Did Italian banks trade-off lending with government bond purchases?

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Abstract

Using a sample of 105 Italian co-operative banks lending to 2,200 firms operating in Italy, we study banks' trade-off between government bond purchases and lending to firms during the post sovereign debt crisis period (2012-2014). Following the identification procedure of Khwaja and Mian (2008), we estimate the impact of the shift of banks' portfolio preferences towards government bonds on credit supply. Our results show that, controlling for loan demand, banks that acquired a larger amount of government bonds reduced relatively more their supply of both lines of credit and long-term loans.

JEL classifications: E51; G21.

Keywords: Credit Supply; Government Bond Purchases; Bank-Firm relationship.

1 Introduction

While the global financial crisis of 2007-2008 had smaller impact on Italian banks than on those of most other developed countries, the shock following the sovereign crisis of 2011 was severe. As shown by Carpinelli and Crosignani (2015), the drop in the value of government bonds impacted on banks' balance sheets, and in turn on their credit supply. At the same time, the ensuing recession caused an increase in non performing loans and a significant drop in profitability. Although the swift reaction of the Eurosystem helped sustaining the value of government bonds in the periphery countries of the euro area, including Italy, their returns remained higher than before the financial crisis. Facing a surge in the riskiness of loans to firms, many banks shifted their asset portfolios towards domestic government bonds, that offered higher returns than in the past and at the same time could also be used as collateral to access large and cheap financing from the ECB. According to one narrative, in the years following the outburst of the sovereign debt crisis it was government debt, as many times in the past, that crowded out bank lending in Italy. And indeed, the decision of the ECB to launch the Targeted long term financing operations (TLTRO), linking the access to central bank's liquidity to the increase in bank loans, can be seen as a reaction to such crowding-out risk, that was certainly possible with the Long term refinancing operations (LTROs) used since the aftermath of the global financial crisis. However, according to an alternative narrative, the drop in the amount of bank loans to the manufacturing sector was not due to a plunge in credit supply, but to a reduction in credit demand, caused by the recession.

While the debate on the determinants of the drop in bank lending in Italy is still open, understanding if crowding out had a role is a crucial policy issue. To better understand this issue, we study the relationship between government bond purchases and loan supply to firms in a large sample of over 100 Italian co-operative banks lending to more than 2,200 firms between 2012 and 2014, the three years following the outburst of the sovereign debt crisis. Following the most recent empirical banking literature, our analysis exploits the presence of multiple banking relationships to fully control for shocks to credit demand by firms, therefore allowing to identify the effect of government bond purchases on credit supply. Our results reveal that banks that acquired a larger amount of government bonds reduced relatively more their supply of both lines of credit and long-term loans.

The rest of the paper is organized as follows. Section 2 briefly reviews the literature that is most relevant for our analysis. Section 3 presents a simple

model based on Khwaja and Mian (2008) to justify our empirical specification. Section 4 describes the data used in the empirical analysis and presents some descriptive statistics. The following section presents the results of the baseline specification and discuss some additional characterizations. Section 6 concludes.

2 Literature review

Starting from the studies documenting purchases of sovereign debt securities by banks during the period following the Lehman Brother collapse and the sovereign debt crisis, our paper contributes both to the literature illustrating a crowding-out effect of sovereign debt crisis on bank lending and to the literature considering its effects on the real economy.

A first strand of literature related to our paper studies the determinants of bank purchases of sovereign securities in the aftermath of the global financial crisis. Government bond purchases by European banks has been a pervasive phenomenon in the aftermath of the global financial crisis. Ongena et al. (2016), for example, show that during the European sovereign debt crisis, domestic banks in fiscally stressed countries were more likely than foreign banks to increase their holdings of domestic sovereign bonds in months with relatively high domestic sovereign bond issuance. This effect is stronger for stateowned banks and for banks with low initial holdings of domestic sovereign bonds, and it is not fueled by Central Bank liquidity provision. By the end of 2013, the share of government debt held by the domestic banking sectors of Eurozone countries was more than twice that held in 2007 (Becker and Ivashina (2014)). Two main hypotheses have been proposed to explain how banks' purchases of sovereign debt securities is affected by macroeconomic determinants (Affinito et al. (2016)). According to the 'moral suasion' hypothesis, Battistini et al. (2013), Ongena et al. (2016), and Acharya and Steffen (2015) state that countries in financial distress exert a kind of moral suasion on their domestic banks in order to ensure the financing of public debt. On the contrary, according to the 'renationalization hypothesis' (Battistini et al., 2013; Angelini et al., 2014), banks attribute a lower degree of riskiness to domestic sovereigns than foreign investors during a crisis, augmenting the domestic bias in asset holdings. A crucial role in this period was also played by the liquidity provision of the central bank. Using a unique security-level data set, Carpinelli and Crosignani (2015) show that the European Central Bank's three-year Long-Term Re-financing Operation was associated with a strong increase in the purchases of short

term domestic government bonds by Portuguese banks. Those same bonds that could be pledged as collateral to obtain central bank liquidity. Indeed, banks' purchases of government bonds also had a positive effect on banks' balance sheets (Hildebrand et al. (2013)). Studying a large sample if Italian banks between 2007 and 2013, Affinito et al. (2016) show that banks used government security purchases to support their financial and economic conditions.

A second strand of literature has focused on the impact of government debt on bank lending to the private sector. Albertazzi et al. (2014) examine the implications of the sovereign debt tensions, through the 10-year BTP-Bund spread, on the Italian credit market. Among other results, they find that the sovereign spread significantly affects the cost of credit for firms and households and exerts a negative effect on loan growth. Neri (2013) makes an empirical assessment of the impact of the tensions in the sovereign debt markets on bank lending rates in the main euro-area countries, concluding that they have had a significant impact on the cost of credit in the peripheral countries. A counterfactual exercise indicates that if the spreads had remained constant at the average levels recorded in April 2010, the interest rates on new loans to non-financial corporations and on residential mortgage loans to households in the peripheral countries would have been, on average, lower by 130 and 60 basis points, respectively, at the end of 2011. Becker and Ivashina (2014) show that firms were more likely to substitute loans with bonds when local banks owned more risky domestic sovereign debt. Using data on banks exposure to government debt, De Marco (2016) investigates the relationship between the sovereign debt crisis and the credit crunch in Europe, showing that banks more exposed to the sovereign shock reduced their credit supply and increased the interest rates on their loans more than less exposed ones. Merilinen (2016), using a panel of 18 Western European countries, investigates how lending growth in banks was affected by the 2008-2009 financial crisis and the subsequent sovereign debt crisis, finding particularly strong results for cooperative banks. Banks with different ability and incentives to actively trade in the government bond market reacted differently to the crisis: Abbassi et al. (2016) show that banks with higher trading expertise increased their investments in securities and reduced their credit supply to firms relatively more than banks with lower expertise. On a partly related ground, Bofondi et al. (2013) study the effect of the increase in Italian sovereign debt risk on credit supply on a large sample of 670,000 bank-firm relationships between December 2010 and December 2011, showing that after the sovereign debt crisis, lending of Italian banks grew by about 3 percentage points less and their interest rates were 15-20

basis points higher than that of foreign banks. Similarly, Popov and Van Horen (2013), using loan-level data, find that syndicated lending by European banks with high exposures to impaired sovereign debt was negatively affected after the euro area sovereign debt crisis. Interestingly, they observe that the overall reduction in lending is not driven by changes in borrowers' demand, quality, or other types of shocks to bank balance sheets.

The third strand of literature related to our paper examines the transmission of a bank balance sheet shock to corporate credit and its effects on the real economy. Acharya et al. (2016) show that the lending contraction depressed investment, job creation, and sales of firms affiliated with banks that were hit relatively more strongly by the crisis. Bottero et al. (2015), using detailed loan level data matching firms and banks in Italy, show that the exogenous shock to sovereign securities held by financial intermediaries was passed on to firms through a contraction of credit supply. However, it led to a reduction in investment and employment only for the smaller firms, especially those which rely heavily on external financing.

3 Theoretical background and empirical specification

Our empirical setting borrows from Khwaja and Mian (2008) to address the usual identification problem in the literature on bank lending. The setting can be better understood focusing on a simple model.

Consider a representative profit maximizing bank that faces the following marginal cost of funding, that depends on its idiosyncratic characteristics at time t, $\bar{d}_t$, and on the amount of funds raised, D_t: $\bar{d}_t + \alpha_d D_t$, where $\alpha_d \geq 0$ is a parameter describing the elasticity of the cost of funding with respect to the amount raised. The bank has two options to use the funds that it has raised, granting loans or acquiring government bonds. We assume for simplicity that the bank has only one borrower and that the marginal return from lending at time t depends on some idiosyncratic characteristics of the bank at time t, $\bar{r}_t$ and on the amount lent, L_t: $\bar{r}_t - \alpha_l L_t$, where $\alpha_l \geq 0$ is a parameter describing the elasticity of the cost of the loan with respect to its size. Finally, we assume that government bonds at time t give a flat return r_t^b, and that the bank, for its internal portfolio decisions, requires a premium θ on bank loan returns with respect to government bonds. Since the bank always has the option of buying government bonds, that gives a fixed and exogenous rate of return, it will be willing to lend only up to the point that the additional amount gives a return that is higher than that

given by government bonds, plus the spread: $\bar{r}_i - \alpha_l L_t \geq r_t^b + \theta$.[1] Assuming for simplicity that this inequality is satisfied as an equality, we therefore obtain the following equilibrium condition:

$$L_t = \frac{\bar{r}_t - r_t^b - \theta}{\alpha_l} \tag{1}$$

At the margin, a profit maximizing bank will also equate the marginal cost of funding with the marginal revenue of lending, that from the arbitrage condition described above is the same as the returns on government bonds: $\bar{d}_t + \alpha_d D_t = r_t^b + \theta$. From this condition we can therefore obtain the optimal amount of funding raised by the bank at time t:

$$D_t = \frac{r_t^b + \theta - \bar{d}_t}{\alpha_d} \tag{2}$$

Since we have assumed, for simplicity, that the bank has only one borrower, the following balance sheet constraint needs to hold: $D_t = B_t + L_t$, where B_t is the total value of government bonds held by the bank at time t. Substituting equations (1) and (2) into the previous expression we therefore obtain the equilibrium level of holdings of government bonds by the bank at time t as a function of bank idiosyncratic idiosyncratic characteristics, the returns on government bonds and the exogenous parameters of the model:

$$B_t = D_t - L_t = \frac{r_t^b + \theta - \bar{d}_t}{\alpha_d} - \frac{\bar{r}_t - r_t^b - \theta}{\alpha_l} \tag{3}$$

Assume next that at time $t+1$ the economy is hit by an exogenous shock that impacts on: (i) the returns on government bonds; (ii) the spread required by the bank on loans with respect to government bonds; (iii) the demand for bank loans; (iv) and the supply of bank loans by bank i. At time $t+1$, the return on government bonds is therefore $r_{t+1}^b = r_t^b + \gamma$, where γ is a measure of the shock on the return on government bonds, and the spread required by the bank on loans with respect to government bonds is $\theta + \kappa$, where κ is a measure of the shock on the spread. At the same time, after the shocks, the marginal revenue on bank loans becomes: $\bar{r}_{t+1} - \alpha_l L_{t+1} + \bar{\eta} + \eta + \zeta$, where $\bar{\eta}$ is a measure of the aggregate shock hitting the demand for bank loans, η is a measure of the idiosyncratic shock hitting the firm borrowing from our representative bank, and ζ is a measure of the idiosyncratic shock

[1] In this setting, accounting for the different probability of default of loans and government is easy, but it would not add to the comprehension of the identification problem that is the objective of this simple model.

hitting the bank. Accounting for the impact of these exogenous shocks, at time $t+1$ the previous equilibrium conditions can therefore be rewritten as:

$$L_{t+1} = \frac{\bar{r}_t - (r_t^b + \theta + \gamma + \kappa) + \bar{\eta} + \eta + \zeta}{\alpha_l} \tag{4}$$

$$D_{t+1} = \frac{r_t^b + \theta + \gamma + \kappa - \bar{d}_t}{\alpha_d} \tag{5}$$

$$B_{t+1} = \frac{r_t^b + \theta + \gamma + \kappa - \bar{d}_t}{\alpha_d} - \frac{\bar{r}_t - (r_t^b + \theta + \gamma + \kappa) + \bar{\eta} + \eta + \zeta}{\alpha_l} \tag{6}$$

From the set of equilibrium conditions at time t and $t+1$ it is possible to obtain an expression for the change between t and $t+1$ in the value of government bond holdings by the bank and in the amount of its loans to the firm:

$$\Delta B = \frac{\gamma + \kappa}{\alpha_d} - \frac{(\bar{\eta} + \eta + \zeta)}{\alpha_l} + \frac{\gamma + \kappa}{\alpha_l} \tag{7}$$

$$\Delta L = \frac{\bar{\eta} + \eta + \zeta - \gamma - \kappa}{\alpha_l} \tag{8}$$

Substituting (7) into (8) we then obtain the baseline relationship of our empirical analysis:

$$\Delta L = \frac{\alpha_l - (1 + \alpha_d)(\bar{\eta} + \eta + \zeta)}{\alpha_l(\alpha_l + \alpha_d)} - \frac{\alpha_d}{\alpha_l + \alpha_d}\Delta B \tag{9}$$

The intuition behind the model described above can be better gauged through a graphical analysis. The top-right panel of Figure 1 describes the loan market, with interest rates measured on the positive interval of the Y-axis and the size of the loan measured on the X-axis. The downward sloping curve represents the loan demand schedule faced by the bank as a negative function of the interest rate: L_t: $\bar{r}_t - \alpha_l L_t$. The top-left panel describes the deposit market, with interest rates again measured on the (positive interval of the) Y-axis, and the size of deposits on the X-axis. Starting from the origin, a move to the left represents an increase in the value of bank's deposits. The upward sloping curve represents therefore the deposit demand schedule faced by the bank as a positive function of the interest rate: D_t: $\bar{d}_t + \alpha_d D_t$. The interest rate $r_t^b + \theta$ on the positive interval of the Y-axis is the lower threshold of the interest rates on bank loans: since the bank

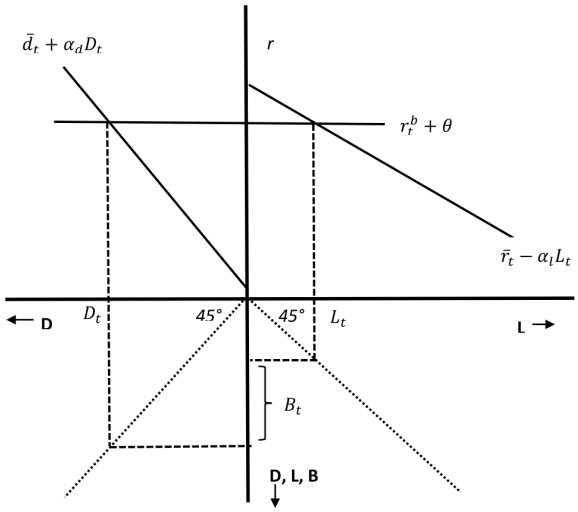

Figure 1: Bank's balance sheet equilibrium

always has the alternative to purchase government bonds at an interest rate r_t^b, that it considers as equivalent to a returns on loans of $\bar{r}_t + \theta$, it will never supply loans at a lower rate. Once the return on bank loans is fixed, from the equilibrium condition between the marginal cost of funding and the marginal revenue of lending, it is possible to find from the top-right panel the total value of loans granted by the bank, L_t, and from the top-left panel the total value of deposits raised by the bank, D_t. Of course, these two amounts do not need to coincide. The dotted line in the bottom-left panel of Figure 1 is the 45-degrees line, so that in the negative interval of the Y-axis we can read the total value of deposits. In the same way, the 45-degrees dotted line on the bottom-right panel allows to map the value of loans on the the negative interval of the Y-axis. The difference between the two values is the amount of bonds, B_t held by the bank. Any shock hitting the economy at time t can be represented as a shift of the schedules in 1. For example, a drop in the demand for loans causes a shift to the left of the schedule in the top-right panel. In turn, assuming that the interest rate elasticity of the demand for loans is higher than that of the demand for deposits, a likely assumption that is mirrored in the Figure, this causes an increase in the bank's holdings of government bonds.

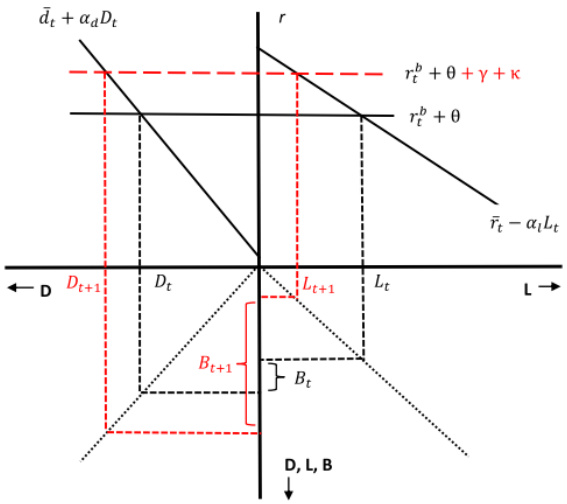

Figure 2: Bank's balance sheet equilibrium after a shock γ and/or κ

Figure 2 presents the similar cases of a positive shock to the returns on government bonds, γ, or of the spread required by the bank on loans with respect to the return on government bonds, κ, that amounts to a shift in the bank's portfolio preferences from loans to government bonds. In the new equilibrium after the shock, bank loans drop from L_t to L_{t+1}, deposits drop from D_t to D_{t+1} and government bond holdings raise from B_t to B_{t+1}. As it was clear from (9), there is negative correlation between lending and government bond holdings.

Equation (9) is the benchmark of our empirical model. Extending the above framework to study a panel of banks lending to many different borrowers, the following equation can be estimated:

$$\Delta L_{ij} = \varphi_1 \Delta B_i + \varphi_2 Dummy\ firm_j + \varphi_3 Bank\ characteristics_i + \epsilon_{ij}, \quad (10)$$

where ϵ_{ij} is a standard error term, and from equation (10) we know that $\varphi_1 = -\alpha_d/(\alpha_l + \alpha_d)$. A crucial assumption in the comparative static analysis of Figure 2 is that the loan demand schedules is fixed. In fact, this hypothesis is fully consistent with our empirical model, in which firm specific idiosyncratic shocks that might alter their demand for loans are

controlled for by firm dummies, and shocks to bank loan supply are captured by $Bank\ characteristics_i$.[2] Clearly, this implies that we are estimating the impact of the drop in credit supply caused by the shift of bank's portfolio preferences towards government bonds.

Since we have panel data on firm loans, (10) can be rewritten in order to take into account of the additional time dimension, as in the following equation:

$$\Delta L_{ijt} = \varphi_1 \Delta B_{it} + \varphi_2 Dummy\ firm_{jt} + \varphi_3 Bank\ characteristics_{it} + \epsilon_{ijt}, \tag{11}$$

where ϵ_{ijt} is a standard error term, time varying specific idiosyncratic shocks to firms' demand are controlled for by the time varying, firm specific dummies $Dummy\ firm_{jt}$, and time varying determinants of bank loan supply are captured by $Bank\ characteristics_{it}$.

Previous research has shown that revolving credit lines are an important source of financing used by corporations (Bottero et al. (2015)). Moreover, recent research has shown that credit lines may display particular sticky response to supply-side shocks because of 'evergreening' practices adopted by banks (Albertazzi and Marchetti (2010)). Accordingly, we estimate equation (11) distinguishing credit lines and long-term loans. Provided that our empirical model allows to control the effect for bank time-varying specific characteristics and for bank-firm relationships, we estimate two set of regressions including both controls.

We present the results of a specification in which all variables are normalized by the level of total assets at the beginning of the sample period. Following the recent empirical literature (see, e.g., Bottero et al., 2015; Altavilla et al., 2016), in some specifications we also account for a number of time varying bank-level characteristics: (i) bank capitalization, measured by the ratio of Tier 1 capital to risk weighted assets (*Tier1 capital ratio*), (ii) profitability, measured by the return on average assets (*ROA*) and (iii) funding structure, measured by the ratio of interbank lending to interbank borrowing (*Interbank ratio*). Additionally, we control for bank-firm relationship including the contribution of each lender to the total bank debt of the borrower (*Bank share credit lines, Bank share term loans*), and the relationship length in terms of year (*Relationship lenght*).

[2] By introducing $Bank\ characteristics_i$ into equation (11) we are assuming that the impact of the shocks ζ_i can be captured by these bank characteristics.

4 Data and summary statistics

To perform the empirical analysis we need both information on banks' purchases of government securities, and on other characteristics of banks' balance sheets, and information on bank lending at the bank-firm, in order to disentangle credit demand and credit supply effects. To this purpose, we use two high quality data sources. On the bank side, we use Bankscope records, that provide balance sheet information for all cooperative banks in our sample. Remarkably, balance sheet data on this set of banks has been directly provided to Buerau van Dijk, the corporation producing Bankscope, by the Italian association of cooperative banks. Data on bank-firm relationships include detailed information on the credit lines granted on checking accounts and on long-term loans collected by CRIF (*Centrale dei Rischi Finanziari*), a credit rating agency providing ratings on Italian firms, and CSD (*Centro Servizi Direzionali*), an Italian consulting company providing electronic data processing services to co-operative banks. Within the Eurozone, Italy is one of the three countries where the cooperative banks have the largest market share. The most important feature of these banks is that of being local, mutual, not-for-profit cooperatives. They are distinguished from commercial banks mainly through their capital structures and their branch networks. On the one hand, cooperative banks are not listed on stock exchanges and are held directly by their clients through member shares. Members participate directly in their governance and elect their representatives through general assembly meetings (Egarius and Weill (2016)).

From the initial sample provided by CRIF and CSD, after checking for outliers, duplicates and missing values, and excluding financial services and the public administration sectors, the resulting sample consists of 2,200 firms and more than 7,000 bank-firm-year observations over the period 2012-2014. Our sample includes a large number of firms that have established multiple lending relationships with more than one bank. Firms operate in the following six macro-industries: agriculture, commerce, transports and hotels, manufacturing, building and services. The 105 co-operative banks in the sample are located in different region across Italy (60 per cent in the North, 23 per cent in the South and remaining banks in the Centre).

Table 1 displays the summary statistics of variables of interest.

On average, the short term and long term credit granted by a bank to a firm shows a negative annual change, normalized by total assets (-0.001 per cent, for both loans supply). Both dependent variables show a high standard deviation (0.007 and 0.025, respectively). These results are consistent with the expectations that banks reduced the amount of both

Variable	mean	st. dev.	1st perc.	99th perc.	obs.
Dependent variable					
Δ credit line (normalized)	-0.001	0.007	-0.041	0.015	7,313
Δ term loans (normalized)	-0.001	0.025	-0.052	0.065	7,228
Key explanatory variable					
Δ government bonds (normalized)	6.988	5.948	-4.139	30.438	7,313
Bank-specific control variables					
Tier1 capital ratio	16	4	9	30	7,306
ROA	0.034	0.515	-2.331	0.774	7,313
Interbank ratio	43.405	31.343	6.656	127.374	7,306
Relationship-specific control variables					
Bank share credit lines	47.159	22.421	0	100	7,301
Bank share term loans	45.575	43.495	0	100	4,626
Relationship length	12	12	1	63	7,258

Table 1: Descriptive statistics

short and long term credit granted to firms. Moving to our main explanatory variable, purchases of government bonds show an average positive annual change (7 per cent of total assets), with a high standard deviation (6 per cent). This is indicative of a high variation of the exposure to the sovereign debt in the cross-section of 105 financial intermediaries. Our sample of banks is heterogeneous also in terms of capitalization: tier1 capital ratio is on average 16 per cent, with values ranging between 9 per cent and more than 30 per cent. In terms of profitability, ROA is on average positive (0.034 per cent) with a very high variation between the 1st percentile (-2.331) and the 99th percentile (0.774). The net interbank ratio is on average 43 per cent, meaning that banks in our sample lend to other banks more than their borrowings from the interbank market. Therefore, the analysis of descriptive statistics shows a high heterogeneity in our sample of banks. Concerning bank-firm relationship, Table 1 shows that the bank seems to be the main bank of the firm since it grants 47 per cent of the total credit line and 45 per cent of the total term loan amounts. Moreover, on average the firm has a relationship with the same bank for 12 years, with values moving from 1 to 63 years.

These results are confirmed by looking at Table 2, that reports significant differences between the two sub-samples of banks, below and above the median level of government bond changes. The table shows that the two subsamples are different in terms of all variables adopted in the analysis, excluding the change of long term loans, capitalization ad relationship length.

Looking at correlations between bank's exposure to sovereign debt and bank's characteristics (Table 3), we find that banks that are more capitalized

Variable	Government bond holdings		Mean diff. test	
	below median	above median		
Dependent variable				
Δ credit line (normalized)	-0.001	-0.001	-2.377	**
Δ long-term loans (normalized)	-0.001	-0.001	-0.454	
Key explanatory variable				
Δ government bonds (normalized)	3.633	9.117	-45.532	***
Bank-specific control variables				
Tier1 capital ratio	15.777	15.794	-0.154	
ROA	0.050	2.372	2.120	**
Interbank ratio	46.997	41.131	7.236	***
Relationship-specific control variables				
Bank share credit line	46.615	47.505	-1.626	**
Bank share term loans	44.098	46.618	-1.949	**
Relationship length	11.908	11.780	0.442	

*** significant at 1% level; ** significant at 5% level

Table 2: Government bond holdings and bank characteristics

and more profitable hold a larger share of government securities. On the contrary, the interbank ratio is negatively and significantly correlated to purchases of government bonds (-0.246).

Variables	1	2	3	4	5	6	7	8	9
1 Δ credit line (normalized)									
2 Δ long-term loans (normalized)	-0.0856*								
3 Δ government bonds (normalized)	-0.0028	0.0018							
4 Tier1	0.0064	-0.0002	0.019						
5 ROA	0.0121	-0.0076	0.0025	0.2751*					
6 Interbank	0.0067	0.0298	-0.2458*	0.0147	0.1310*				
7 Share credit lines	0.0239	0.007	0.0176	0.0348*	0.0137	-0.0121			
8 Share long-term loans	-0.0132	0.0187	0.0390*	-0.0121	0.0014	-0.022	0.1569*		
9 Length	-0.0648*	-0.0288	-0.0127	-0.0282	-0.0241	-0.0238	0.0317*	0.0298	

* significant at 5% level

Table 3: Government bond holdings and bank characteristics: Correlations

5 Results

5.1 Baseline results

This section presents the results of the estimation of the econometric model described in equation (11) to assess to what extent banks change their lending activity to firms as a result to purchases of government securities. We have conducted our analysis normalizing the change in loans and in government bond holdings by the value of bank total assets at the beginning of the period. With respect to the empirical specification of equation (11), this amounts to dividing the left and right hand side variables by the level of

the bank total assets. In the baseline regressions we have included only the cases in which the firm was granted by the bank the loan type under analysis in at least one of the three years. In the robustness checks we present the results of additional specifications to account for all lending relationships with at least one type of loan.

Table 4 reports baseline results considering the impact of government bonds purchases on credit lines on checking accounts, including bank-level controls: bank capitalization (column (2)), profitability (column (3)), funding structure measured by the interbank ratio (column (4)).

	(1)	(2)	(3)	(4)
Δ government bonds	-0.078**	-0.056**	-0.054**	-0.055*
	(0.04)	(0.03)	(0.03)	(0.03)
Tier1 capital ratio		-0.055**	-0.064**	-0.064**
		(0.02)	(0.03)	(0.03)
ROA			-0.044	-0.043
			(0.06)	(0.06)
Interbank ratio				-0.034
				(0.71)
Observations	7,313	7,303	7,303	7,293
Adjusted R^2	0.079	0.082	0.082	0.081

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Government bond purchases and bank lending (normalized variables): credit lines and bank-specific characteristics

Table 4 shows that banks government bond purchases have a negative and statistically significant impact on the value of the credit lines that they make available to firms. Comparing the change in credit supply of two banks whose purchase of government bonds is different, banks with larger purchases of government bonds reduce their lines of credit relatively. Remarkably, consistent with our theoretical model and with other empirical studies (see, among others, Bottero et al. (2015)), this effect on bank lending is a pure supply shock, orthogonal to demand-side shocks that are accounted for by the time-varying firm-specific fixed effects. Our results are robust to the inclusion of bank-specific dummies as well as time-varying bank-specific

characteristics. Among other coefficients in our regression, only bank's capitalization (Tier 1) remains statistically significant with a negative impact on credit line changes.[3]

	(1)	(2)	(3)	(4)
Δ government bonds	-0.100	-0.091	-0.096	-0.121*
	(0.08)	(0.07)	(0.07)	(0.07)
Tier1 capital ratio		-0.067	-0.116**	-0.118**
		(0.04)	(0.05)	(0.05)
ROA			-0.386**	-0.374**
			(0.16)	(0.15)
Interbank ratio				-2.378
				(2.46)
Observations	3,071	3,067	3,067	3,060
Adjusted R^2	0.267	0.263	0.268	0.259

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Government bond purchases and bank lending (normalized variables): term loans and bank-specific characteristics

Government bond purchases have a negative impact also on the value of term loans granted to firms (Table 5). However, even though the sign of the coefficient is always negative, it is not always statistically significant, depending on what control variables are included. Reassuringly, when including all bank-level controls our results show a negative and statistically significant effect of government bond purchases on the supply of long-term loans (column (4)).

The results of the baseline specifications are confirmed also including characteristics of the bank-firm relationship, such as: the share of credit line (Table 6, column (1)) and the share of term loans (column (3)) granted by bank b on the total amount granted by all banks in the sample to firm i, and the length of the lending relationship on credit lines (column (2)) and term loans (column (4)).

[3]This result is consistent with previous empirical research that have emphasized the role of bank capital constraints in determining quantitative restrictions in lending (see, among others, Paravisini, 2008; Khwaja and Mian, 2008).

	Credit lines		Term loans	
	(1)	(2)	(3)	(4)
Δ government bonds	-0.054*	-0.054*	-0.119*	-0.114
	(0.03)	(0.03)	(0.07)	(0.07)
Tier1 capital ratio	-0.065**	-0.069**	-0.118**	-0.123***
	(0.03)	(0.03)	(0.05)	(0.05)
ROA	-0.045	-0.052	-0.377**	-0.376**
	(0.06)	(0.06)	(0.15)	(0.15)
Interbank ratio	-0.018	0.115	-2.479	-2.389
	(0.71)	(0.71)	(2.49)	(2.49)
Bank share credit line	0.028	0.042		
	(0.04)	(0.04)		
Relationship length		-0.003**		-0.009**
		(0.00)		(0.00)
Bank share term loans			-0.232*	-0.193
			(0.13)	(0.13)
Observations	7,281	7,179	3,060	3,026
Adjusted R^2	0.082	0.085	0.262	0.268

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Government bond purchases and bank lending (normalized variables): including relationship-specific characteristics

In the next Section we will strengthen our analysis presenting the result of a set of additional robustness checks.

5.2 Robustness checks

Our first robustness check relates to the estimations technique. Since our data present a high degree of dispersion, we have estimated our baseline specification using robust regression and median regression techniques, that are less affected by the presence of potential outliers. To control for credit demand, we have included the time-varying firm-specific fixed effects estimated from the previous OLS specification (see, e.g., Cingano et al., 2016). Reassuringly, the results are even stronger than those obtained with the OLS specification (Table 7).

	Robust regression	Median regression
	(1)	(2)
Δ government bonds	-0.107***	-0.112***
	(0.02)	(0.03)
Tier1 capital ratio	-0.108***	-0.106***
	(0.00)	(0.01)
ROA	-0.319***	-0.322***
	(0.02)	(0.03)
Interbank ratio	-2.296***	-1.955***
	(0.37)	(0.50)
Bank share term loans	-0.285***	-0.211***
	(0.04)	(0.05)
Relationship length	-0.006***	-0.006***
	(0.00)	(0.00)
Observations	3,026	3,026
Adjusted R^2	0.731	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Government bond purchases and bank lending (normalized variables): robust and median regression on term loans

Next, we have included all cases in which a firm had a lending relationship with a bank. To do so, we have set to zero the value of credit lines for a firms that had a long term loan but not a credit line, and conversely we have set to zero the value of term loans for firms that had a credit line but no term loans. Overall, these results provide stronger support to the crowding-out hypothesis. The coefficient of our key explanatory variables is negative and significant for both credit lines supply (Table 8) and term loans (Table 9).

	(1)	(2)	(3)	(4)
Δ government bonds	-0.070**	-0.064***	-0.062***	-0.066***
	(0.03)	(0.02)	(0.02)	(0.02)
Tier1 capital ratio		-0.029*	-0.034*	-0.033*
		(0.02)	(0.02)	(0.02)
ROA			-0.028	-0.026
			(0.03)	(0.03)
Interbank ratio				-0.318
				(0.63)
Observations	12,759	12,744	12,744	12,721
Adjusted R^2	0.119	0.120	0.120	0.120

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Government bond purchases and bank lending (normalized variables including zeros): credit lines and bank-specific characteristics

Reassuringly, the results are confirmed also when we control for the characteristics of the lending relationship (Table 10).

Next, with a slight departure from what predicted by our simple theoretical framework, we have estimated our baseline specification normalizing the dependent variable and the main explanatory variable with the level of total assets in the previous year (instead of the beginning of the period). Results, reported in Table 11 confirm previous findings for both credit lines and term loans.

Finally, to control for the fact that the value of the credit line granted by a bank to a firm does not change very often through time, we have verified whether banks that increased their holdings of sovereigns were more likely

	(1)	(2)	(3)	(4)
Δ government bonds	-0.055**	-0.053**	-0.044**	-0.035
	(0.02)	(0.03)	(0.02)	(0.02)
Tier1 capital ratio		-0.006	-0.038**	-0.040**
		(0.02)	(0.02)	(0.02)
ROA			-0.170**	-0.174**
			(0.07)	(0.07)
Interbank ratio				0.573
				(0.77)
Observations	14,414	14,395	14,395	14,372
Adjusted R^2	0.090	0.086	0.088	0.083

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Government bond purchases and bank lending (normalized variables including zeros): term loans and bank-specific characteristics

to decrease the value of the credit line, independent on the value of the change. To this purpose, we have defined a dummy variable that is equal to 1 whenever the credit supply by bank b to firm i increased between time t and time *t+1*, and zero otherwise. Since also term loans can suffer from a similar problem, although to a lower extent, we have also defined a similar dummy variable in the case of term loans. In both cases, to control for credit demand by including time-varying, firm specific dummies, we have estimated the binomial regression model using a linear probability model. Columns (1) and (2) of Table 12 present the results for credit lines, whereas columns (3) and (4) present the results for term loans. Interestingly, the estimated coefficients are negative and statistically significant in both cases. Specular results (i.e., a positive and statistically significant coefficient for an increase in government bond holdings) are obtained estimating a binomial regression model for the cases in which bank loans show a decrease (Table 13).

5.3 Additional results

The incentives for a bank to shift its asset portfolio towards government bonds and away from lending depend on the portfolio's initial composition.

	Credit lines		Term loans	
	(1)	(2)	(3)	(4)
Δ government bonds	-0.080***	-0.081***	-0.084**	-0.088**
	(0.03)	(0.03)	(0.04)	(0.04)
Tier1 capital ratio	-0.043	-0.045*	-0.038	-0.044
	(0.03)	(0.03)	(0.03)	(0.03)
ROA	-0.022	-0.026	-0.230**	-0.236**
	(0.04)	(0.04)	(0.11)	(0.11)
Interbank ratio	-0.767	-0.694	0.979	0.889
	(0.62)	(0.62)	(1.46)	(1.48)
Bank share credit line	0.141***	0.148***		
	(0.04)	(0.04)		
Relationship length		-0.003**		-0.003**
		(0.00)		(0.00)
bank share term loans			-0.125**	-0.116**
			(0.06)	(0.06)
Observations	9,763	9,653	7,933	7,837
Adjusted R^2	0.069	0.071	0.114	0.117

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Government bond purchases and bank lending (normalized variables and including zeros): relationship-specific characteristics

	Credit lines		Term loans	
	(1)	(2)	(3)	(4)
Δ government bonds	-0.000*	-0.000*	-0.000*	-0.000*
	(0.00)	(0.00)	(0.00)	(0.00)
Tier1 capital ratio	-0.066**	-0.069**	-0.126***	-0.130***
	(0.03)	(0.03)	(0.05)	(0.05)
ROA	-0.051	-0.058	-0.394**	-0.394**
	(0.06)	(0.06)	(0.15)	(0.15)
Interbank ratio	0.116	0.249	-2.267	-2.180
	(0.69)	(0.69)	(2.48)	(2.48)
Bank share credit line	0.027	0.041		
	(0.04)	(0.04)		
Relationship length		-0.003**		-0.009**
		(0.00)		(0.00)
Bank share term loans			-0.228*	-0.189
			(0.12)	(0.12)
Observations	7,281	7,179	3,060	3,026
Adjusted R^2	0.082	0.085	0.266	0.272

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Government bond purchases and bank lending (normalized variables on yearly total assets and excluding zero)

	Credit lines		Term loans	
	(1)	(2)	(3)	(4)
Δ government bonds	-0.488***	-0.475***	-0.480***	-0.485***
	(0.17)	(0.16)	(0.16)	(0.16)
Tier1 capital ratio	-0.210	-0.202	-0.148	-0.147
	(0.13)	(0.13)	(0.11)	(0.11)
ROA	-0.148	-0.140	-1.178***	-1.176***
	(0.20)	(0.19)	(0.41)	(0.42)
Interbank ratio	-7.303***	-7.267***	-4.781	-4.948
	(2.77)	(2.73)	(4.04)	(4.08)
Bank share credit line	0.971***	0.992***		
	(0.09)	(0.10)		
Relationship length		-0.004		-0.002
		(0.00)		(0.00)
Bank share term loans			2.436***	2.445***
			(0.18)	(0.18)
Observations	9,763	9,653	7,933	7,837
Adjusted R^2	0.147	0.149	0.220	0.221

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Government bond purchases and bank lending (increase of lending and including zeros)

	Credit lines		Term loans	
	(1)	(2)	(3)	(4)
Δ government bonds	0.311***	0.311***	0.413**	0.409**
	(0.09)	(0.09)	(0.18)	(0.19)
Tier1 capital ratio	0.114	0.127	0.164	0.173
	(0.08)	(0.08)	(0.13)	(0.13)
ROA	-0.151	-0.139	1.195***	1.179***
	(0.12)	(0.12)	(0.40)	(0.41)
Interbank ratio	1.197	1.037	6.880	7.069
	(2.41)	(2.37)	(4.77)	(4.84)
Bank share credit line	-0.528**	-0.563***		
	(0.20)	(0.20)		
Relationship length		0.013***		-0.002
		(0.00)		(0.01)
Bank share term loans			5.165***	5.160***
			(0.16)	(0.17)
Observations	9,763	9,653	7,933	7,837
Adjusted R^2	0.123	0.124	0.331	0.333

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Government bond purchases and bank lending (decrease of lending and including zeros)

From simple inspection of Figure 2 it is apparent that, *ceteris paribus*, a bank with a steeper loan supply schedule (a larger α_l) will initially hold a larger amount of government bonds. However, for a given shock to government bond returns,γ, or to the required spread on bank loans, κ, a bank with a steeper loan supply schedule will also experience a smaller increase in government bond holdings. This same result is confirmed by inspecting equations (3) and (7). Similarly, equation (9) shows that the change in bank loans for a given change in government bond holdings is an increasing function of α_l. Therefore, since banks with a larger α_l also initially hold more government bonds, we should find that, *ceteris paribus*, the impact of government bond purchases on bank lending is a decreasing function of the initial amount of government bonds held by the bank. To test this additional implication of our framework we have expanded the baseline specification including the share of government bonds over total assets held by the bank in the previous period, and its interaction with the change in the amount of government bonds.

	Credit lines	Term loans
	(1)	(2)
Δ government bonds	-0.482**	-0.314
	(0.19)	(0.55)
Share of government bonds over total assets (lagged) x Δ government bonds	1.159**	0.916
	(0.55)	(1.54)
Share of government bonds over total assets (lagged)	-0.043***	0.016
	(0.01)	(0.04)
ROA	0.022	-0.369***
	(0.05)	(0.14)
Tier1 capital ratio	-0.008	-0.152**
	(0.03)	(0.07)
Interbank ratio	-0.944	-2.287
	(0.76)	(2.62)
Observations	7,293	3,060
Adjusted R^2	0.083	0.259

The coefficient of lagged government bonds is multiplied by 100. Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: The bank lending channel (excluding zero): interactions with initial bond holdings

Table 14 shows that, as expected, the impact of government bond purchases on lending is smaller for banks that initially held a larger amount of bonds, although the effect is only significant for credit lines and not for term loans. Interestingly, in the case of credit lines the marginal effect of an increase in government bond holdings is also in this case negative and statistically significant at the 1% level, and its impact becomes statistically insignificant only when the initial holdings are above 40% of total assets. On the contrary, in the case of term loans, the marginal effect is statistically insignificant at all initial levels of government bond holdings.

Finally, since not all lending relationships have been maintained during our sample period, we analyzed whether banks that increase their holdings of government bonds are less likely to start a new lending relationship or are more likely to severe an existing one. While all firms in our sample are in theory potential targets for a new ending relationship, in reality our sample is made mainly by small banks with limited geographical reach. Considering all firms in our sample as potential targets of a new lending relationship would therefore artificially inflate our sample size and eventually bias our results. For this reason we have considered as potential targets only firms that already had a lending relationship with the bank, as a term loan in the equation in which we estimate the probability that a new credit line is granted, and conversely as a credit line in the equation in which we estimate the probability that a new term loan is granted. Of course, no such problem is posed by the analysis of lending relationship that are severed.

We have therefore estimated four linear probability models where the dependent variables take the value of one if a new lending relationship is started or an existing one is severed, respectively for credit lines and term loans. The results of Table 15 show that there is a negative and statistically significant relationship between a change in the holdings of government bonds and the probability that a new lending relationship is started, both for credit lines and term loans. On the contrary, there is no evidence of a statistically significant effect on the probability that a lending relationship is terminated. This confirms that the decision of banks to reallocate part of their asset portfolio towards government bonds in the aftermath of the sovereign debt crisis impacted both the intensive margin (the size of loans granted), and the extensive margin (the probability that a loan is granted).

	Credit lines		Term loans	
	New	Severed	New	Severed
Δ government bonds	-291.900**	17.801	-305.689***	-41.674
	(122.47)	(61.50)	(81.56)	(42.51)
ROA	-222.031*	120.121*	-715.104***	290.899***
	(127.01)	(71.15)	(264.39)	(68.24)
Tier1 capital	-192.239**	42.450	-46.818	115.957**
	(78.40)	(39.95)	(52.43)	(44.88)
Interbank ratio	-1333.431	-1395.783	-3507.764**	-1156.209
	(1543.38)	(1184.52)	(1729.08)	(1189.27)
Observations	12,721	12,721	14,372	14,372
Adjusted R^2	0.170	0.337	0.124	0.105

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: The bank lending channel (new and closed relationships)

6 Conclusions

The sovereign crisis of 2011 had a severe impact on bank lending in Italy. Part of this was due to the negative impact on bank balance sheets and part on the drop in credit demand. But some anecdotal also points to the shift in bank asset portfolios from loans to domestic government bonds. Using a large sample of over 100 Italian co-operative banks lending to more than 2,200 firms between 2012 and 2014, the three years following the outburst of the sovereign debt crisis, we have studied the relationship between government bond purchases and loan supply to firms. Exploiting the presence of multiple banking relationships, we have been able to fully control for shocks to credit demand shocks, therefore neatly identifying the effect of government bond purchases on credit supply. Our analysis provides convincing evidence that banks that acquired a larger amount of government bonds reduced relatively more their supply of both lines of credit and term loans to firms.

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