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# The impact of bank recapitalization on firms' access to credit: Evidence from Portugal\*

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## Abstract

During the recent financial crisis the Portuguese banks experienced several private and government capital injections. This paper investigates the impact of bank recapitalizations on the supply of credit in the period between the first quarter of 2010 and the fourth quarter of 2013. The results suggest that bank bailouts contributed to an increase in the supply of credit. This effect is negatively related to the capital buffer of recapitalized banks and applies to the sectors of manufacturing and trade. There is no evidence that bank recapitalizations contributed to a selective behavior in the supply of credit to distressed firms when compared to other firms.

**JEL classifications:** G21, G28, G32

**Keywords:** Bank recapitalization, Distressed firm, Firm access to credit, Financial crisis

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# 1 Introduction

The market capitalization of Portuguese banks was negatively affected by the sovereign debt crisis that affected several European countries, following the international financial crisis. The loss of access to medium and long-run international wholesale funding markets and the successive sovereign debt rating downgrades by several rating agencies contributed to the deterioration of Portuguese banks' liquidity conditions. On the other hand, the increasing impairments associated both with worse macroeconomic conditions and the extraordinary inspections of banks' credit portfolios promoted by the Banco de Portugal, and the deterioration of the net interest margin via volume and price effects, led to the announcement of negative profits which stressed the solvency position of Portuguese banks. In this context, the importance for financial stability of strengthening the banks' solvency conditions was reinforced in the "financial stability pillar" of the Economic and Financial Assistance Program (EFAP), and stronger minimum capital requirements were implemented. In the middle of 2011, the minimum Core Tier 1 ratio was revised from 8 to 9 per cent, with compliance set to the end of that year, and again in 2012 with a 1 percentage point increase to a minimum capital ratio of 10 per cent, for banks to comply from the end of that year<sup>1</sup>. Simultaneously, institutions subject to the stress tests of the European Banking Authority (EBA) were submitted to stricter capital requirements<sup>2</sup>. These additional capital requirements contributed to the Portuguese bank bailouts in June and December 2012.

The bank bailouts in June 2012 (BCP, BPI, CGD) and December 2012 (BANIF<sup>3</sup>) through the issuance of Contingent Convertible Bonds (CoCos) allowed banks to comply with stricter minimum capital requirements, as defined by the EBA in respect of BCP, BPI and CGD, and by the Banco de Portugal in the case of BANIF. The recapitalization operations aimed at reinforcing the banks' capital base, amid the deterioration of credit portfolios motivated by worse macroeconomic conditions and

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<sup>1</sup>Notice no. 3/2011 of the Banco de Portugal.

<sup>2</sup>The four largest Portuguese banks (BCP, BES, BPI and CGD) were under a tighter Core Tier 1 regulation, which was defined by the EBA. For further information, see the Financial Stability Report, November 2011.

<sup>3</sup>In the case of BANIF, the issuance of Contingent Convertible bonds (CoCos) complemented a significant issuance of special shares. BANIF only accounted for the capital increase in the first quarter of 2013.

the compression of the net interest margin, given the historical low levels of money market interest rates. In this period, BANIF, BCP, BPI, ESFG and Montepio Geral benefited from additional private capital injections.

The economic and financial crisis highlighted the importance of reducing the debt levels in the Portuguese economy. For this reason, a wide range of measures envisaging the reduction of public and private debt levels were considered in the EFAP. The generalized deleveraging process of the Portuguese economy is a strong challenge since it may have adverse feedback effects on the economic activity by reinforcing the negative outlook of the economy, and on the financial stability if it occurs in a disorderly way (see Figure 1). Under these conditions it is crucial to combine the adjustment of public and private debt levels with the flow of funds to firms with viable outlook and profitable investment projects. This resource allocation may minimize the economic costs of the adjustment process by promoting the acceleration of the economic activity. The economic costs of the adjustment process are minimized by this resource allocation, which actively promotes the acceleration of the economic activity.

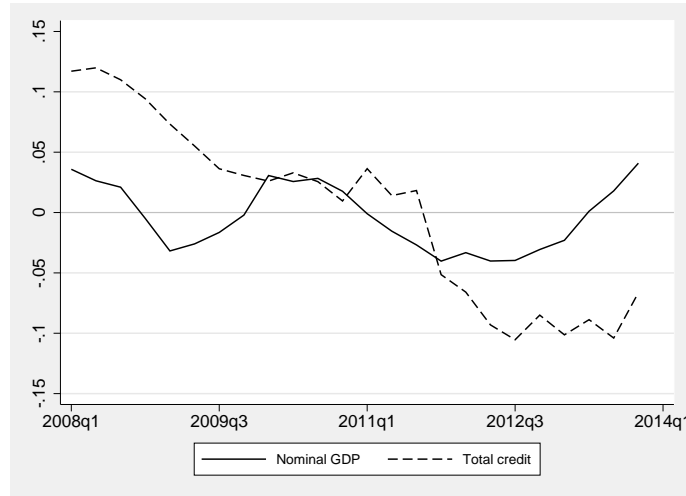


Figure 1 – Year-on-year growth rate of the total amount of loans granted to non-financial corporations and nominal GDP.

In this context, bailed out banks agreed to preserve their supply of credit to the economy at sensible levels (namely to households, small and medium-sized enterprises, and enterprises with economic activity on the tradable goods and services sector)<sup>4</sup>.

<sup>4</sup>Executive Order No. 150-A/2012 May 17th.

This effect may be limited by the necessary adjustment in banks' balance sheets, resulting from the deterioration of their liquidity and solvency positions.

Empirical evidence for Portugal suggests that credit growth showed a negative trend during the analyzed period, when controlling for firm heterogeneity. [Antunes and Martinho \(2012\)](#) estimate an equation to study the access to credit of Portuguese non-financial corporations, for the period between the first quarter of 1995 and the first quarter of 2012, and show that firms' access to credit got more difficult from 2009 onwards. [Farinha and Félix \(2014\)](#) estimate a two-stage model to evaluate the relative contribution of the conditions of firms and banks to the deleveraging process. The results suggest that banks with more difficult access to the interbank and wholesale markets and lower capital buffers supply on average less credit. This result is particularly relevant in the more recent period given the financing constraints on the interbank and wholesale markets and the stricter prudential regulations imposed by the regulator on Portuguese banks.

This paper investigates the impact of bank recapitalizations on the supply of credit to Portuguese non-financial corporations using a similar methodology to [Giannetti and Simonov \(2013\)](#), and considers the period between the first quarter of 2010 and the last quarter of 2013. These authors analyze the Japanese banking crisis occurred in the 1990s and suggest that recapitalizations that allowed banks to comply with the minimum prudential capital requirements contributed to an increase in the supply of credit. On the other hand, bank recapitalizations that did not allow banks to meet the minimum capital requirements did not contribute to an increase in credit supply, and rather promoted evergreening practices, i.e. the supply of credit by banks to firms in a financially stressed situation to avoid the recognition of losses in the short run.

The estimated models in this study allow to test if the effects of bank recapitalizations depend on the magnitude of capital injections (relative to the banks' risk weighted assets) and on the banks' ex post capital buffer. Also, it is possible to examine whether Portuguese bank recapitalizations promoted a selective behavior by banks to distressed firms. We characterize distressed firms based on the overdue credit ratio and the number of loan defaults in the banking system for each firm.

The Portuguese bank recapitalization is an interesting case since it comprises recapitalizations with different characteristics, including bank bailouts that occurred in the middle and at the end of 2012, benefiting four of the eight largest Portuguese



banks, and occurring in a context of EPAF with an adverse underlying scenario. The affected banks had heterogeneous ex ante conditions and benefited from considerably different capital injection amounts.

The results suggest that bank bailouts contributed to decelerate the decrease in the credit supply to non-financial corporations, and that this effect is negatively related to the capital buffer (measured as the difference between the banks' capital ratio and the minimum prudential capital requirement) of recapitalized banks. This result applies to the manufacturing and trade sectors. There is no evidence that bank recapitalizations promoted a selective behavior in the supply of credit to distressed firms when compared to other firms.

The paper is organized as follows. Section 2 discusses the Portuguese case. Section 3 describes the empirical approach and the data used in the estimation. Section 4 presents the results. Section 5 concludes.

## 2 The Portuguese case

The financial crisis and the sovereign debt crisis that affected some euro area countries contributed for the deterioration of the Portuguese banks' liquidity and solvency positions. The accumulation of losses had a negative impact on the Own Funds of Portuguese banks. This effect was aggravated by the contemporaneous increase in Risk Weighted Assets (RWAs). In the period previous to the recapitalization, Core Tier 1 ratios of BANIF, BCP, BPI and CGD were below the 10 per cent minimum prudential capital requirement defined by the Banco de Portugal for institutions to comply by the end of 2012. Additionally, BCP, BPI and CGD must comply with the minimum capital requirement of 9 per cent defined by the EBA, starting from the middle of 2012. In this context, the issuance of CoCos totaling 3,000M, 1,500M and 900M in June 2012 for BCP, BPI, and CGD, respectively, and 400M in December 2012 for BANIF, allowed banks to comply with the minimum capital requirements defined by the Banco de Portugal and the EBA. These bailouts were accompanied by additional private capital issuances, with the exception of BPI. BCP and BANIF placed around 300M on privately subscribed shares between the second quarter of

2012 and the second quarter of 2013<sup>5</sup>.

The heterogeneity on government and private recapitalization injection amounts, the considerably different ex ante conditions on liquidity, solvency, and profitability of the Portuguese recapitalized banks, and the size of the recapitalized banks (affected four of the eight largest Portuguese banks) allow to test a comprehensive set of hypothesis and make the Portuguese bank recapitalizations occurred in this period an interesting case study.

## 3 Econometric analysis

### 3.1 Empirical specifications

This paper analyses the impact of the recent bank recapitalizations in the Portuguese banking system on the supply of credit to non-financial corporations. This analysis is similar to that of [Giannetti and Simonov \(2013\)](#).

The economic theory suggests that the effects of bank recapitalization depend on the injection amounts, the capacity of the bank to comply with the minimum prudential capital requirements, and the quality of its clients. According to the economic models of [Diamond and Rajan \(2000\)](#) and [Diamond \(2001\)](#), recapitalizations in a sufficient amount to guarantee the compliance with the minimum capital requirements imposed by the regulatory authority, tend to promote efficient credit supply policies, by allocating the available credit to the better firms. However, when recapitalizations are insufficient for the bank to meet the minimum capital requirements, the opposite behavior may occur: banks may have the incentive to supply credit to distressed firms to limit short-run losses. In fact, the absence of incentives for highly indebted banks to recognize losses and increase capital highlights the importance of regulation. The introduction of more restrictive regulation in favorable periods should induce banks to increase capital or retain profits and, thus, limit adverse effects in less favorable economic times.

The empirical analysis performed in this study is divided in three parts. In the

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<sup>5</sup>CGD issued government subscribed shares adding up to 750M, contemporaneous to the issuance of the CoCos. It is not a private recapitalization in strict sense, but it has a different nature from the issuance of the CoCos.

first part, the impact of (government and private) bank recapitalizations on credit supply is investigated. The identification strategy encompasses the selection of firms with multiple banking relationships considering the eight largest banks. We estimate the model using a fixed effects estimator that allows for the comparison of the credit supply of recapitalized banks and that of non-recapitalized banks to the same firm (a similar procedure to that of [Khwaja and Mian \(2008\)](#), [Giannetti and Simonov \(2013\)](#), and [Bofondi, Carpinelli, and Sette \(2013\)](#)). This procedure allows to hold the firms' characteristics constant (namely, credit demand and firms' productivity).

In the second part, the analysis considers the injection amounts and the capacity of recapitalized banks to comply with the minimum prudential capital requirements after the recapitalization. In the Portuguese case, the government recapitalization contributed for recapitalized banks to meet the minimum capital requirements and, therefore, there are no undercapitalized banks after the government recapitalization in the sample. As a result, we considered the capital buffer<sup>6</sup> as a measure of the capacity of banks to comply with the minimum prudential capital requirements.

Lastly, we introduced a variable that measures the credit performance of firms to which the recapitalized banks granted credit. We considered two alternative definitions of distressed firm. According to the first definition, we considered distressed firms<sup>7</sup> those firms with overdue credit above the 15 per cent threshold<sup>8</sup>. The alternative definition of a distressed firm considers the number of loan defaults in the banking system for each firm.

The base specification of the regression equation is the following:

$$\Delta loan_{ik,t+2} = \beta_0 + \beta_1 rec_{ik,t} \times share_{ik,t} + \beta_2 share_{ik,t} + \alpha_{i \times t+2} + \mu_k + u_{ik,t+2} \quad (1)$$

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<sup>6</sup>The relevant capital ratio (i.e. the capital ratio which is binding to banks) and the prudential minimum differ across the analyzed period. The relevant capital ratio is the solvency ratio between 2010q1 and 2011q3 and the Core Tier 1 ratio from 2011q4 up to the end of the sampling period (for BCP, BES, BPI and CGD the relevant capital ratio is the one defined by EBA from 2012q2 onwards). The minimum prudential capital ratio was 8 per cent until 2011q3, 9 per cent until 2012q4 and 10 per cent onwards (with the exception of the EBA's minimum prudential capital ratio which is equal to 9 per cent).

<sup>7</sup>This is the terminology used by [Bonfim, Dias, and Richmond \(2001\)](#).

<sup>8</sup>The conclusions hold, even if we consider different thresholds in the neighborhood of 15 per cent.

where  $\Delta loan_{ik,t+2}$  is the two-period increase in bank loans that firm  $i$  receives from bank  $k$  and is computed as the two-period change in the natural logarithm of the consolidated exposure of firm  $i$  to bank  $k$  in quarter  $t$ . The variable  $rec_{ik,t}$  is a dummy variable that takes the value one if the bank  $k$  of firm  $i$  is recapitalized in quarter  $t$ , and is equal to zero otherwise. The variable  $share_{ik,t}$  is the proportion of loans (on the banking system) that firm  $i$  received from bank  $k$  in quarter  $t$ . This variable quantifies the intensity of the banking relationship between firm  $i$  and bank  $k$  in the quarter of the recapitalization. The interaction term  $rec_{ik,t} \times share_{ik,t}$  is included to assess the impact of the recapitalization on an individual exposure, i.e. to test if firms with larger relative exposure to a recapitalized bank benefit more from the recapitalization. The unit of analysis in this study is the firm-bank-quarter relationship. Including a vector of interactions between fixed effects at firm level and time fixed effects ( $\alpha_{i \times t+2}$ ) we control for constant and time-varying observed and non-observed heterogeneity at firm level. It also accounts for aggregate shocks. The inclusion of a fixed effects vector for banks ( $\mu_k$ ) controls for time-invariant systematic differences on balance sheets of banks. The term  $u_{ik,t+2}$  is an error term with the conventional properties.

The coefficient  $\beta_1$  measures the variation in the credit exposure of firm  $i$  in the recapitalized bank  $k$ . A positive coefficient indicates that the firms' exposure to recapitalized banks increased in the sequence of the recapitalization.

The equation formulated in (1) does not consider the importance of the injection amount and the subsequent capacity of recapitalized banks to comply with the minimum capital requirements. For this reason, we considered the model formulated in equation (2), which takes into consideration the injection size (weighted by the banks' RWAs) and the ex post capital buffer. Therefore, it is possible to study whether the supply of credit of recapitalized banks depends on the injection size and the ex post ability to meet the minimum capital requirements. The following equation was estimated:

$$\begin{aligned} \Delta loan_{ik,t+2} = & \gamma_0 + \gamma_1 recsize_{ik,t} \times share_{ik,t} + \gamma_2 recsize_{ik,t} \times share_{ik,t} \times buffer_{kt} + \\ & + \gamma_3 share_{ik,t} + \gamma_4 buffer_{kt} + \alpha_{i \times t+2} + \mu_k + u_{ik,t+2} \end{aligned} \quad (2)$$

where  $recsize_{ik,t}$  is the injection size weighted by the bank's RWAs in the quarter

previous to the recapitalization<sup>9</sup> and the variable  $buffer_{kt}$  is the difference between the capital ratio that is binding for banks and the minimum prudential capital requirement of bank  $k$  in quarter  $t$ , divided by the minimum prudential capital requirement. For a given credit exposure of firm  $i$  on bank  $k$ , the marginal impact of the recapitalization on the supply of credit is equal to  $\gamma_1 + \gamma_2 \times buffer_{kt}$ . If banks benefiting from larger capital injections increase their credit supply, the coefficient  $\gamma_1$  should be positive. On the other hand, if banks with ex post stressed capital ratios supply less credit than the other banks, the coefficient  $\gamma_2$  should also be positive.

Finally, to evaluate the importance of firms' quality to explain the evolution of credit supply after the recapitalization, we introduced the following equation:

$$\begin{aligned} \Delta loan_{ik,t+2} = & \delta_0 + \delta_1 recsize_{ik,t} \times share_{ik,t} + \delta_2 recsize_{ik,t} \times share_{ik,t} \times buffer_{kt} + \\ & + \delta_3 recsize_{ik,t} \times share_{ik,t} \times buffer_{kt} \times distressed_{it} + \delta_4 share_{ik,t} + \delta_5 buffer_{kt} + \\ & + \alpha_{i \times t+2} + \mu_k + u_{ik,t+2} \quad (3) \end{aligned}$$

where  $distressed_{it}$  is a measure of the financial distress of firm  $i$  in quarter  $t$ . For a given exposure level, the marginal impact of the recapitalization on the supply of credit to non-stressed firms is equal to  $\delta_1 + \delta_2 \times buffer_{kt}$  while for distressed firms it equals  $\delta_1 + (\delta_2 + \delta_3) \times buffer_{kt}$ .

According to the economic models formulated by [Diamond and Rajan \(2000\)](#) and [Diamond \(2001\)](#), it is expected that recapitalized banks able to comply with the minimum capital requirements increase their supply of credit, with the exception of firms in financial distress. In contrast, the opposite relation is expected for banks that remain undercapitalized after the recapitalization. As we previously mentioned, all Portuguese banks were able to meet the minimum capital requirements defined by the regulatory authority after the recapitalization. Therefore, we formulated an alternative specification that considers the role of the bank ex post capital buffer on the evolution of banks' credit supply after the recapitalization. This way, recapitalized banks with larger capital buffers are expected to contribute more to the supply of

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<sup>9</sup>Weighting the injection size by the RWAs measured in the quarter prior to the recapitalization is motivated by the potential change in the RWAs structure due to the contemporaneous capital increase.

credit (i.e.  $\delta_1 > 0$  and  $\delta_2 > 0$ ), with the exception of distressed firms (i.e.  $\delta_3 \leq -\delta_2$ ).

### 3.2 Data

The main dataset used in this analysis is the Central Credit Register (CCR) of the Banco de Portugal. The granularity of these data allows considering sophisticated micro-econometric approaches to identify the effects of the bank recapitalization on the supply of credit. In this study we consider the loan outstanding amount of non-financial corporations for the period between the first quarter of 2010 and the fourth quarter of 2013.

The dependent variable  $\Delta loan_{ik,t+2}$  measures the change on bank loans that firm  $i$  receives from bank  $k$ . The credits with firms being the second creditor were not considered in the analysis. The firm bank loans are consolidated at the bank level. We included in the analysis the eight largest Portuguese banks: BANIF, BCP, BES, BPI, BST, CGD, MG and SICAM.

The classification of firms as distressed considers the overdue credit amounts as reported in the CCR. The definition of loan default is the following: a credit is considered as in default if a positive amount of credit is overdue for three or more consecutive months.

The information about the timing and the amount of government and private recapitalizations was obtained on the financial statements of banks.

The main descriptive statistics of a comprehensive set of variables that characterize the recapitalizations, namely, the recapitalization amount weighted by RWAs, the banks' capital buffer and the firms exposure to recapitalized and non-recapitalized banks<sup>10</sup>, are reported in Table 1. The period analyzed is characterized by government recapitalizations occurred in the middle and by the end of 2012 and several private recapitalizations spread across time. The government injection amounts are significantly higher than those of private recapitalizations, representing on average four times the value of private injections. The dispersion observed on government injection amounts is also considerably larger than that on private recapitalizations.

The capital buffer is included in the analysis as a measure of the banks compliance

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<sup>10</sup>Observations with quarter-on-quarter growth rates lower than the 1st percentile and higher than 99th percentile of the quarter-on-quarter growth distribution were not included in the analysis.

level with the minimum prudential capital requirements. The recapitalized banks have on average lower buffers than those which were not recapitalized. The data on the intensity of the firm-bank relationship suggests that the government recapitalization affected banks which on average supply larger proportions of credit to their clients, although this difference is not particularly significant.

Table 1 – Portuguese bank recapitalization

	Obs.	Average	St. dev.	Median
Recapitalization amount	22	1.894	2.456	0.748
Government recapitalization	6	4.121	3.809	3.823
Private recapitalization	16	1.059	0.938	0.712
Capital buffer	123	1.672	2.108	1.670
Government recapitalization	6	1.334	1.477	0.733
Private recapitalization	14	1.709	1.483	1.285
Non-recapitalized	79	1.612	2.365	1.837
Share	3,917,102	0.583	0.381	0.605
Government recapitalization	244,833	0.631	0.376	0.738
Private recapitalization	505,368	0.599	0.383	0.651
Non-recapitalized	3,166,901	0.576	0.381	0.589

*Notes:* The reported recapitalization amount (government and private) is the recapitalization amount weighted by the institutions RWAs (as measured at the quarter before recapitalization), in percentage terms. The capital buffer is the difference between the prudential capital ratio and the minimum capital requirement. The reported results (in percentage terms) for recapitalized banks refer to the period subsequent to the recapitalization and for non-recapitalized banks to the quarters not subjacent to capital injections. The intensity of the banking relationship is the proportion of the firms' exposure to recapitalized and non-recapitalized banks. The sample period comprises the first quarter of 2010 to the fourth quarter of 2013. The study includes the eight largest Portuguese banks (BANIF, BCP, BES, BPI, BST, CGD, MG and SICAM).

The descriptive statistics of the main variables included in the analysis are reported in Table 2. The quarter-on-quarter average growth of credit supply to non-financial corporations was approximately minus 5 per cent. This evolution is explained by credit demand factors, given the significant reduction of the economic activity and the high leverage levels of the economy, but also by the need of accelerating the deleveraging

process of the Portuguese banking system, given the reduced access to funding as well as the stricter solvency requirements.

The information reported in the CCR allows for the construction of several credit performance indicators, related to firms' overdue credit. This study includes two firm distress indicators based on firms' overdue credit (as reported in the CCR). The variable *Distressed - def. 1* is a dummy variable equal to one if a firm has overdue credit higher than 15 per cent of their total exposure to the banking system, and equal to zero otherwise. The statistics reported in Table 1 suggest that one fifth of the total firms have overdue credit above 15 per cent. The variable *Distressed - def. 2* is the number of loan defaults in the banking system for each firm.

The sample includes 201,768 non-financial corporations and 327,777 loans (firm-bank pairs). The results suggest that firms have on average two banking relationships<sup>11</sup>.

## 4 Results

### 4.1 Bank recapitalization

The estimation results of equation (1) are presented in columns (2) and (4) of Table 3. The results reported in columns (1) and (3) of Table 3 were obtained by estimating equation (1) without weighting the impact of recapitalization by the firms' exposure to the recapitalized banks. We estimate the models using a within-firm estimator, where firm idiosyncratic time effects account for time varying and time invariant heterogeneity and, therefore, it is possible to compare the proportional variation of a firm's exposure to a recapitalized bank against the other banks. According to the results reported in column (4), the effect of private and government recapitalizations on the supply of credit is not statistically significant. The estimated coefficient for the variable *Share* suggests that the intensity of the banking relationship has a negative effect on the change of banks' credit supply<sup>12</sup>.

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<sup>11</sup>This finding is similar to that presented in Bonfim and Dai (2012).

<sup>12</sup>This result is similar to that of Giannetti and Simonov (2013) and might be explained by the inclusion of the interaction terms of firm and quarter fixed effects. This way, if loans granted by banks to a given firm grew at a faster pace, firms would converge to a situation of a single banking relationship.



Table 2 – Descriptive statistics

	Obs.	Mean	St. dev.	Q2	P5	P95
$\Delta$ Loan	3,917,102	-5.020	33.444	-2.259	-55.668	42.671
Share	3,917,102	0.583	0.381	0.605	0.022	1,000
Intervention $\times$ Share	3,917,102	0.117	0.292	0.000	0.000	1,000
Government Intervention $\times$ Share	3,917,102	0.039	0.179	0.000	0.000	0.184
Private Intervention $\times$ Share	3,917,102	0.077	0.243	0.000	0.000	0,938
Buffer	3,828,009	0.015	0.019	0.012	-0.005	0.045
Distressed - <i>def. 1</i>	3,917,102	0.184	0.387			
Distressed - <i>def. 2</i>	3,917,102	0.439	0.999			
Exposure $\times$ Injection size	3,917,102	0.002	0.009	0.000	0.000	0.012

*Notes:* The loan represents the firm consolidated outstanding amount to a given bank. The variable  $\Delta$  loan is the quarter-on-quarter loan growth rate and is calculated as the quarterly difference of the natural logarithm of credit granted to firms (multiplied by 100). The variable *Share* is the proportion of a single firm exposure to a bank in its total exposure to the banking system. The interaction terms *Intervention $\times$ Share*, *Government Intervention $\times$ Share* and *Private intervention $\times$ Share* measure the firms' average exposure to each of the recapitalizations. We considered two definitions of distressed firms based on the overdue amount of credit reported in the CCR: *Distressed - def. 1* considers that a firm is financially distressed if the overdue credit ratio is higher than 15 per cent; and *Distressed - def. 2* measures the firm's number of loan defaults in the banking system.

Table 3 – Estimation results: Government and private recapitalizations

	$\Delta \ln(\text{loan})$ (1)	$\Delta \ln(\text{loan})$ (2)	$\Delta \ln(\text{loan})$ (3)	$\Delta \ln(\text{loan})$ (4)
Recapitalization	0.0030 (0.0026)			
Recapitalization $\times$ Share		0.0061 (0.0056)		
Government recapitalization			-0.0050 (0.0039)	
Private recapitalization			0.0067** (0.0030)	
Government recapitalization $\times$ Share				0.0122 (0.0086)
Private recapitalization $\times$ Share				0.0024 (0.0069)
Share	-0.0829*** (0.0042)	-0.0839*** (0.0043)	-0.0829*** (0.0042)	-0.0839*** (0.0043)
Fixed effects	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank
No. of observations	3,323,453	3,323,453	3,323,453	3,323,453
Adjusted $R^2$	0.1020	0.1020	0.1020	0.1020

*Notes:* The dependent variable is the two-period growth rate of credit granted to firm  $i$  by bank  $k$ , calculated by the two-period difference of the natural logarithm of the exposure of firm  $i$  on bank  $k$ . The explanatory variables are defined in Table 2 and are included in the estimation lagged by one semester. The parameters are estimated with the fixed effects estimator. The standard errors are reported in parentheses and are robust to heteroskedasticity and autocorrelation. \*\*\*, \*\*, and \* stand for statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

The estimation results of equation (2) are reported in Table 4 and consider the capital injection amounts and a measure of the compliance level of banks with the minimum prudential capital requirements. According to the results presented in column (1), government and private recapitalizations do not have a statistically significant impact on the supply of credit. Nevertheless, when decomposing this effect according to the institutions capital buffer, banks with lower capital buffers supply on average more credit to firms. The estimation results reported in column (2) indicate that the credit supply of banks with a capital buffer equal to 1.33 percentage points (sample mean of government recapitalized banks) to firms with a share equal to 58.3 per cent from a bank benefiting from a government recapitalization of 4.12 per cent of its RWAs increases by 1.56 per cent ( $=0.842*0.583*4.12-14.6*0.583*4.12*0.0133$ ).

The impact of the private recapitalization is not statistically significant. This result may be explained by the significant difference in the capital injection amounts associated to government and private recapitalizations and by the agents' perception of private recapitalizations, since these are less related to future financial stress of the bank than the government recapitalization.

The private recapitalization is considered in combination with the government recapitalization in the columns (3) and (4) of Table 4. The magnitude of the estimated coefficients in column (4) decreases significantly, and this may be explained by the larger dispersion of the recapitalization variable.

The potential benefits from the bank recapitalization include strengthening the financial stability and ensuring credit flows to the economy. Nonetheless, there may be incentives to grant credit not only to viable firms facing credit restrictions but also to distressed firms, to limit bank losses to be registered in the short-run. This possibility is even more relevant in the context of the implementation of stricter minimum capital requirements and the promotion of an orderly and progressive deleveraging process.

Table 5 presents the estimates of equation (3). The results suggest that there are no statistical differences in the credit supply policy of recapitalized banks according to the financial situation of firms, and that this result is independent of the banks' ex post capital buffer and hold for both the definitions of distressed firm considered in the analysis (see column (3) of Table 5).

In conclusion, the estimates suggest that the government recapitalization had a positive impact on the supply of credit. Additionally, this increase is negatively re-

Table 4 – Estimation results: The size of capital injections

	$\Delta \ln(\text{loan})$ (1)	$\Delta \ln(\text{loan})$ (2)	$\Delta \ln(\text{loan})$ (3)	$\Delta \ln(\text{loan})$ (4)
Government recap. <b>Size</b> $\times$ Share	0,0110 (0,1900)	0,8416** (0,3610)		
Government recap. <b>Size</b> $\times$ Share $\times$ Buffer		-14,604*** (5,3640)		
Private recap. <b>Size</b> $\times$ Share	-0,2504 (0,4700)	-0,3220 (0,4700)		
Recapitalization_ <b>Size</b> $\times$ Share			-0,0172 (0,1830)	0,0470 (0,2254)
Recapitalization_ <b>Size</b> $\times$ Share $\times$ Buffer				-0,6990 (1,4120)
Buffer	0,0394*** (0,0079)	0,0402*** (0,0079)	0,0391*** (0,0079)	0,0392*** (0,0079)
Share	-0,0825*** (0,0043)	-0,0818*** (0,0044)	-0,0827*** (0,0043)	-0,0826*** (0,0043)
Fixed effects	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank
No. of observations	3 294 591	3 294 591	3 294 591	3 294 591
Adjusted $R^2$	0.1020	0.1020	0.1020	0.1020

*Notes:* The dependent variable is the two-period growth rate of credit granted to firm  $i$  by bank  $k$ , calculated by the two-period difference of the natural logarithm of the exposure of firm  $i$  on bank  $k$ . The explanatory variables are defined in Table 2 and are included in the estimation lagged by one semester. The parameters are estimated with the fixed effects estimator. The standard errors are reported in parentheses and are robust to heteroskedasticity and autocorrelation. \*\*\*, \*\*, and \* stand for statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

Table 5 – Estimation results: Financial stress of firms

	$\Delta \ln(\text{loan})$ Distressed - <i>def.1</i> (1)	$\Delta \ln(\text{loan})$ Distressed - <i>def.1</i> (2)	$\Delta \ln(\text{loan})$ Distressed - <i>def.2</i> (3)
Recap_Size $\times$ Share	0.0771 (0.2284)	0.0943 (0.2350)	0.0488 (0.2290)
Recap_Size $\times$ Share $\times$ Distressed	-0.3450 (0.3250)		-0.0860 (0.1220)
Recap_Size $\times$ Share $\times$ Buffer		-0.4320 (1.4230)	
Recap_Size $\times$ Share $\times$ Buffer $\times$ Distressed		-3.8251 (3.3240)	
Buffer	0.0392*** (0.0079)	0.0392*** (0.0079)	0.0392*** (0.0079)
Share	-0.0828*** (0.0043)	-0.0826*** (0.0043)	-0.0827*** (0.0043)
Fixed effects	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank
No. of observations	3,294,591	3,294,591	3,294,591
Adjusted $R^2$	0.1020	0.1020	0.1020

*Notes:* The dependent variable is the two-period growth rate of credit granted to firm  $i$  by bank  $k$ , calculated by the two-period difference of the natural logarithm of the exposure of firm  $i$  on bank  $k$ . The explanatory variables are defined in Table 2 and are included in the estimation lagged by one semester. The parameters are estimated with the fixed effects estimator. The standard errors are in parentheses and robust to heteroskedasticity and autocorrelation. \*\*\*, \*\*, and \* stand for statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

lated with the banks capital buffer. There is no evidence that recapitalized banks contributed to a selective behavior to distressed firms when compared to other firms.

## 4.2 Sector analysis

The previous analysis evaluates the impact of the bank recapitalization on the supply of credit to non-financial corporations. This section replicates the analysis by sector of activity. The exposure to different activity sectors, namely those more affected by internal demand conditions and the slowdown in the economic activity, may motivate different credit supply strategies by recapitalized banks.

We considered in the analysis the construction and real estate sectors, the trade sector and the manufacturing sector. The manufacturing sector may be considered as a proxy for the tradable goods sector, since it is less exposed to internal market conditions (albeit it does not comprehend all the tradable goods and services). These sectors represented 64 per cent of the firm-bank pairs considered in the initial analysis.

The results of the estimation of equations (2) and (3) by sector of activity are reported in Tables 6 and 7, respectively. The results presented in columns (4) and (6) of Table 6 suggest that the government recapitalization had a positive impact on the supply of credit in the case of the manufacturing and trade sectors, with banks with higher capital buffers contributing on average less to this effect. The firms that belong to the manufacturing sector benefited from a credit supply increase of approximately 3.5 per cent ( $=2.218*0.496*4.12-38.91*0.496*4.12*0.013$ ) and firms that belong to the construction and real estate sector benefited from a credit supply increase of approximately 2.59 per cent ( $=1.455*0.577*4.12-24.49*0.557*4.12*0.013$ ). There are no statistical significant differences on the credit supply to firms that belong to the construction sector.

The results presented in Table 7 suggest that there are no statistical significant differences on the supply of credit to distressed firms when compared to the other firms and that this result applies to the three different sectors.

Table 6 – Estimation results: The size of capital injections

	Construction		Manufacturing		Trade	
	$\Delta \ln(\text{loan})$ (1)	$\Delta \ln(\text{loan})$ (2)	$\Delta \ln(\text{loan})$ (3)	$\Delta \ln(\text{loan})$ (4)	$\Delta \ln(\text{loan})$ (5)	$\Delta \ln(\text{loan})$ (6)
Government Recap <b>Size</b> $\times$ Share	-0.4210 (0.4607)	-0.1560 (0.8025)	-0.0146 (0.4271)	2.2185** (0.8159)	0.0725 (0.3172)	1.4550** (0.6370)
Government Recap <b>Size</b> $\times$ Share $\times$ Buffer		-4.5530 (10.850)		-38.911*** (12.104)		-24.485** (9.7620)
Private recap <b>Size</b> $\times$ Share	-1.4720 (1.0260)	-1.4980 (1.0270)	-0.9300 (1.0030)	-1.1020 (1.0040)	0.4404 (0.7710)	0.3310 (0.7714)
Buffer	0.0477*** (0.0183)	0.0480*** (0.0183)	0.0611** (0.0168)	0.0633*** (0.0168)	0.0293** (0.0129)	0.0306** (0.0129)
Share	-0.0749*** (0.0091)	-0.0747*** (0.0092)	-0.0951*** (0.0010)	-0.0933*** (0.0010)	-0.0956*** (0.0076)	-0.0945*** (0.0076)
Fixed effects	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank
No. of observations	603,960	603,960	509,596	509,596	993,574	993,574
Adjusted $R^2$	0.0868	0.0868	0.0590	0.0591	0.1105	0.1105

*Notes:* The dependent variable is the two-period growth rate rate of credit granted to firm  $i$  by bank  $k$ , calculated by the two-period difference of the natural logarithm of the exposure of firm  $i$  on bank  $k$ . The estimates reported in columns (1) and (2) refer to firms of the construction and real estate sector, those in columns (3) and (4) refer to firms of the manufacturing sector, and those in columns (5) and (6) refer to firms of the trade sector. The explanatory variables are defined in Table 2 and are included in the estimation lagged by one semester. The parameters are estimated with the fixed effects estimator. The standard errors are reported in parentheses and are robust to heteroskedasticity and autocorrelation. \*\*\*, \*\*, and \* stand for statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

Table 7 – Estimation results: Financial stress

	Construction	Manufacturing	Trade
	$\Delta \ln(\text{loan})$ (1)	$\Delta \ln(\text{loan})$ (2)	$\Delta \ln(\text{loan})$ (3)
Recapitalization_Size $\times$ Share	-0.3696 (0.6237)	-0.0621 (0.5137)	0.3050 (0.3696)
Recapitalization_Size $\times$ Share $\times$ Distressed	-0.4770 (0.7754)	-0.1787 (0.7174)	-0.7400 (0.5680)
Buffer	0.0467** (0.0183)	0.0603*** (0.0168)	0.0299** (0.0129)
Share	-0.0758*** (0.0091)	-0.0958*** (0.0099)	-0.0953*** (0.0076)
Fixed effects	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank
No. of observations	603,960	509,596	993,574
Adjusted $R^2$	0.0868	0.0590	0.1105

*Notes:* The dependent variable is the two-period growth rate rate of credit granted to firm  $i$  by bank  $k$ , calculated by the two-period difference of the natural logarithm of the exposure of firm  $i$  on bank  $k$ . The estimates reported in columns (1) and (2) refer to firms of the construction and real estate sector, those in columns (3) and (4) refer to firms of the manufacturing sector, and those in columns (5) and (6) refer to firms of the trade sector. The explanatory variables are defined in Table 2 and are included in the estimation lagged by one semester. The parameters are estimated with the fixed effects estimator. The standard errors are reported in parentheses and are robust to heteroskedasticity and autocorrelation. \*\*\*, \*\*, and \* stand for statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.



### 4.3 Government recapitalization

This subsection focuses on the impact of the government recapitalization that occurred in 2012 on the supply of credit to non-financial corporations<sup>13</sup>. As we previously mentioned, the Portuguese government recapitalizations that occurred in the middle of 2012 and at the end of 2012 had a different nature from the remaining recapitalizations. First, the government injection size is considerably larger than any other recapitalization. Second, four of the eight largest Portuguese banks, characterized by different ex ante liquidity and solvency conditions, benefited from this recapitalization. Third, the recapitalization through the issuance of CoCos, a financial instrument with high interest rates, attributed to the capital increase a temporary loan character instead of a permanent capital increase<sup>14</sup>. Finally, recapitalized banks committed to a set of specific covenants, including ensuring sensible levels of credit supply to households, small and medium-sized firms, and firms in the tradable goods and services sector.

In addition to the particular characteristics of the government recapitalization, it is important to contextualize this event in the adverse macroeconomic scenario in which it occurred, with Portugal conditioned by the EFAP, and the simultaneous pressure for the deleveraging of several institutional sectors.

Therefore, an alternative specification to the previous models was introduced. We considered the following specification to evaluate the impact of the government recapitalization on the supply of credit by bank  $k$  to firm  $i$ :

$$\Delta loan_{ik,t+2} = \beta_0 + \beta_1 dpub_{ik,t} \times share_{ik,t} + \beta_2 dpriv_{ik,t} \times share_{ik,t} + \beta_3 share_{ik,t} + \alpha_{i \times t+2} + \mu_k + u_{ik,t+2} \quad (4)$$

where  $dpub_{ik,t}$  is a dummy variable equal to one from the quarter of the recapitalization onwards if bank  $k$  benefited from the government recapitalization, and equal to zero

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<sup>13</sup>In this sub-section government recapitalization stands for the government recapitalization which took place in the middle of 2012 (for BCP, BPI and CGD) and at the end of 2012 (for BANIF).

<sup>14</sup>The government recapitalization through the issuance of CoCos with high interest rates associated is consistent with the discouragement to use public funds, conferring the State the role of lender of last resort, as well as avoiding subsidizing banks in unfavorable economic circumstances.

otherwise; and  $dpriv_{ik,t}$  is a dummy variable equal to one if bank  $k$  benefits from a private capital increase in quarter  $t$ , and equal to zero otherwise. The remaining variables are described in the previous section.

The previous specification does not consider the relative weight of the recapitalization on the RWAs of each recapitalized bank. Therefore, we introduced a specification that considers the relative weight of the recapitalization through the issuance of CoCos on the RWAs of each recapitalized bank and the reimbursement of the CoCos by recapitalized banks during the analyzed period. We created a variable that represents the relative weight of the CoCos on the capital of recapitalized banks. The estimated equation is the following:

$$\Delta loan_{ik,t+2} = \beta_0 + \beta_1 cocos_{ik,t} \times share_{ik,t} + \beta_2 recpriv_{ik,t} \times share_{ik,t} + \beta_3 share_{ik,t} + \beta_4 buffer_{kt} + \alpha_{i \times t+2} + \mu_k + u_{ik,t+2} \quad (5)$$

where  $cocos_{ik,t}$  is the CoCos capital amount divided by bank  $k$  total capital in quarter  $t$ , and  $recpriv_{ik,t}$  is the amount of bank  $k$  private recapitalizations in quarter  $t$ . This specification allows for the evaluation of the impact of the recapitalization through the issuance of CoCos on the supply of credit, controlling for the possibility of private recapitalizations, and considering the CoCos reimbursement.

The results of the estimation of equations (4) and (5) are presented in columns (1) and (2) of Table 8, respectively. The results suggest that the government recapitalization had a positive and statistically significant impact on credit supply, notwithstanding the small magnitude of this effect. According to the estimates reported in column (2), the government recapitalization contributed to an average increase of 0.01 per cent in credit supply ( $=0.0044 \times 3.3423 \times 0.543$ ).<sup>15</sup> One possible explanation for this result is the different nature of the government recapitalization. The CoCos issued by recapitalized banks allowed them to comply with the minimum capital requirements but at an onerous responsibility, motivated by the payment of increasing rate coupons

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<sup>15</sup>These figures correspond to the sample averages considering firms which during the government recapitalization period got credit from at least one recapitalized bank and one non-recapitalized bank. The sample average relative to the government injection size (weighted by RWAs) is considerably lower than the one reported in the previous section, which may be justified by the progressive reimbursement of the CoCos by recapitalized banks.

starting at 8.5 per cent and rising up to 11 per cent. The recapitalization costs contributed to the prioritization of its reimbursement, in a scenario of uncertainty of losses to be registered in a set of credit portfolios. Consequently, the compliance with the minimum prudential capital ratios persisted as a negative binding constraint on the banks' RWAs, suggesting that better recapitalized banks did not strengthen their credit portfolios, opting instead for exposures which would not penalize the RWAs, namely sovereign debt instruments.

In what concerns to the government recapitalization under analysis, there is no enough dispersion in the capital buffer of the four banks that benefited from the recapitalization that would allow to test if recapitalized banks with different capital buffers have heterogeneous credit supply policies. However, it is possible to test if the government recapitalization favored the credit supply to distressed firms in aggregate terms. The estimated equation is presented below:

$$\begin{aligned} \Delta loan_{ik,t+2} = & \beta_0 + \beta_1 cocos_{ik,t} \times share_{ik,t} + \beta_2 cocos_{ik,t} \times share_{ik,t} \times distressed_{it} + \\ & + \beta_3 recpriv_{ik,t} \times share_{ik,t} + \beta_4 share_{ik,t} + \beta_5 buffer_{kt} + \alpha_{i \times t+2} + \mu_k + u_{ik,t+2} \quad (6) \end{aligned}$$

The estimated coefficients for equation (6) are reported in columns (3) and (4) of Table 8. The results suggest that there no significant systematic differences on the supply of credit to distressed firms by government recapitalized banks.

Table 8 – Estimation results: Government recapitalization

	$\Delta \ln(\text{loan})$ (1)	$\Delta \ln(\text{loan})$ (2)	$\Delta \ln(\text{loan})$ <i>Distressed - def.1</i> (3)	$\Delta \ln(\text{loan})$ <i>Distressed - def.2</i> (4)
CoCos Recap $\times$ Share	0.0122* (0.0072)			
Private Recap $\times$ Share	0.0003 (0.0068)			
Cocos Recap_ <b>Size</b> $\times$ Share		0.0044** (0.0017)	0.0044** (0.0020)	0.0040** (0.0020)
CoCos Recap_ <b>Size</b> $\times$ Share $\times$ Distressed			-0.00004 (0,0027)	0.0006 (0,0011)
Private Recap_ <b>Size</b> $\times$ Share		-0.2887 (0,4590)	-0.2889 (0,4590)	-0.2920 (0,4590)
Buffer		0.0365*** (0,0076)	0.0365*** (0,0076)	0.0363*** (0,0076)
Share	-0.0924*** (0.0045)	-0.0924*** (0.0045)	-0.0924*** (0.0045)	-0.0925*** (0.0045)
Fixed effects	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank	Firm $\times$ Quarter, Bank
No. of observations	2,728,921	2,706,986	2,706,986	2,706,986
Adjusted $R^2$	0.090	0.090	0.090	0.090

*Notes:* The dependent variable is the two-period growth rate rate of credit granted to firm  $i$  by bank  $k$ , calculated by the two-period difference of the natural logarithm of the exposure of firm  $i$  on bank  $k$ . The estimates reported in columns (1) and (2) refer to firms of the construction and real estate sector, those in columns (3) and (4) refer to firms of the manufacturing sector, and those in columns (5) and (6) refer to firms of the trade sector. The explanatory variables are defined in Table 2 and are included in the estimation lagged by one semester. The parameters are estimated with the fixed effects estimator. The standard errors are reported in parentheses and are robust to heteroskedasticity and autocorrelation. \*\*\*, \*\*, and \* stand for statistical significance at 1 per cent, 5 per cent, and 10 per cent, respectively.

## 5 Conclusions

The international financial crisis and the sovereign debt crisis that affected some euro area countries contributed significantly to the deterioration of the Portuguese banks solvency conditions. The funding restrictions in international markets motivated by successive downgrades of the sovereign debt rating and the persistent decreases in the banks' profitability led to the announcement of negative results, which stressed the banks' capital ratios. Simultaneously, and in the context of the EFAP and the EBA's stress tests, stricter minimum capital requirements were implemented to ensure the stability of the banking system during the economic crisis.

This context led to the bailout of four of the eight largest Portuguese banks in June 2012 and December 2012. These bailouts were mainly through the issuance of CoCos with the goal of guaranteeing the compliance with the stricter minimum capital requirements and the reinforcement of the solvency levels of banks. These bank bailouts were contemporaneous to a set of private recapitalizations.

The costly nature of bank bailouts and the difficulty to preserve solid solvency levels concurred with the commitment assumed by recapitalized banks of financing firms, in a context of the deleveraging process of the Portuguese economy.

This paper analyses the impact of the government and private recapitalizations on the supply of credit to Portuguese non-financial corporations between the first quarter of 2010 and the fourth quarter of 2013. The formulated models allow to test if the impact of the recapitalization on the supply of credit to non-financial corporations depends on the magnitude of the recapitalization (against the banks' initial position) and on the ex post capacity of recapitalized banks to comply with the minimum capital requirements, measured by the banks' capital buffer. Additionally, the estimated models allow to test for the existence of heterogeneous supply policies according to the credit performance of firms.

The estimation results suggest that the government recapitalization had a positive and statistically significant impact on the supply of credit. When this effect is decomposed according to the banks' compliance level with the minimum capital requirements defined by the prudential authority, we find that recapitalized banks with a larger capital buffer increased less their supply of credit.

The estimates indicate that there are no significant differences in the credit supply

policy of recapitalized banks towards financially distressed firms. This result does not depend on the capital buffer of recapitalized banks.

Furthermore, these models were estimated separately for different sectors of activity (construction and real estate, manufacturing and trade). For firms in the manufacturing and trade sectors, the recapitalization contributed to an increase in the supply of credit, with banks with larger capital buffers contributing less for this result. In addition, the analysis suggests that there are no significant statistical differences on the supply of credit according to the firms' performance of credit.

Finally, the analysis focusing on the government recapitalization that occurred in the middle and at the end of 2012 suggests that the government recapitalization contributed to the reduction in the slow-down of credit, although this effect is marginally small. A possible explanation for this result may rely on the specific characteristics of the government recapitalization through the issuance of CoCos. The high interest rates associated with these instruments may have stressed the credit supply strategy of recapitalized banks, favoring the acquisition of financial instruments that would guarantee a certain level of yield without further stressing the banks' RWAs.

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