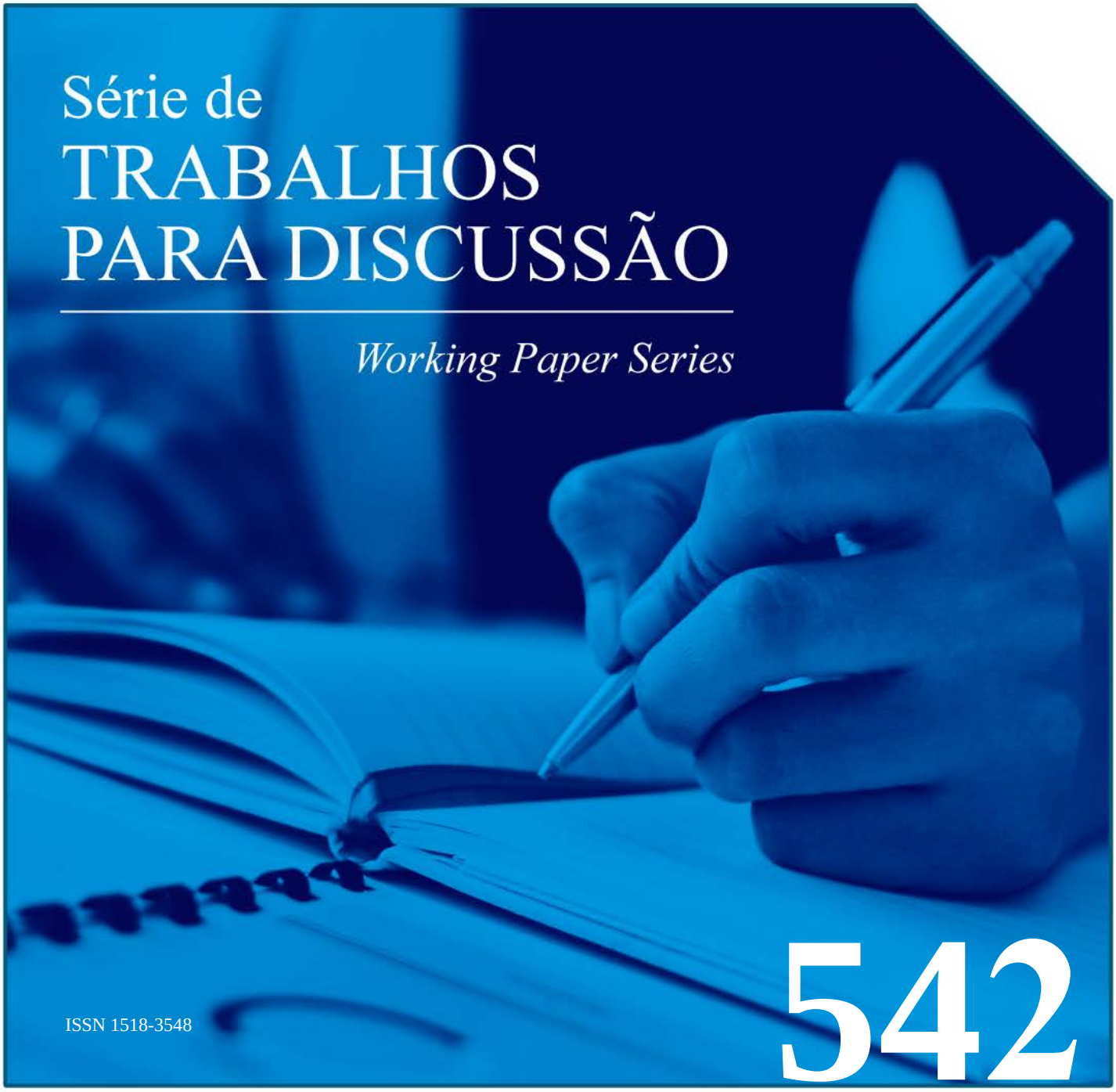

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Deposit insurance and brokerage firms: impacts on the market discipline of the Brazilian banking industry

Marília Pinheiro Ohlson, Gerlando Augusto Sampaio Franco de Lima, Tony Takeda

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Non-Technical Summary

Market discipline can be defined as the influence exercised by market participants on financial institutions' behavior. In the deposit market, the discipline occurs when the depositors demand higher interest rates the higher the bank risk (interest rate), deposit in shorter terms in riskier banks (maturity) or withdraw their deposits from these institutions (deposit growth). These three movements (interest rate, maturity, and deposit growth) are described in the literature as the mechanisms of market discipline.

Institutional and macroeconomic factors, however, can influence market discipline. One such factor is deposit insurance. Depositors would be less willing to exercise discipline if they were guaranteed to receive their funds in case of an institution bankruptcy.

This study empirically evaluated the phenomenon of market discipline in Brazil, and the impact of both the increase in deposit insurance coverage occurred in 2013 and the growth in the performance of brokerage firms intermediating bank deposits through electronic platforms (*fintechs*) on the market discipline.

Results showed there is evidence of market discipline through the mechanisms of interest rate and maturity, with the size of banks and their capitalization being the main disciplinary factors. Deposit insurance reduced market discipline for both mechanisms, while intermediaries' performance reduced the size and capitalization advantages. The results did not indicate the existence of market discipline through the deposit growth mechanism. The performance of brokerage firms also reduced the size and capitalization advantages for this mechanism. This result suggests an increase in the competitiveness of small and medium-sized banks in the deposit market. However, significant indicators in the market discipline literature related to the banks' credit portfolio were not relevant, indicating that the discipline can be reinforced.

The study contributes to understanding Brazil's market discipline issues, since the disciplinary role of depositors is considered complementary to government supervision. In addition, it contributes to the assessment of future impacts of deposit insurance coverage changes, the performance of new financial intermediaries and new technologies.

Sumário Não Técnico

A disciplina de mercado pode ser definida como a influência exercida pelos participantes de um mercado sobre o comportamento das instituições financeiras. No mercado de depósitos bancários, a disciplina ocorre quando os depositantes exigem taxas de juros mais altas quanto maior o risco do banco (custo de captação), depositam em prazos mais curtos em bancos mais arriscados (maturidade) ou retiram seus depósitos dessas instituições (quantidade). Esses três movimentos (custo de captação, maturidade e quantidade) são descritos na literatura como os mecanismos de disciplina de mercado.

Fatores institucionais e macroeconômicos, entretanto, podem influenciar a disciplina. Um desses fatores é o seguro de depósitos. Tendo a garantia de recebimento de seus recursos em caso de quebra de uma instituição, os depositantes estariam menos dispostos a exercer a disciplina.

Este estudo avaliou empiricamente o fenômeno da disciplina de mercado no Brasil e os impactos, sobre a disciplina, do aumento de cobertura do seguro de depósitos ocorrido em 2013 e do crescimento da atuação das corretoras de valores intermediando a captação de depósitos bancários por meio de plataformas eletrônicas (*fintechs*).

Os resultados mostraram que há indícios de disciplina de mercado por meio dos mecanismos do custo de captação e da maturidade, sendo o porte dos bancos e sua capitalização os principais fatores disciplinadores. O seguro de depósitos reduziu a disciplina de mercado para ambos os mecanismos, enquanto a atuação dos intermediários reduziu as vantagens de porte e de capitalização. Os resultados não apontaram a existência da disciplina de mercado pelo mecanismo da quantidade. A atuação das corretoras também reduziu as vantagens de porte e de capitalização para esse mecanismo. Esse resultado sugere um incremento na competitividade dos bancos pequenos e médios no mercado de captação. Entretanto, indicadores significantes na literatura de disciplina de mercado relacionados à carteira de crédito dos bancos não se mostraram relevantes no mercado brasileiro, indicando que a disciplina pode ser reforçada.

O estudo contribui para a compreensão de questões de disciplina de mercado no Brasil, uma vez que a atuação dos depositantes é considerada complementar à supervisão governamental. Além disso, contribui para a avaliação de futuros impactos de alterações na cobertura do seguro de depósitos, da atuação de novos intermediários financeiros e de novas tecnologias.

Deposit insurance and brokerage firms: impacts on the market discipline of the Brazilian banking industry

Marília Pinheiro Ohlson[1]

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Tony Takeda

Abstract

This study seeks to assess the phenomenon of market discipline in Brazil and analyze whether the increase in deposit insurance coverage in 2013 and the role of brokerage firms in the funding market changed this discipline. The database includes accounting information of Brazilian banks from 2010 to 2017. We calculated the parameters using the Systemic Generalized Method of Moments (GMM-Sys). We found evidence of market discipline through interest rate and maturity of deposits, with the size of banks and their capitalization being the main disciplining factors. Deposit insurance has reduced market discipline for both interest rate and maturity mechanisms, while brokerage firms have reduced the size and capitalization advantages of banks. The results did not indicate the existence of market discipline through the quantity mechanism and deposit insurance did not change this scenario. Brokerage firms also reduced the size and capitalization advantages on this mechanism. However, significant indicators in the market discipline literature, mainly related to banks' credit portfolios, were not relevant in the Brazilian market, indicating discipline might be reinforced. The results were similar in the analysis excluding "too-big-to-fail" banks, with slightly higher parameters, indicating the discipline is stronger for smaller banks.

Keywords: Market Discipline. Banking supervision. Financial intermediation. Deposit insurance. Brokerage Firms

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1. INTRODUCTION

In the banking context, market discipline can be defined, according to De Ceuster and Masschelein (2003), as "a regulatory mechanism that delegates the task of monitoring and disciplining (banks) not only to national and international regulators, but also to market participants whose wealth is affected by the conduct of banks." The market's actions, therefore, help to monitor the risk taking of banks and, based on this monitoring, impose penalties or offer rewards, through its own mechanisms. The mechanisms of market discipline referenced in the literature—that is, the ways in which depositors can "punish" or "reward" banks—are usually three (Tovar-García, 2016; Aysan, Disli, Duygun, & Ozturk, 2017): one, the interest rate (depositors will demand higher interest rates of riskier banks); two, deposit growth (represented by the flow of deposits; in increased risk, depositors tend to withdraw their resources); and three, maturity (less common in the literature; reflects the term of deposits, with depositors more willing to keep their resources in the institution for longer periods when there is a lower risk).

Market discipline phenomenon, however, is not static. Institutional and macroeconomic factors can influence the capacity and incentives of depositors to monitor the bank risks and respond to them (Levy-Yeyati, Martinez-Pería and Schmukler, 2004). Among these factors, the presence of guarantees, through deposit insurance, has been explored in the literature in relation to its impact on the market discipline. Deposit insurances are structures created to guarantee the payment of deposits in case a bank defaults, and is commonly related in literature with the phenomenon of market discipline (Hassan, Karels & Peterson, 1994; Mondschean & Opiela, 1999; Martinez-Pería & Schmukler, 2001; Bartholdy, Boyle & Stover, 2003; Carapella & Di Giorgio, 2004; Demirguç-Kuhn & Huizinga, 2004; Opiela, 2004; Imai, 2006; Ioannidou & De Dreu, 2006; Karas, Pyle & Schoors, 2013; Berger & Turk-Ariss, 2015; Aysan et al., 2017), because the existence of this insurance may lead to a weakening of discipline by reducing the amount of deposits subject to default risk.

In Brazil, deposit insurance is carried out through the "Fundo Garantidor de Créditos" (Creditor Guarantee Fund - FGC), a private nonprofit civil society association, established in 1995, with the main purpose of protecting depositors and investors up to a limit established by regulation. In May 2013, Brazilian deposit insurance coverage increased from R$ 70.000 to R$ 250.000, an amount that continues until the current date. According to Central Bank of Brazil (2013), this change aimed to increase the security of depositors and align the value to the ones established in similar economies. This alteration

caused a greater number of depositors to be protected from banks' credit risks. In December 2013, according FGC, 99,69% of the depositors were covered.

Parallel to the increase made in 2013, and possibly driven by it, a new movement in the Brazilian deposit market emerged. The emergence of brokerage firms using sophisticated financial technology (*fintechs*) to mediate deposits for small and medium banks became more intense. Through the Internet and apps, these firms began to offer deposits from various institutions that they had not previously captured in the retail market. Thus, investors were able to distribute their deposits through a single registration with the brokerage firm, keeping within the limit of FGC coverage for each one of them. Both brokerage firms and small and medium banks used the deposit insurance as a selling point to attract depositors.

This movement is in line with what Shy, Stenbacka and Yankov (2016) and Mondschean and Opiela (1999) have pointed out: when different deposit insurance coverage structures state the limited coverage for each financial institution, but without global limit, clients are induced to distribute their deposits in various institutions, seeking maximum coverage. The new financial intermediation structure of the Brazilian market allowed a similar movement.

The study's proposal, therefore, is to analyze possible changes in market discipline after the increase in deposit insurance coverage and the growth of brokerage firms in the deposit market.

It is expected that both the increase in deposit insurance coverage and the brokerage firms' practice will reduce market discipline in Brazil. On the one hand, more deposits became covered by insurance, and on the other, even informed depositors were able to more easily divide their deposits into several institutions and remain covered by insurance.

The Brazilian funding market, therefore, has presented an interesting dynamic in recent years, with small depositors migrating to smaller institutions. This makes the Brazilian funding market in this period, with relevant changes in the deposit distribution dynamics, a pertinent study object, contributing to the expansive literature on the influence of deposit insurance and of market structure in the discipline.

Macey and Garrett (1988), Basel Committee on Banking Supervision (1998), De Ceuster and Masschelein (2003), Tsatsaronis (2004), Caprio and Honohan (2004), International Association of Deposit Insurers (2014), and Bliss and Flanery, 2002) emphasize transparency and adequate accounting principles as fundamental factors for

market discipline. With adequate and timely information on banks, market participants could assess the risks of these institutions and, based on their analysis, decide where to allocate their resources. This relationship between market discipline and disclosure of information emphasizes the importance of the role of accounting in this process. Considering that, market discipline is a form of *value relevance* of the accounting information, because it relates this information with market parameters, such as interest rate, maturity, and deposit growth.

Mishkin (1990) points out that one of the main concerns of central banks is to prevent bank crises. With deposit insurance and bank regulation linked to bankroll prevention (Calomiris & Gordon, 1990), the search for an optimal deposit insurance structure that protects the majority of depositors but allows a significant portion of the deposits to be subjected to risk so that market discipline is carried out (IADI, 2014) is a government concern linked to financial stability. In assessing whether changes in deposit insurance coverage and additional market movements changed market discipline, this study contributes to the assessment of the impact of such measures.

In addition, knowing the market discipline can impact the time and energy spent in supervisory matters. Martinez-Peria and Schmukler (2001), Bliss (2004), and Rochet (2004) argue that banking supervisors can rely on market discipline to monitor banks, reducing the social cost related to supervision activity. Rochet (2004) points out that market discipline would be useful for banking supervisors to control an increasingly sophisticated, globalized, and complex market. Our study may also contribute to future emphasis on supervisory matters and on the restructuring of deposit insurance in Brazil and in other countries.

Our study also extends the analysis of influential market discipline factors currently addressed in the literature by including the presence of a new financial intermediary in the analysis.

Through the GMM-Sys methodology, covering data from Brazilian banks from 2010 to 2017, we identified that the market discipline is present in Brazil, most strongly through interest rate and maturity mechanisms. The size factor and the capitalization of banks were the main risk indicators used by depositors to discipline banks. Both the increase in insurance coverage and the performance of brokerage firms reduced market discipline, reducing the advantage of large banks to raise more funds and at a lower interest rate.

This work contains four more sections. In the next section, we present a literature review on market discipline and its relationship with deposit insurance. The following two sections describe the collection and analysis of data and discuss the results. Finally, we provide summary and conclusion in the final section.

2. LITERATURE REVIEW

2.1. Market discipline

Tastsaronis (2004) defines market discipline as "the influence that 'external agents' (stakeholders without executive decision-making power) exert on 'internal agents' (the decision-makers of an economic unit) to encourage behaviors aimed at increasing the value of the latter." According to the literature, participants with the potential to exercise market discipline are those depositors or holders of debt securities not covered by external guarantees. By assuming risk of loss in the event of default, those depositors would have the incentive to monitor the activities of banks and charge a risk premium for their deposits.

For this reason, it is stated that market discipline can only be effective in an adequate "incentive system," which occurs when depositors suffer losses when a financial institution defaults. Blanket guarantee, for example, nearly eliminates the incentive for depositors to monitor the risk of institutions, and search only for the highest return, since the risk of default is minimized. Cubillas, Fonseca, and González (2012), Macey and Garrett (1988), and Caprio and Honohan (2004) point out that government bailouts to financial institutions at crisis events can also reduce this incentive, as it could create the expectation of future bailouts. Government deposits and relief insurance illustrate forms of "safety nets" often built around the financial sector. Karas et al. (2013) emphasize that while these safety nets have the capacity to prevent bank crises, they often weaken other forces that could contribute to financial stability, such as market discipline.

The Bank of International Settlements - BIS (2011) encourages market discipline through the Basel Committee on Banking Supervision (BCBS), which holds that bank resolution regimes in its member countries should predict losses to shareholders, holders of subordinated securities, and other shareholders. By imposing this penalty in case of default, the BCBS seeks to encourage the various counterparties of financial institutions to also act as auditors. Mendonça and Loures (2009) state that the Basel Accord "places market discipline at the same level of government oversight." Cubillas et al. (2012) reinforced the view that market discipline joins the oversight and capital requirements

brought about by the Basel Accord to increase the stability of the financial system. In addition, Demirguç-Kunt and Huizinga (2004) affirm that market discipline and banking supervision are the existing mechanisms that can restrict excessive risk taking by financial institutions.

Bliss (2004) points out that market discipline is based on the principal agent conflict inherent in the separation between those responsible for the governance of banks (management) and capital providers, including shareholders, debt holders, and depositors. According to the author, market discipline would be part of the solution to such a conflict. Tsatsaronis (2004) argues that accounting information, provided through quality regulatory reports, would be the way in which external stakeholders could make decisions based on the risk of entities and, exercising market discipline, influence internal agents to act in the interests of the former.

An efficient market discipline can also reduce the social cost represented by government banking supervision activity. Flannery (1998) highlights that market discipline has a greater chance of providing timely information about financial institutions over traditional government oversight. Caprio and Honohan (2004) and Rochet (2004) point out that this rapid response to interest rates and deposit flows can be used by government oversight to guide its actions. Hamalainen (2006) summarizes that these benefits derive from the fact that the market would be a large, anonymous, multi-stakeholder entity, less subject to lobbying. Macey and Garrett (1988) comment that, unlike the prudential rules applied to financial institutions, which are normally uniform to all of them, the market discipline would have the capacity to reach each bank individually, according to its level of risk—and would therefore be more specific.

Empirical studies have addressed market discipline in various contexts. Cubillas et al. (2012) state that most of the work has been devoted to studying market discipline in a specific country in a given period of time. Crises and changes in deposit insurance are also exploited as natural experiments to verify changes in market discipline. Karas et al. (2013) associate economic crises with market discipline, pointing out that crisis would warn depositors of the possibility of losses, causing a *wake-up call* effect.

Still within the context of economic crises, Balasubramnian and Cyree (2014) analyzed market discipline before and after the approval of the Dodd-Frank Act in the American market. Based on secondary market trading of subordinated debt, the authors concluded that, after the law, the discount rate based on bank size declined by 47% and the discount rate of too-big-to-fail banks declined by 94%. This demonstrates that the

measure led to an increase in market discipline. Bennet, Hwa, and Kwast (2016) examined market discipline during the sub-prime crisis of the United States from 2008 to 2010 and concluded that discipline beginning before bank or regulatory action signals that corrective actions should be taken.

Empirical evidence, however, shows market discipline may be affected by other external factors. Hasan, Jackowicz, Kowaliwski, and Kozlowski (2013) examined the central bank market discipline in Central Europe, dominated by subsidiaries of foreign banks. In this scenario, banks' parent companies were often worse off than their subsidiaries. The authors concluded that, based on a study with banks operating in 11 Central European countries, deposit growth variables are more related to facts and press rumors than to institution risk factors (which means market discipline has been weakened). Hou, Gao, and Wang (2016) verified that the informational power of the Internet changed the market discipline in China.

Little research on market discipline has been carried out in the Brazilian market. Oliveira (2007) analyzed the presence of the market discipline in Brazil exercised by depositors through interest rates and deposit growth mechanisms, based on a sample of 54 banks from 1999 to 2006, and concluded there is some evidence of the existence of market discipline, but also that depositors behave in a manner consistent with the existence of a policy to save big and state-owned banks. For this reason, the author claimed it is impossible to state unequivocally there was an active market discipline during that period.

Mendonça and Loures (2009) evaluated the presence of the market discipline in Brazil, using as proxy the subordinated debt interest rates. They concluded the market discipline is weak because the tests showed the macroeconomic environment has a relevant influence on the interest rates charged.

It can be seen, therefore, that market discipline is a consolidated phenomenon in the literature of financial intermediation; however, evidence shows external factors such as economic crises, norms, and market structure itself can influence this mechanism of control exercised by market participants.

2.2. Market discipline and deposit insurance

Allen, Carletti, and Leonello (2011) point out deposit insurance emerged as a balancing device to avoid bank runs, because with a guarantee of repayment, depositors would not have the incentive to withdraw their resources prematurely if a bank suffers

financial difficulties. According to Miller (2011), bank runs occur because the financial system, unlike other sectors of the economy, is more subject to the panic effect. According to the author, panic, in the financial context, would be "a condition in which people become prone to sell or buy at any price for fear that if they do not do so, they will be in a much worse situation in the future" (p. 22).

However, the existence of deposit insurance structures may lead to a weakening of market discipline (Santana, 2003) because, by reducing the amount of deposits subject to default risk, fewer participants would be willing to monitor the risk taken by financial institutions. Thus, deposit insurance would go against an incentive system for market discipline, as discussed earlier, increasing the instability it proposes to reduce (Angkinand & Wihlborg, 2010).

With part of their depositors protected by insurance and therefore unwilling to exercise market discipline, banks would have more incentives to take greater risks in their operations, because such a risk would not be "charged" by depositors through the mechanisms already treated (interest rates, deposit growth, and maturity). This phenomenon is called moral hazard and has been one of the main criticisms of deposit insurance. Leaven (2004) argues that moral hazard would be the main indirect cost of deposit insurance systems. Along this line, Macey and Garrett (1988) highlight that deposit insurance would be favorable to bank shareholders because it would reduce the limitation of the risk taking exercised by depositors, allowing the managers to invest in riskier projects that, by definition, have potentially greater returns. Anginer, Demirguc-Kunt, and Zhu (2014) point out that, while deposit insurance may favor the moral hazard effect, it also may increase the confidence of depositors and reduce the risk of bank races, contributing to financial stability. According to the authors, the negative aspect of deposit insurance, related to the increase in risk taking, can be minimized by a strong banking supervision structure.

The effect of deposit insurance on market discipline is not absolute. Martinez-Peria and Schmukler (2001) analyzed the interaction of market discipline, deposit insurance, and economic crises in Mexico, Chile, and Argentina. Analyzing deposit growth and interest rate variables in relation to representative bank risk variables, the authors mainly identified the following: first, depositors "punish" banks in these countries in relation to risk behavior, withdrawing deposits or charging higher interest rates; second, both large and small depositors discipline banks, because even if large ones have a higher value at risk, small deposits usually represent a high percentage of their wealth,

giving these incentives to the discipline of the market; and third, deposit insurance schemes do not necessarily reduce market discipline, demonstrating that they might be not fully credible (in the countries under review). These results contribute to presenting small depositors as agents of market discipline as well, in line with Flannery (1998), who points out that even small depositors have been able to distinguish risk factors of the banks.

Hadad et al. (2011), for example, explored financial crises and regulatory changes in Indonesia, including changes in deposit insurance coverage, and their relations to market discipline measured through the cost of deposits. The adoption of a blanket guarantee scheme as well as the reduction of coverage amidst a country recovering from a financial crisis reduced market discipline.

Carapella and Di Giorgio (2004) analyzed the effect of introducing explicit deposit insurance on the spread between credit and bank lending operations in 55 countries (including developed and developing countries), and concluded that this introduction increases the spread between borrowings and loans from banks. According to the authors, this increase in spread is related not to the reduction of the funding rate, but to the rates of credit operations, in line with the moral hazard effect widely documented in the literature.

The institution or change of deposit insurance is also associated with the follow-up of economic crises. Berger and Turk-Ariss (2015) argued that one of the reactions of governments in several American and European countries to the 2008 crisis was to expand insurance cover or to rescue institutions in difficulty. This paper is in line with Bucchi's (1992) indirect criticism that, as some deposit insurance structures arose after banking crises, the existence of deposit insurance would better protect the financial system than the depositor. Similarly, Hett and Schmidt (2018) identified that the bailout provided by the US government to institutions in response to the 2008 crisis weakened market discipline.

Anginer et al. (2014) analyzed banks' risk taking and the influence of deposit insurance in times of crisis and financial stability, concluding that the moral hazard represented by insurance is more prominent in times of economic stability, while the effect in times of crisis is significantly lower.

Imai (2006) analyzed the impact of Japan's deposit insurance reform in 2002 on funding costs. In general terms, the reform, aimed at increasing market discipline, reduced the amount of deposits insured in the country's financial system. As a result,

market discipline was, in fact, raised after the reform, as the sensitivity of deposit interest rates to specific risk factors strengthened.

In the Polish market, Mondschean and Opiela (1999) also analyzed the impact of a reform of the deposit insurance structure, which increased the coverage of deposits of private banks that previously were not covered. The study showed institutions' risk variables were less likely to explain differences in their interest rates, meaning that there was a reduction in market discipline.

Önder and Özyildirim (2008) analyzed the behavior of depositors vis-à-vis the Turkish banking market in the period before a strong banking crisis in the country in 2001. The authors showed that between 1988 and 2000, depositors exercised market discipline, charging banks higher interest rates in relation to their risk, especially in the period in which deposit insurance was deemed "generous" by the depositors. However, the authors suggest explicit coverages may not be effective to ensure economic stability for emerging countries, because market discipline has not been effective in inhibiting banks' risk behavior.

Despite some divergent results, we conclude, in general, the higher the coverage, the lower the market discipline. Despite that, we cannot ignore that effects such as economic crises, credibility of the insurance system, concentration, and competition issues, among other factors, can moderate this relation.

The increase in Brazilian deposit insurance coverage, accompanied by the development of electronic platforms to intermediate the deposit market, allowed investors to more easily distribute their resources in various institutions. Comparing with the scenario before the increase in coverage and without brokerage firms, even average and informed investors could more easily have 100% of their resources covered by guarantees, with a lower cost, by distributing their resources in multiple institutions.

Based on the theoretical constructs, we established the following research hypotheses:

H_1*:* There is market discipline in the Brazilian banking market for price, quantity, and maturity mechanisms;

H_2: The increase in deposit insurance coverage in 2013 reduced market discipline for price, quantity, and maturity mechanisms; and

H_3*:* The performance of independent brokers has reduced market discipline for price, quantity, and maturity mechanisms.

3. Research design

3.1. Sample and data

Our analysis covers the period from 2010 to 2017 and uses quarterly data from the Brazilian banks, comprising eight years of observations that total 32 quarters, totaling 3,835 observations. The analysis period starts in 2010 as it was the date of the institution of the limit of R$ 70.000 for the fund's coverage and it ends in 2017, when a global limit of coverage per depositor for the whole financial system was established. We excluded regional and national development banks and cooperative banks from the sample because their funding characteristics differ from the other banks.

It is important to note that during the period of analysis, some financial institutions merged. Considering that the main model uses variables in lag, one must consider the effects of these corporate reorganizations (mergers and acquisitions) on the model, as the t data of a bank may not be comparable with the $t + n$ data of the merged bank. The proposed treatment follows Martinez-Pería and Schmukler (2001), who considered the reorganized bank as a new bank.

3.2. Variables

3.2.1. Dependent variables

Dependent variables correspond to each of the market discipline mechanisms referenced in the literature, calculated as in Table 1.

We calculated the variables considering both covered and not covered deposits because the objective of our study is to evaluate the market discipline in the Brazilian context after changes in the market (deposit insurance and independent brokerage firms). In addition, Kaufmann and Seelig (2001), Martinez-Pería and Schmukler (2001), and Hasan et al. (2013) point out that in emerging countries, both insured and uninsured depositors exercise market discipline. We excluded demand deposits because they pay no interest rate.

Demirgüç-Kunh and Huizinga (2004), Ungan, Caner, and Ozyildrim (2008), Önder and Özyildirim (2008), Hadad et al. (2011), Karas et al. (2013), and Aysan et al. (2017) used a similar methodology to calculate the implicit interest rate of deposits because the real funding rate of each financial institution was unavailable. However, these authors used as proxy for the implicit interest rate the annual interest rate expense divided

by the total deposits in the financial statement. The calculation we propose, considering quarterly data, presents a refinement, because it more accurately addresses the fact that an expense could refer to deposits that matured over the periods included in our study. We annualized and subtracted the quarterly rates from the average government rate of the reference quarter. $Intrate_{it}$ was winsorized at 99% because quarterly values may contain rare classification balance errors and be distorted by voluminous operations that may have occurred during the period. This procedure reduces the impact of eventual outliers. Oliveira et al. (2015), Hou et al. (2016), and Andrievskaya and Semenova (2015) used a similar approach.

The use of the first difference in the deposit log (variable $VarDep_{it}$) to determine their variation is being investigated in a similar way to Martinez-Pería and Schmukler (2001), Karas et al. (2013), Tovar-García (2016), and Aysan et al. (2017). Following Marcondes (2008), considering the Brazilian market has a non-negligible inflation rate, deposit balances were deflated by the change in the Broad Consumer Price Index (IPCA) in order to capture only the real growth of deposits.

The maturity proxy represents a novelty in the literature on market discipline in Brazil. This measure was explored in the literature only in Tovar-García (2014 and 2016) and Goday et al. (2005), for the Mexican and Uruguayan markets, respectively. In our study, we use the segregation of the quarter-end balance sheets provided by the the Central Bank of Brazil (BCB) in each of the accounts for "Up to 90 days" and "After 90 days." Tovar-García (2014 and 2016) used a similar proxy.

3.2.2. Independent variables – risk *proxies*

Our selection of risk measures followed the literature on market discipline. We determined the risk measures of the banks by means of accounting data. Table 2 presents the risk variables, indicating the related literature and the expected signal based on previous studies. Following Hou et al. (2016), Hadad et al. (2011), Cubillas et al. (2012), and Hasan et al. (2013), we treat accounting variables as endogenous in the GMM-Sys model.

3.2.3. Control variables

As control variables, we included the effect of DPGE[3] funding ($EfDPGE_{it}$), as these deposits can influence both the funding rate and the maturity and volume of deposits. We calculated the variable by interacting the log of the total volume of deposits in this modality ($lnDPGE_{it}$) with the percentage of deposits over 90 days over the total deposits ($MatDPGE_{it}$). Through this interaction, we sought to better assess the effect of these deposits on bank funding. A high volume of deposits maturing in the short term may influence a bank's appetite for deposits differently than the same volume, but with a longer maturity.

In addition, we included the measures of each of the mechanisms as controls in determining the discipline of the third mechanism. For example, in determining market discipline through the price mechanism, we included deposit variation and maturity measures as controls. It is understood that all these characteristics of the deposits influence each other. We also included dummy variables for each quarter.

3.3. Applied model

Considering the potential endogeneity of the data, we will use the GMM-Sys model of Blundell and Bond (1998) to estimate the parameters. The GMM-Sys model allows us to remove the premise of exogeneity of the regressors (Hadad et al. 2011) and is therefore suitable for analyses in which accounting or financial data are used both as dependent and as independent variables. The GMM-Sys model is also widely used in market discipline studies (Goday et al., 2005; Oliveira, 2007; Fonseca & González, 2010; Balasubramnian & Cyree, 2011 and 2014; Hadad et al., 2011; Cubillas, Fonseca & Gonzalez, 2012; Hasan, Jackowicz, Kowaliwski & Kozlowski, 2013; Karas et al., 2013; Tovar-García, 2014 and 2016; Oliveira, Schiozer & Barros, 2015; Hou, Gao & Wang, 2016) (Goday et al., 2005; Oliveira, 2007; Fonseca & González, 2010; Balasubramnian & Cyree, 2011 and 2014; Hadad et al., 2011; Cubillas, Fonseca & Gonzalez, 2012; Hasan, Jackowicz, Kowaliwski & Kozlowski, 2013; Karas et al., 2013; Tovar-García, 2014 and 2016; Oliveira, Schiozer & Barros, 2015; and Hou, Gao & Wang, 2016).

[3] In March 2009, the Time Deposit with Special Guarantee (DPGE) was created "in response to the impacts of the international financial crisis" and "to restore the liquidity of smaller banks" (Santana, 2013), which established a coverage of up to R$ 20 million per institution per depositor, specifically for this special type of deposit (DPGE), which in practice is similar to a time deposit.

We measured the possible change in the market discipline caused by the variations in Brazilian deposit insurance coverage and the presence of fintech based on the following model.

Price mechanism:

$$Intrate_{it} = \beta_1 Intrate_{\text{it-n}} + \beta_2 LogTA_{\text{it-n}} + \beta_3 Default_{\text{it-n}} + \beta_4 Liquidity_{\text{it-n}} + \beta_5 Equity_{\text{it-n}} + \beta_6 LLR_{\text{it-n}} + \beta_7 ROA_{\text{it-n}} + \beta_8 VarDep_{\text{it-n}} + \beta_9 Maturity_{\text{it-n}} + \beta_{10} EfDEGE_{\text{it-n}} + \beta_{11} POST + \beta_{12} FinInterm_{\text{it-n}} + \beta_{13} LogTA_{\text{it-n}} * POST + \beta_{14} Default_{\text{it-n}} * POST + \beta_{15} Liquidity_{\text{it-n}} \beta_3 * POST + \beta_{16} Equity_{\text{it-n}} * POST + \beta_{17} LLR_{\text{it-n}} * POST + \beta_{18} ROA_{\text{it-n}} * POST + + \beta_{19} LogTA_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{20} Default_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{21} Liquidity_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{22} Equity_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{23} LLR_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{24} ROA_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{25-55} QUARTER + u_{\text{it}} \quad (2)$$

Quantity mechanism:

$$VarDep_{it} = \beta_1 VarDep_{\text{it-n}} + \beta_2 LogTA_{\text{it-n}} + \beta_3 Default_{\text{it-n}} + \beta_4 Liquidity_{\text{it-n}} + \beta_5 Equity_{\text{it-n}} + \beta_6 LLR_{\text{it-n}} + \beta_7 ROA_{\text{it-n}} + \beta_8 Intrate_{\text{it-n}} + \beta_9 Maturity_{\text{it-n}} + \beta_{10} EfDEGE_{\text{it-n}} + \beta_{11} POST + \beta_{12} FinInterm_{\text{it-n}} + \beta_{13} LogTA_{\text{it-n}} * POST + \beta_{14} Default_{\text{it-n}} * POST + \beta_{15} Liquidity_{\text{it-n}} \beta_3 * POST + \beta_{16} Equity_{\text{it-n}} * POST + \beta_{17} LLR_{\text{it-n}} * POST + \beta_{18} ROA_{\text{it-n}} * POST + + \beta_{19} LogTA_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{20} Default_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{21} Liquidity_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{22} Equity_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{23} LLR_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{24} ROA_{\text{it-n}} * FinInterm_{\text{it-n}} + \beta_{25-55} QUARTER + u_{\text{it}} \quad (3)$$

Maturity mechanism:

$$Maturity_{it} = \beta_1 Maturity_{\text{it-n}} + \beta_2 LogTA_{\text{it-n}} + \beta_3 Default_{\text{it-n}} + \beta_4 Liquidity_{\text{it-n}} + \beta_5 Equity_{\text{it-n}} + \beta_6 LLR_{\text{it-n}} + \beta_7 ROA_{\text{it-n}} + \beta_8 Intrate_{\text{it-n}} + \beta_9 VarDep_{\text{it-n}} + \beta_{10} EfDEGE_{\text{it-n}} + \beta_{11} POST + \beta_{12} FinInterm_{\text{it-n}} + \beta_{13} LogTA_{\text{it-n}} * POST + \beta_{14} Default_{\text{it-n}} * POST + \beta_{15} Liquidity_{\text{it-n}} \beta_3 * POST + \beta_{16} Equity_{\text{it-n}} * POST + \beta_{17} LLR_{\text{it-n}} * POST + \beta_{18} ROA_{\text{it-n}} * POST +$$

$$+ \beta_{19} LogTA_{\mathrm{it-n}} * FinInterm_{\mathrm{it-n}} + \beta_{20} Default_{\mathrm{it-n}} * FinInterm_{\mathrm{it-n}} +$$
$$\beta_{21} Liquidity_{\mathrm{it-n}} * FinInterm_{\mathrm{it-n}} + \beta_{22} Equity_{\mathrm{it-n}} * FinInterm_{\mathrm{it-n}} +$$
$$\beta_{23} LLR_{\mathrm{it-n}} * FinInterm_{\mathrm{it-n}} + \beta_{24} ROA_{\mathrm{it-n}} * FinInterm_{\mathrm{it-n}} +$$
$$\beta_{25-55} QUARTER + \mathrm{u_{it}} \quad (3)$$

The $* POST$ term refers to the risk variables interacting with the dummy variable that represents 1 for the post-change period and 0 for the previous period. The use of the dummy variable follows the literature that analyzed changes in coverage deposit insurance structures in specific countries, as related in Imai (2006), Aysan et al. (2017), Hadad et al. (2011), and Ungan et al. (2008).

Unlike the change in deposit insurance policies promoted in 2013, which have a start date and can thus be exploited as experiments, the brokerage firms' performance is not a phenomenon with a determined beginning, but rather a growing, observable movement. In this way, we followed the work of Hou et al. (2016), who analyzed how Internet growth may have influenced market discipline in Japan. We calculated an indicator of the growth of independent brokerage firms, which will be a proxy for the increase in the presence of these companies in the intermediation market. The measure assesses the amount of financial intermediation revenue obtained from the purchase and sale of Fixed Income securities (in which securities issued by small and medium-sized banks and sold to clients by brokerage firms are included) to brokerage firms operating through Internet portals in relation to total bank interest rate expenses. However, this does not include those banks considered "too big to fail" (TBFT), because they have their own funding channels through an agency network and do not use brokerage houses in large scale. $FinInterm$ represents the growth of independent brokerage firms and was measured as detailed in Table 3.

In line with Aysan et al. (2017), Mendonça and Loures (2009), and Morgan and Stiroh (2001), accounting variables will come with a lag. This lag is justified by the fact that the deposit market may take some time to adjust to the risk factors of the banks, because not all the applications have the liquidity that allows a depositor’s immediate response to the risk. The time of disclosure and capture and analysis by market participants should also be considered. Literature generally uses a one-year lag, because it normally uses yearly data and it would not be reasonable to conjecture a two-year response time for depositors. In our study, we calculate the models with a lag from t-1 to

t-6 (from one to six quarters) to evaluate if there is a temporal difference in the depositor´s response to the risk variables. This approach will allow the detection of differences, if any, in responses to risk factors in relation to each of the market discipline mechanisms. Goday et al. (2005) and Karas et al. (2013) used a similar approach.

The existence of market discipline is evaluated by the significance and sign of β_1 to β_7 according to the theory, whereas the alteration of the discipline will be present if the β_{13} to β_{24} parameters prove to be non-significant or significant, but with the opposite sign.

4. RESULTS

Table 4 presents the descriptive statistics. The wide variation between the minimum and maximum values of the $Intrate$ variable (which measures the average funding rate in percentage above the SELIC[4]) shows there is variation in the interest rate between institutions, which indicates that banks pay different risk premiums to depositors, in line with the hypothesis of market discipline.

Also noteworthy are the extreme values of 0 and 1 of the $Maturity$ variable, which indicates the percentage of deposits over 90 days, compared to the total deposits. Banks with a zero value in this indicator have all their deposits in the short term (up to 90 days), while those with a value of 1 have all their deposits with a term of more than 90 days.

It is worth highlighting the breadth of the variable $LogTA_{\mathrm{it}}$. The Brazilian banking market has a strong concentration, with the presence of a small number of large banks. We included a complementary test to assess the effect of both changes on the groups of small and medium-sized banks, evaluating these groups separately. The variables related to the loans ($Default_{\mathrm{it}}$ and LLR_{it}) also had a high amplitude. As $Default_{\mathrm{it}}$ is an important risk factor in the banking sector, it is expected that this variability is reflected in the dependent variables, confirming the hypothesis of market discipline.

Table 5 presents the correlation matrix. With regard to the correlation between the independent variables and the risk variables, it can be seen that $Depgr_{it}$ and $Intrate_{it}$ and $Maturity_{it}$ are significantly correlated risk variables, signaling those three variables might respond to the bank risks factors, indicating the existence of market discipline.

[4] The government interest rate in Brazil.

4.1. Interest rate

In general, the literature has been successful in pointing out that depositors charge higher interest rates from higher risk banks, based on accounting numbers (Sironi, 2003; Flannery & Sorescu, 1996; Hadad et al. 2011; Tovar-García, 2016), demonstrating the existence of market discipline through the price mechanism.

Table 6 shows the result of the estimates by GMM-Sys with the implicit interest rate on deposits as the dependent variable. Models (i) to (vi) represent the inclusion of risk variables with lags from one to six quarters, respectively.

Through this analysis, we seek to identify whether the phenomenon of market discipline through the interest rate mechanism is present in Brazil, whether the increase in deposit insurance had the effect of weakening this discipline, and if the performance of brokerage firms (*fintechs*) changed this scenario.

Before presenting the results, it is important to evaluate the validity of the models. Model (i) presents an unsatisfactory result in Hansen´s test (statistic lower than 10%), which assesses the validity of the variables used as instruments. Models (ii) and (v) presented unsatisfactory results in the second-order self-correlation test. Thus, it is understood that the results of models (i), (ii), and (v) should be viewed with caution.

It can be seen, therefore, that the models with three, four, and six quarters lags [models (iii), (iv), and (vi)] are adequate, for assessing the behavior of the market discipline. These three models presented satisfactory results in the Hansen test.

In addition, it is highlighted that the coefficient β_0, related to the lagged dependent variable, was positive and statistically significant in models (iii), (iv), and (vi). The values of the coefficients are adequately between the OLS (upper limit) and fixed effects (lower limit) values, according to Roy, Vértesy, and Vivarelli (2018).

Finally, in all models, we have fewer instruments than groups. The opposite situation, although not a definitive limitation of the model, can characterize an excess of instruments, which could bias the tests and, consequently, the results. Thus, Roodman (2009a) points out this restriction as a parameter to be observed.

In analyzing market discipline in Brazil and considering the interest rate mechanism, we noticed that the effect of the size of the banks influences the price, in line with the hypothesis of the existence of market discipline. Larger banks (as measured by

$LogTA_{it-n}$) are seen as less risky and are able to raise funds at a lower rate. Besides the too-big-to-fail effect, larger banks can diversify their risks across business lines, regions etc. (Nier and Baumann, 2006), tending to be considered as "safer" banks by depositors. We see this effect in models (iii) and (iv), which showed a negative and significant sign in the coefficient of the variable $LogTA_{it-n}$. The size effect shows similar sign in the literature, such as in the works of Flannery and Sorescu (1996), Hadad et al. (2011), Tovar-García (2016), Imai (2006), and Morgan and Stiroh (2001).

Also in line with market discipline, we observed that the variable $Equity_{it-n}$, which measures the total equity in relation to the total asset—that is, the level of capitalization—presented a negative relationship with funding costs in models (iii) and (iv). This relationship shows more capitalized banks are seen as less risky by investors and has the advantage of raising funds at lower interest rates. A similar effect has been identified in the literature, such as in Martinez-Pería and Schmukler (2001), Aysan et al. (2017), Karas et al. (2013), and Demirgüç-Kunt and Huizinga (2004).

The variable $Liquidity_{it-n}$, in line with previous studies such as Hadad et al. (2011), Goday et al. (2005), and Demirgüç-Kunt and Huizinga (2004), also confirm the hypothesis of market discipline in Brazil, because it presented a negative and significant relationship with the interest rate in the three models ([iii] and [iv] and [vi]). More liquid banks would have a more comfortable financial situation and would therefore be seen by investors as less risky banks. The significance of the liquidity variable can also be seen in a context where more liquid banks would have a lower appetite for funding and would be willing to pay lower fees for deposits.

Evaluating the variables without interaction, we see there is market discipline in Brazil through the interest rate mechanism (Hypothesis 1), and the most important risk factors for depositors are the size of the banks ($LogTA_{it-n}$), its capitalization ($Equity_{it-n}$), and its liquidity ($Liquidity_{it-n}$). In addition, the number of significant coefficients, the degree of significance, and its sign and magnitude demonstrate that the discipline occurs mainly in a six-quarter lag [model (vi)]—meaning the price of deposits can take a year and a half to respond to changes in bank risk factors.

The introduction of deposit insurance and the performance of brokerage firms (measured by the interactive variables $* POST$ and $* FinInterm_t$) caused a change in the market discipline measured by the interest rate. We noticed that, with the increase in deposit insurance, none of the variables interacted with the period after the increase in

coverage (* *POST*) showed significance. Thus, for the interest rate mechanism, Hypothesis 2 is also confirmed: the increase in insurance reduced discipline.

The performance of independent brokers has further changed this scenario. The advantage of the size of the institutions is reduced by the effect of the brokers ($LogTA_{it-n} * Cindep_t$) when models (iii) and (vi) are analyzed, because the size of the institution was positively related to the price of deposits, with a significance of 10% in model (iii) and 1% in model (vi). In other words, in this new scenario, smaller institutions were able to raise funds at lower rates, which can indicate a better competition scenario. This result is compatible with the perception that the performance of independent brokers facilitated the access of small and medium-sized banks to retail depositors (Pinheiro & Moreira, 2018).

Also in models (iii) and (vi), we noticed that the sign and the significance of the variable $Equity_{it-n} * Cindep_t$, related to the capitalization of banks, did not bear out the hypothesis of market discipline—that is, less capitalized banks were able to raise funds at lower rates.

In model (iii), we see that the coefficient associated with the variable $Default_{it-n} * Cindep_t$, which measures the effect of lower quality credit operations on the price of deposits with the influence of *fintechs*, is positive and significant. It shows that, with this lag, depositors perceived the credit risk of banks and were charged higher rates based on this risk. This result is in line with that observed by Flannery and Sorescu (1996), Morgan and Stiroh (2001), Martinez-Pería and Schmukler (2001), and Ioannidou and De Dreu (2006).

These findings partially confirm Hypothesis 3 (reduction of discipline due to the performance of independent brokers) for the interest rate mechanism, given that, despite the size and capitalization of banks having changed their influence on the price of funding in relation to the non-interacting variables, credit quality became relevant in the pricing of deposits.

Taking the models together, the Brazilian market shows signs of market discipline when considering the interest rate mechanism. Considering the magnitude, quantity, and significance of the coefficients associated with the risk variables, the discipline is more robust when considering six-quarter lags (model [vi]). This finding represents a contribution to the literature, which normally uses annual data as a standard. Thus, it is reasonable to evaluate the discipline with different lags, because characteristics of the

markets (liquidity, competition, the possibility of migrating deposits, etc.) can alter the depositors' response time to risk factors.

Considering the Brazilian banking market is highly concentrated in a small number of institutions, we carried out a complementary analysis of the three mechanisms, eliminating banks that, due to their size, can be considered too-big-to-fail (TBTF) [5]. TBTF banks tend to suffer less discipline due to the implicit perception of investors that in the event of financial problems, government entities would assist the banks (World Bank Group, 2019). Ungan et al. (2008), Tovar-García (2014 and 2016), Oliveira et al. (2015), Mondschean and Opiela (1999), and Karas, Pyle, and Schoors (2010) adopted bank segregations to analyze market discipline.

For the interest rate mechanism, the market discipline scenario without TBTF banks did not change significantly in relation to the models found with the complete sample in terms of the sign and significance of the variables[6], considering both the non-interacted variables and the effect of the deposit insurance and *fintechs*. However, the value of the coefficients were higher than the values obtained with the complete sample, which indicates the deposit price paid by small and medium-sized banks is more sensitive to their risk factors—that is, the market discipline is more pronounced.

4.2. Quantity

The purpose of analyzing market discipline through the quantity mechanism is to verify whether depositors, when assessing bank risk factors, respond to these risks by withdrawing their deposits from higher risk banks and migrating deposits to less risky ones. In general, the literature has shown there is market discipline through the quantity mechanism (Aysan et al., 2017; Martinez-Pería & Schmukler, 2001; Ioannidou & Dedreu, 2006; Tovar-García, 2014).

Table 7 shows the result of the estimates by GMM-Sys with the percentage change in the volume of deposits in each quarter as a dependent variable, adjusted for inflation.

[5] To segregate large banks from the rest, we used the cluster analysis methodology based on the size of the banks' assets. Oliveira et. al (2015) pointed out that size is the main parameter for segregating systemically important banks. In complementary tests, the authors identified that, in the Brazilian market, other measures such as total deposits, number of branches, total assets plus brokerage operations keep bank segregation unchanged. Clustering segregated banks into two groups, with the first group having six (larger) banks and the second with the others.

[6] Unreported results.

Models (i) to (vi) represent the inclusion of risk variables with one to six quarters lags, respectively.

As with the interest rate mechanism, we evaluated the test results of each model. Hansen's tests invalidate the results of models (ii) to (iv) because the adequacy of the instruments was not accepted at a significance level of 10%, although the second order auto-correlation test (AR2) was satisfactory in all of the models.

The β_0 coefficient, related to the lagged dependent variable, was statistically significant only in models (ii) and (iv). However, when we calculated the same models using OLS (upper limit) and fixed effects (lower limit), these coefficients were not within the values of the two models. Tovar-García (2014 and 2016) indicates that in this case, it shows the amount raised in the previous period is not related to the amount raised in the current period, but it does not detract from the applicability of the GMM-Sys model, as this lagged variable is used as a control.

Therefore, only model (i) can be considered in the analysis of market discipline in Brazil by the quantity mechanism. If a 5% rejection is considered in the Hansen test, model (ii) could also be assessed. However, its results must be considered with caution.

In evaluating the market discipline without the effects of deposit insurance and brokerage firms, using models (i) and (ii), few risk indicators were significant. In model (i), greater liquidity is related to a lower volume of funding, due to the negative result of the coefficient of the variable $Liquidity_{it-n}$; however, its significance level is only 10%. These results differ from those found by Karas, et al. (2013) and Tovar-García (2016), but are in line with those identified by Ungan et al. (2008) and Aysan et al. (2017). This result may be linked to a lower appetite for capturing deposits due to greater liquidity, and not linked with a disciplinary effect.

Still in model (i), the negative coefficient of the variable LLR_{it-n} indicates banks with a higher volume of expected credit losses have a positive variation in the amount of deposits in the following quarter. This result strays from the market discipline hypothesis. However, this indicator can also demonstrate that banks with higher recorded loss amounts could be considered safer by depositors, as they have extra protection against defaults. Ioannidou and De Dreu (2006) identified a similar result.

Finally, in model (i), the control variable $Maturity_{it-n}$ shows a positive and significant coefficient at a 1% significance level. This means banks with longer-term deposits had a positive flow of deposits in the following quarter. This result conflicts with the expected, because longer deposits could reduce the appetite for bank borrowings. In

model (ii), as we analyzed the non-interacting variables, we noticed that only the lagged dependent variable was significant, reinforcing the weak indication of market discipline through the quantity mechanism.

Therefore, based on the small number of significant variables in the valid models and the unexpected sign of the variables LLR_{it-1}, $Liquidity_{it-1}$, and $Maturity_{it-1}$, the presence of market discipline through the quantity mechanism is weak and does not confirm Hypothesis 1. Macey and Garret (1988) highlighted convenience and location can be important factors in the decision to allocate resources, superimposing the risk analysis by considering less sophisticated depositors.

Regarding the effects of the increase in deposit insurance and *fintechs*, we noticed that in model (i), the variables $Default_{it-n}$ *, $POST$, and $LLR_{it-n} * POST$ proved to be significant. The first one was contrary to market discipline, but in line with Ioannidou and De Dreu (2006) and similar to the non-interacted variable result. The second also was contrary to market discipline, because banks with higher volumes of low-quality loans are associated with a positive flow of funds. In addition, this coefficient differs from the findings by Aysan et al. (2017), Martinez-Pería and Schmukler (2001), Berger and Turk-Ariss (2015), and Ioannidou and De Dreu (2006).

In model (ii), the variable $LLR_{it-n} * POST$ indicates that banks with higher volumes of expected credit losses accounted for would be considered of greater risk and therefore would attract fewer deposits, consistent with market discipline.

The results, mainly of model (i), show the increase in deposit insurance coverage weakened market discipline through the quantity mechanism, confirming Hypothesis 2.

Moving on to the analysis of the effect of *fintechs* on the market discipline, only the variable $LLR_{it-1} * FinInterm_t$ was significant, both in models (i) and (ii). While in model (i) it showed a sign consistent with market discipline (positive), in model (ii) the result was the opposite. With this, we considered that the performance of independent brokers did not significantly change the scenario of weak market discipline through the quantity mechanism, thus not confirming Hypothesis 3.

Based on the analyses carried out, the market discipline through the quantity mechanism is weak in Brazil, because it is not possible to strongly relate risk indicators to the variation in deposits. Few indicators showed significance, and of those that did, they showed a sign contrary to the discipline hypothesis.

We also performed a complementary analysis to the quantity mechanism excluding TBTF banks. The market discipline scenario did not show significant changes

in the sample without the TBTF[7] banks in relation to the full sample. The same few indicators proved to be significant, with identical signs and degree of significance—that is, the market discipline through the quantity mechanism for small and medium-sized banks is weak.

4.3. Maturity

Market discipline through the maturity mechanism occurs when banks with lower risk attract longer-term deposits based on investors' assessment and perception of these risks. Trusting the bank's security and stability, depositors would be willing to keep their resources for longer terms. The indicator calculated in the present work shows the percentage of long-term deposits (maturity over 90 days) in relation to total deposits.

Table 8 shows the result of the estimates by GMM-Sys for the maturity mechanism, as proposed, with the explanatory variables considered in lags from one to six quarters [models (i) to (vi)].

First, it is important to evaluate the test results for each model, to define whether the results presented can be considered reliable or not. The models (i), (ii), (iii), and (vi) presented unsatisfactory values in the Hansen test. In addition, in models (i), (ii), and (iii), the second order auto-correlation test also did not show a satisfactory result. In all models, the Wald test confirms the joint significance of the independent variables.

In this way, market discipline through the maturity mechanism is stronger when we consider the risk variables of banks with a lag of four and five quarters [models (iv) and (v)]. The value of 0.391 on the Hansen test in model (iv) was above the 0.25 parameter pointed out by Roodman (2009a). Despite this parameter, studies using the GMM-Sys model published in journals have accepted values greater than 0.25 for the Hansen test, including Djalilo and Piesse (2019), Andrievskaya and Semenova (2015), Oliveira et al. (2015), Stolz and Wedow (2011), and Furceri and Zdzienicka (2012). Excessively high values in the Hansen test can occur when the number of instruments in the model exceeds the number of groups (Roodman, 2009a), which did not occur in the models presented in Table 8.

In both models, the lagged dependent variable was significant at a level of 1%. The values of the coefficients are adequately between the value determined by OLS

[7] Unreported results.

(upper limit) and fixed effects (lower limit), according to Roy, Vértesy, and Vivarelli (2018).

In analyzing market discipline without considering the interacted variables in models (iv) and (v), we found the size of banks is associated with a higher volume of funding in the long term. The coefficient associated with $LogTA_{it-n}$ was positive and significant in both cases, which is in line with the hypothesis of market discipline.

In addition, the coefficient associated with the variable $Equity_{it-n}$, which demonstrates the level of capitalization of the banks, is positive and significant in model (v), again in line with the market. More capitalized banks are less risky and, therefore, raise funds over longer terms, based on depositors' greater confidence in their solvency.

In both valid models, the coefficient associated with the variable $Liquidity_{it-n}$ was positive and significant, in line with the market discipline and with the results of Tovar-García (2014, 2016) and Goday et al. (2005). Banks with a higher volume of liquid assets over total assets are seen by depositors as safer to maintain their funds over longer periods.

In model (v), the variable ROA_{it-n}, which measures profitability on banks' assets, presented a positive coefficient; that is, more profitable banks are associated with a higher volume of long-term funding. This result is also in line with market discipline.

Based on these results, considering that risk variables are associated with deposit maturity, we can confirm Hypothesis 1: In Brazil there is market discipline through the maturity mechanism.

Analyzing the effect of increasing deposit insurance and the performance of independent brokerage firms, we see that in model (iv) the effect of the variable that measures low quality credits ($Default_{it-n}$) was changed by the effect of deposit insurance. The hypothesis of discipline occurs when the coefficient associated with this variable is negative—that is, when banks with a greater amount of lower quality credits raise deposits in the short term. The increase in insurance coverage ($Default_{it-n} * POST$) made this variable visible to investors, in line with the findings of Tovar-García (2014 and 2016). In other words, banks with higher volumes of low-quality loans are seen as riskier and attract fewer long-term deposits. This effect can be seen as an increase in discipline caused by the new deposit insurance. Thus, although important risk indicators did not prove to be significant after the increase in coverage, the significance of this indicator (that insurance partially reduced discipline) partially confirms Hypothesis 2.

In model (v), the performance of brokers changed the trend of the $LogTA$ variable. The interactive variable $LogTA_{it-n}$* $FinInterm_t$ showed a negative and significant coefficient, contrary to market discipline. This phenomenon may be related to the fact that, with independent brokers, the retail public now has access to smaller institutions and started to use these institutions to allocate their resources. This result is in line with Tovar-García (2014).

Regarding the variable $Equity_{it-n}$, which measures the capitalization of banks, we see the coefficient associated with it has become negative and significant in model (v) with the performance of independent brokers ($Equity_{it-1} * FinInterm_t$). This result is in line with the one identified by Tovar-García (2014) but is at odds with the hypothesis of market discipline, which shows a weakening of discipline with the performance of brokerage firms. This confirms Hypothesis 3, that brokerage firms have reduced market discipline.

Finally, in model (v), the variable * POST was negative and significant, indicating depositors reduced their deposit terms after the increase in deposit insurance. By intuition, we expected the opposite, because depositors could extend their deposits with greater security offered through the insurance. However, when considering the new scenario with *fintechs*, it is possible that the migration to smaller banks has led depositors to reduce the application periods.

Taken together, the evaluated models demonstrate evidence of market discipline through the maturity mechanism in Brazil. The risk indicators analyzed by depositors are mainly the size, capitalization, liquidity, and profitability of banks. The strongest discipline, considering the number of significant indicators, their values, and the result of the Hansen test, occurs with the risk variables determined with five quarters of lag—that is, model (v).

Both the increase in deposit insurance and the performance of independent brokers reduced discipline, with capitalization and size having an opposite effect, demonstrating that after these events, these risk variables started to be negatively related to risk.

For the sample without the TBTF banks, the same variables proved to be significant, showing there is market discipline to those banks. The magnitude of the significant coefficients was also higher in relation to the general sample, which confirms that small and medium-sized banks would be more closely monitored by depositors.

5. CONCLUSION

Based on our analyses, we see market discipline occurring through the interest rate mechanism in the Brazilian market. The risk parameters associated with a higher interest rate were size and capitalization. After the increase in deposit insurance coverage, the risk parameters became statistically not significant in relation to the price paid by banks for their funding, indicating a reduction in discipline.

The performance of *fintechs* changed the sign of the significant risk parameters, reducing the size and capitalization advantage and indicating a reduction in discipline. This change, on the other hand, may indicate an improvement in competitiveness, given that smaller banks started to raise at more advantageous rates with the *fintechs*. However, the significance of the variable related to the loan portfolio shows discipline has not been eliminated.

Regarding the quantity mechanism, by the estimation conducted in the paper, market discipline is weak in Brazil. The risk variables were not significantly associated with the flow of deposits. The increase in insurance did not change this scenario; however, with the *fintechs*, we noticed that the coefficient associated with size and capitalization was contrary to the hypothesis of discipline. As the price mechanism, this effect may signal a reduction in the concentration of deposits, with the public migrating to small and medium-sized banks, which would be positive for competitiveness. Market dynamics, with independent intermediaries and the use of technology (e.g., independent brokers using portals to facilitate access to banks without a branch network), can also help to reduce the negative theoretical effects of increasing deposit insurance on the decrease in discipline. The market discipline exercised by the maturity mechanism, less explored in the literature, shows evidence of existing in Brazil. The size of banks and their capitalization are associated with the facility to capture longer-term deposits. Deposit insurance reduced discipline, with the variables becoming less significant. However, as in the price mechanism, a variable related to the quality of the credit portfolio has become significant, which shows discipline has not been eliminated. Regarding the performance of brokers, as well as in other mechanisms, the size and capitalization variables reduced discipline.

The discipline applied to small and medium-sized banks (that is, Brazilian banks except those considered TBTF) proved to be similar to the complete sample. However, the discipline was slightly stronger for the small and medium-sized banks.

Tsatsaronis (2004) and Tarullo (2008) point out that one of the ways to reinforce market discipline is to determinate subordinated debt, with neither insurance coverage nor government guarantees coverage. Although not free of controversy, this proposal has the advantage of inserting informed and uninsured participants in the liabilities of all banks. These participants, through the mechanisms already discussed, would exercise disciplinary power in order to limit the moral hazard.

Evanoff and Wall (2001) argue that proposals to increase subordinated debt would reduce potential regulatory arbitrage that large banks could carry out in relation to capital requirements and would reduce risk taking by banks, especially the largest ones, leading to a safer financial system and less subject to systemic crises.

Lang and Robertson (2002) argue that, in view of the associated cost, subordinated debt should be mandatory only for large institutions. In addition to the direct disciplinary power, these subordinated debts would act as signals to regulatory authorities about the market perception of each institution's risk. This information would be useful in designing supervisory procedures. Imai (2019) reinforces that the regulators of the financial system must be attentive to discipline market behavior and, when identifying any weakening, must be ready to exercise efficient regulatory and inspection discipline to avoid moral hazard.

Regarding moral hazard, Demirgüç-Kunt and Kane (2002) suggest that contributions associated with bank risk factors, instead of linear contributions based on deposit amount, as is the Brazilian model, can reduce this incentive. Thus, insurance would better fulfill its role of protecting the small depositor, reducing bank runs and promoting financial stability, without harming market discipline. This point was also highlighted by Silva (2008) as a possibility to improve the current insurance system in the country. Scott (2004) includes as an alternative to reinforce market discipline the reduction or even elimination of governmental safety nets to the financial system, which would lead to a more adequate pricing of the capital and debt instruments of these institutions.

Another important factor in stimulating market discipline is the timeliness and quality of disclosure of banks' risk information. Demirgüç-Kunt and Kane (2002) point out transparency is one of the fundamental factors for limiting banks' risk taking in the existence of deposit insurance. In this regard, in September 2019 the BCB created on its website a repository of financial statements called the Financial Statements Center. This portal brings together, in a single location, the financial statements of all institutions

regulated by the BCB, facilitating public access to bank data. Such access can improve the transparency of risk information and ultimately reinforce market discipline. Extensions of our work can assess whether the measure, in fact, was reflected in greater disciplinary power in the market in relation not only to deposits, but also to the stock price of banks.

As an innovation of our work, the inclusion of risk variables with several lags (one to six quarters) may contribute to the bank supervision the understanding of how early market depositors signal they have identified an increase in the bank risks and, thus, can offer an added dimension to supervision procedures.

In addition, this approach also contributes to the market discipline literature, because the literature usually considers a year lag in relation to risk variables. The results we presented here show the depositors' response may occur in different time frames and may also differ in relation to each of the mechanisms.

The results of our study can be considered important for bank supervisors to monitor changes in the deposit market (whether regulatory, such as increases in insurance coverage, or as a result of the development of technology, such as *fintechs*), and, based on this monitoring, evaluate supervisory procedures and propose actions that reinforce market discipline, as pointed out by Hou et al. (2016).

Deposit insurance and its influence on market discipline are also phenomena of interest to regulatory bodies. According to Demirgüç-Kunt and Kane (2002), when banking supervision is weak, deposit insurance tends to be more in demand, which represents a cost to taxpayers, in the case of government funding insurance, or to depositors, because its cost, in the case of private funding, is included in the interest rate, reducing the remuneration.

Finally, the significance from accounting measures to the price and maturity of deposits demonstrated accounting information has relevance to the deposit market, reinforcing the theory of value relevance.

Our analysis, however, is not free from limitations. As pointed out by Oliveira (2007), the calculation of the implicit interest rate on deposits, despite being a measure used in the literature, may contain distortions, because deposits can start and mature within the period, so that the average balance of deposits shows only an approximation of the amount. The use of quarterly data reduces this distortion but is not able to eliminate it. Likewise, the use of the average effective term of deposits, instead of the segregation

between "maturity up to 90 days" and "maturity over 90 days," could improve the analysis. Extensions of our work could perform this analysis.

Finally, since deposit insurance covers all banks equally in Brazil, it is not possible to identify an effective control group in order to identify a causal relationship between the phenomena. However, our analysis managed to demonstrate the scenario of market discipline in Brazil, contributing to the understanding of the phenomenon.

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Table 1: Dependent variables

Variable	Description	Formula
$Intrate_{it}$	*Implicit interest rates*	Quarterly time deposits and letters interest rate expenses divided by the average of total deposits of the same quarter and the previous quarter, elevate by 4 minus the average government interest rate (exclude saving deposits, because their interest rate is defined by the government and it does not change between banks).
$DepGr_{it}$	*Deposit Growth*	Deflated logarithm of the total deposits (include time deposits, letters and savings deposits, but excludes DPGE) of the quarter minus log of the total deposits of the previous quarter.
$Maturity_{it}$	*Maturity of the deposits*	Total deposits up to 90 days over total deposits (include time deposits, letters and savings deposits and excludes DPGE).

Table 2: Independent variables

Variable name	Description	Expected sign – Interest rate	Expected sign – Deposit growth	Expected sign – Maturity
$LogTA_{it}$	Logarithmic function of the total assets of the financial institution in the reference quarter	Flannery e Sorescu (1996); Hadad et al. (2011), Tovar-García and Demétrio (2016) – Negative	Aysan et al. (2017) – Positive	Tovar-García (2014) - Negative
$Default_{it}$	Credit classified in the E-H ratings/ Total assets	Flannery e Sorescu (1996); Morgan e Stiroh (2001); Martinez-Pería and Schmukler (2001) – Positive	Aysan et al. (2017) / Martinez-Pería and Schmukler (2001) / Berger and Turk-Ariss (2015) - Negative	Tovar-García (2014 and 2016) – Negative
$Liquidity_{it}$	Sum of financial assets available for sale and trading / total assets	Goday et al. (2005), Hadad et al. (2011) – Negative	Aysan et al. (2017) – Negativa / Karas, et al. (2013) and Tovar-García and Demétrio (2016) / Ungan et al. (2008) - Positive	Tovar-García (2014 e 2016) / Goday et al. (2005) - Positive
$Equity_{it}$	Total Equity / Total assets	Tovar-García (2014) / Martinez-Pería and Schmukler (2001) / Aysan et al. (2017) / Karas et al. (2013) - Negative	Tovar-García (2014) / Berger and Turk-Ariss (2015) / Martinez-Pería and Schmukler (2001) / Aysan et al. (2017) / Goday et al. (2005) / Karas, et al. (2013) / Ungan et al. (2008) - Positive	Tovar-García (2014) - Negative
$LLRes_{it}$	Loan loss reserves / Total assets	Jacewitz and Pogach (2014); Hadad et al. (2011) - Positive	-	-
ROA_{it}	Return on assets (12 months)	Goday et al. (2005), Martinez-Pería and Schmukler (2001), Flannery e Sorescu (1996), Morgan e Stiroh (2001) – Negative	Martinez-Pería e Schmukler (2001) - Positive	Goday et al. (2005) – Positiva / Tovar-García (2014) - Negative

Table 3: Growth of independent brokerage firms

Variable	Description	Formula
$FinInterm_t$	Growth of independent brokerage firms	Fixed income assets revenues of brokerage firms over total interest rate expenses of banks, except TBTF

Table 4 – Overall Descriptive Statistics of Quantitative Variables

	$Ccap_{it}$	$VarDep_{it}$	$Maturity_{it}$	$LogTA_{it}$	$Default_{it}$	$Equity_{it}$
Mean	1.049484	0.023186	0.713210	21.97763	0.021649	0.191286
Median	1.016167	0.010077	0.819212	21.98284	0.017073	0.141776
Min	0.318066	-5.27749	0.000000	16.62674	0.00000	0.002444
Max	4.484453	12.20943	1.000000	27.99982	0.524345	1.016457
SD	0.342508	0.428098	0.298896	2.195077	0.041201	0.157698
CV	0.326358	18.46360	0.419085	0.099837	1.516731	0.824412
p.25	4.513180	6.903249	-1.38506	0.335795	5.034005	2.530430
p.75	0.916848	-0.062622	0.625678	20.45675	0.003127	0.095977

	$Liquidity_{it}$	LLR_{it}	ROA_{it}	$EfDPGE_{it}$	$Cindep_t$
Mean	0.337020	0.140525	0.003899	5.366437	3835
Median	0.303824	0.042608	0.011164	0.000000	0.224310
Min	0.000082	0.000000	-1.94782	0.000000	0.124332
Max	0.998559	38.58714	0.366385	21.61488	-0.109298
SD	0.208067	1.221373	0.069767	8.000801	0.866277
CV	0.617341	8.691498	17.89063	1.490986	0.272614
p.25	0.720023	22.58326	-10.5424	0.894454	1.215344
p.75	0.180574	0.021366	0.001969	0.000000	1.223717

Notes: $Ccap_{it\,it}$ represents the implicit interest rate; $VarDep_{it\,it}$ represents the deflated logarithm of the total deposits of the quarter minus log of the total deposits of the previous quarter; $Maturity_{it}$ represents the maturity of the deposits; $LogTA_{it}$ represents the logarithmic function of the total assets of the financial institution in the reference quarter; $Default_{it}$ represents the amount of credit operations classified in the E-H ratings over total assets; $Liquidity_{it}$ represents the sum of financial assets available for sale and trading over total assets; $Equity_{it}$ represents total equity over total assets; LLR_{it} represents loan loss reserves over total assets; ROA_{it}represents return on assets (12 months); $FinInterm_{it}$ represents the growth of independent brokerage firms (percentage of brokerage revenues on banks' funding expenses, except TBTF); and $EfDPGE_{it}$ represents the logarithmic function of total fundraising via DPGE multiplied by the percentage of fundraising in this modality over 90 days.

Table 5 – Correlation matrix

	$Ccap_{it}$	$VarDep_{it}$	$Pdep_{it}$	$Ccap_{it-1}$	$VarDep_{it-1}$	$Pdep_{it-1}$	$LogTA_{it}$	$Default_{it}$	$Equity_{it}$	$Liquidez_{it}$	$Perdasest_{it}$	ROA_{it}	$EfDPGE_{it}$
$VarDep_{it}$	0.0847[a]												
$Pdep_{it}$	0.0571[a]	0.0109											
$Ccap_{it-1}$	0.7982[a]	0.0943[a]	0.0616[a]										
$VarDep_{it-1}$	0.0793 [a]	-0.0508[b]	-0.0017	0.0962[a]									
$Pdep_{it-1}$	0.0493[b]	0.0386[b]	0.7309[a]	0.0574[a]	0.0043								
$LogTA_{it}$	-0.115[a]	0.0146	0.1181[a]	-0.1128[a]	0.0011	0.1159[a]							
$Default_{it}$	0.0775[a]	-0.0311[c]	0.1264[a]	0.0754[a]	-0.0130	0.1329[a]	-0.1287[a]						
$Equity_{it}$	-0.0042	-0.0399[b]	-0.0400[b]	0.0011	-0.0168	-0.0334[b]	-0.6100[a]	0.0238					
$Liquidez_{it}$	-0.195[a]	0.0323[b]	-0.1202[a]	-0.1884[a]	0.0064	-0.1179[a]	-0.1621[a]	-0.2691[a]	0.2798[a]				
$Perdasest_{it}$	-0.0091	-0.0049	-0.0532[b]	-0.0133	0.0328[c]	-0.0527[b]	-0.0044	-0.0065	-0.0077	0.0560[a]			
ROA_{it}	-0.0130	0.0571[a]	0.0299[c]	-0.0180	0.0361[c]	0.0043	0.1446[a]	-0.2532[a]	0.0293[c]	-0.0355[b]	-0.0248		
$EfDPGE_{it}$	0.0905[a]	-0.0084	0.1217[a]	0.0879[a]	-0.0142	0.0950[a]	-0.1675[a]	0.2247[a]	-0.0616[a]	-0.1399[c]	-0.0381[b]	-0.0648[c]	
$Cindep_t$	-0.0280[c]	0.0012	0.0689[a]	-0.0331[b]	-0.0065	0.0625[a]	0.0339[b]	0.1070[a]	0.0205	0.0134	-0.0373[b]	-0.0051	-0.0840[c]

Notes: $Ccap_{it_{it}}$ represents the implicit interest rate; $VarDep_{it_{it}}$ represents the deflated logarithm of the total deposits of the quarter minus log of the total deposits of the previous quarter; $Maturity_{it}$ represents the maturity of the deposits; $LogTA_{it}$ represents the logarithmic function of the total assets of the financial institution in the reference quarter; $Default_{it}$ represents the amount of credit operations classified in the E-H ratings over total assets; $Liquidity_{it}$ represents the sum of financial assets available for sale and trading over total assets; $Equity_{it}$ represents total Equity over total assets; LLR_{it} represents loan loss reserves over total assets; ROA_{it}represents return on assets (12 months); $FinInterm_{it}$ represents the growth of independent brokerage firms (percentage of brokerage revenues on banks' funding expenses, except TBTF); and $EfDPGE_{it}$ represents the logarithmic function of total fundraising via DPGE multiplied by the percentage of fundraising in this modality over 90 days.
a, b and c denote significance at 1, 5, and 10%, respectively

Table 6 – Estimation results for price mechanism ($Intrate_{it}$) – GMM Systemic

	Models (b)					
Variables	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
$Intrate_{it-n}$	**0.579*** (4.94)**	**0.187* (1.88)**	**0.389*** (2.97)**	**0.509*** (2.97)**	**0.539*** (3.49)**	**0.300** (2.12)**
$LogTA_{it-n}$	**-0.035** (-2.33)**	**-0.044** (-2.47)**	**-0.040** (-2.02)**	-0.026 (-1.43)	-0.023 (-0.94)	**-0.059** (-2.04)**
$Default_{it-n}$	0.355 (1.19)	-0.341 (-0.80)	-0.224 (-0.49)	0.062 (0.11)	-0.326 (-0.32)	-0.411 (-0.56)
$Equity_{it-n}$	-0.238 (-1.32)	**-0.400* (-1.66)**	**-0.440* (-1.69)**	-0.319 (-1.45)	-0.299 (-1.09)	**-0.693** (-2.48)**
$Liquidityz_{it-n}$	**-0.176** (-2.05)**	**-0.234** (-2.33)**	**-0.31*** (-3.05)**	**-0.238* (-1.91)**	-0.214 (-1.63)	**-0.354** (-2.37)**
LLR_{it-n}	0.001 (0.28)	**0.003** (2.09)**	-0.008 (-1.00)	-0.012 (-1.08)	-0.003 (-0.38)	-0.006 (-0.67)
ROA_{it-n}	0.222 (0.74)	0.103 (0.30)	-0.032 (-0.05)	0.007 (0.01)	-0.233 (-0.22)	1.026 (0.88)
$Maturity_{it-n}$	0.039 (1.19)	0.021 (0.45)	-0.096 (-0.75)	**-0.267* (-1.89)**	-0.182 (-1.28)	-0.157 (-0.94)
$VarDep_{it-n}$	-0.014 (-0.75)	0.001 (0.01)	**0.136* (1.91)**	0.040 (0.47)	**0.195*** (2.72)**	0.013 (0.20)
$EfDPGE_{it-n}$	-0.002 (-1.37)	-0.001 (-0.95)	0.000 (0.03)	0.001 (0.54)	0.002 (0.57)	0.004 (0.93)
$LogTA_{it-n} * POST$	0.012 (0.95)	-0.006 (-0.41)	-0.011 (-0.69)	-0.001 (-0.03)	-0.005 (-0.30)	-0.004 (-0.23)
$LogTA_{it-n} * FinInterm_t$	0.013 (0.69)	0.099 (1.11)	**0.138* (1.86)**	0.097 (1.28)	0.153 (1.61)	**0.275*** (2.77)**
$Default_{it-n} * POST$	-0.277 (-0.83)	0.083 (0.14)	-0.009 (-0.01)	0.523 (0.83)	1.022 (0.84)	1.254 (1.55)
$Default_{it-n} * FinInterm_t$	0.510 (1.09)	**2.220* (1.74)**	**2.441* (1.80)**	1.977 (1.39)	0.453 (0.31)	0.428 (0.18)
$Equity_{it-n} * POST$	0.172 (0.91)	-0.081 (-0.39)	-0.142 (-0.45)	0.147 (0.47)	0.033 (0.11)	0.139 (0.40)
$Equity_{it-n} * FinInterm_t$	0.198 (0.87)	1.414 (1.51)	**1.769** (2.21)**	1.092 (1.07)	1.841 (1.35)	**3.272** (2.11)**
$Liquidity_{it-n} * POST$	-0.001 (-0.01)	0.03 (0.25)	-0.032 (-0.03)	0.034 (0.30)	-0.021 (-0.13)	-0.003 (-0.02)
$Liquidity_{it-n} * FinInterm_t$	0.045 (0.39)	0.195 (0.74)	0.581 (1.64)	0.485 (1.27)	0.383 (0.85)	**1.061** (2.07)**
$LLR_{it-n} * POST$	**-0.020*** (-2.88)**	-0.010 (-1.23)	-0.011 (-0.70)	0.006 (0.26)	-0.045 (-0.84)	-0.049 (-0.85)
$LLR_{it-n} * FinInterm_t$	0.060 (1.53)	-0.019 (-0.49)	-0.027 (-0.31)	-0.087 (-0.82)	0.230 (0.79)	0.199 (0.66)
$ROA_{it-n} * POST$	-0.308 (-0.91)	0.022 (0.06)	0.175 (0.25)	0.281 (0.33)	1.467 (1.18)	-0.779 (-0.63)
$ROA_{it-n} * FinInterm_t$	**0.718* (1.82)**	-0.081 (-0.17)	-0.660 (-0.60)	-0.834 (-0.57)	-2.151 (-1.25)	-2.629 (-0.79)
$POST$	-0.596 (-1.30)	**1.692*** (4.04)**	**2.010*** (4.58)**	-1.745 (-1.55)	0.675 (1.43)	**1.824** (2.44)**

Instruments (a)	2-3	2-3	2-3	2-3	2-3	2-3
Observations	2,994	2,960	2,928	2,897	2,871	2,839
No. of observations	97	97	97	97	97	97
No of groups	129	126	125	123	121	121
Quarter Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Wald Test Prob>(chi2)	**1,074*** (0.000)**	**13,21*** (0.000)**	**22,51*** (0.000)**	**812.20*** (0.000)**	**38,10*** (0.000)**	**30,11*** (0.000)**
AR(1) (d)	**-3.31*** (0.001)**	**-2.72*** (0.007)**	**-2.89*** (0.004)**	**-2.77*** (0.006)**	**-3.21*** (0.001)**	**-2.78*** (0.005)**
AR(2) (d)	0.87 (0.385)	**-2.29*** (0.024)**	0.03 (0.973)	-0.31 (0.758)	**-1.91** (0.057)**	-1.63 (0.103)
Hansen test (c)	**55.17* (0.056)**	47.82 (0.157)	43.05 (0.264)	48.06 (0.105)	49.96 (0.242)	40.46 (0.242)

Notes: $Intrate$ represents the implicit interest rate; $LogTA$ represents the logarithmic function of the total assets of the financial institution in the reference quarter; $Maturity$ represents the maturity of the deposits; $Depgr$ represents the deflated logarithm of the total deposits of the quarter minus log of the total deposits of the previous quarter; $Default$ represents the amount of credit operations classified in the E-H ratings over total assets; $Liquidity$ represents the sum of financial assets available for sale and trading over total assets; $Equity_{it}$ represents total equity over total assets; LLR represents loan loss reserves over total assets; ROA represents return on assets (12 months); $EfDPGE$ represents the log of the total volume of deposits in this modality ($lnDPGE_{it}$) with the percentage of deposits over 90 days over the total deposits; $POST$ represents a dummy which assumes the value of 1 in the period before the increase in insurance coverage and 0 otherwise; $FinInterm$ represents the growth of independent brokerage firms.

(a) In the xtabond2 command of the stata software, gmmstyle option was used with the variables without lag.

(b) The model used was GMM-Sys, in first differences (orthogonal) of two steps, robust for heteroscedasticity.

(c) The Hansen test confirms the validity of the lagged variables as instruments.

(d) The AR (1) and AR (2) test the first and second order correlation, respectively. The validity of the model is given by the rejection of the second order correlation.

***, ** e * denote significance at 1, 5, and 10%, respectively.

(i) refers to the model with the dependent variables included with a lag of 1 period (1 quarter), (ii) refers to the model with dependent variables included with a lag of 2 periods (2 quarters), and so on until (vi).

Table 7 – Estimation results for quantity mechanism ($VarDep_{it}$) – GMM Systemic

	Modelos (b)					
Variável	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
$VarDep_{it-n}$	-0.075 (-0.99)	**0.071**** **(2.10)**	-0.123 (-0.93)	**-0.268*** **(-1.74)**	0.180 (1.49)	0.065 (0.68)
$LogTA_{it-n}$	0.015 (0.64)	0.004 (0.23)	0.003 (0.16)	-0.001 (-0.04)	0.012 (0.30)	0.020 (0.73)
$Default_{it-n}$	-0.869 (-1.53)	-0.469 (-1.24)	-0.509 (-0.63)	0.785 (0.67)	-1.162 (-1.19)	-0.470 (-0.39)
$Equity_{it-n}$	0.380 (1.02)	0.122 (0.40)	-0.038 (-0.14)	-0.234 (-0.65)	0.210 (0.47)	0.416 (1.30)
$Liquidity_{it-n}$	**-0.210*** **(-1.79)**	-0.035 (-0.53)	-0.041 (-0.57)	-0.164 (-0.82)	-0.032 (-0.24)	-0.129 (-0.98)
LLR_{it-n}	**0.013***** **(3.57)**	0.004 (1.49)	-0.001 (-0.04)	-0.002 (-0.17)	-0.005 (-0.34)	0.006 (0.58)
ROA_{it-n}	-0.202 (-0.43)	0.245 (0.49)	0.103 (0.14)	2.463 (1.16)	0.003 (0.00)	-1.707 (-0.93)
$Intrate_{it-n}$	0.064 (0.99)	-0.007 (-0.12)	0.022 (0.20)	0.104 (0.42)	-0.142 (-0.66)	-0.009 (-0.10)
$Maturity_{it-n}$	**0.215**** **(2.83)**	-0.044 (-1.40)	-0.180 (-0.95)	**-0.506*** **(-1.99)**	-0.083 (-0.36)	-0.230 (-1.51)
$EfDPGE_{it-n}$	-0.001 (-0.42)	0.001 (0.33)	-0.005 (-1.00)	-0.006 (-1.03)	0.003 (0.29)	-0.002 (-0.48)
$LogTA_{it-n} * POST$	-0.014 (-0.67)	-0.034 (-1.24)	0.012 (0.57)	-0.012 (-0.44)	0.001 (0.09)	0.033 (1.44)
$LogTA_{it-n} * FinInterm_t$	-0.020 (-0.41)	0.021 (0.40)	-0.044 (-0.92)	-0.052 (-0.60)	-0.073 (-0.82)	**-0.314***** **(-2.63)**
$Default_{it-n} * POST$	**1.029*** **(1.84)**	0.598 (1.35)	0.168 (0.28)	-0.691 (-0.52)	1.051 (0.94)	-1.130 (-0.88)
$Default_{it-n} * FinInterm_t$	-0.841 (-0.58)	-0.359 (-0.34)	1.387 (1.18)	1.112 (0.52)	-0.035 (-0.01)	5.519 (1.13)
$Equity_{it-n} * POST$	0.258 (0.68)	-0.536 (-1.02)	0.381 (1.31)	-0.178 (-0.44)	-0.003 (-0.01)	0.303 (0.52)
$Equity_{it-n} * FinInterm_t$	-1.548 (-1.58)	0.074 (0.09)	**-1.241**** **(-2.24)**	-1.346 (-1.23)	-1.491 (-1.05)	**-5.152**** **(-2.36)**
$Liquidity_{it-n} * POST$	0.125 (1.07)	0.137 (1.36)	0.166 (1.34)	**0.297*** **(1.84)**	0.133 (0.81)	0.152 (0.68)
$Liquidity_{it-n} * FinInterm_t$	-0.047 (-0.22)	-0.222 (-1.08)	-0.091 (-0.35)	-0.140 (-0.31)	-0.229 (-0.42)	0.062 (0.07)
$LLR_{it-n} * POST$	**0.046***** **(3.07)**	**-0.041**** **(-2.38)**	0.008 (0.17)	0.002 (0.06)	-0.008 (-0.10)	**-0.201**** **(-2.27)**
$LLR_{it-n} * FinInterm_t$	**-0.290***** **(-2.85)**	**0.189**** **(2.24)**	-0.261 (-1.03)	**-0.271*** **(-1.70)**	0.008 (0.02)	0.885 (1.50)
$ROA_{it-n} * POST$	0.549 (1.15)	-0.073 (-0.11)	-0.719 (-0.96)	-2.157 (-0.75)	-1.378 (-0.52)	-4.701 (-1.55)
$ROA_{it-n} * FinInterm_t$	-0.308 (-0.30)	0.698 (0.33)	**1.823**** **(2.06)**	2.894 (0.66)	3.812 (0.65)	**24.21**** **(2.35)**

$POST$	0.00 (omitted)	0.717 (1.35)	0.767 (1.12)	0.694 (0.76)	0.196 (0.22)	-0.774 (-1.03)
Instruments (a)	2-3 (a)	2-3 (a)	2-3 (a)	2-3 (a)	2-3 (a)	2-3 (a)
Observations	2,994	2,959	2,927	2,896	2,870	2,838
No. of observations	97	97	97	97	97	97
No of groups	129	126	125	123	121	121
Quarter Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Wald test Prob>(chi2)	**237.50*** (0.000)**	**166.70*** (0.000)**	**316.09*** (0.000)**	**130.04*** (0.000)**	**183.30*** (0.000)**	**205.50*** (0.000)**
AR(1) (d)	**-3.05*** (0.002)**	**-4.96*** (0.000)**	**-5.02*** (0.000)**	**-4.70*** (0.000)**	**-4.92*** (0.000)**	**-4.50*** (0.000)**
AR(2) (d)	0.38 (0.70)	-0.37 (0.71)	0.23 (0.85)	1.10 (0.27)	1.04 (0.30)	1.54 (0.12)
Hansen test (c)	45.65 (0.249)	**50.78* (0.09)**	**53.74** (0.04)**	**60.98*** (0.00)**	**54.88** (0.02)**	**54.61*** (0.01)**

Notes: $Intrate$ represents the implicit interest rate; $LogTA$ represents the logarithmic function of the total assets of the financial institution in the reference quarter $Maturity$ represents the maturity of the deposits; $Depgr$ represents the deflated logarithm of the total deposits of the quarter minus log of the total deposits of the previous quarter; $Default$ represents the amount of credit operations classified in the E-H ratings over total assets; $Liquidity$ represents the sum of financial assets available for sale and trading over total assets; $Equity_{it}$ represents total equity over total assets; LLR represents loan loss reserves over total assets; ROA represents return on assets (12 months); $EfDPGE$ represents the log of the total volume of deposits in this modality ($lnDPGE_{it}$) with the percentage of deposits over 90 days over the total deposits; $POST$ represents a dummy which assumes the value of 1 in the period before the increase in insurance coverage and 0 otherwise; $FinInterm$ represents the growth of independent brokerage firms.

(a) In the xtabond2 command of the stata software, the gmmstyle option was used with the variables without lag.

(b) The model used was GMM-Sys, in first differences (orthogonal) of two steps, robust for heteroscedasticity.

(c) The Hansen test confirms the validity of the lagged variables as instruments.

(d) The AR (1) and AR (2) test the first and second order correlation respectively. The validity of the model is given by the rejection of the second order correlation.

***, ** e * denote significance at 1, 5, and 10%, respectively.

(i) refers to the model with the dependent variables included with a lag of 1 period (1 quarter), (ii) refers to the model with dependent variables included with a lag of 2 periods (2 quarters), and so on until (vi).

Table 8 – Estimation results for maturity mechanism ($Maturity_{it}$) – GMM Systemic

	Modelos (b)					
Variável	**(i)**	**(ii)**	**(iii)**	**(iv)**	**(v)**	**(vi)**
$Maturity_{it-n}$	**0.372*** **	**0.223** **	**0.711*** **	**0.672*** **	**0.515*** **	**0.518*** **
	(4.10)	**(2.23)**	**(4.57)**	**(5.08)**	**(3.90)**	**(3.67)**
$LogTA_{it-n}$	0.023	**0.036***	**0.042***	**0.031***	**0.061** **	**0.037***
	(1.16)	**(1.87)**	**(1.72)**	**(1.72)**	**(2.52)**	**(1.73)**
$Default_{it-n}$	-0.039	0.770	0.275	1.181	0.981	**2.451** **
	(-0.10)	(1.51)	(0.71)	(1.57)	(1.38)	**(2.31)**
$Equity_{it-n}$	**0.364***	0.272	0.327	0.153	**0.613***	0.174
	(1.67)	(1.28)	(1.05)	(0.82)	**(1.96)**	(0.69)
$Liquidity_{it-n}$	-0.072	0.041	0.175	**0.280** **	**0.317***	**0.395***
	(-0.70)	(0.43)	(1.60)	**(2.01)**	**(1.93)**	**(1.94)**
LLR_{it-n}	0.003	**0.006** **	-0.013	-0.019	-0.016	**-0.021** **
	(0.55)	**(2.35)**	(-0.84)	(-1.38)	(-0.96)	**(-2.03)**
ROA_{it-n}	-0.185	0.108	-0.086	**1.659***	-1.055	-1.075
	(-0.75)	(0.30)	(-0.26)	**(1.81)**	(-0.77)	(-0.68)
$Intrate_{it-n}$	0.035	0.046	0.115	0.227	**0.291** **	**0.474** **
	(0.91)	(1.30)	(1.01)	(1.53)	**(2.31)**	**(2.44)**
$VarDep_{it-n}$	0.001	0.019	0.019	**-0.151** **	0.017	0.021
	(0.08)	(1.50)	(0.30)	**(-1.93)**	(0.34)	(0.22)
$EfDPGE_{it-n}$	0.001	0.003	**0.007***	0.004	**0.008***	0.001
	(0.43)	(1.42)	**(1.67)**	(1.40)	**(1.69)**	(0.06)
$LogTA_{it-n} * POST$	**0.033***	0.033	0.001	-0.004	-0.010	-0.032
	(1.75)	(1.47)	(0.11)	(-0.32)	(-0.53)	(-1.43)
$LogTA_{it-n} * Cindep_t$	**-0.085***	**-0.141** **	-0.103	-0.086	**-0.108***	-0.028
	(-1.92)	**(-2.28)**	(-1.45)	(-1.17)	**(-1.69)**	(-0.32)
$Default_{it-n} * POST$	0.474	0.351	0.328	**-1.545** **	-0.604	-0.784
	(1.37)	(0.79)	(0.66)	**(-2.18)**	(-0.58)	(-0.66)
$Default_{it-n}$	-0.525	**-2.255** **	**-1.766** **	-0.228	-0.727	-3.801
$* Cindep_t$	(-0.67)	**(-2.15)**	**(-2.05)**	(-0.18)	(-0.77)	(-1.55)
$Equity_{it-n} * POST$	0.445	0.356	0.049	0.074	0.017	-0.476
	(1.56)	(1.23)	(0.25)	(0.34)	(0.06)	(-1.50)
$Equity_{it-n}$	**-1.086***	**-1.318***	-0.878	-1.135	**-1.653***	-0.149
$* FinInterm_t$	**(-1.86)**	**(-1.90)**	(-0.99)	(-1.38)	**(-1.91)**	(-0.13)
$Liquidity_{it-n} * POST$	**0.168** **	0.092	0.014	-0.204	-0.194	-0.189
	(1.98)	(0.98)	(0.14)	(-1.63)	(-1.15)	(-0.97)
$Liquidity_{it-n}$	-0.123	-0.230	**-0.394***	-0.089	-0.162	-0.186
$* FinInterm_t$	(-0.66)	(-1.16)	**(-1.96)**	(-0.33)	(-0.63)	(-0.40)
$LLR_{it-n} * POST$	-0.012	-0.028	0.012	0.016	-0.018	-0.016
	(-0.89)	(-1.27)	(0.39)	(0.59)	(-0.32)	(-0.22)
$LLR_{it-n} * FinInterm_t$	-0.039	-0.034	-0.124	-0.078	0.072	-0.384
	(-0.53)	(-0.43)	(-1.21)	(-0.85)	(0.22)	(-0.61)
$ROA_{it-n} * POST$	0.182	-0.077	0.039	-1.748	0.253	2.442
	(0.59)	(-0.21)	(0.09)	(-1.56)	(0.18)	(1.32)
$ROA_{it-n} * FinInterm_t$	0.305	-0.597	-0.172	0.150	0.590	**-6.409***
	(0.74)	(-1.52)	(-0.30)	(0.11)	(0.40)	**(1.71)**
$POST$	**0.862***	-1.249	-0.954	-0.735	**-1.207** **	0.827
	(1.68)	(-1.54)	(-1.60)	(-1.37)	**(-2.11)**	(1.44)

Instruments (a)	2-3 (a)	2-3 (a)	2-3 (a)	2-3 (a)	2-3 (a)	2-3 (a)
Observations	2,994	2,960	2,928	2,897	2,871	2,839
No. of observations	97	97	97	97	97	97
No of groups	129	126	125	123	121	121
Quarter Dummy	Sim	Sim	Sim	Sim	Sim	Sim
Wald Test Prob>(chi2)	**9,063*** (0.000)**	**5,824*** (0.001)**	**11,996*** (0.000)**	**11,447*** (0.000)**	**8,255*** (0.000)**	**666.7*** (0.000)**
AR(1) (d)	**-5.20*** (0.000)**	**-5.17*** (0.000)**	**-5.65*** (0.000)**	**-4.93*** (0.000)**	**-5.54*** (0.000)**	**-4.97*** (0.000)**
AR(2) (d)	**2.40** (0.016)**	**-2.14** (0.032)**	**3.13* (0.002)**	1.16 (0.245)	1.00 (0.316)	-0.60 (0.547)
Hansen test (c)	**57.69** (0.035)**	**72.04*** (0.001)**	**55.24** (0.035)**	38.75 (0.391)	46.87 (0.106)	**49.62* (0.052)**

Notes: $Intrate$ represents the implicit interest rate; $LogTA$ represents the logarithmic function of the total assets of the financial institution in the reference quarter; $Maturity$ represents the maturity of the deposits; $Depgr$ represents the deflated logarithm of the total deposits of the quarter minus log of the total deposits of the previous quarter; $Default$ represents the amount of credit operations classified in the E-H ratings over total assets; $Liquidity$ represents the sum of financial assets available for sale and trading over total assets; $Equity_{it}$ represents total equity over total assets; LLR represents loan loss reserves over total assets; ROA represents return on assets (12 months); $EfDPGE$ represents the log of the total volume of deposits in this modality ($lnDPGE_{it}$) with the percentage of deposits over 90 days over the total deposits; $POST$ represents a dummy which assumes the value of 1 in the period before the increase in insurance coverage and 0 otherwise; $FinInterm$ represents the growth of independent brokerage firms.

(a) In the xtabond2 command of the stata software, the gmmstyle option was used with the variables without lag.

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(c) The Hansen test confirms the validity of the lagged variables as instruments.

(d) The AR (1) and AR (2) test the first and second order correlation respectively. The validity of the model is given by the rejection of the second order correlation.

***, ** e * denote significance at 1, 5, and 10%, respectively.

(i) refers to the model with the dependent variables included with a lag of 1 period (1 quarter), (ii) refers to the model with dependent variables included with a lag of 2 periods (2 quarters), and so on until (vi).