Online Appendix to "The (Unintended?) Consequences of the Largest Liquidity Injection Ever"*

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In this Online Appendix, we illustrate the dataset construction (section A), present additional derivations of the model developed in the paper appendix (section B), develop a simple model of the collateral trade taking into account that the central bank may trigger margin calls (section C), illustrate the ECB collateral framework (section D), present additional figures (section E), and present additional tables (section F).

A Dataset Construction

Our final dataset is the merger of two proprietary datasets.

1. Monetary and Financial Statistics (MFS), a proprietary dataset from the BdP, that includes monthly balance sheet data for all monetary and financial institutions regulated by the BdP. We have data on book values, disaggregated by type of asset/liability, type of counterpart, geographical location of counterpart, and, for some assets and liabilities, maturity.[1] Monetary and financial institutions are divided in three categories: banks, savings institutions, and money market mutual funds. Most of the institutions are banks; savings institutions is an obsolescent category that applies only to agricultural credit cooperatives. Money market funds are small given the undeveloped nature of the Portuguese money funds market. More specifically, the different dimensions for which data are available are: (i) Asset category: banknotes and coins, loans and equivalent (with repricing date up to 1 year, 1 to 5 years, more

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[1] Maturity, as classified by the MFS, refers to next residual repricing maturity, or time left until the next repricing date. Lending, for example, is disaggregated as lending with maturity less than 1 year, between 1 and 5 years, and more than 5 years. This measure of maturity does not coincide with contractual residual maturity if the contract is repriced at a frequency lower than its contractual maturity. Due to the institutional characteristics of the Portuguese financial markets, most long-term loans such as mortgages are floating rate loans, indexed to some reference rate such as the Euribor. This means that they are classified as short-term loans in our dataset.

than 5 years), securities except equity holdings (up to 1 year, 1 to 2 years, more than 2 years), equity holdings, physical assets, and other assets (of which derivatives); (ii) Counterparty's geographical area: Portugal, Germany, Austria, Belgium, Cyprus, Slovenia, Spain, Estonia, Finland, France, Greece, Netherlands, Ireland, Italy, Latvia, Luxembourg, Malta, Slovakia, European Monetary Union excluding Portugal, Non-EMU Countries, European Central Bank; (iii) Counterparty's institutional sector: monetary and financial institutions, social security administration, local government, regional government, insurance and pension funds, private individuals, central government, other financial intermediaries, non-financial firms, other sectors. For the other side of the balance sheet, the counterparty classification is the same, and the liability categories are: demand deposits, deposits redeemable at notice (less than 90 days, more than 90 days), other deposit equivalents (less than 1 year, 1 to 5 years, more than 5 years), repurchase agreements, securities (up to 1 year, more than 1 year), other liabilities, capital and reserves. Crosignani et al. (2015) describes this dataset in more detail and analyzes the evolution of the balance sheets for the Portuguese monetary financial sector during the full sample period.

2. *Sistema Integrado de Estatísticas de Títulos* (SIET), another proprietary dataset from the BdP, which contains monthly information on quantity (face value), book value, and market value for all ISINs that refer to debt instruments issued by the Portuguese central government and a few public companies, and that are owned by financial institutions domiciled in Portugal. This dataset corresponds to the universe of financial institutions in Portugal, conditional on them owning any of these securities. It includes several types of institutions, including monetary and financial institutions, mutual funds, hedge funds, pension funds, brokerage companies, etc.

For the MFS dataset, we keep the following information for each bank, in each period: assets, cash and equivalents, lending, lending to households, lending to non-financial firms, holdings of non-equity securities, holdings of government debt, holdings of Portuguese government debt, holdings of GIIPS government debt, holdings of equity securities, and other assets. For the other side of the balance sheet: equity and reserves, demand deposits, savings deposits, time deposits, repo, securities, other liabilities, short-term (less than 1 year) borrowing from the central bank, medium-term (1-2 years) borrowing from the central bank, and long-term (more than 2 years) borrowing from the central bank.

For the SIET dataset, we keep its original structure, a three-dimensional panel (j, i, t), where j is an ISIN, owned by institution i at time t. For each observation, the SIET gives us quantity (face value), market value, and book value. The latter is only available for certain institutions, but we only use it for consistency purposes. Note that while the datasets intersect, neither is contained in each other: the MFS includes monetary financial institutions which may not own any Portuguese sovereign debt security and thus are excluded from the SIET dataset, while the

SIET dataset includes other types of institutions that are not included in the MFS dataset, such as pension funds, etc.

B Model Derivations

Bank Portfolio Choice, Equilibrium Conditions, and Proposition 1 We solve the banks' problem backwards, starting at $t = 1$. At this period, the bank chooses how to rebalance its long-term debt portfolio and whether to store/borrow from funding markets,

$$\max_{b'_L, d} \left[b'_L + d \left\{ \mathbf{1}[d \geq 0] + \kappa \mathbf{1}[d < 0] \right\} \right]$$
$$\text{s.t.}$$
$$W_1 = q_1 b'_L + d$$

Using the budget constraint, note that setting $d \geq 0$ is equivalent to setting

$$b'_L \leq \frac{W_1}{q_1}$$

In this case, the bank's payoff at $t = 2$ is equal to

$$\pi_2|_{d \geq 0} = b'_L + W_1 - q_1 b'_L$$

Since $q_1 < 1$, the bank seeks to set b'_L as high as possible. Will it ever set b'_L such that $d < 0$? In this case, the payoff is

$$\pi_2|_{d<0} = b'_L + \kappa W_1 - \kappa q_1 b'_L$$

We will assume that funding costs are high enough that $\kappa \underline{q} > 1$, in which case the optimal policy is to set $b'_L = 0$, and so $d < 0$ is inconsistent with optimality. The bank still runs the risk of borrowing: assuming it cannot short-sell long-term bonds, $b'_L \geq 0$, the bank needs to borrow whenever $W_1 < 0$. This occurs when

$$b_S + q_1 b_L + c - R€ < 0$$

Note that it occurs whenever the value of the portfolio is low enough due to a low realization of q_1, or whenever the bank has borrowed enough at $t = 0$, that is, $R€$ is high. In such case, the value of the payoff is

$$\pi_2|_{d<0, b'_L = 0} = \kappa W_1 < 0$$

We can then characterize the bank's strategies at $t = 1$, given q_1, as

$$b'_L = \begin{cases} b_L + \frac{b_S + c - R€}{q_1} & \text{if } q_1 \geq \frac{R€ - c - b_S}{b_L} \\ 0 & \text{otherwise} \end{cases}$$

$$d = \begin{cases} 0 & \text{if } q_1 \geq \frac{R€ - c - b_S}{b_L} \\ b_S + q_1 b_L + c - R€ & \text{otherwise} \end{cases}$$

Note then that the expected value of $t = 2$ profits at $t = 0$ can be written as

$$\mathbb{E}_0[\pi_2] = \int_{\underline{q}}^{\frac{R€ - c - b_S}{b_L}} \kappa \left[b_S + q_1 b_L + c - R€\right] \mathrm{d}F(q_1) + \int_{\frac{R€ - c - b_S}{b_L}}^{\bar{q}} \left[b_L + \frac{b_S + c - R€}{q_1}\right] \mathrm{d}F(q_1)$$

The bank's problem at $t = 0$ is then,

$$\begin{aligned} \max_{b_L, b_S, c, €} \; & \mathbb{E}_0[\pi_2] \\ & \text{s.t.} \\ & W_0 + € = q_S b_S + q_L b_L + c \\ & € \leq (1 - h_L) q_L b_L + (1 - h_S) q_S b_S \end{aligned}$$

In order to illustrate the forces at play, we now assume that $\kappa \to \infty$: the costs of financing in the intermediate period are prohibitive. The bank is infinitely averse to seeking out funding in the intermediate period and will therefore adjust its $t = 0$ decisions to avoid any shortfall. We believe that, while stark, this assumption captures the motive for holding liquid asset reserves at any point in time. Additionally, it simplifies considerably the solution and characterization of the model.

For $\kappa \to \infty$, we can restate the bank's problem as follows: the objective function now becomes

$$\mathbb{E}_0[\pi_2] = \int_{\underline{q}}^{\bar{q}} \left[b_L + \frac{b_S + c - R€}{q_1}\right] \mathrm{d}F(q_1) = b_L + (b_S + c - R€)\mathbb{E}_0\left[\frac{1}{q_1}\right]$$

and the bank faces an additional (liquidity) constraint, imposing a zero shortfall in the second period even for the worst realization of q_1

$$b_S + c + \underline{q} b_L - R€ \geq 0$$

Letting (λ, δ, η) denote the Lagrange multipliers on the budget, collateral and liquidity constraints, respectively, and defining

$$\tilde{q} \equiv \mathbb{E}_0\left[\frac{1}{q_1}\right]^{-1}$$

as the expected value of the price of the long-term bond at $t = 1$ adjusted by a Jensen term, we can write the first-order conditions for the bank's problem as

$$\begin{aligned}
\tilde{q} - q_L[\lambda - \delta(1 - h_L)] + \underline{q}\eta \leq 0 \perp b_L \geq 0 \\
1 - q_S[\lambda - \delta(1 - h_S)] + \eta \leq 0 \perp b_S \geq 0 \\
1 - \lambda + \eta \leq 0 \perp c \geq 0 \\
-R + \lambda - \delta - \eta R \leq 0 \perp \text{€} \geq 0
\end{aligned}$$

Assuming that $b_S, b_L > 0$, and so that both first-order conditions bind, we can write the slope of the yield curve as

$$\frac{1}{q_L} - \frac{1}{q_S} = (\lambda - \delta)\left[\frac{1}{\tilde{q} + \underline{q}\eta} - \frac{1}{1 + \eta}\right] + \delta\left[\frac{h_L}{\tilde{q} + \underline{q}\eta} - \frac{h_S}{1 + \eta}\right]$$

Notice first that if none of these constraints bind, $\delta = \eta = 0$, the bank prices debt at each maturity using a traditional unconstrained arbitrage condition that equates inter-period returns,

$$\frac{1}{q_S} = \frac{\tilde{q}}{q_L} = \lambda$$

where λ measures the marginal cost of funds for the bank. If any of the constraints is active, however, the bank's preference is tilted towards short-term debt. This means that, for the same quantities of outstanding debt, the price of short-term debt increases relative to the price of long-term debt. Thus the yield curve becomes steeper.

We focus on equilibria with strictly positive yields, $q_S, q_L < 1$. From bank optimality, this means that cash is always a strictly dominated asset, $c = 0$. From the bank's optimality conditions, notice that there are two factors that may motivate a preference for short- over long-term debt from the bank's perspective: the first is if short-term debt commands a more favorable haircut, $h_S < h_L$. This preference is scaled by the multiplier on the collateral constraint, δ. The second is that short-term debt allows for better liquidity management, since it yields a certain cash-flow of 1 in the second period, while long-term debt yields a worst-case payoff of $\underline{q} < 1$. This preference is scaled by the multiplier on the liquidity constraint, η.

C Model of Margin Calls and the Collateral Trade

Consider a risk-neutral investor that lives for three periods, $t = 0, 1, 2$ and can choose at $t = 0$ to undertake a leveraged investment on either a short-term bond maturing at $t = 1$, a medium-term bond maturing at $t = 2$, or a long-term bond that does not mature in the investor's lifetime. The investor can partially finance this investment with a collateralized loan that matures at $t = 2$. If the value of the collateral falls (or the collateral matures) before the loan is due, the investor is subject to a margin call and needs to raise sufficient liquidity to compensate the lender for this shortfall. We assume that raising liquidity is costly: each unit of liquidity raised at $t = 1$ costs r at $t = 2$.

The bonds are priced by deep-pocketed, risk-neutral investors with discount factor $\eta < 1$. This means that the price of a bond with maturity s is η^s at $t = 0$. At each subsequent period $t = 1, 2$, with probability α, these investors may receive a preference shock that lowers their discount factor permanently by a factor of $\rho^- < \eta$, or raises their discount factor permanently by a factor of $\rho^+ > \eta$. Thus the price of a bond with maturity s at $t = 1$ becomes $(\rho^x \eta)^s$ after shock $x \in \{-, +\}$. This revaluation may trigger a margin call for longer maturity bonds. We assume that $\alpha\rho^- + (1 - \alpha)\rho^+ < 1$, so that the yield curve is always upward sloping (longer-term bonds are cheaper). This means that the frictionless yields for each of the bonds are

$$
\begin{aligned}
y_S &= \frac{1}{\eta} \\
y_M &= \frac{1}{\eta^2} \\
y_L &= \frac{\alpha\rho^- + (1 - \alpha)\rho^+}{\eta^2}
\end{aligned}
$$

Let us analyze separately the payoffs of investing in a short-, medium- and long-term bond. Let $h \in (0, 1)$ denote the haircut on collateral, and R the interest rate on the LTRO loan. Since we want to focus on the relative preference for different maturities, and not on the desirability of the carry trade *per se*, we assume that $\eta < 1 + R$, so that an unconstrained carry trade is always profitable at any maturity. We assume that there is storage with return unity.[2]

A short-term bond costs η at $t = 0$ and is completely riskless, yielding 1 at $t = 1$. The bank invests by borrowing $h\eta$. Since the collateral matures before the loan, the bank is requested to deposit $h\eta$ at $t = 1$. Since $1 > h\eta$, this margin call is inconsequential and the bank does not need to raise any external liquidity. It receives the margin call deposit at $t = 2$, and repays the loan plus interest. The total profit from this trade is

$$\pi_S = -\eta + h\eta + (1 - h\eta) + [h\eta - (1 + R)h\eta] = 1 - \eta - Rh\eta$$

Given the bank's initial capital, $k < \eta^3$, it can purchase a quantity equal to $\frac{k}{(1-h)\eta}$, and so the

[2]Basically, the investor can save for a net return of zero and borrow for a net cost of r.

profit of this trade is equal to

$$\pi_S = \frac{k}{1-h}\left[\frac{1}{\eta} - 1 - Rh\right]$$

Similarly, we can show that the profits for investing in medium and long-term bonds are given by

$$\pi_M = \frac{k}{1-h}\left[\frac{1+\alpha r h \rho^- \eta}{\eta^2} - 1 - Rh - \alpha r h\right]$$
$$\pi_L = \frac{k}{1-h}\left[\frac{\alpha\rho^-\eta + (1-\alpha)\rho^+\eta + \alpha r h(\rho^-)^2\eta^2}{\eta^3} - 1 - Rh - \alpha r h\right]$$

We can show that $\pi_L \leq \pi_M$ if

$$\alpha r h \rho^- \eta(1-\rho^-\eta) \geq \alpha\rho^- + (1-\alpha)\rho^+ - 1$$

So that, if the probability of a downwards revaluation (and the magnitude of that revaluation) is high enough, and exceeds the return benefits of investing in a long-term bond, the investor may prefer to invest in a medium-term bond. We can derive similar conditions, under which $\pi_L \leq \pi_S$. They are mainly related to liquidity risk: the short-term investment exposes the bank to no type of liquidity risk whatsoever. The medium-term bond exposes the bank to margin call risk, with probability α. The long-term bond exposes the bank to both margin call *and* funding liquidity risk at the final period, since the bond's payoff (its price on the secondary market) may be uncertain. Since there is no discounting, the unconstrained, risk-neutral investor would simply prefer the bond that offers the ex-ante higher return, which is the long-term bond by assumption. Due to liquidity risk, emanating both from margin calls and uncertain prices at loan maturity, the investor may prefer to invest at the shorter term.[3]

D ECB Collateral Framework and the LTRO

Eligible collateral at the ECB falls in two broad asset classes: marketable assets and non-marketable assets. The first comprises debt instruments such as unsecured bonds, asset-backed securities, and covered bank bonds. The second class includes fixed-term deposits from eligible monetary policy counterparties, credit claims (bank loans), and non-marketable retail mortgage-backed debt instruments.[4] The LTRO period was characterized by an expansion of the eligible collateral. On

[3]Our analysis is robust to adding an additional period, so that the investor would obtain a certain payoff from the long-term bond. This would, however, still entail funding risk at loan maturity, since the investor would need to either sell the bond (as in our set-up) or raise costly external funds to repay the loan.

[4]See Section 6 of ECB (2011) for additional details on the eligibility of assets as collateral in the Eurosystem.

the day of the announcement of the operations, the ECB also announced collateral availability by allowing riskier asset-backed securities and allowing national central banks (NCBs) to temporarily allow additional credit claims that satisfy their specific criteria, as long as the risks of this acceptance were assumed by the NCB.

On February 9, twenty days before the second allotment, BdP detailed the criteria for Portugal regarding these additional credit claims. Portfolios of mortgage-backed loans and other loans to households, as well as of loans to non-financial corporations became increasingly pledgeable as collateral. The expansion of these rules also suggests banks were collateral scarce at the time of the first allotment. Although we do not have asset-level data on the holdings of these classes of assets by banks, we rely on aggregate measures of pledged collateral for each bank. These measures include non-marketable assets whose risk was borne by the Eurosystem, additional credit claims (ACCs), government guaranteed bank bonds (GGBBs) issued from a government fund expanded around the time of the troika intervention in mid-2011, and other marketable assets.

E Additional Figures

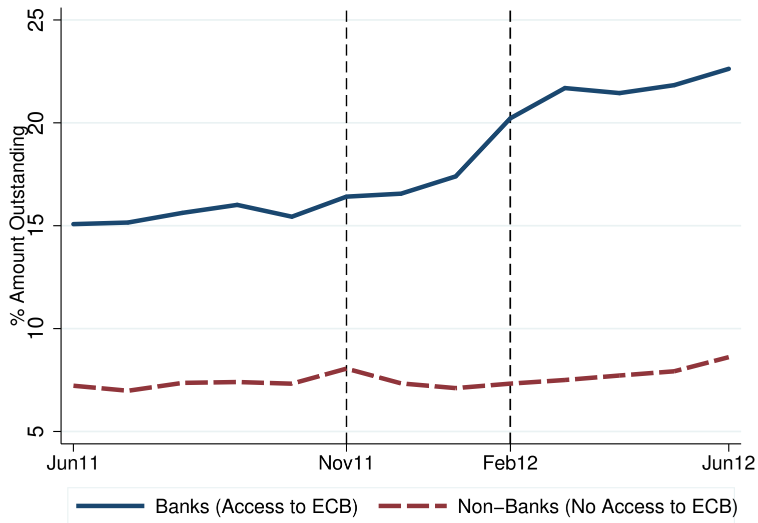

Figure E.1: Holdings of Domestic Government Debt, Normalized by Amount Outstanding. This figure plots the evolution of domestic government bonds held by banks (solid line) and non-banks (dashed line) from June 2011 to June 2012, normalized by the stock of public debt outstanding. The two vertical dashed lines delimit the LTRO allotment period.

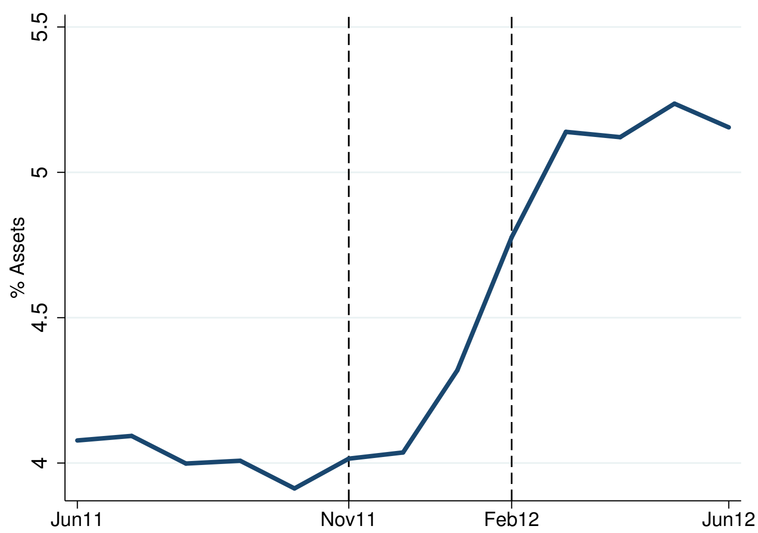

Figure E.2: Holdings of Domestic Government Debt, Normalized by Assets. This figure plots the evolution of domestic government bonds held by banks, divided by total assets, from June 2011 to June 2012. The two vertical dashed lines delimit the LTRO allotment period.

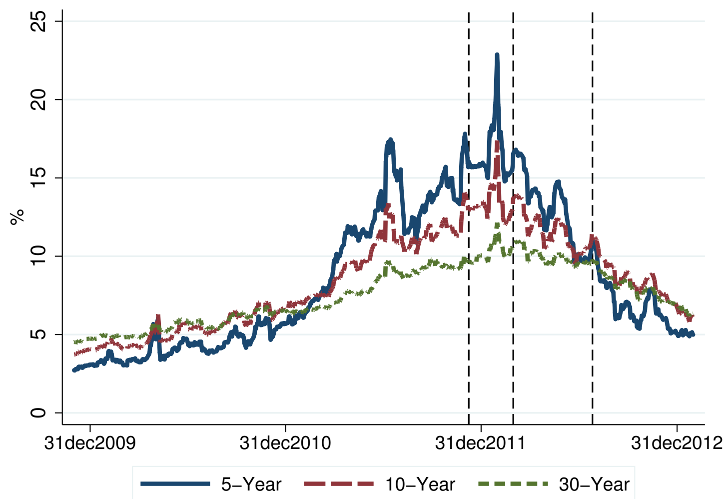

Figure E.3: Portuguese Sovereign Yields. This figure shows the time series of Portuguese 5Y, 10Y, 30Y sovereign yields from November 2009 to January 2013. The dashed vertical lines correspond to the LTRO announcement (December 8, 2011), the second LTRO allotment (February 29, 2012), and the OMT announcement (July 26, 2012).

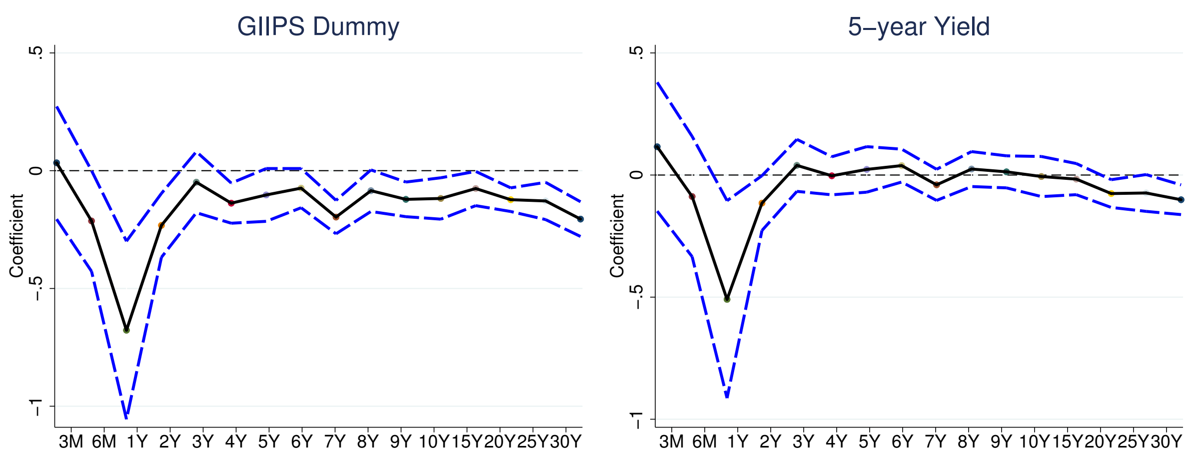

Figure E.4: Yield Curve Steepening, October 2011 1-Year LTRO. This figure plots the $\beta_{(m)}$ estimates of specification (7) as a function of maturity (m). Regressions are estimated separately for each maturity; the sample period is daily from September 27 to October 17 (the announcement date is October 6); and sample countries are the Netherlands, Portugal, Spain, France, Ireland, Belgium, Germany, Italy, Austria, Finland, Cyprus, Slovakia, and Slovenia. In the left panel, Risk is a dummy equal to 1 for Ireland, Italy, Spain, and Portugal. In the right panel, Risk is the log of the 5-year yield on September 26, 2011. Dashed lines delimit the 99% confidence interval. Standard errors are robust. Source: Bloomberg.

F Additional Tables

LHS Var.: LTRO2	(1)	(2)	(3)	(4)	(5)
ΔGovt (Face Value)		1.089***		0.933***	
		(0.010)		(0.091)	
ΔGovt (Market Value)			1.207***		1.034***
			(0.009)		(0.098)
ΔGGBB	1.575***	2.012***	2.060***	1.196**	1.229**
	(0.300)	(0.260)	(0.200)	(0.583)	(0.553)
ΔACC	0.935***	0.800***	0.800***	0.837***	0.838***
	(0.320)	(0.038)	(0.037)	(0.031)	(0.030)
ΔOtherMarketable	1.062**	0.793***	0.792***	0.802***	0.801***
	(0.441)	(0.047)	(0.046)	(0.036)	(0.035)
Total $\text{Collateral}_{\text{Nov11}}$				0.218*	0.221*
				(0.131)	(0.125)
Balance Sheet Controls	✓	✓	✓	✓	
Observations	68	68	68	68	68
R-squared	0.187	0.941	0.943	0.960	0.962

Table F.1: Banks' Buy-and-Borrow Behavior, Robustness. This table presents the estimation results for specification (1), without bank-level controls X_i. The dependent variable is total uptake at LTRO2 normalized by total assets in November 2011. Independent variables include changes in holdings of central bank eligible collateral between November 2011 and February 2012, and the stock of eligible collateral in November 2011. Eligible collateral includes domestic government bonds, additional credit claims (ACC), government guaranteed bank bonds (GGBBs), and other marketable securities. All variables are normalized by bank assets in November 2011. All independent variable are haircut-adjusted. In the first (second) column, we measure changes in government bond holdings using face (market) values. In this Online Appendix, we provide a detailed description of the ECB collateral framework. Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

LHS Var.: LTRO2	(1)	(2)	(3)	(4)	(5)
Δ Govt (Face Value)		0.822***		0.738***	
		(0.174)		(0.219)	
Δ Govt (Market Value)			1.013***		0.948***
			(0.207)		(0.184)
Δ GGBB	2.662**	2.698**	2.763**	1.715**	1.762**
	(1.126)	(1.157)	(1.139)	(0.694)	(0.666)
Δ ACC	0.859***	0.820***	0.815***	0.864***	0.859***
	(0.049)	(0.051)	(0.051)	(0.049)	(0.049)
Δ Other Marketable	0.793***	0.790***	0.790***	0.813***	0.813***
	(0.048)	(0.052)	(0.052)	(0.049)	(0.050)
Total $\text{Collateral}_{\text{Nov11}}$				0.250*	0.254*
				(0.139)	(0.133)
Δ Cash	-0.625	0.522	0.405	2.485	2.451
	(5.441)	(2.910)	(2.943)	(2.845)	(2.747)
Δ Non-Govt Bonds	-0.931***	-0.234*	-0.155	-0.135	-0.031
	(0.053)	(0.135)	(0.140)	(0.200)	(0.142)
Δ Equity Holdings	0.006	-0.129	-0.143	-0.336*	-0.357**
	(0.140)	(0.123)	(0.121)	(0.170)	(0.155)
Δ Non-PT Govt Bonds	-0.750***	-0.062	0.022	-0.288	-0.185
	(0.258)	(0.300)	(0.307)	(0.309)	(0.292)
Δ Lending	-0.884***	-0.222*	-0.146	-0.124	-0.025
	(0.041)	(0.124)	(0.130)	(0.193)	(0.137)
Δ Book Equity	0.791***	0.131	0.054	0.148	0.050
	(0.152)	(0.206)	(0.214)	(0.213)	(0.170)
Δ Securities Issued	0.051	-0.445	-0.514	-0.470	-0.555
	(1.046)	(1.012)	(1.014)	(0.622)	(0.620)
Δ Demand Deposits	0.772***	0.196*	0.124	0.131	0.040
	(0.086)	(0.115)	(0.120)	(0.176)	(0.129)
Δ Saving Deposits	1.721**	0.631	0.362	0.387	0.088
	(0.683)	(0.742)	(0.737)	(0.531)	(0.501)
Δ Time Deposits	0.935***	0.234*	0.154	0.137	0.033
	(0.040)	(0.133)	(0.138)	(0.206)	(0.145)
Δ Repo Borrowing	0.398*	0.071	0.032	-0.011	-0.062
	(0.216)	(0.320)	(0.346)	(0.227)	(0.257)
Balance Sheet Controls	✓	✓	✓	✓	✓
Observations	68	68	68	68	68
R-squared	0.935	0.947	0.948	0.968	0.970

Table F.2: Banks' Buy-and-Borrow Behavior, Robustness. This table presents the estimation results for specification (1). Columns (4) and (5) corresponds to Columns (1) and (2) of Table 1 in the main text. The dependent variable is total uptake at LTRO2 normalized by total assets in November 2011. Independent variables include changes in holdings of central bank eligible collateral between November 2011 and February 2012, the stock of eligible collateral in November 2011, and changes in balance sheet components (assets and liabilities). Eligible collateral includes domestic government bonds, additional credit claims (ACC), government guaranteed bank bonds (GGBBs), and other marketable securities. Assets include: cash, non-sovereign bond holdings, non-domestic sovereign bond holdings, equity holdings, and loans. Liabilities include: book equity, securities issued, demand deposits, saving deposits, time deposits, and repo. All variables are normalized by bank assets in November 2011. All independent variable are haircut-adjusted. In the first (second) column, we measure changes in government bond holdings using face (market) values. In this Online Appendix, we provide a detailed description of the ECB collateral framework. Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

LHS: $\text{Holdings}_{i,m,t}/\text{AmtOutstanding}_{m,t}$	(1)	(2)	(3)	(4)	(5)
Post	0.371**	0.047*			
	(0.157)	(0.024)			
Post × Short			0.329**	0.329**	0.324**
			(0.149)	(0.129)	(0.140)
Bank FE	✓	✓	✓		
Maturity FE	✓	✓	✓	✓	
Time FE			✓		
Bank-Time FE				✓	✓
Bank-Maturity FE					✓
Specification	(2a)	(2a)	(3)	(3)	(3)
Sample Bonds	Short-Term	Long-Term	Full Sample	Full Sample	Full Sample
Observations	2,478	2,478	4,956	4,956	4,950
R-squared	0.402	0.507	0.285	0.375	0.679

Table F.3: LTRO and Government Bond Purchases, Alternative Dependent Variable. This table presents the results of specifications (2a) in column (1), (2b) in column (2), and (3) in columns (3)-(5). The dependent variable is the share of total public debt outstanding of maturity m held by bank i. Independent variables include a Post dummy equal to one on and after December 2011 and a Short dummy equal to one if the government bond portfolio matures on or before February 2015. Column (1) and column (2) only include bonds maturing on or before and after February 2015, respectively. The sample period includes 12 months and runs at a monthly frequency from June 2011 to May 2012. The sample includes only banks. Standard errors double clustered at the bank-maturity and month levels are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

References

Crosignani, M., M. Faria-e-Castro, and L. Fonseca (2015): "The Portuguese Banking System during the Sovereign Debt Crisis," *Banco de Portugal Economic Studies*, 1, 43–80.

ECB (2011): *The Implementation of Monetary Policy in the Euro Area*, general Documentation on Eurosystem Monetary Policy Instruments and Procedures.