5574)	0.0643 (1.0511)	0.2062* (2.9625)	1.2230 (1.6275)	0.0279 (0.1830)
Lag (working capital)	-0.0877 (-0.2003)	0.1520 (1.0013)	-0.0648 (-1.4508)	-0.0117 (-0.3639)	0.0702 (0.1127)	0.0532 (1.2436)
Lag (current liquidity)	-0.1762 (-1.5355)	0.0240 (0.4993)	0.0313 (1.2196)	0.0143 (0.9307)	-0.1642 (-1.4918)	-0.0468 (-1.2751)
Lag (provisioning)	-2.2506 (-1.5318)	0.4781 (1.2213)	0.3909** (2.0281)	0.0978 (1.9236)	-2.1097 (-1.7489)	0.1304 (1.1704)

Table 6 (cont.). Response of interest rates paid on deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	1998:1 to 2004:1 Between	Within	Random T.	1994:2 to 2004:1 Between
Lag (returns/assets)	-0.0092 (-0.8045)	0.0059 (0.8356)	0.0054* (2.8956)	0.0007** (2.4608)	0.0036 (0.8855)	-0.0011 (-0.9976)
Lag (operational costs)	0.4514 (0.6374)	-0.3699 (-0.3492)	-0.0844 (-0.5117)	-0.0650 (-0.7791)	1.1491 (1.6592)	-0.2641 (-1.4656)
Lag (capital/assets)	1.5288 (1.2776)	-1.6552 (-1.3569)	-0.0832 (-0.6118)	-0.1293** (-2.4861)	0.4407 (0.8817)	0.1147 (0.4926)
Log (deflated assets)	-0.9918 (-0.4449)	-24.6394 (-0.8986)	-1.6088* (-3.4831)	4.7899 (1.8188)	0.4407 (0.8817)	-8.2363 (-1.0531)
Government control (dummy)		7.2287 (0.2561)		-1.5106 (-0.4759)		0.6732 (0.1631)
Adjusted R <sup>2</sup>	0.0491	0.1157	0.1342	0.2811	0.0407	0.1056
F-test fixed effects		1.3321*		3.4791*		1.6506*
F-test time effects		1.7467***		16.4152*		2.7543*
F-test joint effects (fixed and time)		1.5364*		4.3709*		2.2776*
F-test fundamentals	1.9987**	2.1794*	3.5327*	3.4374*	1.8623	2.8336*
Hausman cross-section effects		26.9158*		24.9762*		32.2315*
Hausman time effects				30.3744*		149.3596*
Number of banks	175	174	148	147	184	184
Number of observations	175	1043	148	1636	184	2679

Notes: This table shows the regression results of interest rates paid on deposits on bank risk characteristics. Between and within estimators (fixed effects) are reported. Estimators for time dummies, fixed effects and the constant term are not reported in the table, even though they are included in the regressions. T-statistics are in parentheses. Robust standard errors using the White correction for heteroskedasticity are obtained. F-tests for fixed effects, time effects and bank fundamentals test the null hypothesis that the corresponding group of variables is equal to zero. The \*\*\*, \*\* and \* stand for statistical significance at the 1%, 5% and 10% level, respectively.

Table 7. Response of growth in interest rates paid on deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	Random CS	1998:1 to 2004:1 Within	Within	1994:2 to 2004:1 Between	Within
Lag (non-earning assets)	-0.3981 (0.3709)	-0.7927** (-2.3420)	-0.5550*** (-1.8218)	-0.0051 (-1.4770)	0.0821** (2.0560)	0.0789 (0.4334)	-0.0892 (-1.1467)
Lag (interbanking dependence)	1.4603 (1.1436)	0.3515 (0.4862)	0.6314 (0.7794)	-0.0411 (1.0511)	-0.0044 (-0.0567)	0.1801 (0.4205)	0.3330 (0.8651)
Lag (working capital)	0.2437 (-0.2003)	-0.4690*** (-1.6597)	-0.1766 (-1.6268)	-0.0037 (-1.4508)	0.0840** (2.1040)	0.1582 (0.8387)	-0.0753 (-0.9825)
Lag (current liquidity)	0.4496 (-1.5355)	0.0955 (0.7465)	0.3773*** (1.6673)	-0.0023 (1.2196)	-0.0350*** (-1.7558)	0.2638*** (1.7078)	0.1694 (1.6352)
Lag (provisioning)	3.5181 (-1.5318)	0.4733 (0.6284)	1.6191 (1.5894)	0.1700** (2.0281)	-0.1492 (-1.5271)	1.4299*** (1.7561)	0.1245 (0.5348)
Lag (returns/assets)	0.0378 (-0.8045)	0.0109 (0.6216)	0.0330*** (1.7362)	0.0015* (2.8956)	0.0011* (3.1921)	0.0046 (0.6009)	0.0085** (2.5323)
Lag (operational costs)	1.2103 (0.6374)	-1.0208 (-0.3980)	0.1367 (0.2557)	-0.0788 (-0.5117)	-0.1746 (-1.6054)	-0.0500 (-0.0647)	-0.0630 (-0.1824)
Lag (capital/assets)	-4.1875 (1.2776)	-1.0669 (-0.3541)	-5.1218*** (-1.8406)	0.0028 (-0.6118)	-0.1862* (-2.8565)	-0.8985 (-1.2142)	-1.6826** (-2.3161)
Log (deflated assets)	4.4168 (-0.4449)	97.3601 (1.4670)	-8.5167 (-1.5855)	-0.3781* (-3.4831)	-5.7855*** (-1.9063)	-0.8985 (-1.2142)	31.4541 (1.6036)
Government control (dummy)		-70.5357 (-0.9028)	24.0616 (1.3979)		-4.5663 (-1.2187)		-15.2119 (-1.5837)
Adjusted R <sup>2</sup>	0.1026	0.1158	0.0371	0.0277	0.0478	0.0068	0.0606
F-test fixed effects		1.4353*	1.4353*		0.6526		1.4601*
F-test time effects		3.3304*	3.3304*		9.6567*		3.0250*
F-test joint effects (fixed and time)		1.4646*	1.4646*		1.2910**		1.5764*

Table 7 (cont.). Response of growth in interest rates paid on deposits on bank risk characteristics

Explanatory variables	1994:2 to 1997:2 Between	Within	Random CS	1998:1 to 2004:1 Within	Within	1994:2 to 2004:1 Between	Within
F-test fundamentals	3.1983	0.8584	1.7057***	1.4614	4.4088*	1.1387	1.5372
Hausman cross-section effects		12.4747	12.4747		54.8364*		26.4229*
Hausman time effects					32.3020*		41.3215*
Number of banks	174	174	174	147	147	184	184
Number of observations	174	1043	1043	147	1636	184	2679

Notes: This table shows the regression results of the growth of interest rates paid on deposits on bank risk characteristics. Between and within estimators (fixed effects) are reported. Estimators for time dummies, fixed effects and the constant term are not reported in the table, even though they are included in the regressions. T-statistics are in parentheses. Robust standard errors using the White correction for heteroskedasticity are obtained. F-tests for fixed effects, time effects and bank fundamentals test the null hypothesis that the corresponding group of variables is equal to zero. Random CS stands for Random cross section. The \*\*\*, \*\* and \* stand for statistical significance at the 1%, 5% and 10% level, respectively.

In the second period, interbanking dependence, provisioning and capital/assets ratio were statistically significant. Additionally, the variable of size control also demonstrated significance, showing that larger banks tend to pay lower funding rates.

An explanation for the higher manifestation of market discipline using prices, during the most recent period (1998 to 2004), is the fact that in periods of superior stability, less failures occur. Besides, given the high costs of fund migrating between banks, depositors are likely to charge higher risk premiums from risky institutions without, necessarily, migrating their funds between them.

The governmental control variable doesn't seem to be taken under consideration by depositors when making decisions regarding interest rates, not in any of both periods. The remaining variables didn't have statistically satisfactory results.

The evidence of market discipline using prices means that there isn't just regulatory market discipline (deposit adjustment) but also that depositors demand higher risk premiums if bank fundamentals suggest a larger default probability.

*3.4.3. General evaluation of results.* In general, and according to the performed estimations, it is possible to conclude that market discipline does exist in Brazil. However, it manifested more strongly using quantity and in periods of crisis, in which a more disciplinarian behavior from depositors is expected. In periods of higher stability, market discipline manifests more strongly using prices.

Most of the variables representing fundamentals that reflect the level of risk assumed by institutions, demonstrated an influence over deposits. However, there is still space for an increase in transparency and a larger risk-monitoring attitude by depositors.

During the first period, the variables of liquidity and capital adequacy were the main focus of depositors in both price and quantity analysis. The

significance of time effects demonstrated that, like other studies performed in emerging markets, macroeconomic and systemic factors affect depositor's decisions. It has also been identified that banks have specific characteristics (fixed effects) that explain the behavior of depositors. This aspect must be taken under consideration in the analysis performed by the regulator and by the market of risk premiums paid by banks, which may incorporate not only risk related to the institution, but also systemic risk.

It is important to keep in mind that some of these results may have been, in some way, influenced by the limitation of information, already point out, such as the lack of funding rates per product, level of time deposits, non-opening for secured and non-secured deposits and a level of deposit analysis. The analysis of deposits with larger volume, for example, would allow finding market discipline in a more significant way, considering that it is expected that more specialized investors monitor bank risk more efficiently.

The influence of state banks was only identified during the period of stability. Nevertheless, size demonstrated to be a relevant variable in decision-making, which includes, then, the large state banks. Although specific tests regarding secured and non-secured deposits weren't performed, it is possible to affirm, despite the existence of deposit insurance, that there was manifestation of depositors in relation to the risk of financial institutions.

## Conclusions

This study tested the existence of market discipline in the Brazilian banking sector during the period of 1994 to 2004. The intention was to prove if Brazilian depositors capture the risk of banking institutions and incorporate this information in their decisions. The specification assumes that the volume of deposits of a bank is a function of an institution's risk, individual characteristics and macroeconomic and systemic conditions. Accounting measures of risk were employed to represent the five dimensions of the institution's financial condition: profitability, capital adequacy, liquidity, management efficiency and asset quality.

Considering the period of crisis and restructuring of the banking sector, since Plano Real, the model was estimated for both periods in order to capture the behavior of depositors during crisis periods, and prove if in the post-crisis period market discipline is intensified by the necessity of monitoring institutions more carefully, to avoid new losses.

The first result verified the existence of market discipline in Brazil, using prices and quantity. However, the strongest evidence of market discipline was found using quantity and during the crisis period. The existence of market discipline, using quantity, proved that depositors punished risky banks by withdrawing their deposits during the crisis period.

The most significant variables were those that represented the liquidity and capital adequacy dimensions. Market discipline using prices was, in general, weakly verified, manifesting more strongly in the second period (1998-2004).

The analysis demonstrated that time effects, and the variables regarding macroeconomic and systemic effects, are relevant to the explanation of the behavior of deposits and rates. This means that markets respond to a larger number of risk, than just those directly related with an institution's risk, which in developing countries are highly connected to macroeconomic and institutional conditions.

Other aspect analyzed was the behavior of depositors in relation to state banks and bank size. It was proven that the institution's size is important in the depositor's decision of allocating resources. The result agreed with the "too big too fail" hypothesis, meaning that Brazilian depositors believe that large banks are safe, or that the government wouldn't allow their failure. Governmental intervention was verified in 1995 when the government promoted a restructuring plan (PROER) with special lines of liquidity for banks with financial difficulties.

## References

1. Ashcraft, A. (2008). Does the market discipline banks? New evidence from regulatory capital mix, *Journal of Financial Intermediation*, 17(4), 543-561.
2. Baer, W., and Nazmi, N. (2000). Privatization and restructuring of banks in Brazil, *Quarterly Review of Economics and Finance*, 40, 3-24.
3. Beck, T., Crivelli, J.M., and Summerhill, W. (2005). State bank transformation in Brazil – choices and consequences, *Journal of Banking and Finance*, 29, 2223-2257.
4. BCB (Banco Central do Brasil), 2003. Annual Report.
5. Berger, A. N., Davie, S.M., and Flannery, M. J. (2000). Comparing Market and Supervisory Assessments of Bank Performance: Who Knows What and When? *Journal of Money, Credit and Banking*, 32, 641-667.
6. Basel (Basel Committee On Banking Supervision), 2003. Markets for Bank Subordinated Debt and Equity in Basel Committee Member Countries, Working Paper 12.
7. Basel (Basel Committee on Banking Supervision), 2000. A New Capital Adequacy Framework: Pillar 3, Market

State participation is a characteristic of emerging countries and is capable of affecting market discipline, since depositors tend to believe that the government implicitly secures them. However, the elevated state participation in the banking industry until the end of 1997 wasn't significant in depositor's decisions. Governmental control was only important to explain the behavior of depositors during the period of stability, in which most of the public banks were privatized, restructured or federalized.

The importance of market discipline to complement the minimal required capital (first pillar) and the supervision process (third pillar), and the fact that this study diagnosed the diminishing of market discipline in the most recent period, some measures must be implemented by the regulator to increase information transparency and incentive the manifestation of market discipline, such as: increase the availability of information (today, quarterly); publication of more performance indicators in a resumed form; implementation of a common indicator of performance (such as CAMEL) which would contemplate, besides accounting indicators, the *in loco* evaluations done by the regulator and, finally, increase the publication of bank ratings by private agencies.

Market discipline is crucial for the sound and safety development of banking systems. Besides there is a need for the increase of financial literacy from market players. This could be achieved by programs that incentive financial education for the general population. Easier said than done this should be an important trend and objective in the future that could be pursued by the government to help market players avoid mistakes in financial decisions.

## Acknowledgements

The opinions expressed in this paper are those of the authors and do not necessarily reflect those of their respective institutions. Benjamin M. Tabak gratefully acknowledges financial support from CNPQ Foundation.

The authors thank an anonymous reviewer for helpful comments, which have helped improve the paper.

- Discipline, Consultative Paper 65.
8. Barajas, A., and Steiner, R. (2000). Depositor Behavior and Market Discipline in Colombia, IMF Working Paper 214.
  9. Bundevidich, C. L., and Franken, H. M. (2003). Disciplina de mercado en la conducta de los depositantes y rol de las agencias clasificadoras de riesgo: el caso de Chile, *Economia Chilena*, 6, 45-70.
  10. Calomiris, C. (1997). The postmodern bank safety net: lessons from developed and developing economies. The American Enterprise Institute Press, Washington DC.
  11. Cajueiro, D., and Tabak, B. (2008). The role of banks in the Brazilian interbank market: does bank type matter? *Physica A: Statistical Mechanics and its Applications*, 27, 6825-6836.
  12. Cajueiro, D., Tabak, B., and Andrade, R. (2009). Fluctuations in interbank network dynamics, *Physical Review. E, Statistical, Nonlinear, and Soft Matter Physics (Print)* 79, id. 037101.
  13. Davenport, A., and K. McDill (2006). The Depositor Behind the Discipline: a Micro-Level Case Study of Hamilton Bank, *Journal of Financial Services Research*, 30(1), 93-109.
  14. De Jonghe, O. (2010). Back to the basics in banking? A Micro-Analysis of Banking System Stability, *Journal of Financial Intermediation*, 19(3), 387-417.
  15. Demirguc-Kunt, A., and Huizinga, H. (2004). Market discipline and deposit insurance, *Journal of Monetary Economics*, 51, 375-399.
  16. Demirguc-Kunt, A., Kane, E. (2002). Deposit insurance around the globe: where does it works? *Journal of Economic Perspectives*, 16, 175-195.
  17. Ellis, D.M., and Flannery, M.J. (1992). Does the Debt Market Assess Large Banks Risk? *Journal of Monetary Economics*, 30, 481-502.
  18. Flannery, M.J. (1998). Using market information in prudential bank supervision: a review of the U.S. empirical evidence, *Journal of Money, Credit, and Banking*, 30, 273-305.
  19. Flannery, M.J., and Sorescu, S. (1996). Evidence of Bank Market Discipline in Subordinated Debentures Yields: 1983-1991, *The Journal of Finance*, 51, 1347-1377.
  20. Gatev, E., T. Schuermann, and P.E. Strahan (2009). Managing Bank Liquidity Risk: How Deposit-Loan Synergies Vary with Market Conditions, *Review of Financial Studies*, 22(3), 995-1020.
  21. Goyal, V.K. (2005). Market discipline of bank risk: evidence from subordinated debt contracts, *Journal of Financial Intermediation*, 14, 318-350.
  22. Hancock, D., and Kwast, M.L. (2001). Using Subordinated Debt to monitor Bank Holding Companies: is it Feasible? *Journal of Financial Services Research*, 20, 147-87.
  23. Herring, R.J. (2004). The subordinated debt alternative to Basel II, *Journal of Financial Stability*, 1, 137-155.
  24. Hess, K., and Feng, G. (2006). Is there market discipline for New Zealand non-bank financial institutions? *Journal of International Financial Markets, Institutions and Money* Forthcoming.
  25. Hoggarth, G., Reis, R. and Saporta, V. (2002). Costs of banking system instability: some empirical evidence, *Journal of Banking and Finance*, 26, 825-855.
  26. Hoggarth, G., Jackson, P. and Nier, E. (2005). Banking crises and the design of safety nets, *Journal of Banking and Finance*, 29, 143-159.
  27. Lundberg, E. (1999). Rede de protecao e saneamento do sistema bancario. In Saddi, J. (ed). *Intervencoes e Liquidacoes no SFN: 25 anos da lei 6.024*, Sao Paulo: Textonovo.
  28. Martinez-Peria, M., and Munoz, E. (2002). Existe disciplina de mercado en el sistema bancario costarricense? Working Paper of Division Economica, Departamento de Investigaciones Economicas, Banco Central de Costa Rica.
  29. Martinez-Peria, M. S., and Schmukler, S. (2001). Do Depositors Punish Banks For "Bad" Behavior? Market discipline, Deposit Insurance and Banking Crises, *Journal of Finance*, 56, 1029-51.
  30. Nakane, M.I., and Weintraub, D.B. (2005). Bank privatization and productivity: evidence for Brazil, *Journal of Banking and Finance*, 29, 2259-2289.
  31. Ness, W.L. (2000). Reducing government bank presence in the Brazilian financial system - why and how, *Quarterly Review of Economics and Finance*, 40, 71-84.
  32. Nivorozhkin, E. (2005). Market discipline of subordinated debt in banking: the case of costly bankruptcy, *European Journal of Operational Research*, 161, 364-376.
  33. Park, S., and Peristiani, S. (1998). Market discipline by thrift depositors, *Journal of Money, Credit and Banking*, 30, 497-514.
  34. Rivera, G., and Nickerson, D. (2003). Monitoring Financial Intermediaries with Subordinated Debt: a Dynamic Signal Model for Bank Risk, AFA Washington, DC Meetings.
  35. Rocha, F.A.S. (2001). Evolucao da Concentracao Bancaria no Brasil (1994-2000), Technical Notes of the Central Bank of Brazil, 11 November.
  36. Salviano Junior, C. (2004). Bancos Estaduais: dos problemas crônicos ao PROES, Sao Paulo: Banco Central do Brasil.
  37. Santos, J.A.C. (2004). Do markets "discipline" all banks equally? SSRN Working Paper.
  38. Sironi, A. (2001). Testing for Market Discipline in the European Banking Industry: Evidence from Subordinated Debt Issues.
  39. Federal Reserve Bank of Chicago, Proceedings, May, 366-384.
  40. Tabak, B., Serra, T, Cajueiro, D.O. Topological properties of bank networks: the case of Brazil, *International Journal of Modern Physics, C*, V. 20, p. 1121-1143, 2009.



41. Tarullo D.K. (2008). *Banking on Basel – The Future of International Financial Regulation*, Peterson Institute for International Economics: Washington DC.
42. Van Hoose, D. (2007). *Market Discipline and Supervisory Discretion in Banking*.
43. *Reinforcing or Conflicting Pillars of Basel II?* Networks Financial Institute, Indiana State University, Working Paper 06.
44. Yeyati-Levy, E., Martinez-Peria, S., and Schmukler, S.L., (2004). *Market Discipline in Emerging Economies: Beyond Bank Fundamentals*, *Working Paper 1*, University Torcuato Di Tella.