3 Market Liquidity and Funding Liquidity in a Bank Run:The Brazilian DPGE Experiment

3.1.Introduction

Systemic banking crisis draw extensive attention from economists. Laeven & Valencia (2010) estimate a median output loss of 25 percent of GDP in the last recent crisis and a median increase in public debt of about 24 percent of GDP with the measures taken thereof. The United States government's intervention in the financial sector following the recent world financial crisis imposed on taxpayers a cost between 21 and 44 billion dollars, according to Veronesi & Zingales (2010). Facing a bank run, policymakers often react providing liquidity support, increasing guarantees for bank liabilities or intervening in the banking industry via nationalization, decreeing bank holidays, freezing deposits or buying banking assets[11]. Among those instruments, guarantees on banks' liabilities have a direct impact on preventing bank runs as showed by Diamond & Dybvig (1983). However, they also increase moral hazard because depositors have less incentive to monitor banks' risk taking behavior (Dermiguç-Kunt & Detragiache, 2002). Governments usually implement an increase in insurance by raising the deposit insurance cap limit across the board or by issuing blanket guarantees[12].

In this paper I take advantage of a series of events in Brazil during the most acute period of the 2008 global financial crisis to study the relationship between market and funding liquidity, and to study the impact of deposit insurance during a bank run. I argue that the Brazilian emergency voluntary deposit insurance experiment provides interesting insight on several questions that remain unanswered empirically. Following the Lehman Brothers' bankruptcy,

[11] See Laeven & Valencia (2010) for a comprehensive description of recent bank crises and policymakers reactions

[12] According to Leaven and Valencia (2009), blanket guarantees and the liquidity provision measures associated with a crisis have large fiscal costs, although they successfully reduce the withdrawals of deposits from the banking system.

Brazilian small and medium-sized banks experienced a run on deposits[13]. Figure 3.1 depicts the evolution of total time deposits from small and medium banks in the period encompassing the bank run. After a series of conventional measures to provide liquidity, such as reducing reserve requirements and providing incentives to credit assignments, a new deposit insurance scheme was introduced on April 1st 2009. This new instrument called DPGE (Time Deposits with Special Insurance), insured deposits of up to R$ 20 million, while conventional time deposits were insured up to R$ 60 thousand[14]. The issuance under this new scheme is optional, and the product is expensive: issuers must pay a monthly premium more than six times the value charged on conventional deposits. Deposits recovered after the launching of DPGE since part of the banks chose to adopt this new instrument (while others chose not to).

Using these events, I contribute in several ways to the literature. The first contribution is documenting a bank run on small and medium-sized banks in Brazil after the deepening of global financial crisis led mostly by institutional investors. Second, I document a recovery after the launching of DPGE. I also show a marked heterogeneity among banks that chose to use the issue DPGEs. After the legal establishment of DPGE, general concerns about bank funding liquidity abated. However, only a part of small and medium-sized banks opted to issue under this new insurance scheme. Those banks revealed being more affected by market liquidity shock. In fact, I also investigate the determinants of issuing DPGE and find that banks with less liquid assets and relying more on a well-functioning market for credit assignments issued more DPGE. In particular, banks with more credit-to-assets ratios and with a larger amount of credit assignments before the crisis are more likely to issue DPGEs deposits. While higher credit-to-asset ratio indicates a more illiquid asset, higher credit assignment over total credit shows a more dependence of buyers to liquidate their assets.

These results are in line with Brunnermeier & Pedersen (2009) predictions that market liquidity and funding liquidity reinforce each other during a crisis. Although I do not establish which type of shock (funding versus market) ignited the Brazilian bank run, I find that banks that also suffered more from market

[13] Oliveira et al (2011) compares this bank run with an increase on big bank deposits in an empirical study about a "too big to fail" perception from depositors.

[14] This amount was raised to R$70 thousand in December/2010.

illiquidity during the crisis chose to issue DGPE. Despite attempts from the monetary authority to restore market liquidity, those banks only managed to recover their deposits after the new deposit insurance was made available. This provides evidence of another aspect of the relationship between funding and market liquidity: they may act as substitutes during a banking crisis. Moreover, given heterogeneity among banks in a bank crisis, the Brazilian experience suggests that a voluntary insurance scheme may have desirable features. Instead of raising amounts insured across the board, an optional (and expensive) scheme allows banks that most need it to self-select into the insurance scheme. The higher cost of insurance and signaling from issuing DPGE is paid only for those that are more affected by market illiquidity. Finally, given the recovery after the introduction of DPGE, the Brazilian experiment suggests that, at least with the case in hand, concerns about adverse signaling effects turned out not relevant in practice, a result interesting per se.

My work is related to Oliveira et al (2011). They investigate the same bank run on small and medium-sized banks in order to test the conjecture of "a too big to fail" perception from depositors. They also documented institutional investors leading the bank run. Complementing their study, I focus on DPGE adoption to end the run and identify some determinants for its issuing.

This chapter is structured as follows. The next section describes the features of DPGE. Section 3.3 describes the data and provides a descriptive analysis. Section 3.4 develops the empirical analysis. Section 3.4.1 addresses the determinant of the bank run. Sections 3.4.2 and 3.4.3 investigate respectively the determinants of DPGE issuance and the relevance of this instrument to the funding of those issuers banks. Section 3.4.4 examines the role of this new instrument on the deposits recovery. Section 3.5 concludes.

3.2. The Time Deposits with Special Insurance - DPGE

The Brazilian Monetary Council (CMN – *Conselho Monetario Nacional*) launched DPGE through the Act 3692 on March 26, 2009. According to this legislation, since April 1st of 2009, all banks would be entitled to issue a new Certificate of Deposits (CD) with a larger amount insured. While the other type of deposits (including demand deposits and saving accounts) were already insured

until R$ 60 thousand[15] for each investor in a bank, DPGE were protected to R$ 20 million per depositor in each bank.

Both insurance types were granted by a Credit Guarantee Fund, called FGC (*Fundo Garantidor de Credito*). This fund is privately managed and its directory board is nominated by banks that contribute with the fund patrimony. Insurance contributions are mandatory and based on the total amount of deposits held by banks. While the total amount of conventional deposits are charged monthly at 0.0125%, the insurance paid over DPGE amount is 0.0833% monthly. Fund patrimony is subject to public disclosure of information requirements and their director appointment must be approved by the Central Bank.

DPGE has also other distinguishing features. Banks have a cap limit for its issuing, which cannot exceed R$ 5 billion, and it is determined by the maximum of twice the Tier 1 Capital Amount in December 2008 or the amount of total deposits in June, 2008. Conventional time deposit maturities are freely negotiated between the bank and the investor, and the amount invested in a bank may be withdrawn before maturity, with or without penalty charges. Conversely, DPGE maturity must be between 12 and 60 months, and the CD cannot be redeemed before the contract deadline.

3.3. Data and Descriptive Statistics

3.3.1.Data Sources

Data employed in this work is provided by the Central Bank of Brazil. There are basically three sources of data. The Cosif database comprises detailed balance sheet data for all banks, including incoming and earnings reports and capital adequacy ratios. PESP has information about all kinds of deposits disaggregated by type of investor: institutional investors, other financial institutions, non-financial firms and individuals. Finally, the SCR database contains all credit operations with an amount larger than R$ 5 thousand. I have information of loans granted and outstanding by bank disaggregated by type of loans, maturity and risk classification. I also have the amount of credit overdue.

[15] This amount was raised to R$70 thousand in December/2010.

I collected monthly data from January, 2006 until December, 2010. In the analysis, banks are divided into three groups: big and state-owned banks, small and medium banks that issued DPGE, and small and medium banks that didn't use that instrument. In the sample, there are 34 institutions in the group of non-DPGE issuers, 46 in the group of issuers, and 13 in the group of large and state-owned banks. Table 3.1 provides a brief description of the main variables.

Table 38: Definitions and notation. The table reports the notation, definition and possible values of the variables used in the analysis

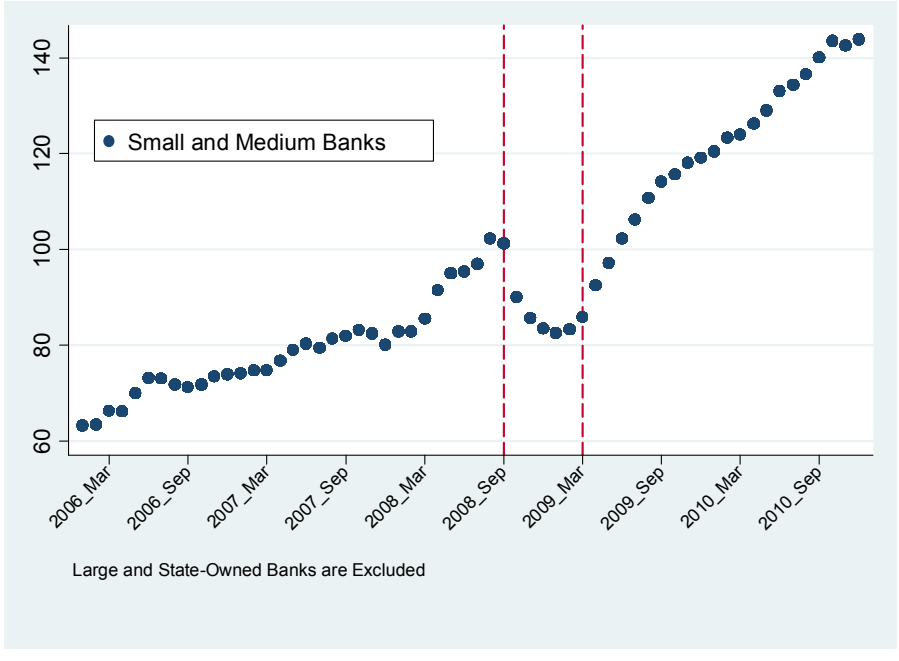
	Description
(A) Asset Characteristics	
Credit-to-Asset Ratio	Ratio of credit to current and long-term assets
Low Quality Loans	Proportion of loans overdue for more than 90 years or with a credit rating below "D"
Bank Size (log)	Natural logarithm of current and long-term asset
Credit Assignments	Ratio of credit assignments with joint liabilities to credit book
(B)Liability Characteristics	
Institutional Investors	Proportion of institutional investors in time deposits
Time Deposits Ratio	Ratio of time deposits to current and long-term assets.
Foreign Funding	Ratio of foreign funding to current and long-term assets. Foreign funding is defined by the sum of the values of liabilities for foreign loans, liabilities in foreign currency, liabilities for securities issued in foreign countries and liabilities for onlendings abroad
Equity Ratio	Ratio of tier 1 capital to current and long-term assets
DPGE Issuer	Indicator that the bank issued DPGE after the crisis. On the regressions of table 3.6, the indicator is that the bank issued DPGE before June, 2009.
Time Deposit Losses	Difference between natural logarithm of time deposits on June, 2008 minus natural logarithm of time deposits on March, 2009.
Change in Time deposits after the crisis	Difference between natural logarithm of time deposits on June, 2009 minus natural logarithm of time deposits on March, 2009.
Proportion of DPGE on Deposits	Ratio of DPGE and total bank deposits in June, 2009
Proportion of DPGE on Time Deposits	Ratio of DPGE and total time deposits in June, 2009

3.4.Descriptive Statistics

Figures 5 and 6 display the evolution of time deposits from 2006 to 2010, by group of banks. While big banks enhanced their time deposits from December 2007 until the launching of DPGE, small and medium banks had their deposits increased until Lehman's failure, facing then a downturn until March, 2010. The graph shows a sharper reduction for those banks that eventually issued DPGE. In Brazil, depositors did not run against banks across the board. Instead, the run was concentrated in small and medium-size banks[16]. In the last quarter of 2008, the first measures were implemented by the monetary authority in order to restore liquidity to those banks, including reserve requirements release, incentives for credit assignment and entitling the FGC to buy banking assets.

[16] See Banco Central do Brasil (2009), pg 42.

Figure 4– **Evolution of Total Time Deposits (R$ Billion) of Small and Medium banks. Right graph shows the evolution of deposits dividing small and medium banks in DPGE issuers and non-Issuers DPGE issuers and non-issuers**



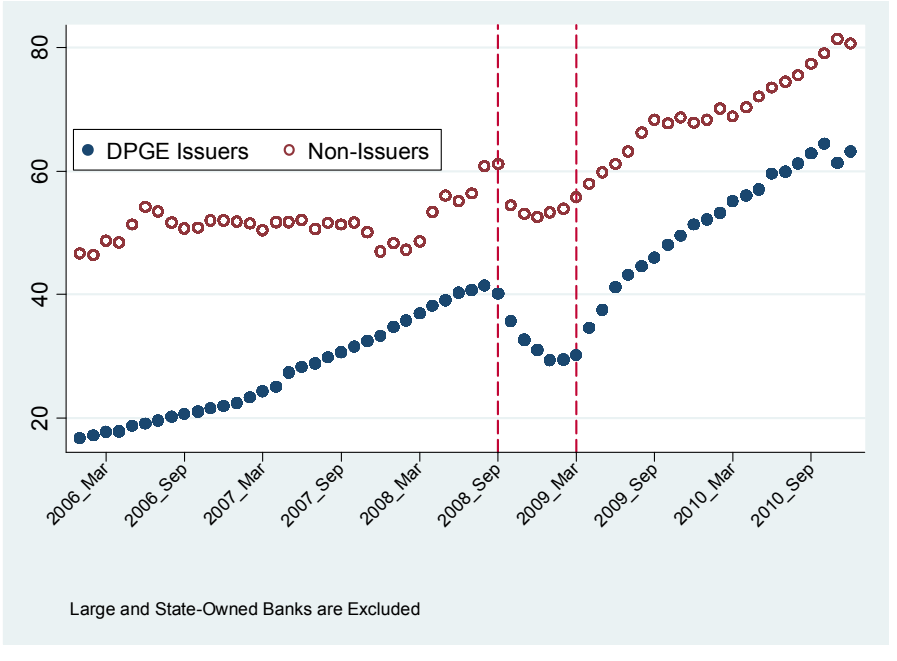


Figure 5 – **Evolution of Time Deposits by group of banks**

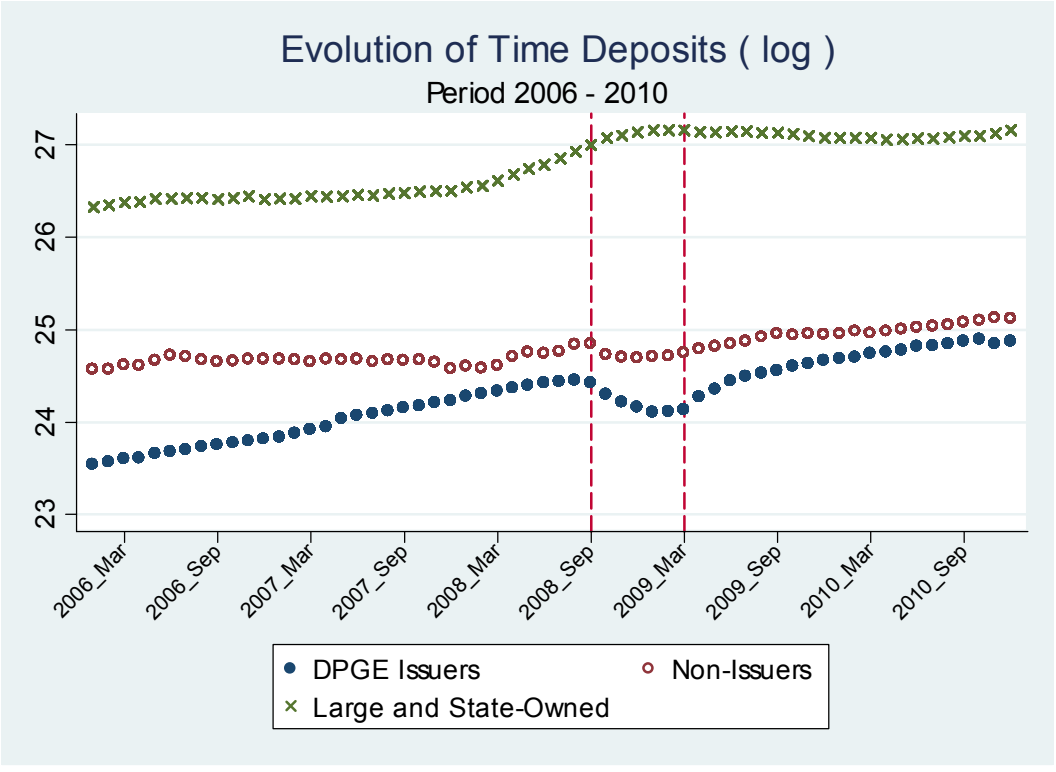


Table 39 shows some descriptive statistics of three groups of banks: large and state-owned banks, small and medium banks that issued DGPE and the others non-issuers. I report three moments in time: December 2007 (when the crisis were still restricted to US and UK), June 2008 (the latest quarter before the crisis contagious in Brazil) and March 2009 (last quarter before DPGE is put in place).

Table 39 - Descriptive Statistics

Variables	December, 2007			June, 2008			March, 2009		
	Small and Medium Banks		Big and State-	Small and Medium Banks		Big and State-	Small and Medium Banks		Big and State-
	Non-Issuers	DPGE Issuers	Owned Banks	Non-Issuers	DPGE Issuers	Owned Banks	Non-Issuers	DPGE Issuers	Owned Banks
Time Deposits (BRL Millions)	1,290	723	18,700	1,550	874	24,600	1,640	651	47,500
	(448)	(129)	(5980)	(576)	(162)	(7620)	(638)	(115)	(16200)
Log(Time Deposits)	19.26	19.43	22.46	19.78	19.63	22.77	19.66	19.42	23.12
	(0.395)	(0.255)	(0.533)	(0.317)	(0.249)	(0.52)	(0.368)	(0.228)	(0.6)
Share of Institutional Investors	0.165	0.276	0.064	0.143	0.251	0.079	0.126	0.174	0.066
	(0.048)	(0.043)	(0.028)	(0.042)	(0.039)	(0.033)	(0.031)	(0.031)	(0.023)
Credit Assignments-to-Loan Book Ratio	0.028	0.182	0.013	0.032	0.158	0.012	0.046	0.191	0.006
	(0.013)	(0.038)	(0.008)	(0.015)	(0.032)	(0.007)	(0.021)	(0.035)	(0.003)
Loan Book-to-Assets Ratio	0.332	0.452	0.302	0.368	0.494	0.303	0.339	0.439	0.337
	(0.05)	(0.033)	(0.025)	(0.05)	(0.033)	(0.024)	(0.04)	(0.028)	(0.018)
Log (Current and Long Term Assets)	21.490	20.713	24.024	21.563	20.842	24.178	21.578	20.733	24.375
	(0.337)	(0.217)	(0.56)	(0.332)	(0.213)	(0.555)	(0.371)	(0.213)	(0.6)
Time Deposits-to-Assets Ratio	0.243	0.415	0.262	0.298	0.421	0.303	0.252	0.377	0.329
	(0.038)	(0.033)	(0.04)	(0.047)	(0.033)	(0.046)	(0.042)	(0.031)	(0.04)
Share of Low Quality Loans	0.045	0.056	0.077	0.044	0.041	0.069	0.067	0.087	0.070
	(0.014)	(0.015)	(0.009)	(0.014)	(0.009)	(0.007)	(0.016)	(0.01)	(0.007)
Share of Foreign Funding	0.378	0.153	0.139	0.355	0.157	0.116	0.409	0.215	0.095
	(0.058)	(0.032)	(0.042)	(0.056)	(0.031)	(0.034)	(0.054)	(0.037)	(0.029)
Change in Credit Assignments in the Crisis							0.011	0.033	-0.006
							(0.012)	(0.015)	(0.006)
Losses in Time Deposits During the Crisis							0.176	0.207	-0.344
							(0.171)	(0.08)	(0.119)

Note: The table above shows descriptive statistics for bank variables, grouped in DPGE issuers (46 banks), non-issuers (34 banks) and large and state-owned banks (13 banks). Losses in time deposits are defined as the negative of the change in logarithm of time deposits. Other variables are reported in December 2007, June 2008 and March 2009. We present the means and stardard-deviation (in parenthesis) of each variable. See table 3.1 for variable description.

Compared with the medium and small-sized banks, non-issuers are in average larger than issuers, measured by current and long term assets[17], have smaller proportion of institutional investors, smaller loan book-to-assets ratio, and assign less credit. Non-issuers also have a smaller proportion of low quality loans, depend less on time deposits and rely more on foreign funding.

Comparing December 2007 to June 2008, one observes a reduction in institutional investors as a share of overall deposits for both the small and medium-sized banks and the non-issuers group. Thus, the bank run was led by the more informed group, as expected. Figure 7 shows the evolution of time deposits owned by institutional investors. Institutional investors increase the amount of CDs from the DPGE issuer group until March 2008, when the trend is reversed. The reversal of the institutional investor trend for the non-issuer group occurs in September 2008, when the bank run started (see Figure 3.1). Figures 8 through 10 depict the evolution of CD from Individuals, Non-Financial Firms and Financial Institutions, respectively. The DPGE issuer group experiences higher withdrawals from all types of depositors, but the phenomenon is more salient for financial institutions.

[17] We excluded Permanent Assets from the analysis since it may be a misleading measure for banking industry.

Figure 6– **Evolution of Time Deposits held by Institutional Investors**

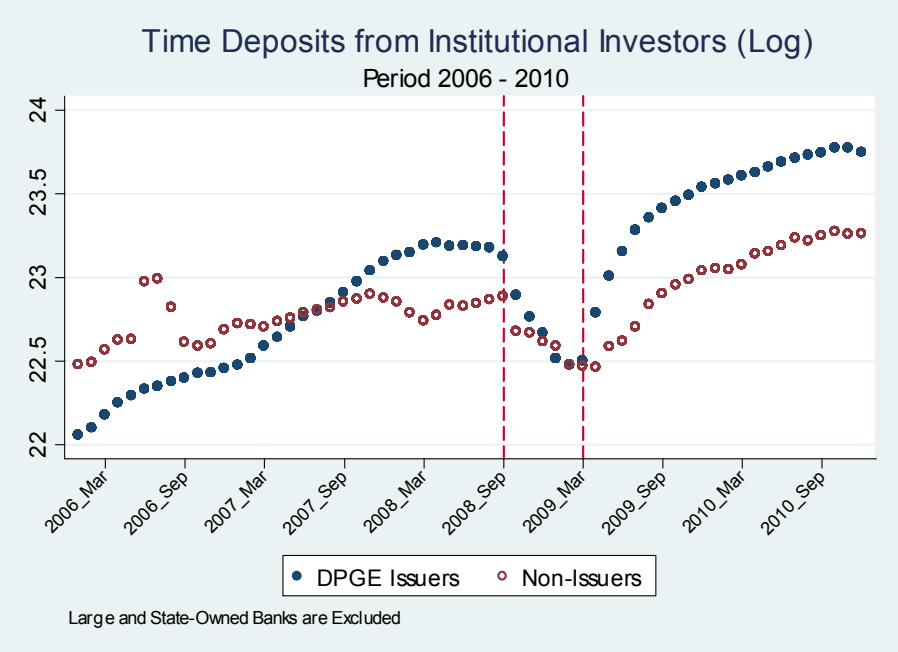


Figure 7 – **Evolution of Time Deposits held by individuals (log)**

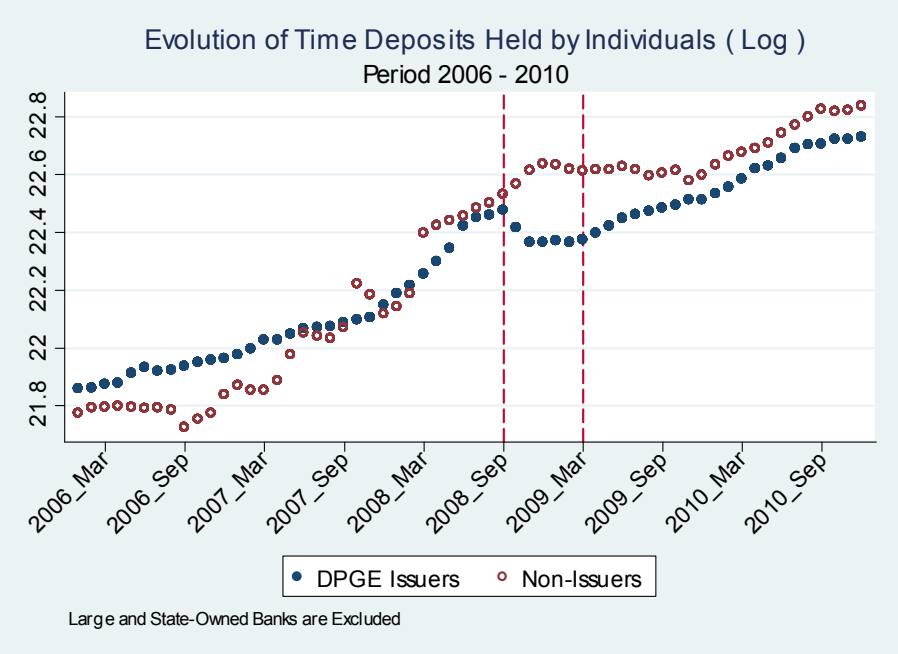


Figure 8 – **Evolution of Time Deposits held by Non-Financial Firms**

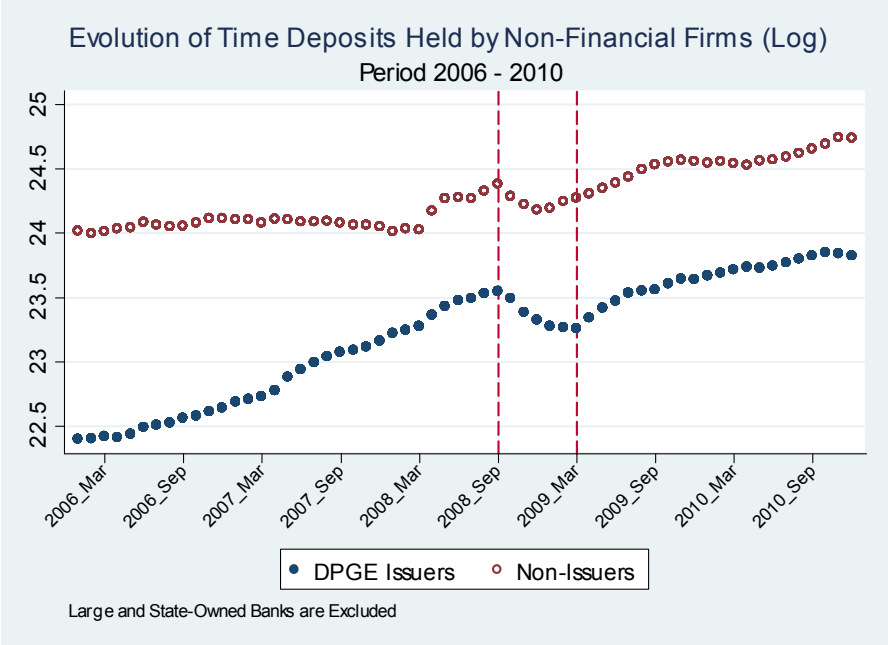


Figura 9 – **Evolution of Time Deposits held by Financial Institutions**

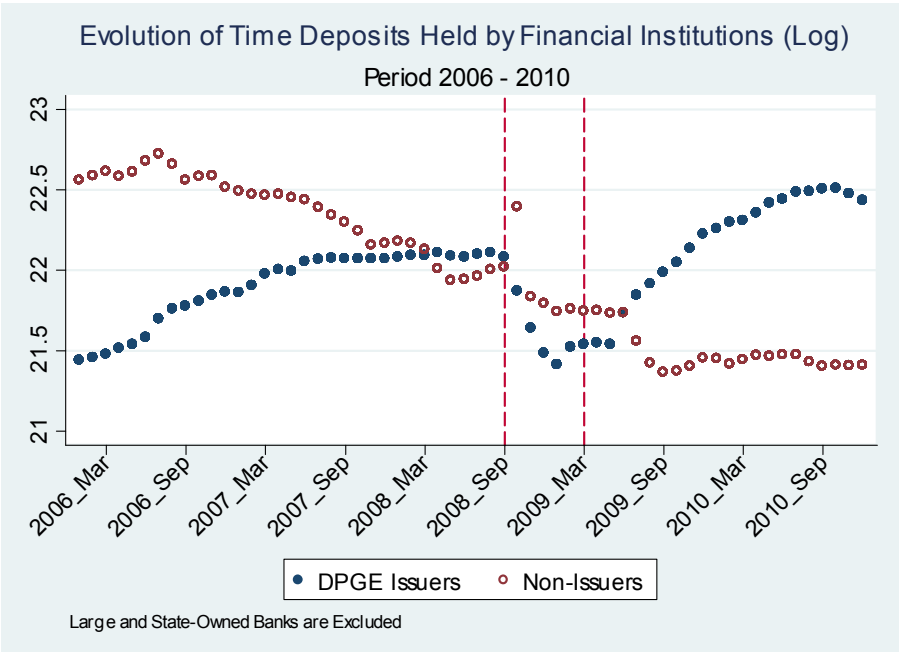


Table 39 also shows a significant reduction in the proportion of credit assignment from the DPGE issuers group. Figure 12 indicates that the reduction in credit assignment for DPGE issuers starts in December 2008, after increasing

sharply between September 2008 and December 8. Before the run, the average credit assignment ratio for the non-issuer group was less than 3%, but started to increase after September 2008, suggesting an increased need to access market liquidity when faced with reduction in funding liquidity.

Figure 10 – **Evolution of Credit-to-Asset Ratio**

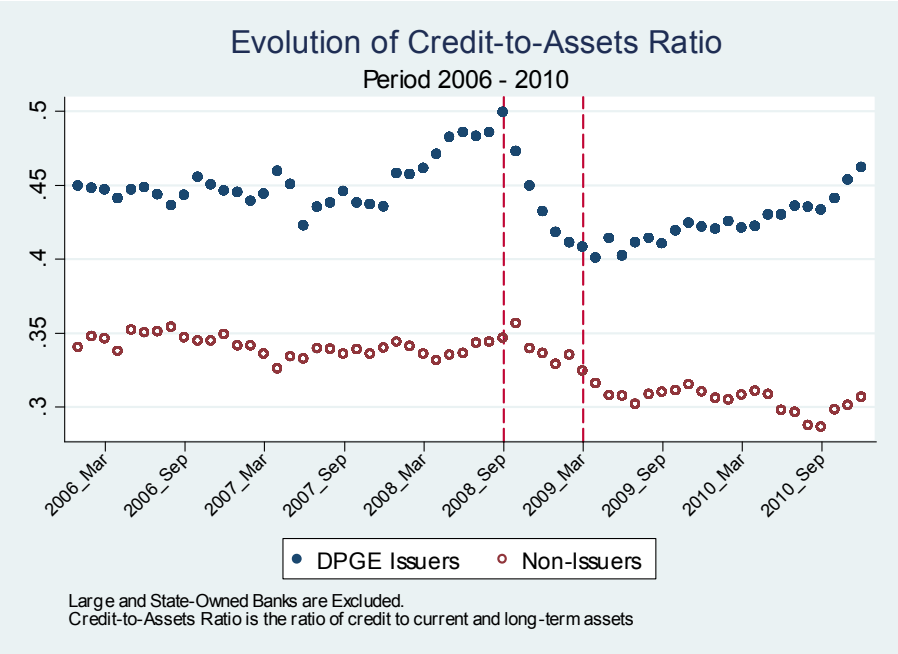


Figure 11– **Evolution of Credit Assignment**

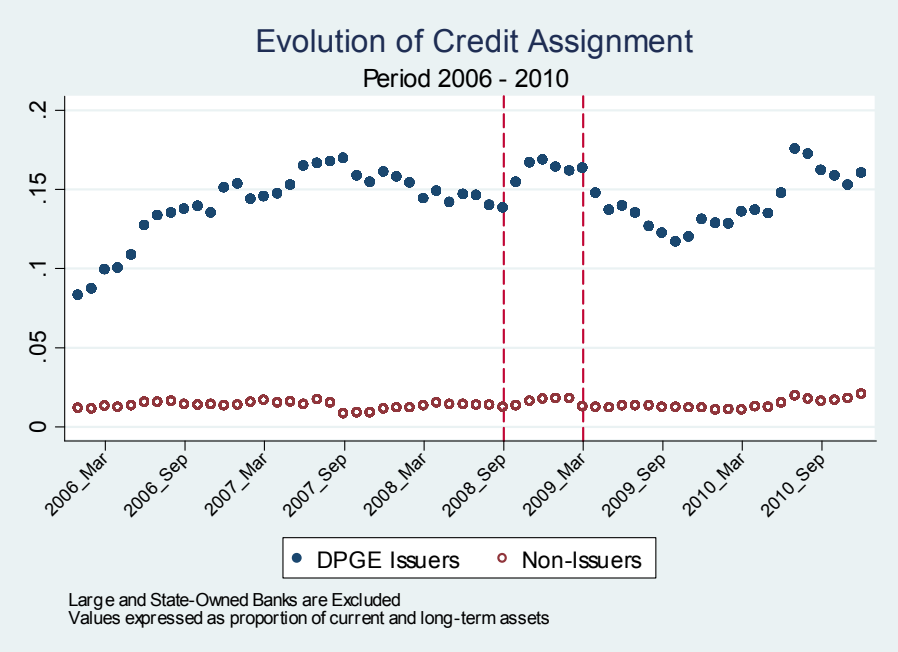


Figure 13 displays the average time deposits ratio from both DPGE issuers and non-issuers. Notice that, while the proportion of time deposits rises in the period immediately preceding the run for the non-issuers group, that proportion dropped after September 2008. Figure 14 displays the average foreign deposit ration from both groups. Both groups had experienced an increase on those ratios during the crisis, the effect being stronger for DPGE issuers.

Figure 12 – **Evolution of Time Deposits Ratio**

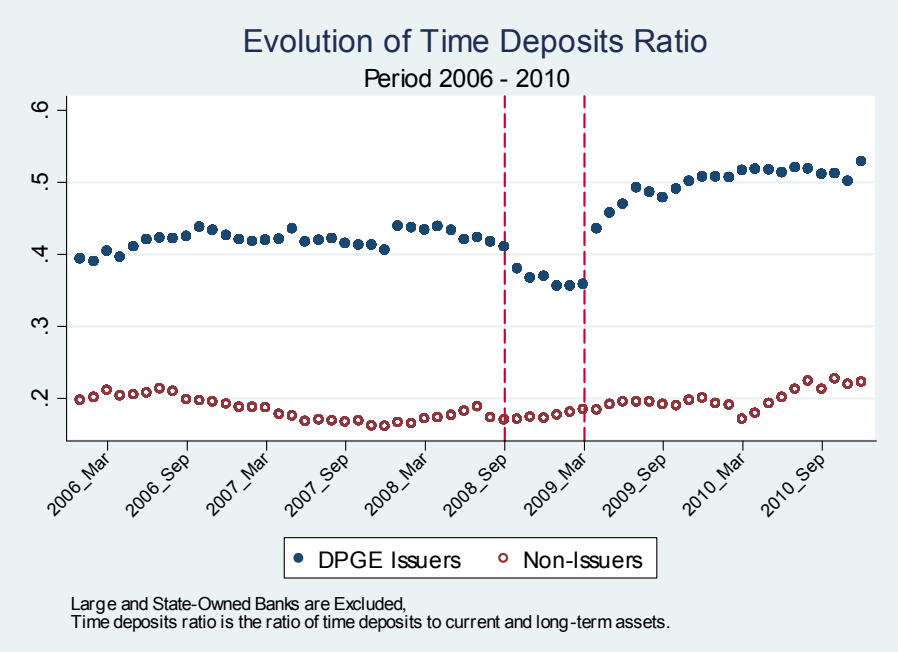
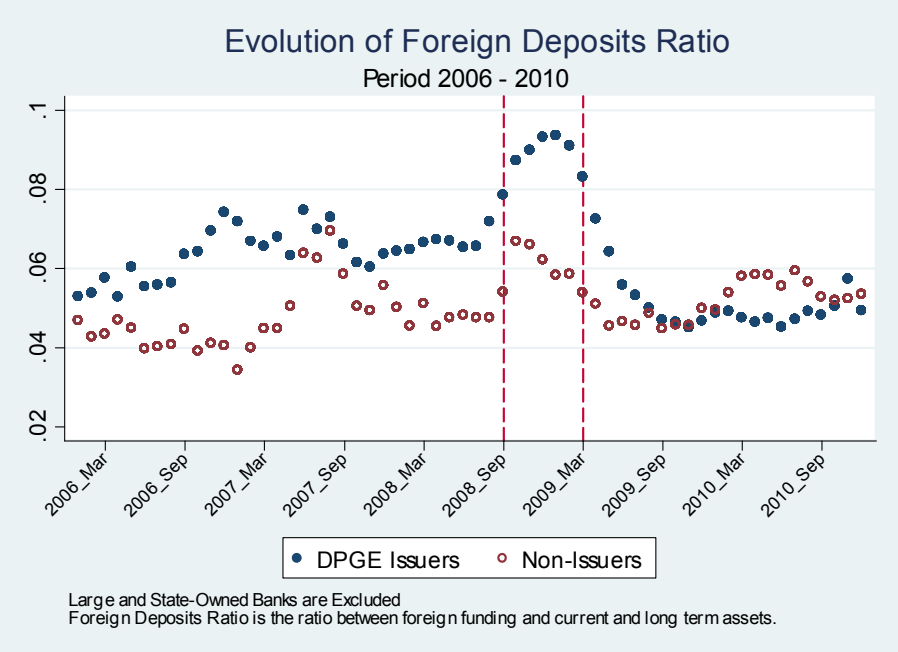


Figure 13– **Evolution of Foreign Deposits Ratio**



3.5. Empirical Analysis

3.5.1.Determinants of the Bank Run

The descriptive analysis shows that small and medium banks experienced a run against their deposits. I first investigate the determinants of the bank run: what features beyond size, if any, explain the run? In other words, I investigate whether features normally associated with fragility – both on the asset and liability sides of the balance sheet - are indeed predictive of larger withdraws of deposits.

I define the measure of bank run as the negative of the change in log of time deposits between June 2008 and March 2009. In order to avoid any influence of the crisis in the explanatory variables, I take their values from December 2007, when USA crisis had not yet contaminated Latin America[18]. Relying on a cross-sectional analysis with few banking observations, I investigated separately whether features related to banking assets or banking liabilities are correlated to the intensity of the banking run. I estimate the following model:

[18] Laeven & Valencia (2009) consider that the last World Financial Crisis started in 2007 only from US and UK. They consider it impacting other countries only in 2008. Brazil in 2008-2009 is not a country with a systemic banking crisis according to their criteria.

$$Deposit\ Losses_i = \alpha + \beta.\text{bank characteristics}_{i200712} + \varepsilon_i \quad (1)$$

Table 40 has the results. Panel A restricts analysis to asset features that could determine the intensity of the bank run. In columns (1) through (3) the sample contains all banks. In columns (4) through (6) I restrict the analysis to small and medium-sized banks. The coefficients on bank size and equity ratio have the expected signs. Higher bank size and higher equity ratio indicate solidity and are associated with less withdrawal. One should notice that bank size is the only variable whose coefficient is statistically significant in all specifications and samples. In contrast, equity ratio, albeit the expected sign, is not statistically different from zero in any specification.

Credit assignments and low quality loans shows a negative correlation with the loss of deposits measure. Although credit assignment is not statistically significant in any regression, low quality loans are significant in five of the six regressions. While one could have expected that banks that assign their book credit and show more delinquency in their credit book would be more affected facing a funding liquidity shock, results show the opposite. Similarly, a higher credit-to-asset ratio also would indicate less asset liquidity and, therefore, would be positively correlated with the depositors' withdrawals. This indeed is the case for this measure, although I do not find any statistical significance.

Taking all under consideration, I do not find evidence that asset characteristics are associated with the depositors' withdrawals. It does not appear to be those with higher asset fragility that suffered the most with the bank run. Conversely, a depositor run seems to affect all small and medium banks despite some features that could signal better liquidity conditions from the asset side of their balance sheet.

Panel B focuses the analysis on the liability side of bank balance sheet. I control for bank size and equity ratio in order to avoid that correlation between these variables and those ones of interest distort the estimations. Again, the first three columns include all banks, while the remaining columns have only small and medium-sized banks. The results show evidence of the role played for institutional investors in the bank run. There is a high correlation between the

share of institutional depositors before the crisis contagious and the intensity of depositor withdrawal. I also observe a higher run for those banks having a higher time deposits ratio.

Results from Table 40 suggest that liabilities features, such as share of institutional investors and proportion of time deposits, were more related to the intensity of the bank run than asset characteristics. Panel A relates to market liquidity while Panel B depicts characteristics associated with funding liquidity. Although I cannot rule out the role played by market liquidity, funding liquidity issues were present in the phenomenon studied.

Table 40 - Time Deposits Losses During the Crisis as a Function of Bank Characteristics in December, 2007.

Panel A: Assets

Dependent Variable:	Losses in Time Deposits (log) between 200806 and 200903					
	all sample			no big banks		
	(1)	(2)	(3)	(4)	(5)	(6)
Credit Assignments		-0.320	-0.306		-0.313	-0.293
		(0.287)	(0.277)		(0.295)	(0.285)
Credit-to-Asset Ratio	0.247		0.236	0.294		0.280
	(0.421)		(0.420)	(0.431)		(0.431)
Low Quality Loans	-1.933**	-2.009**	-1.889*	-1.690*	-1.792*	-1.646
	(0.942)	(0.950)	(0.964)	(0.975)	(0.989)	(1.000)
Bank Size (log)	-0.0842**	-0.0985**	-0.0926**	-0.0342	-0.0516	-0.0426
	(0.0344)	(0.0404)	(0.0384)	(0.0471)	(0.0538)	(0.0510)
Observations	93	93	93	80	80	80
R-squared	0.113	0.114	0.119	0.062	0.059	0.068

Note: The panel shows the coefficients for linear models fitted using the negative of the change in log of time deposits as the dependent variable. Columns (1), (2) and (3) use all banks in the sample. Columns (4), (5) and (6) exclude big and state-owned banks. Credit assignments are measured as the proportion of credit assignments with joint liabilities on current and long-term assets. Bank size is defined by the natural logarithm of current and long-term assets. Low quality loans are defined by the proportion of credit overdue for more than 90 days or classified below level D on the credit book. All explanatory variables relate to December 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

Panel B: Liabilities

Dependent Variable:	Losses in Time Deposits (log) between 200806 and 200903					
	all sample			no big banks		
	(1)	(2)	(3)	(4)	(5)	(6)
Institutional Investors		0.574*	0.726**		0.536	0.674*
		(0.311)	(0.327)		(0.372)	(0.364)
Time Deposits Ratio	1.024*		1.256**	1.139**		1.297**
	(0.530)		(0.556)	(0.571)		(0.596)
Foreign Funding			0.318			0.204
			(0.584)			(0.635)
Bank Size (log)	-0.0627	-0.0978**	-0.0485	0.0150	-0.0505	0.00406
	(0.0441)	(0.0475)	(0.0414)	(0.0554)	(0.0692)	(0.0572)
Equity Ratio	-0.500	-0.337	-0.409	-0.364	-0.242	-0.344
	(0.463)	(0.414)	(0.401)	(0.523)	(0.466)	(0.471)
Observations	93	93	93	80	80	80
R-squared	0.143	0.090	0.203	0.118	0.035	0.167

Note: The panel shows the coefficients for linear models fitted using the negative of the change in the logarithm of time deposits as the dependent variable. Columns (1), (2) and (3) use all banks in the sample. Columns (4), (5) and (6) exclude big and state-owned banks. Institutional investors are measured as the proportion of time deposits that came from institutional investors and firms. Bank size is defined by the natural logarithm of current and long-term assets. Time deposit ratio is the ratio of time deposits to current and long-term assets. Foreign funding is the ratio between foreign funding and current and long-term assets. Equity ratio is the ratio between tier 1 capital and current and long-term assets. All explanatory variables relate to December, 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

3.5.2.Determinants of Issuing DPGE

As previously shown, assets characteristics were not associated with the intensity of the deposit withdrawal. I focus now in whether assets and liabilities features are related to the choice of issuing DPGE. I run a Probit model on the same explanatory variables used for modeling loss in time deposits. Again, I separate the analysis into asset and liabilities features.

Table 41 reports the marginal effects of the Probit estimation. Panel A shows that assets features are associated with the chance of issuing DPGE. I find a positive and statistically significant relation between the chance of issuing DPGE and the measures of credit assignment and credit-to-assets ratio. A higher the proportion of credit assignment may indicate that a bank doesn't have enough liquidity assets in order to hold its loans until maturity. Moreover, banks that are used to selling credit book in exchange to liquidity assets may be more affected when a downturn in market conditions occur. The other variable, credit-to-asset ratio is also associated with asset liquidity. Banks with a higher proportion of credit may have more difficulty in cashing their assets when facing a bank run. Low quality loans, bank size and equity ratio do not have statistically significant coefficients.

Panel B shows that liabilities features are also related to DPGE emission. The share of institutional investors and the time deposits-to-assets ratio are both positively and statistically significant in the Probit regression. Intensity of foreign funding does not seem to explain the issuing of DPGE.

Results in table 41 suggest that banks that relied on market liquidity (to offload loans) and banks that relied more on institutional investors before the crisis were more likely to issue DPGE in order to restore their volume of deposits. In next section I document the relation between change in credit assignments and the volume of DPGE issued. Assuming that credit assignment is related to market liquidity and DPGE issuing is associated with funding liquidity, the relationship between credit assignment and issuing DPGE is informative about whether market and funding liquidity act as substitutes or complements.

Table 41 - Issuing DPGE as Function of Bank Characteristics

Panel A: Assets

Dependent Variable:	DPGE Issuer					
	all sample			no big banks		
	(1)	(2)	(3)	(4)	(5)	(6)
Credit Assignments		1.320***	1.303***		1.196***	1.187***
		(0.413)	(0.394)		(0.385)	(0.370)
Credit-to-Asset Ratio	0.395		0.420*	0.345		0.364
	(0.246)		(0.243)	(0.242)		(0.234)
Low Quality Loans	0.210	-0.112	0.0892	0.511	0.162	0.341
	(0.551)	(0.562)	(0.571)	(0.674)	(0.546)	(0.551)
Bank Size (log)	-0.0873***	-0.0776**	-0.0671**	-0.0654*	-0.0577	-0.0462
	(0.0300)	(0.0310)	(0.0311)	(0.0365)	(0.0361)	(0.0365)
Observations	93	93	93	80	80	80
R-squared	0.119	0.185	0.210	0.0760	0.146	0.170

Note: The panel shows the marginal effects in the mean for probit models fitted using the DPGE issuer indicator as the dependent variable. Columns (1),(2) and (3) use all banks in sample. Columns (4), (5) and (6) exclude big and state-owned banks. Credit assignments are measured as the proportion of credit assignments with joint liabilities on current and long-term assets. Bank size is defined by the natural logarithm of current and long-term assets. Low quality loans are defined by the proportion of credit overdue for more than 90 days or classified below level D on the credit book. All explanatory variables relate to December 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

Panel B: Liabilities

Dependent Variable:	DPGE Issuer					
	all sample			no big banks		
	(1)	(2)	(3)	(4)	(5)	(6)
Institutional Investors		0.634***	0.576**		0.490**	0.374*
		(0.223)	(0.226)		(0.219)	(0.222)
Time Deposits Ratio	0.702**		0.462	0.760***		0.488*
	(0.278)		(0.287)	(0.281)		(0.296)
Foreign Funding			-0.372			-0.517
			(0.393)			(0.396)
Bank Size (log)	-0.0303	-0.0800**	-0.0532	0.00170	-0.0654	-0.0216
	(0.0353)	(0.0353)	(0.0369)	(0.0454)	(0.0430)	(0.0478)
Equity Ratio	0.468	0.413	0.523	0.441	0.367	0.527
	(0.378)	(0.370)	(0.384)	(0.408)	(0.381)	(0.414)
Observations	93	93	93	80	80	80
R-squared	0.141	0.164	0.204	0.118	0.0975	0.162

Note:The panel shows the marginal effects in the mean for probit models fitted using the DPGE issuer indicator as the dependent variable. Columns (1), (2) and (3) use all banks in sample. Columns (4), (5) and (6) exclude big and state-owned banks. Institutional investors are measured as the proportion of time deposits that came from institutional investors. Bank size is defined by the natural logarithm of current and long-term assets. Time deposit ratio is the ratio of time deposits to current and long-term assets. Foreign funding is the ratio between foreign funding and current and long-term assets. Equity ratio is the ratio between tier 1 capital and current and long-term assets. All explanatory variables relate to December 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

3.5.3.Determinants of the Amount of DPGE issuance

Previous subsections show that the run on banks was more related to liability features than to asset features. However, banks that relied more on credit assignments as a source of liquidity and whose assets included more credit before the crisis were more likely to become DPGE issuers.

I now investigate the bank features that determined the amount of DPGE issuance. I use the proportion DPGE to total deposits in June 2009 as a measure for its relative importance in the aftermath of the bank run on smaller banks. The advantage of choosing June is that it captures the issuances made to fulfill immediate liquidity needs. I estimate the following model:

$$PropDPGE_i = \alpha + \beta.\,\text{bank characteristics}_{i200712} + \varepsilon_i \quad (2)$$

Table 42 displays the results. I use a Tobit model censored at zero. The same explanatory variables as in table 41 are used, except for the addition of the change in the ratio of credit assignments between June 2008 and March 2009. I include this variable to measure the use of credit assignments as a source of liquidity during the crisis, since reserve requirements' legislation was changed in order to provide incentives for large banks to act as counterparties of these transactions. In columns (1) through (4) all banks are included in the sample. In columns (5) through (8) I exclude large and state-owned banks. In panel A I focus on asset features.

Banks that normally sell more credit also issued more DPGE. Having (as of December 2007) one basis point more of credit assignment as a proportion of loans is associated with issuing roughly two-thirds of a basis-point more of DPGE as a proportion of time deposits. The change in credit assignments during the crisis is also associated with more DPGE as a proportion of deposits. The coefficient on the change in credit assignments is positive and larger than one, showing that banks that had to sell more loans during the crisis also issued more DPGE.

Table 42

Proportion of DPGE on Deposits after the Crisis as Function of Bank Characteristics

Panel A: Assets

Dependent Variable:	Proportion of DPGE in Time Deposits in June 2009							
	all sample				no big banks			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit Assignments		0.687***	0.685***	0.671***		0.661***	0.657***	0.649***
		(0.114)	(0.114)	(0.107)		(0.112)	(0.111)	(0.104)
Credit-to-Asset Ratio	-0.0441		-0.0220	-0.0171	-0.0759		-0.0469	-0.0379
	(0.147)		(0.111)	(0.0969)	(0.146)		(0.110)	(0.0961)
Change in Credit Assignments				1.180***				1.132***
				(0.214)				(0.212)
Low Quality Loans	0.388	0.313	0.302	0.248	0.505	0.426	0.401	0.317
	(0.296)	(0.360)	(0.366)	(0.412)	(0.318)	(0.333)	(0.338)	(0.380)
Bank Size (log)	-0.0753***	-0.0485***	-0.0489***	-	-0.0631**	-0.0389*	-0.0400*	-0.0349*
	(0.0216)	(0.0182)	(0.0183)	(0.0164)	(0.0262)	(0.0218)	(0.0218)	(0.0190)
Observations	93	93	93	93	80	80	80	80
R-squared	0.179	0.406	0.406	0.584	0.141	0.390	0.392	0.587

Note: The panel shows the coefficients for Tobit models fitted using the proportion of DPGE on total bank deposits in June 2009 as the dependent variable. Columns (1) to (4) use all banks in sample. Columns (5) to (8) exclude big and state-owned banks. Credit assignments are measured as the proportion of credit assignments with joint liabilities on current and long-term assets, and its variation is calculated between June 2008 and March 2009. Bank size is defined by the natural logarithm of current and long-term assets. Low quality loans are defined by the proportion of credit overdue for more than 90 days or classified below level D on the credit book. All explanatory variables relate to December 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

Panel B: Liabilities

Dependent Variable:	Proportion of DPGE in Time Deposits in June 2009					
	all sample			no big banks		
	(1)	(2)	(3)	(4)	(5)	(6)
Institutional Investors		0.360***	0.345***		0.306**	0.268**
		(0.118)	(0.118)		(0.122)	(0.124)
Time Deposits Ratio	0.161		-0.0680	0.162		-0.0946
	(0.189)		(0.192)	(0.193)		(0.196)
Foreign Funding			-0.205			-0.279
			(0.184)			(0.196)
Equity Ratio	0.341*	0.336	0.362*	0.320	0.309	0.349
	(0.204)	(0.209)	(0.212)	(0.213)	(0.213)	(0.219)
Bank Size (log)	-0.0505**	-0.0689***	-0.0618**	-0.0405	-0.0648**	-0.0497
	(0.0245)	(0.0231)	(0.0257)	(0.0299)	(0.0273)	(0.0325)
Observations	93	93	93	93	80	80
R-squared	0.202	0.280	0.298	0.391	0.151	0.209

Note: The panel shows the coefficients for Tobit models fitted using the proportion of DPGE on total bank deposits in June 2009 as the dependent variable. Columns (1) to (3) use all banks in sample. Columns (4) to (6) exclude big and state-owned banks. Institutional investors are measured as the proportion of time deposits that came from institutional investors. Bank size is defined by the natural logarithm of current and long-term assets. Time deposit ratio is the ratio of time deposits to current and long-term assets. Foreign funding is the ratio between foreign funding and current and long-term assets. Equity ratio is the ratio between tier 1 capital and current and long-term assets. All explanatory variables relate to December 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

Low quality loans display a positive correlation, but it is not statistically significant in any specification. Equity ratio has a positive correlation in most specifications. The magnitude of its coefficient, however, is substantially reduced when credit assignments ratio is included as an explanatory variable. This may be explained by the fact that credit assignments increase the equity ratio, since it is marked as revenue.

As expected, bank size has a negative and statistically significant impact on all specifications using the full sample. However, when large banks and state-owned banks are excluded from the sample, the impact of size is no longer robust

Panel B displays the results for the regressions on liabilities variables. Banks with more deposits from institutional investors issued more DPGE, as expected given previous results because institutional investors led the bank run on small and medium-sized banks. Because DGPE insures large amounts, one should expect that institutional investors that fled during the crisis returned only when they could insure their deposits. Time deposit ratio coefficients are not statistically significant and its sign changes depending on the specification. Foreign funding shows a negative correlation, but coefficients are not statistically significant. Equity ratio shows a positive correlation but only marginally significant in only two specifications. Again, larger banks issue less DPGE.

The role of DPGE issuance on deposit recovery

I now investigate whether DPGE fulfilled its expected role: did the bleeding in deposits stop (or even get reversed) for banks that choose to issue this new instrument? To test this hypothesis, only small and medium-sized banks are kept on the sample. I compare the change in deposits between DPGE issuers and non-issuers in the first quarter after the introduction of this new funding instrument. The estimated model is:

$$\Delta Time\_Deposits_i = \alpha + \beta.\,\mathrm{DPGE} + \gamma.\,\mathrm{bank\ characteristics_i} + \varepsilon_i \quad (3)$$

The dependent variable is the change in log of deposits for a bank *i* between March 2009 and June 2009. *DPGE* is a dummy variable indicating whether the bank issued DPGE in the period analyzed. The variables *bank characteristics*$_i$ control for the same variables used in previous regressions. Table 43 displays the results.

Table 43 Change in Time Deposits After the Crisis as Function of DPGE indicator

Dependent Variable:	Change in Time Deposits (log)		
	All Small and Medium Banks		
	(1)	(2)	(3)
DPGE Issuer	0.414***	0.382***	0.375***
	(0.0634)	(0.0586)	(0.0588)
Bank Size (log)		-0.0520***	-0.0354
		(0.0189)	(0.0248)
Equity Ratio			0.244
			(0.269)
Constant	0.0368	1.149***	0.736
	(0.0323)	(0.403)	(0.574)
Observations	79	79	79
R-squared	0.341	0.403	0.414

Note: The panel shows the coefficients for OLS models fitted using the change in natural logarithm of time deposits between March, 2009 and June, 2009 as the dependent variable. All columns exclude big and state-owned banks. Bank size is defined by the natural logarithm of current and long-term assets, and relates to December, 2007. DPGE issuer is an indicator that the bank had already issued DPGE in June, 2009. Equity ratio, defined as the ratio of tier 1 capital to current and long-term assets, also relates to December, 2007.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

I find deposit recovery for DPGE issuers when compared to non-issuers following the adoption of the new instrument. This provides evidence of the effectiveness of DPGE in restoring funding liquidity for those banks opting for its issuance. In order to examine the role of DPGE issuing in the increasing the deposits, I go further and regress the change in deposits on the proportion of DPGE for the issuer group of banks. I test the hypothesis that the amount of DPGE issuance is relevant to deposit recovery against the hypothesis that the launching of this new instrument just removes the funding illiquidity faced by a group of institutions. In other words, I test whether DPGE issuers have to rely in this new instrument to restore their deposits or whether they were able to increase their funding with conventional deposits. Table 44 shows a high correlation between the proportion of DPGE and the increase in deposits, corroborating for the hypothesis that the amount issued explains the deposit recovery.

Table 44 - Change in Time Deposits After the Crisis as Function of Proportion of DPGE on Time Deposits

Dependent Variable:	Change in Time Deposits (log)		
	Only DPGE Issuers		
	(1)	(2)	(3)
Proportion of DPGE on Time Deposits	1.302***	1.207***	1.210***
	(0.116)	(0.135)	(0.138)
Bank Size (log)		-0.0289	-0.0310
		(0.0283)	(0.0270)
Equity Ratio			-0.0304
			(0.159)
Constant	0.0667*	0.695	0.748
	(0.0386)	(0.619)	(0.598)
Observations	42	42	42
R-squared	0.734	0.745	0.745

Note: The panel shows the coefficients for OLS models fitted using the change in natural logarithm of time deposits between March, 2009 and June, 2009 as the dependent variable. All columns exclude big and state-owned banks. Bank size is defined by the natural logarithm of current and long-term assets, and relates to December, 2007. We excluded banks that hadn't issued DPGE in June, 2009, as well as big banks. Equity ratio, defined as the ratio of tier 1 capital to current and long-term assets, also relates to December, 2007. Proportion of DPGE on time deposits relates to June, 2006.

*** = significant at the 1% level, ** = significant at the 5%, * = significant at the 10%. All standard errors are robust.

3.6. Conclusion

This paper examines a bank run on small and medium-sized banks in Brazil in the most acute phase of the 2008 Global Financial Crisis in order to study the relationship between market and funding liquidity. My contribution is threefold: 1) I document the bank run from small and medium and their determinants; 2) I document the adoption of a new effective insurance instrument to provide bank guarantees in response to bank runs and showed that this instrument can reveal those banks more affected by market illiquidity; 3) I show that the provision of funding liquidity through this new instrument was used as a substitute for market liquidity after the launching of DPGE.

These results are important for several reasons. First, the fact that some banks resorted to expensive insurance to substitute for credit assignments during the bank run suggests that a shock in funding liquidity could not be compensated by market liquidity alone (selling loans). Second, in order to restore normality, the government had to intervene improving funding liquidity (facilitating market liquidity through subsidies to credit assignments was not enough). Third, the fact that banks that relied on the credit assignments (market liquidity) issued DGPE

suggests that a voluntary insurance program may be superior to a mandatory one. Why impose expensive insurance on those that have enough market liquidity (less credit in their balance sheets) to resist the shock in funding liquidity?