Macroprudential Regulation, Quantitative Easing, and Bank Lending

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Abstract

We show that widely used macroprudential regulations that rely on historical cost accounting (HCA)—to insulate banks' balance sheets from financial market volatility—significantly affect the transmission of monetary policy. Using detailed supervisory data from Italian banks, we find that HCA mutes the transmission of quantitative easing on bank lending supply, weakening the effectiveness of monetary policy in reducing firm credit constraints. We also show that a drop in the market price of HCA-valued securities is equivalent to a reduction in capital requirements, which is large and nearly identical in Italy and the US.

1. Introduction

Sovereign securities are a major part of banks' assets holdings. Fluctuations in the value of these securities can affect banks' equity, leading to financial instability, credit crunches, and other negative real effects. Recent examples of this phenomenon include the sovereign-bank "diabolic loop" in European countries, the collapse of Silicon Valley Bank (SVB) and First Republic Bank, and the distress at some regional US banks in 2023.[1] To contain the impact of sovereign

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[1] See Brunnermeier et al. (2016), Gennaioli et al. (2014), and Jiang et al. (2023). SVB and First Republic Bank experienced losses on their securities—triggered by increases in interest rates—and a run precipitated their failure.

asset price movements on banks' balance sheets and loan supply, regulators have implemented accounting-based macroprudential policies. These policies have become a crucial part of the broader macro-stabilization toolkit.[2] For example, during the European sovereign debt crisis of the early 2010s, most sovereign assets were valued using historical cost accounting (HCA) to shield European banks' regulatory capital and lending capacity from volatility in sovereign bond prices. In 2018, mark-to-market accounting (MMA) became prevalent, allowing most price changes to pass through onto banks' balance sheets; in 2020, HCA was reimplemented in response to COVID-19 (Figure 1).[3] In the US, the use of HCA has also evolved with macroeconomic conditions, expanding when interest rates rose in both 1994-1995 and 2022.[4]

Despite the ubiquitous joint use of macroprudential accounting tools and monetary policy to stabilize economies, little is known about how these macroprudential tools mediate the transmission of monetary policy onto bank loan supply to firms. We address this gap. Our empirical setting uses the European Central Bank's largest quantitative easing (QE) program—the Public Sector Purchase Programme (PSPP)—together with the changes in macroprudential regulation shown in Figure 1. In particular, we study the introduction of the PSPP in January 2015—when HCA was used to value most sovereign securities—and the relaunch of the PSPP in 2019—when MMA was prevalent. These policy changes, along with credit register and granular supervisory data, provide an ideal empirical setting to study the interaction between macroprudential policy and QE on bank lending. We focus on lending by banks in Italy—the largest country affected by the sovereign-bank "diabolic loop."

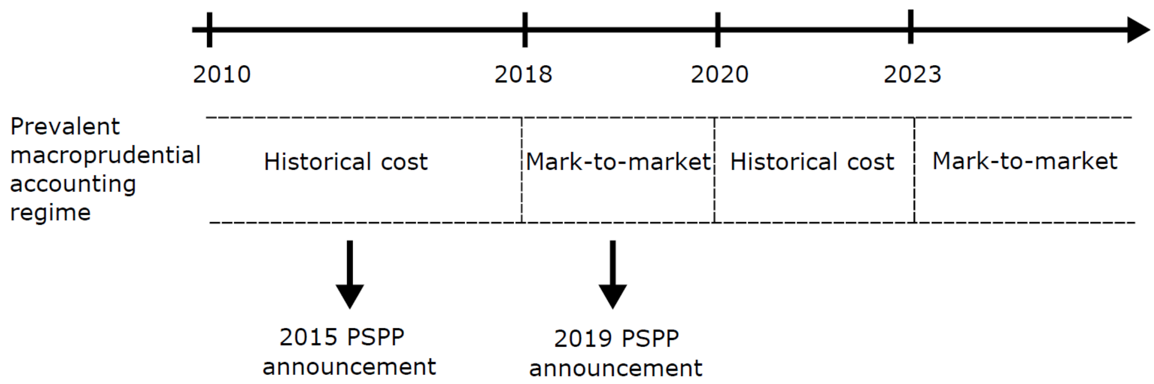
The impact of macroprudential rules such as HCA on the effectiveness of QE is an empirical question. On the one hand, HCA limits the bank recapitalization channel of QE. According to this channel, an increase in asset prices triggered by QE has a positive impact on banks' net

[2] The active use of accounting rules in banking regulation began in the early 1990s in the wake of the savings and loans crisis. Mark-to-market accounting was intended to prevent banks from hiding bad assets and "gains trading" their good assets, and historical cost accounting was intended to reduce the volatility of equity and earnings (Ellul et al. 2015; Greenspan 1990; Shaffer 1992).

[3] Accounting-based macroprudential policies are employed in many jurisdictions. For instance, HCA in the US is used by most banks and MMA is prevalent only for larger "advanced approaches" banks (Fuster and Vickery, 2018; Kim et al., 2019). In Australia, MMA is prevalent for all banks (Lonsdale, 2023).

[4] For example, in 2022, regulators allowed six large banks to move about $500 billion in assets from the MMA to HCA classification, as reported by the Wall Street Journal (Weil, 2023).

Figure 1: Macroprudential accounting regime for sovereign securities, and QE announcements.



The figure shows the evolution of some key aspects of the European Union macroprudential accounting regime that banks use to value their holdings of sovereign securities when computing regulatory net worth (see Section 2 for more details) and the two main announcements of the PSPP—the ECB's largest QE program.

worth and, thus, on lending capacity. However, under the HCA rules in place in 2015, QE-related asset price increases could not directly affect banks' regulatory net worth, limiting the impact on lending supply via this recapitalization channel. In contrast, the 2019 resumption of QE should have had a larger impact on lending because of the shift to MMA that allowed a full pass-through of asset price changes on banks' net worth. On the other hand, the macroprudential accounting regime could be irrelevant if QE affects banks' balance sheets through other channels. For instance, QE could signal the central bank's commitment to prolonged monetary easing (Bhattarai et al., 2022), enhance the liquidity of all assets held by banks, or lower the cost of raising equity by increasing banks' market value. All these effects could stimulate bank lending independent of the recapitalization channel and render irrelevant the role of accounting.

We find that HCA has a large impact on the bank recapitalization channel of QE, muting the pass-through of the PSPP onto bank lending. Only banks exposed to the PSPP through their holdings of MMA sovereign assets have higher lending growth rates after the PSPP was announced. This result holds in both 2015 and 2019, that is, under two very different macroprudential accounting regimes. The magnitude of the effect, however, is very different across the two periods, consistent with the prevalence of HCA relative to MMA. In 2015, HCA was prevalent to protect the banking system, and MMA only covered sovereign securities classified in the trading book. Few banks had significant trading book holdings, leading to a very small effect of the PSPP on bank lending—approximately €214 million according to a back-of-the-envelope calculation. The lending response was much larger in 2019 when MMA was prevalent and encompassed not only trading book assets but also those classified as available for sale, representing a significant portion of the PSPP-eligible securities held by Italian banks. These effects are first order: we observe a lending response through the same channel that is 56 times larger in 2019 than in 2015, or approximately €12 billion.

These results imply that while HCA can shield bank equity when sovereign assets lose value, HCA also prevents central banks' yield curve management policies from increasing loan supply to firms during periods of distress. We use a simple analytic framework to elaborate this basic intuition. The framework shows that a hybrid accounting approach that passes through changes in the risk-free rate, but fixes the sovereign spread at its historical value, can both stabilize banks' equity and allow policies such as QE to increase loan supply to firms.

Motivated by the link between HCA and banks' capital, we also use the framework to demonstrates that HCA rules are equivalent to using MMA with a time-varying capital requirement. A 3 percentage point increase in the sovereign default spread—a magnitude similar to what was observed during the 2010s sovereign debt crisis in Italy—is equivalent to forcing Italian banks to use MMA and reducing their capital requirements by 24% on average. For comparison, using US data in 2022, the required reduction in capital requirements is also around 24% if US banks are forced to use MMA to value their security holdings.

Identifying the impact of the macroprudential accounting regime on the transmission of QE faces some important identification challenges. A key issue is the endogenous response of both macroprudential and monetary policy to current and expected economic conditions (Nakamura and Steinsson 2018). In our setting, the risk of deflation and weak credit supply in the aftermath of the European sovereign crisis spurred the 2015 PSPP announcement, while improved economic conditions fostered the 2018 change in macroprudential policy toward MMA. Another concern is that QE is implemented alongside other policies, making it hard to disentangle the impact of macroprudential accounting policies on QE from that of other policies. Also, measurement error can contaminate inference. Accounting-based macroprudential policies are highly targeted tools, and changes in the price of an asset can affect a bank's net worth very differently depending on where the asset is recorded on the balance sheet. For example, different macroprudential accounting rules apply for an asset recorded in the trading book on a bank's balance sheet relative to the same asset recorded as held to maturity. As a result, analyses based on a broad aggregation of a bank's asset holdings suffer from considerable measurement error and cannot identify the relevant transmission channels.

We address these issues by using monthly granular supervisory Italian bank balance sheet data and monthly firm-bank-level data from the Italian credit register. The relatively high frequency of monthly data reduces the risk of contamination from other policies, and granular supervisory data on banks' asset holdings, including the specific location on banks' balance sheets and their accounting treatment, allow us to precisely measure the pass-through of QE on each bank. In addition, access to credit register data and a suite of fixed effects address endogeneity concerns by non-parametrically absorbing the variation in latent demand at the firm-month-year level.

We also conduct several robustness checks, a few of which we briefly summarize here. An instrumental variables approach based on lagged exposure helps rule out the concern that some banks might have anticipated the PSPP announcement and self-selected into exposure or reclassified securities from HCA to MMA. The results are also robust when we extend the sample to include over 50 million firm-bank-time observations—23 million for 2015 and 33 million for 2019—to account for seasonal trends and richer counterfactuals.

We then provide a series of additional results that corroborate the main finding. First, our main result is stronger for less capitalized banks, consistent with the hypothesized bank recapitalization channel. Second, interest rates declined by about 150 and 90 basis points for loans originated by exposed banks in 2015 and 2019, respectively, relative to less exposed ones. The decrease in rates, along with the increase in loan volume, implies that we are identifying changes in supply as opposed to latent movements in credit demand.[5] Third, the results of the extensive margin analysis based on loan application data are also consistent with our main

[5] Any latent demand explanation would thus have to posit that latent loan demand increased after the PSPP announcement, both for firms matched to banks exposed to the PSPP and for firms borrowing for the first time from exposed banks, and in both 2015 and 2019. This possibility is highly unlikely and is inconsistent with the reduction in interest rates that we document, as an increase in latent demand should produce an increase in interest rates.

findings.

These results have important implications. The debate over MMA versus HCA in bank regulation has generally focused on the trade-off between the benefits of providing timely information to ensure market discipline versus the costs of excess volatility and its impact on banks' investment decisions and asset prices.[6] Very little attention has been devoted to understanding whether these macroprudential accounting policies influence other macro-stabilization tools—such as the impact of central bank yield curve management on bank loan supply to firms. To our knowledge, this is the first paper to suggest that attempts to stabilize the banking system through HCA might perversely make monetary policy less effective in preventing credit crunches. This result also informs the broader literature on optimal monetary, financial, and macroprudential policy.

We build on a large literature, and the next section places our contribution in context. Section 2 provides institutional details about the macroprudential accounting regulations based on HCA, Section 3 describes the data, and Section 4 presents the main results. Section 5 tests the mechanism behind our results, Section 6 provides additional analyses, and Section 7 presents our simple analytic frameworks and discusses the impact of HCA on capital requirements.

1.1 Related literature

A small but growing literature analyzes the effects of macroprudential accounting rules on banks' investment and risk-taking decisions. For instance, Fuster and Vickery (2018) and Kim et al. (2019) study the consequence of a shift toward MMA for large US banks. They find mixed results about the effects on risk-taking decisions but document that banks reclassify securities toward sections of their balance sheet subject to HCA. Granja (2023) shows that weaker US banks reclassified securities in 2022 to take advantage of HCA. In general, this literature focuses on the effects of macroprudential accounting rules on banks' investment decisions. Differently, our paper is the first—to our knowledge—that studies how these rules shape the effects of other

[6] Some have argued that MMA propagated shocks through the financial system in 2008-2009; see Allen and Carletti (2008) and Plantin et al. (2008) for models that discuss the potential costs of MMA in bank capital regulation. Ellul et al. (2015) provide evidence on some of the potential drawbacks of HCA in the context of the US insurance industry.

major interventions such as monetary policy and capital requirements.

Our work is related to the literature that studies the interaction between macroprudential and monetary policies. The key difference with our paper is that the literature does not focus on accounting-based macroprudential rules, even though such rules are widely used in practice. The theoretical arguments in Di Tella (2019) and Farhi and Werning (2016) suggest that macroprudential policies that stabilize banks' net worth can reduce booms and busts, and the joint implementation of monetary and macroprudential policies can further dampen the real effects of adverse shocks; see for instance Van der Ghote (2021). Empirically, Aiyar et al. (2016) find little evidence of an interaction between conventional monetary policy and capital requirements, and Altavilla et al. (2020) and Bruno et al. (2017) study whether accommodative macroprudential environments tend to boost the effects of monetary policy easing. However, they use broad indexes of macroprudential regulation rather than focusing on the specific channels of the accounting-based macroprudential policies as we do.[7]

We also build on the growing literature on QE. In the case of the PSPP, previous studies have focused mostly on the asset price responses to the program's announcement. Notably, the evidence in Andrade et al. (2016) and Altavilla et al. (2021) suggests that the PSPP's announcement led to a drop in European sovereign yields and an increase in asset prices, including the stock prices of banks. Extrapolating from this asset price response, the model-based results in Andrade et al. (2016) suggest that the PSPP led to an increase in output in part through the bank lending channel. However, the actual transmission of these policies onto bank loan supply and the overall efficacy of QE remain open questions; see the survey in Fabo et al. (2021). Our results on the effects of the macroprudential accounting regimes may suggest why the effects of QE can be heterogeneous and difficult to detect.

Beyond micro and macroprudential channels, the evidence in Peydró et al. (2021) observes that the transmission of monetary policy onto bank lending can be impaired if banks hoard liquidity or engage in securities trading instead of lending; see also Abbassi et al. (2016) in the

[7] Other papers study macroprudential policies alone using credit register data; notably, Jiménez et al. (2017) focus on countercyclical capital buffers. Some macroprudential policies also encompass household leverage; see for example DeFusco et al. (2020).

case of German banks. Using Italian micro data similar to ours, Peydró et al. (2021) observe that banks more exposed to the PSPP may have engaged in more securities trading. However, those authors do not directly measure the effects of the PSPP onto loan supply, nor do they study the role of macroprudential accounting regulations.

Our analysis of the bank lending channel of QE is also closely related to work based on US data (Foley-Fisher et al. 2016; Rodnyansky and Darmouni 2017; Chakraborty et al. 2020; Luck and Zimmermann 2020).[8] With detailed supervisory data on banks' asset holdings, we can make progress in understanding the effects of heterogeneity in the application of MMA and HCA in asset valuation. The relatively high frequency of the data—monthly—also help us to be clear on the counterfactual and exclude alternative interpretations stemming from other economic news. Moreover, because we observe the near-universe of Italian firms, our results are less likely to be sensitive to the choice of firms in any given sample. The credit register data also identify firm credit applications, allowing us to study the effects of the PSPP at the extensive margin. Finally, our approach builds on the broader literature examining the bank lending channel using microeconomic data, such as Jiménez et al. (2014), and the classic studies such as Kashyap and Stein (2000) and Peek and Rosengren (2000).

2. Background on macroprudential accounting regulation

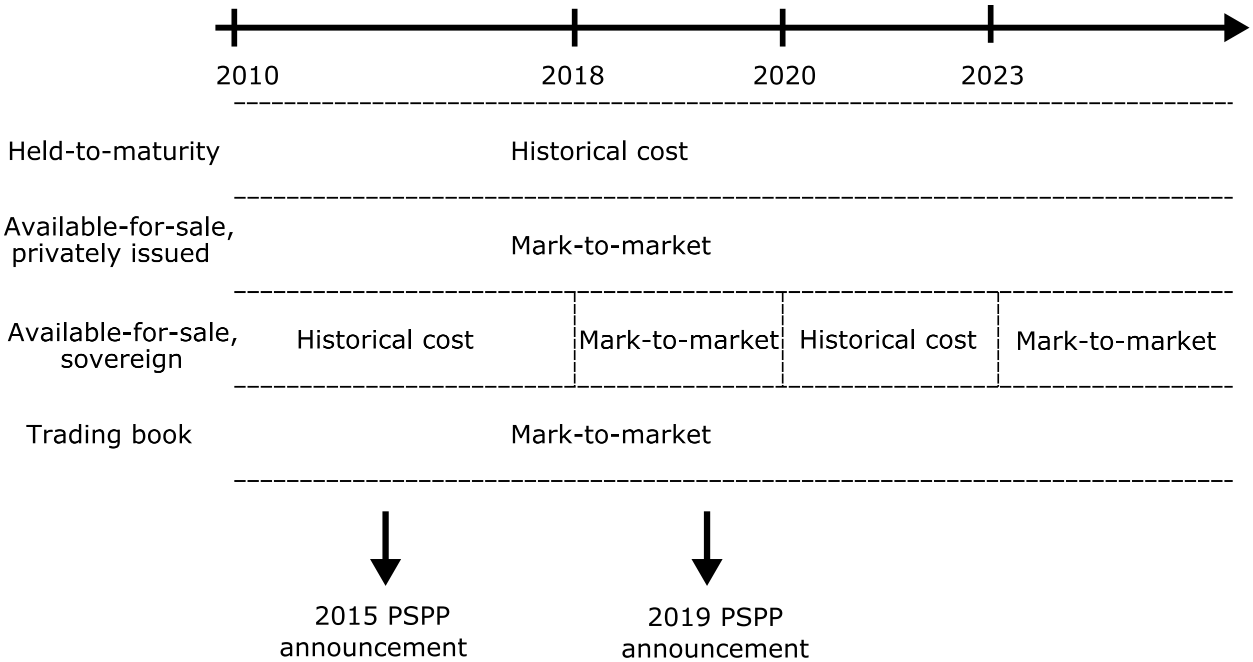
This section provides a bird's-eye view of macroprudential accounting rules used by banks to value their asset holdings for the purpose of computing regulatory capital and measuring whether they meet capital requirements. We focus on the main elements that are relevant for our analysis.

A security can be valued using historical cost accounting (HCA) or mark-to-market accounting (MMA) for the purpose of capital requirement regulation. Under HCA, the value of a security depends essentially on the purchase price, so that changes in market prices affect neither the bank's balance sheet nor regulatory net worth. In contrast, under MMA, the security is valued using current market prices, and changes in market condition affect regulatory net worth.

Whether a security is valued using MMA or HCA depends on how a bank classifies the

[8] There is also a sizeable literature on the transmission of QE through the mortgage and housing channel. See, for example, Di Maggio et al. (2017), Beraja et al. (2019), Di Maggio et al. (2020), and Ramcharan (2020).

Figure 2: Security holdings and macroprudential accounting rules



This figure shows how identical assets on the balance sheet are valued differently depending on their regulatory classification. Between 2010 and 2018, sovereign assets classified as available for sale were valued at historical cost. Between 2018 and 2019, sovereign assets classified as available for sale were then marked to market. In 2020, amid the COVID-19 pandemic, regulators introduced a *prudential filter* that allowed banks to again value available-for-sale sovereign assets at historical cost, based on the market value as of December 31, 2019. Assets classified as held to maturity are always valued at historical cost, whereas those in the trading book are always marked to market.

security on its balance sheet: holdings of the same securities can be valued differently depending on their classification. In general, banks can classify a security in one of three ways: *held to maturity*, *available for sale*, or at *fair value through profit or loss*. The latter is often referred to as *trading book*.[9] If the bank plans to hold the security until maturity, it typically classifies it as held to maturity. If the bank intends to keep the security on its balance sheet but wants to keep the option to sell it, it typically classifies it as available for sale. And finally, securities that are traded more frequently are typically classified as part of the trading book. Regulators require banks to classify securities based on banks' plans to hold or trade them and heavily scrutinize

[9] We use the terminology based on the IAS 39 accounting framework. IFRS 9, which has been applied since 2018, says that an entity can classify its securities in three ways: *amortized cost*, *fair value through other comprehensive income*, and *fair value through profit or loss*. We map these categories to *held to maturity*, *available for sale*, and *trading book*, respectively.

such classifications, so that systematic misclassifications are unlikely.[10] Key for our analysis is that these assignments are relatively sticky, as banks cannot easily reassign securities without prior regulatory approval.[11]

The macroprudential accounting rules that apply to Italian banks are summarized in Figure 2. The rules depend on whether a security is classified as held to maturity, available for sale, or in the trading book. The rules governing held-to-maturity and trading book securities are similar for sovereign and non-sovereign securities and have been relatively unchanged over time. Held-to-maturity securities are valued using HCA, and trading book securities are valued using MMA.[12]

For available-for-sale securities, the accounting rule depends on the issuer—a sovereign versus a private entity—and that has changed over time as a time-varying macroprudential tool. For sovereign securities issued by euro area central governments—which correspond to those that are eligible to be purchased under the PSPP—regulators have applied different regimes over time. To insulate the banking system from the effects of the sovereign crisis, during the early 2010s and until the end of 2017, regulators permitted banks to use HCA for sovereign securities.[13] As of 2018, regulators required all available-for-sale securities to be valued using MMA, including sovereign ones. But as the COVID-19 crisis hit in 2020—after the end of our sample period—European regulators allowed banks to again use HCA for available-for-sale securities.[14]

This regulatory structure creates variation in the accounting rules used to classify sovereign securities—both at any given point in time across classifications and over time for the available-

[10] In the case of available for sale versus trading book, if a bank were to classify securities as available for sale but then trade them frequently—as if they were in the trading book—regulators can flag this behavior and take corrective actions.

[11] Under the IAS 39 rules in place until 2018, the reclassification of a held-to-maturity security is generally not allowed and, if it takes place, it can trigger the re-evaluation of all banks' holdings based on market prices. This trigger is part of the so-called *tainting rule*. Under IFRS 9, in place since 2018, reclassifications are only possible when an entity changes its business model for managing financial assets, such as in the event of mergers and acquisitions.

[12] More precisely, held-to-maturity securities are valued at amortized cost, and trading book securities are valued at fair value. However, throughout the analysis, we use the more general terms HCA and MMA to keep the exposition simple.

[13] Formally, available-for-sale securities are always evaluated using current market prices, but between 2010 and 2017 regulators allowed banks to omit unrealized gains and losses resulting from fair value accounting from the income statement and from the computation of regulatory capital. This is equivalent to using HCA for the purpose of computing regulatory capital and, thus, we simply refer to this rule as HCA. See CEBS (2004); Regulation EU No 575/2013, page 508, Article 467; and Bank of Italy (2010).

[14] Formally, regulators have introduced a so-called *prudential filter*, allowing unrealized gains and losses accumulated since December 31, 2019, to be excluded from the computation of regulatory capital until the end of 2022. See Regulation EU 2020/873 of June 24, 2020; EBA guideline EBA/GL/2020/11; and Bank of Italy (2020).

for-sale classification. Our analysis exploits these variations and studies how they affect the transmission channel of quantitative easing on credit supply. In particular, the first PSPP announcement took place in January 2015 when only trading book sovereign securities had to be marked to market. The resumption of the PSPP was announced in 2019 when both available-for-sale and trading book sovereign securities had to be marked to market. That is, in addition to the different classification at any point in time, we also take advantage of the switch of available-for-sale sovereign securities from HCA in 2015 to MMA in 2019. Moreover, micro data observed at a relatively high frequency help us control for the latent demand and aggregate factors. We describe these data in the following section.

3. Data

On January 22, 2015, the European Central Bank (ECB) announced the PSPP program—to be started in March—consisting of the purchases of about €50 billion per month of euro-denominated debt securities issued by euro area central government and supranational institutions with residual maturity between 2 and 30 years.[15] The program was paused at the end of December 2018, and then the ECB announced on September 12, 2019, a restart as of November of that year.[16]

The recapitalization channel predicts that the impact of the PSPP on bank lending is expected to vary depending on a bank's holdings of securities eligible for purchase under the PSPP ("eligible securities") and, possibly, on how banks classify these securities—which in turn determines the amount of securities that are valued at historical cost versus marked to market. Measuring this cross-sectional variation in bank exposure to the PSPP and disentangling any supply effects from firm demand and other latent factors require detailed micro data. This

[15] Because the exact criteria for international institutions were not fully clarified at the time, we consider as eligible the debt of supranational institutions with main headquarters in a euro area country. See the technical annex at https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_1.en.html. In addition, the securities had to fulfil the collateral eligibility criteria for the ECB and must have had a credit rating of at least CQS3 (i.e., Credit Quality Step 3). This corresponds to at least BBB- for S&P's and Fitch and Baa3 for Moody's.
[16] When the PSPP restarted in 2019, debt issued by euro area local governments had become eligible to be purchased under the program too. See Decision (EU) 2015/2464 of the European Central Bank December 16, 2015. Overall, purchases were estimated at €20 billion per month.

subsection describes the data in detail. We draw on several sources of data, primarily collected by the Bank of Italy.

First, we use the Italian Central Credit Register, which contains information for each firm-bank lending relationship. The credit register is a monthly panel dataset at the firm-bank-time level. That is, each entry represents the amount of lending made by a particular bank to a particular nonfinancial firm in a given month. All loans above €30,000 are included in the register, thereby making the coverage near-universal. Second, we use AnaCredit and Taxia, two datasets with information collected by the Bank of Italy, to retrieve interest rate data on new term loans. AnaCredit has data at a monthly frequency but only covers 2019, whereas Taxia has data for 2015 but only at a quarterly frequency. Third, we use the Initial Information Service (IIS) dataset, which records the instances in which a bank accesses the credit history of a firm—typically, when a firm applies for new credit from a bank it was not previously borrowing from. Fourth, we use the Bank of Italy Credit and Financial Institutions' Supervisory Reports to obtain banks' balance sheet data. A key element of these data is represented by banks' security holdings at the ISIN level, and for each ISIN, the breakdown of the holdings classified as held to maturity, available for sale, or in the trading book. This level of granularity allows us to construct each banks' measure of exposure to the 2019 and 2015 QE announcements.

In most of our analyses, we work with monthly data over a 12-month window around the QE announcement dates (i.e., around September 12, 2019, and January 22, 2015). However, we also extend the sample period for some of the robustness analyses. We focus on banking groups (hereinafter referred to as "banks") for which the bank holding company is a joint stock company. That is, we exclude mutual and cooperative banks because they are subject to different regulations. We also drop foreign banks, leaving our final sample at 90 banks for 2019 and 95 banks for 2015. Our focus on banking groups (as opposed to single banks) is motivated by the fact that key regulations such as capital requirements are checked by regulators at the group level.[17] Our approach is similar to that used in recent papers with Italian banking data, such as

[17] Because of the regulatory approach, banks within the group do not need to meet capital requirements individually. This implies, for instance, that a credit expansion can be carried out only by some banks that are part of the group without the need to observe within-group borrowing and lending, which would cancel out anyway when regulators check group-level capital ratios.

Benetton and Fantino (2021) and Bottero et al. (2022).

Table 1 provides key summary statistics about the firm-bank lending relationships, the loan application data from the IIS, and the interest rate data. Our main analysis uses the growth rate of the amount borrowed for each firm-bank pair with an ongoing lending relationship. Focusing on firms with at least two lending relationships (Khwaja and Mian 2008), we have access to more than 8 million observations for the 2019 episode and 6 million for 2015.

Table 2 contains summary statistics about banks in our sample and shows that holdings of PSPP-eligible securities were substantial. Banks held 17.06% and 11.44% of assets in securities eligible to be purchased under the PSPP prior to the 2019 and 2015 announcement, respectively. Holdings of eligible securities valued at historical cost were 11.12% and 11.00% in 2019 and 2015, respectively, and holdings of eligible securities marked to market were 6.00% and 0.45% in 2019 and 2015, respectively. The 2015 mark-to-market figure appears small, as it includes only securities in the trading book as discussed in Section 2, but there is significant heterogeneity across banks that gives rise to a large cross-sectional variation: the coefficient of variation is in fact higher in 2015 than in 2019. We also find substantial heterogeneity when using a dummy measure of exposure for both 2019 and 2015, which we use to provide robustness analyses to control for possible noise and outlier effects (see Sections 4.1 and 4.2 for the definition of the dummy measures). In particular, before the 2015 announcement, banks classified as exposed based on this dummy held 3.00% of assets or 41.23% of the trading book in eligible securities, in comparison to 0.01% and 3.92% for banks classified as non-exposed. Table 2 also lists the other variables that we use in our analysis. These include a list of standard balance sheet items as well as other variables that capture banks' exposure to ECB policies other than the PSPP and that we use in our extensive list of robustness checks.

4. Macroprudential regime and the impact of QE on credit supply

We begin by analyzing the impact of the PSPP announcement on bank lending and whether it is mediated by the macroprudential accounting regulation. Our main analysis in Sections 4.1 and 4.2 focuses on the effects of the 2019 and 2015 PSPP announcements on preexisting lending relationships (i.e., the intensive margin), respectively. We then use an instrumental variable approach to show in Section 4.3 that banks' anticipation of the announcements, seasonality effects, and latent factors are not a source of bias. We then conduct additional robustness checks in Section 4.4 and 4.5 to control for variables that might be related to banks' exposure to the PSPP and for the possible effects of other policies.

4.1 The effects of the PSPP under the 2019 macroprudential regime

The "recapitalization channel" of QE predicts that the accounting-based macroprudential regime can determine whether central bank asset purchases affect a bank's net worth and loan supply. Banks more exposed to the PSPP would likely experience the biggest increase in net worth on account of the PSPP asset purchases and, thus, expand loan supply the most. Our research design combines the cross-sectional variation in banks' exposure to the PSPP with monthly data on lending to measure the importance of this recapitalization channel. This cross-sectional variation in a bank's PSPP exposure stems from its share of assets eligible for purchase under the PSPP and valued using MMA.

The endogenous variation in loan demand, along with contamination from other central bank policies, can make it difficult to interpret the evidence. Endogenous loan demand arises if banks exposed to the PSPP are also matched to firms with greater loan demand. In this case, any increase in loan growth might reflect latent demand rather than the causal effect of the PSPP on loan supply. Other ongoing central bank policies can also influence loan supply, making it hard to distinguish the effects of the PSPP. In addition, the anticipation of the PSPP can yield biased inference due to self-selection. Banks, for example, can self-select into "exposure" by acquiring eligible assets or tilting their portfolio toward mark-to-market holdings.

We therefore combine the bank-level variation in PSPP exposure with monthly lending data from the credit register at the bank-firm level within a difference-in-difference framework to address these identification challenges. Our difference-in-difference research design uses firm-by-year-month fixed effects to absorb non-parametrically loan demand at the firm level at the monthly frequency. This approach uses firms borrowing from two banks within the same month, and by holding firm loan demand constant over a month, we can identify whether the PSPP elicited a bank lending supply response (Khwaja and Mian 2008). Later in Section 6.1, we also study the impact of the PSPP on interest rates, which confirms that our approach indeed identifies variation in banks' lending supply. Also, by using a narrow time window around the PSPP, the research design reduces concerns that the estimates reflect other ECB policies, such as negative interest rates and the targeted longer-term refinancing operations (Andreeva and García-Posada 2021; Benetton and Fantino 2021). Note further that because the Italian credit register contains the near-universe of these bank-firm credit relationships, we can measure the effects of QE on business lending more completely than inferring a treatment effect based on a selected sample of larger firms, usually from DealScan or through regulatory data in the US.

To be clear about the research design at the intensive margin, the dependent variable is the growth rate in lending, that is, the change in the logarithm of disbursed loans from bank b to firm f at time t, in comparison to t-1, $\log(L_{b,f,t}) - \log(L_{b,f,t-1})$. We use the specification

$$\Delta \log \mathrm{L}_{b,f,t} = \sum_{\tau \neq 2019\mathrm{m}8} \beta_\tau \times I_\tau \times QE_b + \sum_{\tau \neq 2019\mathrm{m}8} \boldsymbol{\gamma}_\tau \times I_\tau \times \boldsymbol{Y_b} + \delta \mathrm{Z}_{b,t} + \psi_b + \psi_{f,t} + \varepsilon_{b,f,t}. \quad (1)$$

The variable QE_b is a measure of a bank's exposure to the PSPP based on the bank's holdings of securities eligible for purchase under the PSPP in the month before the announcement. Thus, in the case of the September 2019 announcement, QE_b is computed using banks' asset holdings at the end of August 2019. We interact this variable with a set of time dummies I_τ, one for each month, dropping the one that corresponds to the pre-announcement month. Thus, our coefficients of interest are the β_τ, which capture the effects of the PSPP announcement on bank lending supply and allow us to check for any possible pre-trend in lending growth. The terms ψ_b and $\psi_{f,t}$ are bank and firm-by-time fixed effects, respectively. Firm-by-time fixed effects $\psi_{f,t}$ allow us to control for demand factors, and standard errors are clustered at the bank level. But even with this suite of fixed effects, other factors that correlate with a bank's exposure to the PSPP could also affect lending growth right at the time of the PSPP's announcement.

To exclude alternative interpretations, the benchmark specification includes three controls, captured by the vector $\boldsymbol{Y_b}$ and the term $\mathrm{Z}_{b,t}$ in Equation (1). First, we include bank size using the log of total assets as of the month before the announcement, interacted with time dummies centered around the announcement month. Second, because banks' holdings of central bank assets as well as borrowing from the ECB have been shown to independently affect bank behavior (Diamond et al. 2020; Drechsler et al. 2016), we include central bank reserves (as a fraction of total assets, computed as of the month before the announcement and interacted with time dummies centered around the announcement month) and the logarithmic change in the euro value that bank b borrows from the ECB at time t, denoted by $Z_{b,t}$. Additional controls, including those related to bank characteristics and banks' exposure to other ECB policies, are added in the robustness checks of Sections 4.4 and 4.5.

To illustrate the importance of the macroprudential accounting regime in shaping the transmission of the PSPP onto loan supply, we first follow the literature and begin with the broadest exposure definition, that is, the ratio of a bank's securities that are eligible to be purchased under the PSPP to total bank assets (Rodnyansky and Darmouni 2017; Luck and Zimmermann 2020). Note that this broad exposure measure, defined as all eligible assets to total assets, ignores the macroprudential-based accounting treatment of sovereign assets. As noted before, we compute the broad measure of exposure for August 2019—the month before the announcement. Italian banks hold a large amount of sovereign securities, and in that month, they had on average 17.06% of assets in PSPP-eligible securities. Column 1 of Table 3 shows the results of estimating Equation (1) using the broad measure of exposure to the PSPP. We find no evidence that broad exposure to the PSPP is associated with an increase in lending after the announcement. The point estimates are small and show a pre-trend, with no clear differences between the pre- and post-announcement periods.[18]

Column 2 of Table 3 uses supervisory data to create a measure of exposure that accounts for the accounting-based macroprudential regulation in place in 2019. To gauge the salience of mark-to-market versus historical cost accounting in shaping the impact of the PSPP on lending, Column 2 uses an exposure measure that includes only eligible securities that are marked to market. Based on the 2019 macroprudential rules, sovereign securities were marked to market if classified as available for sale or held in the trading book, which jointly account for 6.00% of

[18] Formally, we find a significant pre-trend (average March-July 2019: 0.06, p-value: 0.007), and the coefficient on the announcement month—September 2019—is not statistically different from the March-July 2019 average (difference: 0.05, p-value: 0.104).

total assets.

The results using only mark-to-market eligible securities are drastically different from those derived before. Column 2 of Table 3 shows that banks exposed to the PSPP via their holdings of mark-to-market securities increased lending supply at the intensive margin almost immediately upon the PSPP's announcement. This measure of exposure also shows no trend difference in lending growth between exposed and non-exposed banks in the period before the PSPP announcement (average March-August 2019: 0.06, p-value: 0.394), and the September 2019 coefficient is significantly greater than the March-August 2019 average (difference=0.18, p-value: 0.004). Column 2 also shows a positive effect in December 2019—which is likely related to the actual restart of the purchases—and no subsequent reversal in loan growth.[19]

A back-of-the-envelope calculation suggests that the PSPP increased the loan supply by about €12.1 billion, based on the counterfactual in which all the banks have zero exposure. We obtain this number by considering the lending responses in September and December 2019—the only two months with a statistically significant coefficient. The effect is nearly identical at €13 billion if we instead use the average lending response between September and December 2019 (average September-December 2019: 0.156, p-value: 0.048). In Appendix G, we show that the increase in lending by more exposed banks did not crowd out lending by less exposed ones, so the €12.1 billion figure represents a net increase in loan supply.

Column 3 of Table 3 includes, in a single regression, two possible exposure measures—the one used in Column 2 based on eligible securities that are marked to market (i.e., those classified as available for sale or in the trading book), and a second one based on eligible securities valued at historical costs (i.e., holdings classified as held to maturity). Both exposure measures are interacted with the time dummies centered on the PSPP announcement month. The coefficients of the mark-to-market exposure are essentially unchanged. Appendix A shows that the coefficients of the historical cost exposure are similar to those in Column 1 and based on the

[19] A negative effect is detected in October 2019, but it is small in magnitude (-0.07 in October 2010 vs. 0.24 and 0.34 in September and December 2019), not statistically significant, and in general not robust. The coefficient shrinks to approximately -0.01 in some of the robustness checks—for instance, when controlling for banks' exposure to the TLTRO or to the covered bonds and ABS program through securitization (see Section 4.5 and Columns 1 and 3 in Table 8a)—and the sign flips to positive in Column 4 of Table 3, where we use an exposure dummy to deal with possible noise and outlier effects.

broad measure of exposure. Thus, the historical cost exposure results in lending growth rates that are not statistically different from those in the months before the PSPP announcement.

To deal with possible noises and outlier effects, Column 4 of Table 3 uses a dummy measure of exposure and compares banks in the top tercile of the exposure distribution with those in the bottom tercile, as in, for example, Chakraborty et al. (2020). The results are essentially the same as those derived using the continuous exposure measure. In particular, the most exposed banks—those in the top tercile—increased lending supply by 2.61 percentage points right after the 2019 PSPP announcement and 3.37 percentage points in December 2019, relative to less exposed ones. We again find no evidence of any significant difference in loan growth in the period before the announcement: the average of the March-August 2019 coefficients is 0.57 (p-value=0.423).

We conduct a long list of robustness checks in Sections 4.3-4.5, and we provide a short recitation here. First, Section 4.3 shows that the results are not affected by anticipatory biases. The mark-to-market exposure measure is very persistent over time (the autocorrelation coefficient in the six months before the announcement is 0.67), and we use an instrumental variable approach to show that the results are not driven by banks' anticipation of the PSPP announcement. Second, Section 4.4 shows that the results are not driven by other bank characteristics. The mark-to-market exposure is unrelated to some key bank characteristics such as size, holdings of non-eligible securities, or loan-to-assets ratio. While we find a link between exposure and a few other bank characteristics, controlling for these variables does not affect the results. Finally, Section 4.5 controls for banks' exposure to other policies, showing that the results are again unchanged.

4.2 The effects of the PSPP under the 2015 macroprudential regime

We now repeat the analysis of the previous section—studying the effects of the PSPP—by focusing on the 2015 PSPP announcement. Unlike 2019, the 2015 announcement took place under a macroprudential regime that used MMA accounting only for assets in the trading book; sovereign assets classified as available for sale—most sovereign assets—were valued at HCA in 2015. This difference in the macroprudential regime between 2019 and 2015 allows us to confirm the role of macroprudential policy—and in particular, mark-to-market versus historical cost accounting—in transmitting unconventional monetary policy onto bank lending.

Before describing the results in detail, we note at the onset that the results for the 2015 analysis are identical to those derived using the 2019 announcement. That is, the PSPP had an expansionary effect for banks more exposed toward holdings of mark-to-market sovereign securities, and we find no additional effect when using a broad exposure measure that ignores the accounting regulation in place at the time. The key fact is that because MMA was limited to the trading book in 2015, the impact of the QE announcement on bank lending is substantially smaller than in 2019. To verify this fact, we also perform a falsification test in which we define the 2015 exposure based on the set of securities that should have been mark-to-market according to the 2019 macroprudential accounting rules. We find no effects, further supporting our main claim about the role of macroprudential accounting regulation in affecting the transmission of quantitative easing programs.

We now describe the results in detail. Column 1 of Table 4 shows the results using the broad measure of exposure to the PSPP that ignores the accounting regime, that is, the ratio of all PSPP-eligible securities to total assets. This measure is calculated as of December 2014, that is, the month before the announcement, in line with the approach used in Section 4.1. Similar to what we obtained for 2019, we find no evidence that broad exposure to the PSPP is associated with an increase in lending supply after the announcement. The point estimates are small and show no clear differences between the pre- and post-announcement periods. In the announcement month and the three following months (i.e., January-April 2015), none of the coefficients is statistically different from the July-November 2014 average.

Column 2 of Table 4 uses banks' exposure to the PSPP based only on mark-to-market eligible securities according to the 2015 macroprudential accounting framework—those classified in the trading book. Along the lines of the 2019 mark-to-market results, we find that banks more exposed to the PSPP via mark-to-market securities increased lending at the intensive margin almost immediately upon the PSPP's announcement. There are also no pre-trends in the period before the PSPP announcement (average July-November 2014: 0.13 p-value: 0.502), and the January 2015 coefficient is significantly greater than the July-November 2014 average (difference: 0.30, p-value: 0.000). These results are again unchanged when we control for banks' holdings of eligible securities valued at historical cost, as shown in Column 3. As in Section 4.1, both the mark-to-market and historical cost exposure measures are interacted with the time dummies centered on the PSPP announcement month (see Appendix A for the full list of coefficients).

Column 4 of Table 4 uses an exposure dummy to deal with possible noises and outlier effects. Holdings of mark-to-market eligible securities were much smaller in 2015, in comparison to 2019. In particular, only 36 of the 95 banks in our 2015 sample have strictly positive holdings of mark-to-market securities, and the distribution is highly skewed. Hence, we define the 2015 exposure dummy as equal to one if a bank is in the top 15% of the distribution; this corresponds approximately to the median of the distribution of mark-to-market eligible securities relative to total assets, conditional on strictly positive holdings. Column 4 shows that our result is again robust to using the dichotomous measure of exposure. Loan growth increases by about 1.76 percentage points for highly exposed banks in January 2015, relative to less exposed ones. Further, there is no evidence of any significant difference in loan growth across banks in the period before the announcement: the average of the PSPP exposure coefficients in July-November 2014 is 0.07 (p-value=0.904).

Column 5 presents a falsification test. We construct a 2015 exposure measure using the set of eligible securities that would have been marked to market according to the 2019 macroprudential accounting regulation—those classified as available for sale or in the trading book. These securities account for slightly more than 10% of assets held by Italian banks as of December 2014. In addition, this exercise addresses the concern that the PSPP might have elicited an increase in lending through its effect on banks' holdings of securities that they can sell, as opposed to those that are marked to market. Banks can easily sell securities in the trading book and, to a lesser extent, those classified as available for sale (see Section 2). The results are similar to those derived with the broad measure of exposure in Column 1: there is no evidence that exposure to the PSPP via this measure significantly affects lending. Thus, this falsification test rules out the interpretation that QE affects banks through their holdings of securities that banks are allowed to sell per se and supports the recapitalization channel mechanism through the securities that are marked to market.

We conduct a long list of robustness checks for the 2015 event too, which we briefly summarize here; see Sections 4.3-4.5 for the details. We find a high persistence of the exposure measure (the autocorrelation coefficient in the six months before the announcement is 0.92), no evidence that banks anticipated the PSPP announcement using an instrumental variable approach, and no evidence that our results are driven by seasonal effects (Section 4.3). We find no links between exposure and most bank characteristics, and our results are unchanged when controlling for the few characteristics that are related to exposure (Section 4.4). Finally, we find no changes when we control for banks' exposure to other policies (Section 4.5). These results support our identification strategy and, in particular, rule out the possibility that only the largest Italian banks were highly exposed to the PSPP or that banks purchased eligible securities in anticipation of the PSPP.

The implied effect of the 2015 PSPP on loan supply is much smaller than in 2019. Our estimates imply an increase in lending of €214 million in 2015, in contrast to €12.1 billion in 2019. The very small 2015 lending effect is the by-product of the macroprudential accounting regulation, which effectively reduced the mark-to-market exposure of the banking system to the PSPP in 2015. In 2015, sovereign securities had to be marked to market only if held in the trading book, whereas the 2019 macroprudential regulation was much broader and required banks to mark to market available-for-sale and trading book sovereign securities. Because banks recorded a significant amount of sovereign assets as available for sale, the 2019 PSPP announcement induced a much broader lending response relative to 2015, when few banks had a substantial exposure to the PSPP through their trading book sovereign securities.

In sum, the PSPP elicits a stronger lending response when a larger fraction of the eligible securities was marked to market as per capital regulation. In addition, the PSPP had no significant impact on lending through the recapitalization channel among banks that were exposed to the program mainly through securities valued at historical cost. We next subject this claim to a battery of tests.

4.3. Robustness analysis, part I: instrumental variables, no anticipatory bias, no seasonality effects

We now describe the first set of robustness checks. Monetary policy can induce anticipatory biases, as banks could have anticipated the PSPP announcement and tilted their portfolios toward eligible securities, and we use an instrumental variable approach to rule out this risk. We also control for seasonality effects by expanding each of the sample windows to four years, resulting in 33 million and 23 million firm-bank-level observations for the 2019 and 2015 announcements, respectively. Overall, we obtain very strong support for the baseline results of Sections 4.1-4.2. We run all the robustness checks of this and the next two sections for both the 2019 and 2015 announcements, and for each announcement, using both the continuous and dummy measure of exposure.

We first focus on anticipatory biases. The main concern is that some banks might have anticipated the announcement and increased their holdings of eligible securities in the preceding months. For instance, with respect to the January 2015 announcement, the speech by then ECB president Mario Draghi at Jackson Hole in August 2014 might have foreshadowed the January 2015 ECB's asset purchase announcement. Before describing our tests, we note that the analysis of banks' balance sheets over time suggests that anticipatory biases are likely limited. As reported in Sections 4.1 and 4.2, banks' exposure to the PSPP is very persistent over time: the autocorrelation coefficient is 0.67 and 0.92 in the six months before the 2019 and 2015 announcements, respectively. Similarly, when using the dummy measures of exposure, 83% of the banks that were highly exposed six months before the 2019 announcement were still highly exposed in the month before the announcement. The figure is 71% for the 2015 announcement.

To rule out anticipatory biases, our main test uses an instrumental variable (IV) approach.[20] We restrict attention to the month immediately after the announcement—September 2019 and January 2015, respectively. Columns 1 and 4 in Table 5 repeat our baseline analysis, showing that the results are very close to those of the baseline estimates of Tables 3 and 4. The IV

[20] A second approach in Appendix C defines a bank as exposed if it held a large amount of MMA sovereign securities both in the month before the announcement and six months before, and it draws similar conclusions.

regressions instrument banks' exposure in the month before the announcement using the same exposure measure calculated six months before (i.e., February 2019 and June 2014 for the 2019 and 2015 announcements, respectively). Columns 2-3 and 5-6 of Table 5 show that the IV approach confirms and strengthens our results, using both the continuous and dummy measures of exposure. We emphasize that the IV regressions have a very high Kleibergen-Paap F-statistic (corresponding to the first-stage robust F-statistic in our setting)—as high as 927.99. Thus, there is no concern about weak instruments (Andrews et al. 2019). The strength of the instrument comes from the high persistence in the exposure.[21]

Table 6 deals with possible seasonality concerns as well as the choice of counterfactual around the change in the macroprudential regime. In the case of the former, both the 2019 and 2015 announcements took place after periods of holidays in Italy. Business activities typically slow down in August in relation to summer holidays, as well as during the holiday season at the end of December and early January. As a result, a possible concern is that our results could reflect seasonal changes in loan supply at particular bank-firm combinations rather than the causal effect of the PSPP. In the case of the latter concern, the results might reflect latent factors specific to the particular time period that also precipitated the PSPP. Extending the time period allows us to identify the effects of these policies with respect to a different counterfactual.

To this end, we expand our sample window from one to four years. For the 2019 announcement, we extend the sample backward in time, starting in March 2016, and we end in February 2020 as in our main analysis. This expansion of the sample allows us to exclude the COVID-19 period and work with 32 million observations. For the 2015 announcement, we keep the sample window centered around the announcement date, so that our sample runs from July 2012 to June 2016 (23 million observations). Table 6 shows the results. We restrict attention to the response immediately after the PSPP, and thus we interact the September 2019 and January 2015 time dummies with their respective exposures. We again find evidence of a significant increase in lending among banks more exposed to the PSPP in both September 2019 and January

[21] The Kleibergen-Paap F-statistic is somewhat low in Column 3, which refers to the 2015 IV regression that uses the dummy measure of exposure. Nonetheless, we note that the Kleibergen-Paap F-statistic is 873.1 when using the 2015 continuous exposure, and, thus, we conclude that our IV analyses are immune to weak instruments concerns.

2015, relative to the much larger set of counterfactual outcomes in this specification.

4.4 Robustness analysis, part II: exposure and bank characteristics

We now check whether banks' exposure to the PSPP is correlated with other bank characteristics and control for some of these characteristics to reduce omitted variable bias. Table 7 shows the results of regressing the PSPP exposure based on mark-to-market eligible securities on several bank characteristics.

We include three sets of variables; we describe them here briefly and then provide more details about them in Appendix B. The first one is total assets (in log), to deal with the concern that only the largest banks could be the ones that are more exposed to the policy. The second one is a list of standard characteristics: holdings of non-eligible securities, business loans, cash and reserves, and deposits—all measured in percentage of total assets—and Tier 1 capital as a fraction of risk-weighted assets.[22] The third set includes variables that measure banks' exposure to other ECB policies: targeted long-term refinancing operations (TLTRO), negative interest rates measured as the net interbank position as in Bottero et al. (2022), the covered bonds and asset-backed securities (ABS) purchase program, the corporate sector purchase program (CSPP), and the two-tier reserve system measured by the unused reserve allowance. The CSPP and unused reserve allowance are included only in 2019 regressions, as these policies were not in place in 2015.

The results of Table 7 show a limited link between PSPP exposure and other banks' variables. For 2019, only the net interbank position is significantly correlated with both the continuous and dummy measure of exposure. A few other characteristics are also correlated to exposure, but only with one type of exposure (i.e., either the continuous or the dummy): cash and reserves, Tier 1 capital ratio, CSPP exposure, and unused reserve allowance. For 2015, the only significant correlations are with Tier 1 capital and the securitization dummy, but the links are weak (p-values = 0.096 and 0.098, respectively) and arise only with the dummy measure of exposure.

[22] We obtain very similar results if we use common equity Tier 1 capital as a fraction of risk-weighted assets.

Despite the weak links with bank characteristics, we repeat the baseline 2019 and 2015 analyses by controlling for all those that are correlated with exposure and that were not already included in the benchmark specification. The controls are included in the regressions by interacting each of them with time dummies centered around the announcement month. Tables D.1 and D.2 in Appendix D provide the results, showing that our main findings are unchanged.

As an additional test, Appendix D controls for holdings of securities that are not eligible to be purchased under the PSPP program. We run this test to rule out possible general equilibrium effects that could impact banks through their holdings of such non-eligible securities. The control is included by interacting it with time dummies centered around the announcement month. Our main results are again unchanged.

4.5 Robustness analysis, part III: exposure to other policies and falsification

In our last set of robustness tests, we control for banks' exposure to other policies in our baseline regressions, including other unconventional policies implemented by the ECB, and we conduct a falsification test. All the tests again confirm the validity of our results.

Table 8a analyzes the 2019 announcement controlling for banks' exposure to the TLTRO and the asset purchase program in which the ECB purchased covered bonds and asset-backed securities. For the covered bonds and ABS purchase program, we measure exposure in two ways: by computing banks' holdings of such securities relative to total assets and by constructing a dummy equal to one for banks that are involved in securitization; see Appendix B for a detailed description of these variables. All the controls are included in the regressions by interacting them with time dummies centered on the announcement month. Our results are unchanged.

We note that we have already controlled for the other unconventional monetary policies in place in 2019—negative interest rates, CSPP, and two-tier reserve system—when studying the link between banks' exposure and bank characteristics in Section 4.4 and Appendix D (see Table D.1 in Appendix D).

Table 8b focuses on the 2015 announcement and control for policies in place at that time. Specifically, we control for banks' exposure to the TLTRO, negative interest rates (measured again as the net interbank position), and the covered bonds and ABS purchase program; see

Appendix B for a detailed description of these variables. For the covered bonds and ABS purchase program, the tables report only the regression in which we control for banks' holdings of covered bonds and ABS because we have already controlled for securitization activity in Section 4.4 and Appendix D; see Table D.2 in Appendix D. We also control for the comprehensive assessments that were conducted in 2013-2014 (i.e., stress tests and asset quality reviews). Exposure to this policy is constructed with a dummy equal to one for banks subject to it. As with all other robustness checks, our main results are essentially unchanged.

Finally, Table 9 conducts a falsification test. We repeat our main analysis one year before the first PSPP announcement; that is, we compute the mark-to-market exposure as of December 2013 and we use the firm-bank lending relationships between July 2013 and June 2014; recall that the first PSPP announcement is in January 2015. Column 1 uses the continuous measure of exposure, and Column 2 uses a dummy defined along the lines of the 2015 analysis.[23] With the continuous measure of exposure—Column 1—we find no statistically significant effects. With the dummy—Column 2—some coefficients are significant, but with inconsistent signs (i.e., some positive and some negative) and with a significant effect before January 2014. Importantly, the January 2014 coefficient is not statistically different from the July-November 2013 average (difference = -0.42, p-value: 0.326). Thus, this falsification test shows that holdings of mark-to-market PSPP-eligible securities one year before the first PSPP announcement do not affect lending.

5. Mechanism: regulatory requirements

The previous section has shown that the lending supply for banks with more holdings of mark-to-market PSPP-eligible securities increased with respect to other banks immediately after the PSPP announcement, both in 2019 and 2015. This result is consistent with the hypothesized recapitalization channel of monetary policy. It implies that banks' regulatory requirements were binding before the announcement, at least for some intermediaries, so that the increase in the

[23] We construct the dummy along the lines of the 2015 baseline analysis (i.e., equal to one for the banks in the top 15% of the exposure distribution) because the macroprudential regulatory framework in the time window of the falsification test was the same as in 2015.

market value of PSPP-eligible securities (Andrade et al. 2016, Altavilla et al. 2021) relaxed banks' regulatory constraints, but only through mark-to-market securities. If the recapitalization channel is salient, we should then observe a bigger effect of the PSPP on bank lending supply for more capital constrained banks.

To gauge this prediction, we interact banks' exposure to the PSPP with pre-announcement measures of capitalization. We also control for another related channel through which QE can transmit its effects, namely, the enhanced liquidity of the eligible securities. Central bank purchases can allow banks to liquidate eligible assets to meet loan demand with a lower risk of generating a price impact. If the liquidity channel is present, it should elicit the largest lending response among the most illiquid banks. We control for the liquidity channel by (i) interacting banks' exposure with a measure of their own pre-announcement liquidity and (ii) including an additional interaction of exposure with both capital and liquidity, as both theoretical and empirical considerations suggest that banks' lending decisions might depend not just on capitalization and liquidity positions alone but also on their interplay.

We restrict attention to the effects of the policy in the month immediately after the announcement—September 2019 and January 2015, respectively. We center the values of capital and liquidity at the 25th percentile of their respective distributions, so that the results can be interpreted as the marginal effects for a bank that has low levels of both capital and liquidity. Table 10 presents the results.[24] We use Tier 1 capital as a share of risk-weighted assets as the measure of capitalization, and cash plus central bank reserves as a fraction of total assets as a measure of liquidity.[25] The impact of the PSPP through the recapitalization channel is significantly lower for more capitalized banks, in both 2019 and 2015. We detect no effects related to banks' holdings of liquidity—neither directly nor in relation to the capital position. To

[24] We run the mechanism tests using only the continuous measure of exposure. The main issue with using the dummy measures of exposure is that, in 2015, only 14 banks are defined as highly exposed (i.e., their exposure dummy is equal to one), as noted in Section 4.1. As a result, it is nearly impossible to find enough variation in capital and liquidity holdings within such a limited set of banks; this variation would be needed to identify the coefficient on the exposure dummy interacted with the capital and liquidity measures. In contrast, with the continuous exposure, we are using cross-sectional variations in capital and liquidity holdings among all the banks in our sample (i.e., approximately 90 banks in both 2015 and 2019).

[25] Results are nearly identical if we define liquidity as central bank reserves only, and capital as common equity Tier-1 capital as a fraction of risk-weighted assets.

give some magnitudes, a 1 percentage point increase in the capital ratio lowers the impact of the PSPP through the recapitalization channel on loan supply by about 4.9% in 2019 and 23% in 2015.[26] The effect is thus stronger in 2015, which is not surprising given that banks tended to have a worse capital position in 2015 relative to 2019 (see, for instance, the IMF Country Report No. 20/81), especially those in the left tail of the capital ratio distribution.

In sum, this evidence is consistent with the view that some banks' regulatory constraints were binding at the time of the announcements. In turn, the PSPP announcements increased asset values, disproportionately relaxing regulatory capital constraints for those banks holding mark-to-market assets and increasing the loan supply of those banks to firms. Before formalizing the links between macroprudential accounting rules, capital requirements, and monetary policy in the discussion of Section 7, the next section provides some additional corroboratory evidence on the loan supply channel.

6. Additional results: interest rates and new lending relationships

This section extends the analysis of Sections 4 and 5 to further support our main findings. We first document that the PSPP not only increased the quantity of bank lending but also reduced the interest rates on new term loans (Section 6.1). We then turn to the extensive margin (i.e., new lending relationships) and provide evidence that banks more exposed to the PSPP started more new lending relationships (Section 6.2).

Two further results are presented in the appendix. In Appendix E, we show that banks more exposed to the PSPP through their mark-to-market holdings sold more eligible securities after the central bank began its purchases, but sales were limited to mark-to-market securities. This implies that macroprudential accounting regulation also affects the portfolio rebalancing channel of QE.[27] In Appendix G, we show that the increase in lending by more exposed banks did not

[26] The 2019 figure is computed as the value of the coefficient [2019m9] $\times QE_b \times$[Tier 1 ratio]$_b$ relative to that of [2019m9] $\times QE_b$, that is, -0.010/0.204 ≈ -4.9%. The 2015 figure is computed similarly.

[27] Koijen et al. (2021) study the portfolio rebalancing triggered by the PSPP between 2015 and 2017, and they find relatively small sales by banks, despite their large holdings. Our portfolio rebalancing results can explain the limited sales by banks, as HCA was prevalent in 2015 and was still being phased out in 2017.

crowd out lending by less exposed ones.

6.1 Effects on interest rates

If the PSPP caused an expansion of credit supply, the price of credit—the interest rate on loans—should decline. In contrast, if our results reflect a coincidental increase in latent credit demand, interest rates should be non-decreasing in exposure to the PSPP. This section provides evidence supporting an expansion of credit supply.

We use data on the interest rate on term loan originations with maturity greater than one year. These data are available only for a subset of banks—our final sample includes 43 banks in 2019 and 37 banks in 2015—and for firms with an overall outstanding loan balance at any given bank of at least €25,000 in 2019 and €75,000 in 2015.[28] The 2019 data are available at a monthly frequency, but the 2015 data are available only at a quarterly frequency.[29] Appendix F shows that our main intensive margin result presented in Tables 3 and 4 holds for the subsample of banks for which we have interest rate data.

We use a modified version of the baseline specification described in Equation (1). The new dependent variable is the interest rate $i_{b,f,t}$ on a term loan originated at time *t* by bank *b* and extended to firm *f*.[30] Because of the limited sample, we focus on the dummy measures of exposure to the PSPP to limit the effects of noise and outliers, as defined in Section 4.1 and Section 4.2. Table 11 presents the results. As in our baseline regressions, we use firm-by-time fixed effects to control for time-varying firm characteristics. We find that more exposed banks reduced the interest rate in comparison to less exposed ones after the announcement, and there are no pre-trends. The result is statistically significant, and the magnitude is economically

[28] The large majority of the new term loans in our estimation sample are on the intensive margin, that is, are extended by banks to firms that were preexisting customers. The sample includes a small number of observations that refer to new lending relationships, but they represent only 0.21% of the sample in 2019 and 0.17% in 2015.

[29] The Bank of Italy changed the interest rate data collection process between 2015 and 2019. To make comparisons between the data collected after the changes with those collected earlier, the Bank of Italy has developed a series of filters that can be applied to the more recent data. The filters—which we apply to construct our final dataset—require the following to be excluded from the 2019 data: (i) loans classified as overdrafts, credit card debt, and other revolving credit; (ii) loans related to trade receivables; and (iii) loans awarded for the specific purpose of financing import and export activities.

[30] The interest rate for newly originated term loans that we use is an APR that accounts for origination fees which is referred to as *Tasso Annuo Effettivo Globale* (TAEG) as defined by EU Council Directive 87/102/EEC.

important: more exposed banks reduce interest rates by about 90 and 150 basis points in 2019 and 2015, respectively, relative to the least exposed banks. These results suggest that the PSPP announcement generated a shift in the loan supply curve, consistent with an increase in quantities and a reduction in prices. As with all our analyses, the results hold for both 2019 and 2015.

6.2 New lending relationships: extensive margin

In addition to increasing loan supply to existing customers, banks with larger holdings of mark-to-market PSPP-eligible securities might also form new credit relationships (i.e., lending at the extensive margin). This section provides evidence of this effect. When a firm applies for a new loan from a bank, Italian banks may use the Bank of Italy's credit register to learn about the firm's credit history. When the credit register is accessed, the request is recorded in the Initial Information Service (IIS) dataset and helps us measure loan demand at the firm level. We can then combine the IIS dataset with the credit register data to determine whether loan demand is met at the extensive margin (Jiménez et al. 2012).

All loan applications are classified as either successful (i.e., a new loan was disbursed over the next three months in response to the application) or unsuccessful (i.e., a lending relationship did not begin). Note that this dataset does not include new loans to existing customers—those are recorded as intensive margin responses—as applications for such loans are typically not recorded in the IIS dataset. That is, successful loan applications are cases in which a bank lends to a particular borrower for the first time, forming a new credit relationship.

We use a linear probability model along the lines of Equation (1), with a few changes to reflect the loan application data. First, our dependent variable equals 1 if a firm's loan application to a bank in a specific month is successful, thereby resulting in a new loan over the next three months, and 0 otherwise; a lag can occur between the loan application and the time the loan is granted and disbursed. This is the same approach used by Jiménez et al. (2012). Second, motivated by the same lag, we interact our exposure measure with quarterly time dummies centered around the announcement month, as opposed to monthly dummies as in our baseline analysis. In particular, the 2019 dummies are constructed so that we can measure the effect of the announcement on exposed banks in the months of September, October, and November of that year (i.e., the three months immediately after the announcement) as well as December 2019, January 2020, and February 2020 (i.e., the following three months). Third, we continue to use bank fixed effects in the regressions, but because loan application data can be noisy, we use firm and time fixed effects separately.[31] Using firm-by-time fixed effects here would force us to focus only on firms that apply to at least two banks in any given month, reducing the sample size dramatically and limiting our ability to make inferences. To further reduce noise and outlier effects, we use the dummy measure of exposure to the PSPP.

Table 12 presents the results. In both 2019 and 2015, we observe a significantly higher probability that a loan application is accepted at exposed banks relative to less exposed ones. More precisely, in the three months after the announcements, these probabilities are higher by 2.4 and 4.1 percentage points in 2019 and 2015, respectively. For reference, the unconditional probabilities that an application made in the six months before the 2019 and 2015 PSPP announcements to an exposed bank leads to a new credit relationship are 15.2% and 15.7%, respectively. In months four to six after the PSPP announcements, the point estimates suggest that the acceptance probability is still higher at more exposed banks, but the result is less precisely estimated: the p-values are 0.193 and 0.075 for 2019 and 2015, respectively.

To sum up, our analysis suggests that banks with more holdings of mark-to-market eligible securities lend more not just to existing clients, as shown in Section 4, but also to new clients.

7. Discussion: macroprudential accounting rules, bank lending, and capital requirements

We now provide a further discussion about the impact of macroprudential accounting rules on the transmission of monetary policy and propose alternative macroprudential regulations that prevent credit crunches induced by increases in sovereign default spreads without muting the pass-through of monetary policy. In addition, motivated by the link between HCA and bank

[31] The noise could arise from difference sources. For instance, a bank might not access the credit register when it receives an application if it has other information about the firm, so that not all the applications are recorded in the IIS. When this is the case, we can nonetheless detect when a loan application is successful (i.e., we observe a new lending relationship in the credit register), but we do not observe if it is rejected.

capital that arises from our empirical analysis, we show that there is an equivalence between HCA on the one hand and MMA combined with a time-varying balance-sheet-specific capital requirement on the other hand. We quantify the variation in the capital requirement that would be required to keep banks' assets unchanged if banks had to use MMA, focusing on Italian banks in 2014 and, for comparison, US banks in 2022.

Consider a bank with liabilities d_{t-1} and just two types of assets, loans l_{t-1} and sovereign securities with face value g purchased at t-1 at price p_{t-1}. This purchase price is the inverse of the yield, which in turn is the sum of two components: a risk-free rate i_{t-1} (which depends on monetary policy) and the sovereign default spread s_{t-1}. Thus, $p_{t-1} = \frac{1}{1+i_{t-1}+s_{t-1}}$ and the time-t price is $p_t = \frac{1}{1+i_t+s_t}$.

If banks use HCA to value the sovereign securities, the level of regulatory capital depends on the purchase price $p_{t-1} = \frac{1}{1+i_{t-1}+s_{t-1}}$ of sovereign securities:

$$capital_t^{HCA} = l_{t-1} + \underbrace{\frac{1}{1+i_{t-1}+s_{t-1}}}_{=p_{t-1}} \times g - d_{t-1}. \tag{2}$$

If instead MMA is used, the level of regulatory capital depends on the current price p_t:

$$capital_t^{MMA} = l_{t-1} + \underbrace{\frac{1}{1+i_t+s_t}}_{=p_t} \times g - d_{t-1}. \tag{3}$$

The bank faces a risk-weighted capital requirement constraint, stipulating that the regulatory capital must be greater than a certain fraction of its risk-weighted assets. We denote such fraction as ξ. We consider a 0% weight on sovereign securities and a 100% weight on loans, so that risk-weighted assets are just equal to loans l_t and regulatory capital is a fraction of loans. For instance, if $\xi = 8\%$, the bank's regulatory capital must be at least equal to 8% of its loans.

If HCA is used to value sovereign securities, the capital requirement is

$$capital_t^{HCA} \geq \xi l_t.$$

From Equation (2), the value of capital is independent of the current monetary policy innovations i_t and the current default spread s_t. As a result, if the capital requirement is binding, changes in i_t and s_t affect neither $capital_t^{HCA}$ nor current lending. This result explains why, when HCA was prevalent in 2014 in Europe, unexpected changes in monetary policy, such as the PSPP, have no significant effect on loan supply among Italian banks. In contrast, if MMA is used, the capital requirement is

$$capital_t^{MMA} \geq \xi l_t$$

and changes to the monetary policy rate i_t and default spread s_t affect lending; see Equation (3). A reduction in i_t—such as the one triggered by the PSPP in 2019—increases banks' capital and allows banks to lend more. However, under MMA, increases in sovereign default spreads also pass through onto the balance sheet and reduce lending.

A hybrid accounting rule $p_t^{hybrid} = \frac{1}{1+i_t+s_{t-1}}$ that fixes default spreads at a historical level, s_{t-1}, but uses the current risk-free rate i_t, can allow expansionary monetary policy to affect loan supply while shielding bank capital from widening sovereign default spreads:

$$capital_t^{hybrid} = l_{t-1} + \underbrace{\frac{1}{1 + i_t + s_{t-1}}}_{=p_t^{hybrid}} \times g - d_{t-1}.$$

This approach requires banks and regulators to separate the yield of risky sovereign debt into a risk-free component and a default premium component. In practice, this does not appear particularly complicated.

A related approach uses market prices to compute regulatory capital (i.e., MMA to value assets) but employs time-varying capital requirements that depend on market prices and banks' balance sheets to target a particular loan supply l_t:

$$capital_t^{MMA} \geq \xi_t^* \, l_t$$

where ξ_t^* is the ratio of the MMA-based value of capital and the hybrid rule-based value of capital:

$$\xi_t^* = \frac{capital_t^{MMA}}{capital_t^{hybrid}}.$$

The time-varying capital requirement decreases when the sovereign default spread goes up (i.e., when the MMA-based value of capital goes down), fully offsetting the impact of such an increase and, thus, preventing credit crunches. That is, ξ_t^* is a countercyclical time-varying capital requirement that avoids the pitfalls of HCA in relation to the pass through of monetary policy.

The time-varying capital requirement approach suggests an equivalence between HCA on the one hand and MMA combined with a time-varying balance-sheet-specific capital requirement on the other hand. This can easily be seen by considering the HCA-based capital requirement rule, $capital_t^{HCA} \geq \xi l_t$, multiplying and dividing the left-hand side by $capital_t^{MMA}$, and rearranging, to obtain:

$$capital_t^{MMA} \geq \xi \frac{capital_t^{MMA}}{capital_t^{HCA}} l_t.$$

This equation says that the capital requirement *effectively* applied to the MMA value of bank capital fluctuates with the ratio of $capital_t^{MMA}$ to $capital_t^{HCA}$ in order to maintain lending. For instance, if the MMA value of capital drops by 20% because of a reduction in security prices—but regulatory capital remains unchanged because of HCA—the effective capital requirement that banks would be required to use under MMA is 20% lower in order to maintain loan supply.

To gauge the magnitude of the link between HCA and capital requirements, we provide a simple quantification. Consider an increase in sovereign default premia at the end of 2014—before the PSPP was announced and at a time when HCA was prevalent. In a scenario with a 3 percentage point increase in the sovereign default spread—similar to what happened during the sovereign crisis of the 2010s—our calculations imply that HCA is equivalent to MMA coupled with an average reduction of capital requirements across banks of 24% (see Appendix H for the details). For comparison, we obtain a nearly identical result when we focus on US banks and consider the combined effects of the 2022 interest rate hikes and the use of HCA to value banks' security holdings (i.e., approximately 23-24%).[32]

8. Conclusion

This paper has used Italian credit register and granular supervisory data to study the role of

[32] The increase in interest rates in the US affected not only Treasury securities (which have zero risk weight) but also other securities (with positive risk weights). Our analysis can be extended to account for the non-zero risk weights of some securities, but the broad message would be unchanged. However, at the end of 2021, about 74% of non-Treasury securities held by US banks were mortgage-backed securities, which typically have only a 20% risk weight.

macroprudential accounting regulation in affecting the pass through of QE onto banks' loan supply to firms. We have studied this question using both the 2015 and 2019 versions of the PSPP—the ECB's largest QE program—along with changes in macroprudential accounting regulation between the two QE programs. Our main result is that macroprudential accounting regulation that uses historical cost to compute regulatory capital mutes the transmission of unconventional monetary policy. Correspondingly, banks exposed to the PSPP through eligible securities that are marked to market increased their lending supply with respect to other banks. The effects are stronger for banks with low regulatory capital.

To place these results in context, we have noted that a large literature has generally reported mixed results on the real effects of QE with little clarity on the factors behind the wide range of estimates. A related and mostly theoretical literature has also wrestled with whether monetary and macroprudential policies are complements or substitutes. This latter literature has generally focused on macroprudential tools in the form of capital and liquidity regulations. Separately, the literature on accounting itself has mainly focused on the trade-off between market discipline versus the costs of excess volatility and contagion. Thus, ours is the first paper, to our knowledge, to use micro data and a plausible identification strategy to study how macroprudential accounting rules can sharply mediate the real effects of QE-type yield curve management policies on firms' access to credit. Our results help explain why estimates of QE's effect might vary across studies.

More generally, our results show that macroprudential accounting policies can directly interfere with other macro-stabilization tools. Besides their effect on limiting monetary policy, we have highlighted the link between macroprudential accounting policies and capital requirements, and we have suggested policies that can achieve the stabilization benefits of macroprudential accounting rules while allowing the pass-through of central bank interventions.

Beyond its policy implications, this paper opens up several directions for future research. Our results suggest that analyses of the trade-off between historical cost and mark-to-market accounting might also incorporate the impact of these accounting regimes on other major macro-stabilization policies such as QE and capital requirements. Future research can also examine whether these macroprudential accounting rules shape the impact of conventional monetary policy and how this relationship might depend on other financial regulations; our work is silent on this. That is, little is currently known about whether the use of HCA versus MMA amplifies the impact of conventional monetary policy and whether post-2010 liquidity requirements further amplify these effects. Our evidence can also help researchers develop more realistic quantitative models of bank capital, monetary policy and real dynamics that can be calibrated for different macroprudential accounting regulations.

Table 1: Summary statistics, firm-bank lending relationships

Panel A: Number of lending relationships

	August 2019		December 2014	
	N	Percent	N	Percent
2	177,719	60	141,323	65
3	62,810	21	44,983	21
4	26,928	9	17,089	8
5	13,101	4	7,330	3
6+	17,331	6	5,993	3
Total	297,889	100	216,718	100

Panel B: Firm-bank lending relationships, 2019-2020

Firm-bank lending relationships	N	Mean	1st quartile	Median	3rd quartile	Std. dev.
All firms						
Amount borrowed, EUR (as of August 2019)	1,627,719	369,160	32,471	71,812	192,847	5,243,616
Log change amount borrowed, % (12-month window)	17,117,125	-0.55	-3.34	-0.33	0.38	50.57
Firms with more than one bank relationship in each month						
Amount borrowed, EUR (as of August 2019)	846,248	533,040	33,068	93,101	287,706	6,942,672
Log change amount borrowed, % (12-month window)	8,780,431	-0.77	-5.72	-0.32	1.99	57.20

Panel C: Firm-bank lending relationships, 2014-2015

Firm-bank lending relationships	N	Mean	1st quartile	Median	3rd quartile	Std. dev.
All firms						
Amount borrowed, EUR (as of December 2014)	1,216,779	414,973	36,370	79,218	211,910	5,444,324
Log change amount borrowed, % (12-month window)	13,186,871	0.17	-2.04	0.00	0.61	46.33
Firms with more than one bank relationship in each month						
Amount borrowed, EUR (as of December 2014)	563,922	625,108	43,978	115,779	346,191	7,587,313
Log change amount borrowed, % (12-month window)	6,117,128	0.19	-2.97	0.00	1.24	51.16

Panel D: Interest rates on new term loans, 2019-2020

Interest rates on new term loans	N	Mean	1st quartile	Median	3rd quartile	Std. dev.
All observations						
Interest rate, %	248,439	4.18	2.44	3.80	5.52	2.35
Firms with new term loans from multiple banks in each month						
Interest rate, %	14,574	3.17	1.63	2.67	4.18	2.10

Panel E: Interest rates on new term loans, 2014-2015

Interest rates on new term loans	N	Mean	1st quartile	Median	3rd quartile	Std. dev.
All observations						
Interest rate, %	127,369	4.82	3.07	4.39	6.13	2.46
Firms with new term loans from multiple banks in each quarter						
Interest rate, %	9,451	3.97	2.39	3.54	5.03	2.19

Panel F: Loan applications and initial information service (IIS), 2019-2020

March 2019 to February 2020	
Number of requests	828,470
Number of unique firms	550,259
Number of firms that submit at least two applications in a month	16,963

Panel G: Loan applications and Initial Information Service (IIS), 2014-2015

July 2014 to June 2015	
Number of requests	662,904
Number of unique firms	440,892
Number of firms that submit at least two applications in a month	11,972

Panel A displays the distribution of the number of lending relationships for the firms with outstanding loans reported in the Italian credit register. Panels B and C display the distribution of the amount borrowed (in August 2019 and December 2014, respectively) and the log change in the amount borrowed (for each month in the sample, that is, March 2019–February 2020, and July 2014–June 2015, respectively). Panels D and E display the interest rates distribution for new terms loans. Panels F and G display key summary statistics about loan applications from the Initial Information Service (IIS).

Table 2: Bank-level summary statistics

		Mean	1st quartile	Median	3rd quartile	Std Dev	Coeff Var
Eligible securities, % of assets	Aug 2019	17.06	7.14	15.14	24.42	13.39	0.79
	Dec 2014	11.44	1.69	8.10	18.37	11.35	0.99
Eligible securities, marked to market, % of assets	Aug 2019	6.00	0.18	3.16	6.66	9.74	1.62
	Dec 2014	0.45	0.00	0.00	0.001	1.63	3.65
Eligible securities, historical cost, % assets	Aug 2019	11.12	3.09	7.68	18.18	10.41	0.94
	Dec 2014	11.00	1.33	8.10	17.46	11.18	1.02
Eligible securities, available for sale and trading book, % of assets	Aug 2019	6.00	0.18	3.16	6.66	9.74	1.62
	Dec 2014	10.42	0.17	6.69	17.65	11.02	1.06
Non-eligible securities, available for sale, % of assets	Aug 2019	3.65	0.29	1.36	4.69	5.57	1.53
	Dec 2014	9.01	1.47	5.66	12.68	10.6	1.18
Non-eligible securities, trading book, % of assets	Aug 2019	4.81	0.15	2.24	6.59	7.11	1.48
	Dec 2014	4.12	0.00	0.19	6.30	6.46	1.56
Log of total assets	Aug 2019	21.85	20.25	21.53	23.39	2.16	0.10
	Dec 2014	21.38	19.41	21.45	22.82	2.20	0.10
Business loans, % of assets	Aug 2019	25.59	7.88	22.46	32.09	38.6	1.51
	Dec 2014	25.07	10.85	26.66	37.21	15.5	0.62
Liquidity (i.e., cash and reserves), % of assets	Aug 2019	3.25	0.27	1.19	3.11	6.67	2.05
	Dec 2014	1.31	0.08	0.76	1.29	1.81	1.39
Tier 1 capital, % of risk-weighted assets	Jun 2019	19.14	12.74	15.17	19.05	12.58	0.66
	Dec 2014	22.10	10.90	14.18	26.00	24.56	1.11
TLTRO exposure, % of total assets	Feb 2019	9.52	5.82	9.98	12.6	5.17	0.54
	Dec 2014	0.33	0.00	0.00	1.00	2.20	6.65
Net interbank position, % of assets	Jun 2019	4.08	-0.64	0.57	4.29	11.20	2.75
	Mar 2014	-0.35	-3.73	0.00	2.97	12.30	-35.64
Securitization dummy	Aug 2019	0.46	0	0	1	0.50	1.10
	Aug 2014	0.28	0	0	1	0.45	1.60
Covered bonds and ABS, available for sale and trading book, % of assets	Aug 2019	1.64	0.00	0.00	1.33	3.58	2.19
	Aug 2014	1.68	0.00	0.00	1.53	3.51	2.09
CSPP-eligible securities, available for sale and trading book, % of assets	Aug 2019	0.07	0.00	0.00	0.03	0.19	2.57
Unused allowance, two-tier reserve system, % of assets	Jun-Sept 2019	1.13	0.00	0.00	0.91	3.51	3.11
Log change of borrowing from the ECB, %	Mar 2019-Feb 2020	-2.3	0.00	0.00	0.00	142	-61.66
	Jul 2014-Jun 2015	-12.2	0.00	0.00	0.00	270	-22.12

The table displays key summary statistics for the banks in our sample. We have 95 banks in 2014 and 90 in 2019. See Appendix B for the definition of TLTRO exposure, net interbank position, securitization dummy, and unused allowance.

Table 3: 2019 PSPP announcement

	(1) Broad measure of exposure	(2) Mark-to-Market Exposure	(3) Mark-to-Market and Historical Cost Exposure	(4) BENCHMARK
[2019m3]× QE_b	-0.008	0.021	0.023	0.845
	[0.015]	[0.078]	[0.079]	[0.970]
[2019m4] × QE_b	0.147***	0.106	0.070	-0.197
	[0.036]	[0.161]	[0.143]	[1.739]
[2019m5] × QE_b	0.054**	0.084	0.072	0.833
	[0.025]	[0.068]	[0.060]	[0.689]
[2019m6] × QE_b	0.004	0.042	0.042	1.349
	[0.024]	[0.125]	[0.130]	[1.554]
[2019m7] × QE_b	0.115***	0.045	0.013	0.028
	[0.033]	[0.149]	[0.138]	[1.715]
[2019m9] × $\boldsymbol{QE_b}$	0.111**	0.244**	0.223**	2.610**
	[0.047]	[0.116]	[0.100]	[1.038]
[2019m10] × QE_b	0.127**	-0.071	-0.102	1.136
	[0.061]	[0.152]	[0.160]	[1.501]
[2019m11] × QE_b	-0.016	0.111	0.112	1.928
	[0.029]	[0.114]	[0.117]	[1.501]
[2019m12] × QE_b	0.104**	0.339***	0.324***	3.367***
	[0.040]	[0.107]	[0.099]	[0.700]
[2020m1] × QE_b	0.111***	0.071	0.047	-0.455
	[0.035]	[0.146]	[0.131]	[1.758]
[2020m2] × QE_b	-0.024	0.031	0.030	-0.161
	[0.015]	[0.051]	[0.051]	[0.379]
QE_b exposure measure	All eligible securities	Eligible securities marked to market (= available for sale and trading book)	Eligible securities marked to market (= available for sale and trading book)	Eligible securities marked to market, dummy (= available for sale and trading book)
Bank FEs	Yes	Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes	Yes
Size, ECB lending, and reserves	Yes	Yes	Yes	Yes
HCA exposure	No	No	Yes	No
Observations	8,346,925	8,346,925	8,346,925	8,346,925
R-squared	0.370	0.370	0.370	0.370

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). In Column 1, the QE exposure variable, QE_b, does not distinguish between MMA and HCA accounting. Column 2 measures QE_b only using MMA assets. Column 3 simultaneously uses two separate exposure measures, one based on MMA—the same as in column 2—and one based on HCA. Appendix A shows the coefficients from the HCA exposure measure; all are insignificant. Column 4 uses a dummy measure of MMA exposure, comparing banks in the top tercile of the exposure distribution with those in the bottom. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: 2015 PSPP announcement

	(1) Broad measure of exposure	(2) Mark-to-Market Exposure	(3) Mark-to-Market and Historical Cost Exposure	(4) BENCHMARK	(5) Falsification test
[2014m7]× QE_b	-0.050	0.079	0.111	0.362	-0.028
	[0.040]	[0.133]	[0.133]	[0.633]	[0.042]
[2014m8] × QE_b	-0.156***	0.183	0.287	0.439	-0.153**
	[0.056]	[0.180]	[0.199]	[0.635]	[0.063]
[2014m9] × QE_b	-0.003	0.278	0.287	0.836	0.026
	[0.055]	[0.234]	[0.228]	[0.582]	[0.055]
[2014m10] × QE_b	-0.089	-0.105	-0.051	-0.910	-0.049
	[0.055]	[0.243]	[0.249]	[0.938]	[0.060]
[2014m11] × QE_b	-0.010	0.232	0.245	-0.363	-0.018
	[0.063]	[0.284]	[0.276]	[0.925]	[0.071]
[2015m1] × $\boldsymbol{QE_b}$	-0.080	0.437**	0.498**	1.759**	-0.007
	[0.054]	[0.182]	[0.196]	[0.733]	[0.053]
[2015m2] × QE_b	-0.078**	0.139	0.192	0.022	-0.072
	[0.039]	[0.187]	[0.196]	[0.703]	[0.045]
[2015m3] × QE_b	0.009	0.058	0.055	0.368	-0.005
	[0.055]	[0.171]	[0.162]	[0.558]	[0.055]
[2015m4] × QE_b	-0.085*	0.084	0.139	0.022	-0.053
	[0.045]	[0.172]	[0.181]	[0.569]	[0.049]
[2015m5] × QE_b	-0.119**	0.039	0.114	-0.563	-0.122**
	[0.051]	[0.194]	[0.199]	[0.766]	[0.057]
[2015m6] × QE_b	0.007	0.055	0.054	0.207	0.005
	[0.055]	[0.138]	[0.126]	[0.504]	[0.052]
QE_b exposure measure	All eligible securities	Eligible securities marked to market (=trading book)	Eligible securities marked to market (=trading book)	Eligible securities marked to market, dummy (=trading book)	Available-for-sale and trading book eligible securities (i.e., falsification)
Observations	5,867,308	5,867,308	5,867,308	5,867,308	5,867,308
R-squared	0.394	0.394	0.394	0.394	0.394
Bank FEs	Yes	Yes	Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes	Yes	Yes
Size, ECB lending, and reserves	Yes	Yes	Yes	Yes	Yes
HCA exposure	No	No	Yes	No	No

The dependent variable is the change in the log of disbursed loans from bank b to firm f in month t (in percentages). In Column 1, the QE exposure variable, QE_b, does not distinguish between MMA and HCA accounting. Column 2 measures QE_b only using MMA assets. Column 3 simultaneously uses two separate exposure measures, one based on MMA—the same as in Column 2—and one based on HCA. Appendix A shows the coefficients from the HCA exposure measure—all are insignificant. Column 4 uses a dummy measure of MMA exposure, equal to one for banks in the top 15% of the distribution of mark-to-market eligible securities relative to total assets. Column 5 measures exposure based on the MMA rules in place in 2019, instead of using the 2015 MMA coverage of assets. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: No anticipatory bias, instrumental variable approach

	2019 announcement				2015 announcement		
	(1)	(2)	(3)		(4)	(5)	(6)
	Baseline	IV	IV, dummy exposure		Baseline	IV	IV, dummy exposure
$[2019m9] \times QE_b$	0.175**	0.214**	2.316***	$[2015m1] \times QE_b$	0.343***	0.417***	7.822**
	[0.070]	[0.084]	[0.591]		[0.056]	[0.081]	[3.765]
Instrument	-	February 2019 exposure	February 2019 exposure		-	June 2014 exposure	June 2014 exposure
Bank FEs	Yes	Yes	Yes		Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes		Yes	Yes	Yes
Size	Yes	Yes	Yes		Yes	Yes	Yes
ECB lending	Yes	Yes	Yes		Yes	Yes	Yes
Reserves	Yes	Yes	Yes		Yes	Yes	Yes
Observations	8,346,925	8,346,925	8,346,925		5,867,308	5,867,308	5,867,308
Kleibergen-Paap F-stat	-	191.08	18.42		-	927.99	3.01

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). In Columns 1 and 4, the PSPP exposure measure QE_b is computed at the end of the month before the announcement (i.e., August 2019 for the 2019 announcement and December 2014 for the 2015 announcement, respectively). In Columns 2, 3, 5, and 6, the PSPP exposure measure QE_b is computed as of the month before the announcement (i.e., August 2019 for the 2019 announcement and December 2014 for the 2015 announcement, respectively) and instrumented using its value six months before (i.e., February 2019 and June 2014 for the 2019 and 2015 announcement, respectively). In Columns 1, 2, 4, and 5, the variable QE_b is computed as the value of mark-to-market PSPP-eligible securities relative to total assets (in percentages). In Column 3, the variable QE_b is a dummy equal to one for banks in the top tercile of the distribution of mark-to-market PSPP-eligible securities relative to total assets, and results are reported relative to banks in the bottom tercile. In Column 6, the variable QE_b is a dummy equal to one for banks in the top 15% of the distribution of mark-to-market PSPP-eligible securities relative to total assets. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Extending the counterfactual

2019 announcement			2015 announcement		
	(1)	(2)		(3)	(4)
[2019m9] × QE_b	0.143**	1.661***	[2015m1] × QE_b	0.278**	1.345***
	[0.060]	[0.550]		[0.113]	[0.407]
QE_b exposure measure	Continuous	Dummy		Continuous	Dummy
Time window	March 2016 – February 2020	March 2016 – February 2020		July 2012 – June 2016	July 2012 – June 2016
[Monthly dummies] × QE_b	Yes	Yes		Yes	Yes
Bank FEs	Yes	Yes		Yes	Yes
Firm-time FEs	Yes	Yes		Yes	Yes
Size	Yes	Yes		Yes	Yes
ECB lending	Yes	Yes		Yes	Yes
Reserves	Yes	Yes		Yes	Yes
Observations	32,883,854	32,883,854		23,396,405	23,396,405
R-squared	0.370	0.370		0.398	0.398

The dependent variable is the change in the log of disbursed loans from bank b to firm *f* in month t (in percentages). In Columns 1 and 3, the variable QE_b is computed as the value of mark-to-market PSPP-eligible securities relative to total assets as of August 2019 and December 2014, respectively (in percentages). In Column 2, the variable QE_b is a dummy equal to one for banks in the top tercile of the distribution of marked-to-market PSPP-eligible securities relative to total assets as of August 2019, and results are reported relative to banks in the bottom tercile. In Column 4, the variable QE_b is a dummy equal to one for banks in the top 15% of the distribution of marked-to-market PSPP-eligible securities relative to total assets as of December 2014. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Banks' exposure and other bank characteristics

	(1) 2019 MMA exposure	(2) 2019 MMA exposure, dummy	(3) 2015 MMA exposure	(4) 2015 MMA exposure, dummy
Log of total assets	-0.386	-0.040	-0.015	-0.019
	[0.724]	[0.029]	[0.087]	[0.019]
Non-eligible securities, available for sale and trading book, % of total assets	-0.065 [0.147]	0.005 [0.007]	-0.008 [0.010]	-0.001 [0.003]
Business loans, % of total assets	-0.008	0.000	-0.002	-0.001
	[0.018]	[0.001]	[0.008]	[0.002]
Cash and reserves, % of total assets	-0.206**	-0.008	-0.085	0.012
	[0.091]	[0.005]	[0.081]	[0.023]
Deposits, % of total assets	0.106	0.001	0.012	0.001
	[0.067]	[0.002]	[0.013]	[0.002]
Tier 1 capital, % of risk-weighted assets	0.286**	0.005	-0.003	-0.002*
	[0.138]	[0.004]	[0.004]	[0.001]
TLTRO exposure, % of total assets	-0.077	0.006	0.063	0.001
	[0.256]	[0.012]	[0.077]	[0.014]
Net interbank position, % of total assets	-0.190**	-0.008**	0.007	0.000
	[0.076]	[0.004]	[0.011]	[0.003]
Securitization dummy	-2.219	-0.147	-0.479	-0.131*
	[3.065]	[0.164]	[0.355]	[0.078]
Covered bonds and ABS, available for sale and trading book, % of total assets	0.136 [0.286]	-0.007 [0.017]	-0.001 [0.017]	-0.006 [0.009]
CSPP exposure, % of assets	-3.496 [5.416]	0.416* [0.231]		
Unused reserve allowance, % of assets	0.023	0.024***		
	[0.136]	[0.009]		
Observations	89	89	93	93
R-squared	0.283	0.282	0.077	0.066

The dependent variable is the bank-level PSPP exposure measure based on mark-to-market PSPP-eligible securities calculated as of August 2019 (for the September 2019 announcement) and December 2014 (for the January 2015 announcement). The 2019 dummy is equal to one for banks in the top tercile of the distribution of mark-to-market eligible securities over assets, and the 2015 dummy is equal to one for banks in the top 15% of the distribution of mark-to-market eligible securities over assets. See Appendix B for the definition of TLTRO exposure, securitization dummy (see "Exposure to covered bonds (CB) and asset-backed securities (ABS) purchase program"), CSPP exposure, and unused reserve allowance. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8a: Banks' exposure to other ECB policies, 2019 announcement

	(1)	(2)	(3)	(4)	(5)	(6)
[2019m3]× QE_b	0.021	0.021	0.020	0.886	0.864	0.863
	[0.077]	[0.082]	[0.079]	[0.988]	[1.010]	[0.973]
[2019m4] × QE_b	0.126	0.114	0.114	0.028	-0.184	-0.210
	[0.161]	[0.169]	[0.168]	[1.782]	[1.773]	[1.730]
[2019m5] × QE_b	0.087	0.081	0.086	0.864	0.802	0.844
	[0.068]	[0.072]	[0.070]	[0.688]	[0.715]	[0.697]
[2019m6] × QE_b	0.046	0.043	0.063	1.492	1.391	1.290
	[0.124]	[0.130]	[0.131]	[1.574]	[1.598]	[1.537]
[2019m7] × QE_b	0.045	0.021	0.039	-0.047	-0.196	0.054
	[0.150]	[0.156]	[0.157]	[1.739]	[1.672]	[1.709]
[2019m9] × $\boldsymbol{QE_b}$	0.238**	0.248**	0.252**	2.526**	2.632**	2.629**
	[0.116]	[0.123]	[0.116]	[1.052]	[1.092]	[1.052]
[2019m10] × QE_b	-0.010	-0.089	-0.014	2.238	1.050	1.207
	[0.132]	[0.158]	[0.136]	[1.573]	[1.565]	[1.481]
[2019m11] × QE_b	0.098	0.101	0.124	1.780	1.871	1.928
	[0.111]	[0.118]	[0.136]	[1.527]	[1.536]	[1.523]
[2019m12] × QE_b	0.327***	0.320***	0.385***	3.184***	3.206***	3.387***
	[0.107]	[0.113]	[0.103]	[0.724]	[0.670]	[0.703]
[2020m1] × QE_b	0.067	0.045	0.040	-0.607	-0.737	-0.488
	[0.145]	[0.158]	[0.163]	[1.781]	[1.777]	[1.774]
[2020m2] × QE_b	0.028	0.028	0.009	-0.199	-0.213	-0.188
	[0.051]	[0.053]	[0.052]	[0.379]	[0.400]	[0.382]
QE_b exposure measure	Continuous	Continuous	Continuous	Dummy	Dummy	Dummy
TLTRO exposure	Yes	No	No	Yes	No	No
Covered bonds and ABS	No	Yes	No	No	Yes	No
Securitization	No	No	Yes	No	No	Yes
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes	Yes	Yes	Yes
Size	Yes	Yes	Yes	Yes	Yes	Yes
ECB lending	Yes	Yes	Yes	Yes	Yes	Yes
Reserves	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,346,934	8,346,934	8,346,934	8,346,934	8,346,934	8,346,934
R-squared	0.370	0.370	0.370	0.370	0.370	0.370

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). The variable QE_b is the exposure of bank *b* to the PSPP as of August 2019. In columns 1-3, QE_b is computed as the value of mark-to-market PSPP-eligible securities relative to total assets (in percentages). In Columns 4-6, QE_b is a dummy equal to one for banks in the top tercile of the distribution of mark-to-market PSPP-eligible securities relative to total assets, and results are reported relative to banks in the bottom tercile. See Appendix B for the definition of TLTRO exposure, covered bonds and ABS exposure, and securitization dummy. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8b: Banks' exposure to other policies, 2015 announcement, continuous exposure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
[2014m7]× QE_b	0.067	0.130	0.056	0.021	0.447	0.527	0.316	0.205
	[0.125]	[0.129]	[0.146]	[0.117]	[0.742]	[0.673]	[0.666]	[0.628]
[2014m8] × QE_b	0.167	0.254	0.169	0.158	0.575	0.653	0.443	0.360
	[0.128]	[0.176]	[0.202]	[0.152]	[0.774]	[0.657]	[0.691]	[0.619]
[2014m9] × QE_b	0.256	0.296	0.341	0.275	0.991	0.881	0.928	0.813
	[0.166]	[0.226]	[0.230]	[0.231]	[0.760]	[0.620]	[0.608]	[0.640]
[2014m10] × QE_b	-0.126	-0.097	-0.063	-0.151	-0.766	-0.881	-0.848	-1.034
	[0.166]	[0.228]	[0.239]	[0.214]	[1.054]	[0.974]	[0.802]	[0.998]
[2014m11] × QE_b	0.213	0.192	0.235	0.075	-0.233	-0.512	-0.373	-0.807
	[0.212]	[0.260]	[0.301]	[0.233]	[1.134]	[0.927]	[0.926]	[1.012]
[2015m1] × QE_b	0.416***	0.494***	0.444**	0.432**	1.895**	1.963**	1.695**	1.741**
	[0.124]	[0.177]	[0.196]	[0.175]	[0.919]	[0.804]	[0.763]	[0.752]
[2015m2] × QE_b	0.123	0.185	0.146	0.158	0.134	0.164	0.021	0.069
	[0.137]	[0.183]	[0.198]	[0.191]	[0.855]	[0.733]	[0.698]	[0.738]
[2015m3] × QE_b	0.045	0.097	0.081	0.059	0.455	0.495	0.403	0.371
	[0.136]	[0.184]	[0.175]	[0.192]	[0.609]	[0.583]	[0.565]	[0.641]
[2015m4] × QE_b	0.070	0.122	0.112	0.085	0.120	0.141	0.065	0.023
	[0.132]	[0.164]	[0.171]	[0.162]	[0.680]	[0.601]	[0.538]	[0.580]
[2015m5] × QE_b	0.023	0.072	0.020	0.002	-0.448	-0.463	-0.610	-0.671
	[0.152]	[0.182]	[0.214]	[0.171]	[0.936]	[0.784]	[0.797]	[0.748]
[2015m6] × QE_b	0.043	0.079	0.103	0.047	0.296	0.286	0.287	0.185
	[0.092]	[0.135]	[0.133]	[0.131]	[0.519]	[0.509]	[0.487]	[0.522]
QE_b continuous	X	X	X	X				
QE_b dummy					X	X	X	X
TLTRO exposure	Yes	No	No	No	Yes	No	No	No
Net interbank position	No	Yes	No	No	No	Yes	No	No
Covered bonds and ABS	No	No	Yes	No	No	No	Yes	No
Comprehensive assessment	No	No	No	Yes	No	No	No	Yes
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ECB lending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reserves	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,867,308	5,867,308	5,867,308	5,867,308	5,867,308	5,867,308	5,867,308	5,867,308
R-squared	0.394	0.394	0.394	0.394	0.394	0.394	0.394	0.394

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). The variable QE_b is the exposure of bank *b* to the PSPP as of December 2015. In columns 1-4, QE_b is computed as the value of mark-to-market PSPP-eligible securities relative to total assets (in percentages). In Columns 5-8, QE_b is a dummy equal to one if the ratio of mark-to-market eligible securities to total assets as of December 2014 is in the top 15% of the distribution. See Appendix B for the definition of TLTRO exposure, net interbank position, covered bonds and ABS exposure, and comprehensive assessment dummy. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Falsification tests, one year before the first PSPP announcement

	(1) Falsification, continuous exposure	(2) Falsification, dummy exposure
[2013m7] × QE_b	0.078	-0.189
	[0.139]	[0.140]
[2013m8] × QE_b	0.204	0.289
	[0.162]	[0.212]
[2013m9] × QE_b	0.254	0.384
	[0.169]	[0.297]
[2013m10] × QE_b	0.177	0.556***
	[0.157]	[0.149]
[2013m11] × QE_b	0.028	0.520
	[0.248]	[0.325]
[2014m1] × $\boldsymbol{QE_b}$	-0.276	-0.907
	[0.330]	[0.633]
[2014m2] × QE_b	0.027	0.171
	[0.152]	[0.174]
[2014m3] × QE_b	-0.112	-0.120
	[0.121]	[0.325]
[2014m4] × QE_b	0.010	-0.134
	[0.114]	[0.180]
[2014m5] × QE_b	0.193	1.104***
	[0.272]	[0.242]
[2014m6] × QE_b	-0.189	-0.634***
	[0.160]	[0.223]
Time window	July 2013–June 2014	July 2013–June 2014
Exposure as of	December 2013	December 2013
Bank FEs	Yes	Yes
Firm-time FEs	Yes	Yes
Size	Yes	Yes
ECB lending	Yes	Yes
Reserves	Yes	Yes
Observations	5,213,795	5,213,795
R-squared	0.380	0.384

The dependent variable is the change in the log of disbursed loans from bank b to firm f in month t (in percentages). The variable QE_b is the PSPP exposure (calculated as of the date indicated next to "Exposure as of") defined as the ratio of mark-to-market eligible securities to total assets as of December 2013 (Column 1; in percentages) or a dummy equal to one if such a ratio is in the top 15% of the distribution (Column 2). Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Mechanism, capital and liquidity

	2019 announcement		2015 announcement
	(1)		(2)
[2019m9] × QE_b	0.204**	[2015m1] × QE_b	0.692**
	[0.101]		[0.286]
[2019m9] × QE_b × [Tier 1 ratio]$_b$	-0.010**	[2015m1] × QE_b × [Tier 1 ratio]$_b$	-0.162**
	[0.005]		[0.069]
[2019m9] × QE_b ×[liquidity/assets]$_b$	-0.009	[2015m1] × QE_b × [liquidity/assets]$_b$	0.049
	[0.021]		[0.434]
[2019m9] × QE_b × [Tier 1 ratio]$_b$×[liquidity/assets]$_b$	-0.003	[2015m1] × QE_b × [Tier 1 ratio]$_b$×[liquidity/assets]$_b$	0.085
	[0.004]		[0.088]
Bank FEs	Yes		Yes
Firm-time FEs	Yes		Yes
Size	Yes		Yes
ECB lending	Yes		Yes
Reserves	Yes		Yes
Observations	8,295,389		5,623,310
R-squared	0.370		0.396

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). The variable QE_b is the ratio of mark-to-market eligible securities to total assets as of August 2019 (Column 1) or as of December 2014 (Column 2, both in percentages). Tier 1 ratio is the ratio of Tier 1 capital to risk-weighted assets (in percent) and liquidity denotes central bank deposits and cash over total assets (in percentages). Tier 1 ratio and liquidity/assets are normalized by their respective first quartile levels. The regressions in Column 1 includes [2019m9]×[Tier 1 ratio]$_b$ and [2019m9]×[Tier 1 ratio]$_b$×[liquidity/assets]$_b$, and similarly for the regression in Column 2. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Interest rates on new term loans

	2019 announcement (1)		2015 announcement (2)
[2019m3]× QE_b	-0.459		
	[0.391]		
[2019m4] × QE_b	-0.570		
	[0.377]		
[2019m5] × QE_b	-0.406	[2014q2] × QE_b	-0.903
	[0.312]		[0.965]
[2019m6] × QE_b	-0.256		
	[0.338]		
[2019m7] × QE_b	-0.443		
	[0.318]		
[2019m9] × $\boldsymbol{QE_b}$	-0.944**	**[2015q1]** × $\boldsymbol{QE_b}$	-1.546***
	[0.429]		[0.452]
[2019m10] × QE_b	-0.415		
	[0.344]		
[2019m11] × QE_b	-0.176		
	[0.350]		
[2019m12] × QE_b	-0.593*	[2015q2] × QE_b	-0.963
	[0.347]		[0.586]
[2020m1] × QE_b	0.216		
	[0.281]		
[2020m2] × QE_b	-0.295		
	[0.299]		
Bank FEs	Yes		Yes
Firm-time FEs	Yes		Yes
Size	Yes		Yes
ECB lending	Yes		Yes
Reserves	Yes		Yes
Observations	14,574		9,451
R-squared	0.808		0.791

The dependent variable is the interest rate on new term loans by bank *b* to firm *f* in month *t* (Column 1) or quarter *t* (Column 2; both in percentages). In Column 1, the variable QE_b is a dummy equal to one if a bank is in the top tercile of the distribution of mark-to-market eligible securities over assets as of August 2019, and the results are reported relative to banks in the bottom tercile. In Column 2, QE_b is a dummy equal to one if a bank is in the top 15% of the distribution of mark-to-market eligible securities over assets as of December 2014. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 12: New lending relationships (i.e., the extensive margin)

	2019 announcement (1)		2015 announcement (2)
[2019m3-2019m5] × QE_b	-0.002	[2014q2] × QE_b	-0.011
	[0.009]		[0.021]
[2019m9-2019m11] × $\boldsymbol{QE_b}$	0.024*	**[2015q1] ×** $\boldsymbol{QE_b}$	0.041**
	[0.012]		[0.016]
[2019m12-2020m2] × QE_b	0.027	[2015q2] × QE_b	0.066*
	[0.020]		[0.036]
Bank FEs	Yes		Yes
Firm FEs	Yes		Yes
Time FEs	Yes		Yes
Size	Yes		Yes
ECB lending	Yes		Yes
Reserves	Yes		Yes
Observations	442,460		359,045
R-squared	0.668		0.699

The dependent variable is a dummy equal to one if a loan application by firm *f* to bank *b* in month *t* is granted between *t* and *t*+3 (i.e., we observe a new credit relationship in the credit register in the month of the application or in the next three months). In Column 1, the variable QE_b is a dummy equal to one if a bank is in the top tercile of the distribution of mark-to-market eligible securities over assets as of August 2019, and the results are reported relative to the bottom tercile. In Column 2, QE_b is a dummy equal to one if a bank is in the top 15% of the distribution of mark-to-market eligible securities over assets as of December 2014. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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INTERNET APPENDIX

A. Historical cost versus mark-to-market exposures

This appendix provides additional results and details about the effect of the PSPP on bank lending and how this effect is mediated by the macroprudential accounting rules. We provide the full list of coefficients of the regressions in Column 3 of Table 3 (2019 announcement) and Column 3 of Table 4 (2015 announcement). In each of those regressions, we have included two exposure measures—one given by the eligible securities that were marked-to-market and another given by the eligible securities valued at historical cost, and both normalized by total assets—and have interacted them with time dummies centered on the PSPP announcement month.

The results are reported in Table A.1. Columns 1a and 1b report the coefficients of the historical cost and mark-to-market exposure of the 2019 announcement, respectively. Columns 2a and 2b report the coefficients of the historical cost and mark-to-market exposure of the 2015 announcement, respectively.

For the 2019 announcement, the results of the historical cost exposure measure are similar to those of the broad exposure shown in Column 1 of Table 3. That is, we find a pre-trend (average March-July 2019 = 0.06, p-value = 0.006), and the September and October coefficients are not statistically different from the pre-trend (difference = 0.02 for September and 0.09 for October, p-values = 0.316 and 0.273 for September and October, respectively). For the mark-to-market measure, the results in Column 1b are the same as those reported in Column 3 of Table 3.

For the 2015 announcement, the exposure based on historical cost displays a pre-trend, similar to the 2019 result. In particular, several coefficients have negative and statistically significant values before the announcement, and the July-November 2014 average is significant as well (July-November 2014 average = -0.07, p-value = 0.043). Some of the coefficients in the post-announcement period are also statistically significant, but the sign and magnitude are the same as those in the pre-announcement months. In particular, in the announcement month and the three following months (i.e., January-April 2015), none of the coefficients are statistically different from the July-November 2014 average. Overall, we find no difference between the pre- and post-announcement period for the exposure measure that uses securities valued at historical cost. For the exposure based on mark-to-market accounting, reported in Column 2a, the coefficients are the same as those reported in Column 3 of Table 4.

Table A.1: Intensive margin, accounting rule and research design

	(1a) Historical cost	(1b) Mark-to-market		(2a) Historical cost	(2b) Mark-to-market
[2019m3]× QE_b	-0.012	0.023	[2014m7]× QE_b	-0.056	0.111
	[0.018]	[0.079]		[0.039]	[0.133]
[2019m4] × QE_b	0.148***	0.070	[2014m8] × QE_b	-0.175***	0.287
	[0.036]	[0.143]		[0.055]	[0.199]
[2019m5] × QE_b	0.043*	0.072	[2014m9] × QE_b	-0.017	0.287
	[0.022]	[0.060]		[0.053]	[0.228]
[2019m6] × QE_b	-0.003	0.042	[2014m10] × QE_b	-0.092*	-0.051
	[0.034]	[0.130]		[0.052]	[0.249]
[2019m7] × QE_b	0.120***	0.013	[2014m11] × QE_b	-0.022	0.245
	[0.039]	[0.138]		[0.060]	[0.276]
[2019m9] × QE_b	0.081**	0.223**	[2015m1] × QE_b	-0.106**	0.498**
	[0.038]	[0.100]		[0.050]	[0.196]
[2019m10] × QE_b	0.146**	-0.102	[2015m2] × QE_b	-0.092**	0.192
	[0.071]	[0.160]		[0.035]	[0.196]
[2019m11] × QE_b	-0.037	0.112	[2015m3] × QE_b	0.006	0.055
	[0.033]	[0.117]		[0.055]	[0.162]
[2019m12] × QE_b	0.058**	0.324***	[2015m4] × QE_b	-0.096**	0.139
	[0.027]	[0.099]		[0.041]	[0.181]
[2020m1] × QE_b	0.109***	0.047	[2015m5] × QE_b	-0.131***	0.114
	[0.039]	[0.131]		[0.047]	[0.199]
[2020m2] × QE_b	-0.031**	0.030	[2015m6] × QE_b	0.004	0.054
	[0.014]	[0.051]		[0.055]	[0.126]
Observations	8,346,925			5,867,308	
R-squared	0.370			0.394	
Bank FEs	Yes			Yes	
Firm-time FEs	Yes			Yes	
Size, ECB lending, and Reserves	Yes			Yes	

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). Columns 1a and 1b refer to one single specification that analyzes to the 2019 announcement and includes two measures of exposures, one based on eligible securities valued at historical cost as a fraction of total assets and the other based on eligible securities marked to market as a fraction of total assets (both in percentages). Columns 2a and 2b refer to one single specification that analyzes to the 2015 announcement and includes two measures of exposures, one based on eligible securities valued at historical cost as a fraction of total assets, and the other based on eligible securities marked to market as a fraction of total assets (both in percentages). Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

B. Variable definitions

This appendix describes the construction of the bank characteristics and bank exposure to other policies that we use in the robustness analysis of Sections 4.3 and 4.4.

Holding of non-eligible securities. This variable is defined as securities that were not PSPP eligible as a fraction of total assets, as of the month before the announcement.

TLTRO III exposure (2019 analysis). TLTRO III was initially announced in March 2019, and on September 12 of the same year, the ECB reduced the interest rate and extended the maturity of the loans under this program. Lending under the TLTRO III program, however, had not yet been disbursed as of September 12. Thus, we define the TLTRO III exposure as the *borrowing allowance* as a fraction of total assets, along the lines of Benetton and Fantino (2021). For each bank, the borrowing allowance is capped at three times the amount of *eligible loans* (i.e., loans to non-financial corporations, households, and non-profits, except loans to households for house purchases, as of February 28, 2019). Eligible loans that had been self-securitized (i.e., where the asset-backed securities resulting from the securitization are fully retained) could also be counted.

TLTRO I exposure (2015 analysis). We control for the amount that banks borrowed from the ECB in the September and December 2014 TLTRO auctions, as a fraction of total assets. We approximate the amount borrowed in the September 2014 TLTRO auctions using the change in the stock of long-term ECB borrowing between August and September 2014 (i.e., borrowing with residual maturity greater than two years), and similarly for the December 2014 auction.

Negative interest rates and net interbank position. On June 5, 2014, the ECB announced a reduction in the deposit rate that brought its level below zero. To control for the possible effects of the ECB's negative interest rate policy, we follow Bottero et al. (2022) and approximate the exposure to the negative interest rate policy as the net interbank position, computed as interbank loans minus deposits with a maturity of up to one week, normalized by total assets. For the 2019 analysis, we use data as of June 2019—the latest available data before the September announcement. For the 2015 analysis, we use data as of March 2014—the latest available data before the negative interest rate policy was implemented for the first time in June 2014.

Exposure to covered bonds (CB) and asset-backed securities (ABS) purchase program. We measure exposure in two ways. First, we use the holdings of CB and ABS relative to total assets. For the 2019 analysis, we use data as of August 2019 (i.e., the month before the September 2019 announcement). For the 2015 analysis, we use data as of August 2014 (i.e., the month before the CB and ABS program was announced for the first time). Second, we use a dummy equal to one for banks that have originated CB or ABS between August 2017 and August 2019 (for the 2019 analysis) and between August 2012 and August 2014 (for the 2015 analysis).

Exposure to the CSPP (2019 analysis). We compute banks' holdings of eligible corporate-sector securities relative to total assets, as of August 2019.

Exposure to the two-tier reserve system policy (2019 analysis). Under the two-tier system announced on September 12, 2019, excess reserves up to six times the reserve requirement earned zero interest, whereas reserves above that limit were subject to the negative interest rate on ECB deposits.[33] This gives rise to an advantage for banks with excess reserves amounting to less than six times the required reserves. Such banks could borrow from those with excess reserves above the limit—which would pay a negative rate to deposit at the ECB—and increase their reserves without incurring the negative rate. We thus construct an *unused allowance* variable, defined as

$$\max\{0, 6*(\text{reserve requirement}) - \text{excess reserves})\}.$$

We compute this variable using the last available data prior to the announcement.[34]

Comprehensive assessment (2015 analysis). Between November 2013 and October 2014, the ECB conducted a comprehensive assessment (i.e., asset quality review and stress tests). We construct a dummy and set it equal to one for the banks subject to the assessment. Among the 95 banks in the sample, 7 were subject to the assessment.[35]

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[33] See https://www.ecb.europa.eu/mopo/two-tier/html/index.en.html and Deutsche Bundesbank "*The two-tier system for reserve remuneration and its impact on banks and financial markets*" Monthly Report, January 2021.

[34] The ECB requires banks to meet reserve requirements on average during each *maintenance period*, with each period typically lasting several weeks. We use data for the maintenance period between July 31, 2019, and September 17, 2019. While this period includes a few business days after the announcement of September 12, the data represent an average of daily figures that refer almost entirely to the pre-announcement period.

[35] Bank of Italy, "*Risultati dell'esercizio di 'valutazione approfondita' (Comprehensive Assesment)*," press release, October 26, 2014, https://www.bancaditalia.it/media/comunicati/documenti/2014-02/cs_261014.pdf.

C. Ruling out anticipatory bias: additional test

This appendix conducts an additional test to rule out anticipatory bias. We use the exposure dummies, and we compare banks that were highly exposed both one month before the announcement and six months before (i.e., banks whose exposure dummies computed one month before the announcement and six months before are both equal to one) with those that were in the bottom category of exposure both one month before the announcement and six months before. Table C.1 shows that the outcome is essentially identical to that of the baseline analysis.

Table C.1: No anticipation, exposure one month before the announcement and six months before

	2019 announcement (1)		2015 announcement (2)
[2019m3]× QE_b	0.890	[2014m7]× QE_b	0.300
	[0.971]		[0.655]
[2019m4] × QE_b	-0.192	[2014m8] × QE_b	0.326
	[1.889]		[0.647]
[2019m5] × QE_b	0.942	[2014m9] × QE_b	0.679
	[0.634]		[0.586]
[2019m6] × QE_b	1.884	[2014m10] × QE_b	-0.943
	[1.574]		[0.948]
[2019m7] × QE_b	-0.113	[2014m11] × QE_b	-0.452
	[1.872]		[0.940]
[2019m9] × QE_b	2.792***	**[2015m1] × QE_b**	1.686**
	[0.929]		[0.748]
[2019m10] × QE_b	1.553	[2015m2] × QE_b	-0.153
	[1.399]		[0.740]
[2019m11] × QE_b	2.218	[2015m3] × QE_b	0.201
	[1.554]		[0.522]
[2019m12] × QE_b	3.377***	[2015m4] × QE_b	-0.114
	[0.654]		[0.568]
[2020m1] × QE_b	-0.255	[2015m5] × QE_b	-0.626
	[1.858]		[0.757]
[2020m2] × QE_b	0.082	[2015m6] × QE_b	0.209
	[0.332]		[0.499]
Exposure as of	August 2019 × February 2019		December 2014 × June 2014
Bank FEs	Yes		Yes
Firm-time FEs	Yes		Yes
Size	Yes		Yes
ECB lending	Yes		Yes
Reserves	Yes		Yes
Observations	8,346,925		5,867,308
R-squared	0.370		0.394

The dependent variable is the change in the log of disbursed loans from bank b to firm f in month t (in percentages). Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

D. Controlling for bank characteristics correlated with exposure

This appendix presents the results of controlling for the bank characteristics that display some correlation with exposure (see Section 4.4 for details about the links between bank characteristics and exposure measures). In all the analyses, we include the controls in the regressions by interacting each of them with time dummies centered around the announcement month. We perform all the robustness checks with both the continuous and dummy exposure measures.

Table D.1 focuses on the 2019 announcement, using the continuous and dummy measure, respectively. In each table, we control for the net interbank position, Tier 1 capital ratio, exposure to the CSPP program, and exposure to the two-tier reserve system measured by the unused reserve allowance (see Appendix B for variable definitions). The results of the baseline regression are unchanged.

Table D.2 focuses on the 2015 announcement and controls for the bank characteristics that are correlated with the measure of exposure at that time, that is, Tier 1 capital ratio and the securitization dummy (see Appendix B for variable definitions). The results are again unchanged.

Finally, Table D.3 performs an additional robustness check. We control for banks' holdings of securities that are not eligible to be purchased under the PSPP program, for both 2019 and 2015. The concern here is that there might be general equilibrium effects that arise through the prices of non-eligible securities as a result of the announcement and that such effects might in turn affect bank lending. The control is again included by interacting it with time dummies centered around the announcement month. The outcome shows that our main results are unchanged when performing this additional test.

Table D.1: Controlling for bank characteristics, 2019 announcement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
[2019m3]× QE_b	0.019	0.048	0.004	0.035	0.841	1.406	0.466	1.309
	[0.080]	[0.088]	[0.063]	[0.083]	[0.980]	[1.041]	[0.756]	[1.063]
[2019m4] × QE_b	0.112	0.101	0.100	0.062	-0.186	-0.316	-0.194	-1.767
	[0.162]	[0.181]	[0.150]	[0.161]	[1.735]	[1.711]	[1.782]	[1.283]
[2019m5] × QE_b	0.080	0.092	0.080	0.078	0.826	1.105	0.868	0.565
	[0.069]	[0.070]	[0.065]	[0.067]	[0.701]	[0.734]	[0.704]	[0.704]
[2019m6] × QE_b	0.043	0.076	0.019	0.050	1.351	2.074	0.830	1.910
	[0.125]	[0.143]	[0.108]	[0.138]	[1.551]	[1.753]	[1.209]	[1.861]
[2019m7] × QE_b	0.046	0.046	0.052	0.006	0.031	0.203	0.393	-1.376
	[0.149]	[0.163]	[0.138]	[0.154]	[1.714]	[1.788]	[1.545]	[1.414]
[2019m9] × $\boldsymbol{QE_b}$	0.237**	0.232*	0.235**	0.224*	2.592**	2.826**	2.616**	2.157**
	[0.116]	[0.117]	[0.111]	[0.114]	[1.053]	[1.092]	[1.067]	[1.052]
[2019m10] × QE_b	-0.061	-0.217	-0.084	-0.146	1.208	-0.391	0.987	-0.438
	[0.144]	[0.232]	[0.156]	[0.183]	[1.467]	[1.925]	[1.637]	[1.723]
[2019m11] × QE_b	0.110	0.138	0.094	0.132	1.921	2.590	1.582	2.811*
	[0.116]	[0.128]	[0.096]	[0.125]	[1.506]	[1.659]	[1.198]	[1.613]
[2019m12] × QE_b	0.337***	0.372***	0.327***	0.330***	3.353***	4.132***	3.308***	3.252***
	[0.105]	[0.119]	[0.104]	[0.109]	[0.708]	[0.868]	[0.749]	[0.741]
[2020m1] × QE_b	0.068	0.071	0.088	0.034	-0.471	-0.510	0.120	-1.859
	[0.147]	[0.157]	[0.135]	[0.148]	[1.766]	[1.735]	[1.538]	[1.402]
[2020m2] × QE_b	0.030	0.059	0.030	0.039	-0.172	0.204	-0.188	0.061
	[0.050]	[0.056]	[0.053]	[0.053]	[0.382]	[0.472]	[0.427]	[0.474]
QE_b continuous	Yes	Yes	Yes	Yes				
QE_b dummy					Yes	Yes	Yes	Yes
Net interbank position	Yes	No	No	No	Yes	No	No	No
Tier 1 ratio	No	Yes	No	No	No	Yes	No	No
CSPP exposure	No	No	Yes	No	No	No	Yes	No
Unused reserve allowance	No	No	No	Yes	No	No	No	Yes
Bank FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ECB lending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reserves	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,346,925	8,295,389	8,346,925	8,346,925	8,346,925	8,295,389	8,346,925	8,346,925
R-squared	0.370	0.370	0.370	0.370	0.370	0.370	0.370	0.370

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). In Columns 1-4, QE_b is constructed as the value of PSPP-eligible securities subject to mark-to-market accounting relative to total assets as of August 2019 (in percentages). In Columns 5-8, QE_b is a dummy equal to one for banks in the top tercile of the distribution of eligible securities subject to mark-to-market accounting relative to total assets as of August 2019, and the results are relative to banks in the bottom tercile. The Tier 1 ratio denotes Tier 1 capital relative to risk-weighted assets (in percentages). See Appendix B for the definition of net interbank position, CSPP exposure, and unused reserve allowance. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table D.2: Controlling for bank characteristics, 2015 announcement

	(1)	(2)	(3)	(4)
[2014m7]× QE_b	0.010	0.076	0.118	0.350
	[0.146]	[0.134]	[0.657]	[0.627]
[2014m8] × QE_b	0.132	0.212	0.361	0.572
	[0.171]	[0.174]	[0.606]	[0.559]
[2014m9] × QE_b	0.209	0.276	0.796	0.816
	[0.232]	[0.233]	[0.581]	[0.538]
[2014m10] × QE_b	-0.207	-0.041	-1.095	-0.611
	[0.219]	[0.233]	[0.900]	[0.744]
[2014m11] × QE_b	0.112	0.324	-0.749	0.056
	[0.273]	[0.268]	[0.897]	[0.716]
[2015m1] × $\boldsymbol{QE_b}$	0.378**	0.441**	1.655**	1.766**
	[0.175]	[0.184]	[0.719]	[0.726]
[2015m2] × QE_b	0.053	0.163	-0.148	0.130
	[0.168]	[0.184]	[0.673]	[0.631]
[2015m3] × QE_b	-0.039	0.049	0.243	0.322
	[0.186]	[0.164]	[0.584]	[0.541]
[2015m4] × QE_b	-0.025	0.102	-0.235	0.101
	[0.162]	[0.170]	[0.545]	[0.528]
[2015m5] × QE_b	-0.063	0.101	-0.812	-0.269
	[0.181]	[0.185]	[0.736]	[0.634]
[2015m6] × QE_b	0.078	0.049	0.488	0.167
	[0.132]	[0.137]	[0.473]	[0.477]
QE_b exposure measure	Continuous	Continuous	Dummy	Dummy
Tier 1	Yes	No	Yes	No
Securitization dummy	No	Yes	No	Yes
Bank FEs	Yes	Yes	Yes	Yes
Firm-time FEs	Yes	Yes	Yes	Yes
Size	Yes	Yes	Yes	Yes
ECB lending	Yes	Yes	Yes	Yes
Reserves	Yes	Yes	Yes	Yes
Observations	5,623,310	5,867,308	5,623,310	5,867,308
R-squared	0.396	0.394	0.396	0.394

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). The variable QE_b is the ratio of mark-to-market eligible securities to total assets as of December 2014 (Columns 1-2, in percentages) or a dummy equal to one for the banks in the top 15% of the distribution (Columns 3-4). The Tier 1 ratio denotes Tier 1 capital relative to risk-weighted assets (in percentages). See Appendix B for the definition of the securitization dummy. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table D.3: Controlling for holdings of non-eligible securities

	2019 announcement			2015 announcement	
	(1)	(2)		(3)	(4)
[2019m3]× QE_b	0.023	0.803	[2014m7]× QE_b	0.077	0.495
	[0.079]	[0.968]		[0.132]	[0.618]
[2019m4] × QE_b	0.105	-0.113	[2014m8] × QE_b	0.180	0.835
	[0.161]	[1.696]		[0.178]	[0.598]
[2019m5] × QE_b	0.086	0.803	[2014m9] × QE_b	0.279	0.886
	[0.066]	[0.685]		[0.233]	[0.596]
[2019m6] × QE_b	0.043	1.314	[2014m10] × QE_b	-0.111	-0.489
	[0.125]	[1.545]		[0.240]	[0.969]
[2019m7] × QE_b	0.045	0.097	[2014m11] × QE_b	0.224	0.205
	[0.150]	[1.682]		[0.279]	[0.976]
[2019m9] × $\boldsymbol{QE_b}$	0.246**	2.594**	**[2015m1] ×** $\boldsymbol{QE_b}$	0.439**	1.742**
	[0.114]	[1.021]		[0.182]	[0.675]
[2019m10] × QE_b	-0.056	1.042	[2015m2] × QE_b	0.139	0.031
	[0.149]	[1.639]		[0.187]	[0.769]
[2019m11] × QE_b	0.114	1.903	[2015m3] × QE_b	0.056	0.570
	[0.115]	[1.497]		[0.169]	[0.546]
[2019m12] × QE_b	0.334***	3.420***	[2015m4] × QE_b	0.085	-0.022
	[0.109]	[0.685]		[0.172]	[0.622]
[2020m1] × QE_b	0.070	-0.432	[2015m5] × QE_b	0.030	-0.009
	[0.147]	[1.739]		[0.187]	[0.696]
[2020m2] × QE_b	0.033	-0.176	[2015m6] × QE_b	0.057	0.144
	[0.053]	[0.376]		[0.138]	[0.560]
QE_b measure	Continuous	Dummy		Continuous	Dummy
Bank FEs	Yes	Yes		Yes	Yes
Firm-time FEs	Yes	Yes		Yes	Yes
Size	Yes	Yes		Yes	Yes
ECB lending	Yes	Yes		Yes	Yes
Reserves	Yes	Yes		Yes	Yes
Non-eligible securities	Yes	Yes		Yes	Yes
Observations	8,346,925	8,346,925		5,867,308	5,867,308
R-squared	0.370	0.370		0.394	0.394

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* in month *t* (in percentages). The variable QE_b is the PSPP exposure of bank *b* calculated as of August 2019 (Columns 1-2) or December 2014 (Columns 3-4). In Columns 1 and 3, QE_b is defined as the ratio of mark-to-market eligible securities to total assets (in percentages). In Column 2, the variable QE_b is a dummy equal to one for banks in the top tercile of the distribution of mark-to-market PSPP-eligible securities relative to total assets, and results are reported relative to banks in the bottom tercile. In Column 4, QE_b is a dummy equal to one for banks in the top 15% of the distribution of mark-to-market PSPP-eligible securities relative to total assets. Non-eligible securities denote the holdings of securities that are not eligible to be purchased under the PSPP program and are classified as available for sale or in the trading book, as a ratio of total assets (in percentages). Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

E. Banks' trading activity and portfolio rebalancing

In this appendix, we show that macroprudential accounting rules also affected banks' trading activity after the PSPP announcement and, thus, the portfolio rebalancing channel of QE.

Given the result that the PSPP stimulates a growth inlending by banks with more holdings of mark-to-market securities, an important question is how banks financed the additional lending stimulated by the PSPP. Banks could rebalance their portfolios away from PSPP-eligible securities and toward bank lending, but this is not necessary as banks could finance some or all of their lending through additional deposits or other liabilities.

We find that the rebalancing of banks' portfolios away from PSPP-eligible securities and toward bank lending explains only a fraction of the increase in bank lending, consistent with the observation that banks can also finance the increase in lending in other ways. Specifically, a back-of-the-envelope calculation finds that 32% of the 2019 increase in lending and 10% of the 2015 increase is financed through portfolio rebalancing. However, because the 2019 increase in lending is much bigger than in 2015, banks' sales of PSPP-eligible securities are much bigger in 2019 than in 2015—€3.9 billion versus €21 million. Thus, the macroprudential accounting rules also affect the portfolio rebalancing channel of QE. Consistent with this statement, we also find that banks did not rebalance their portfolio holdings away from available-for-sale securities after the 2015 portfolio announcement. These securities were valued at historical cost at that time and subject to turnover limits.

To study the portfolio rebalancing channel, we follow Peydró et al. (2021) and define the unit of observation as the trading activity of security s of bank b at time t. A security is defined at the most disaggregate level, that is, by its ISIN. We use data on the notional amount of banks' security holdings at end of each month that are (i) eligible to be purchased under the PSPP and (ii) marked to market. For each bank, we compute the end-of-month quantity of each security using the corresponding end-of-period prices.[36]

We estimate a regression along the lines of our baseline specification, but now we control for

[36] To construct the dataset, we first consider only securities that were eligible throughout our entire 12-month time window. That is, we exclude securities that are ineligible at some point within the sample window because their maturity is above or below the threshold that defines the eligibility criteria (i.e., 2 and 30 years, respectively). Second, we exclude securities for which price data are not available. And third, similar to Peydró et al. (2021), we reduce the influence of securities of small value by excluding, for each bank, securities for which the average notional amount across all periods is below €10,000. We then construct a balanced panel by assigning a zero whenever a bank does not hold a given ISIN in a given month.

security-by-time fixed effects to absorb the influence of time-varying security-level factors that affect all banks equally, in addition to bank fixed effects. The dependent variable is the trading activity of security *s* by bank *b* at time *t*, defined as

$$Trading_{s,b,t} = \frac{\left(Quantity_{s,b,t} - Quantity_{s,b,t-1}\right) \times Price_{s,t}^{average}}{(Total\ assets)_{t-1}}.$$

This variable measures the purchases of a security—or sales, if negative—as a fraction of total assets. Note that we do not observe the actual prices at which banks trade a security, and we approximate this information with the average market price in any given month. This approximation adds noise to the dataset, and we deal with it by estimating the quarter-by-quarter effects of exposure, rather than the month-by-month ones as we do in our baseline analysis. Standard errors are clustered at the bank and ISIN level, as in Peydró et al. (2021).

Table E.1 presents the results. Columns 1 and 2 focus on the 2019 announcement using the continuous and dummy measure of exposure, and Columns 3 and 4 focus on the 2015 announcement. The results suggest that exposed banks sold more securities than less exposed ones in the last quarter of the sample, that is, after the ECB started the purchases. In 2015, the result is significant when we use the continuous measure of exposure (Column 3) and not significant when we use the exposure dummy (Column 4), but the point estimates in Column 4 confirm the overall pattern of Column 3.[37]

To understand the magnitudes, we note that the coefficients in Table E.1 represent the trading per security and per €1 million of assets of an exposed bank relative to a less exposed one. With respect to the 2019 announcement, a back-of-the-envelope calculation based on the results of Column 1 suggests that the PSPP triggered the sale of €3.9 billion in eligible securities (i.e., about 4% of the total holdings of mark-to-market eligible securities) relative to a counterfactual in which all the banks have zero exposure. For context, note that the ECB purchased about €6 billion in Italian sovereign securities in the period in which we detect significant sales by Italian banks.[38] Because the analysis of Section 4.1 suggests that the PSPP increased bank lending by about €12.1 billion, we conclude that banks financed €3.9/12.1=32% of this new lending by rebalancing their portfolios away from mark-to-market PSPP-eligible securities. In 2015,

[37] The p-value of the [2015q2] × QE_b coefficient in Column 4 is p=0.137.
[38] We compute the €6 billion figure using the total monthly purchase of the ECB and the fact that purchases are divided based on each country's ECB capital key. For Italy, the capital key is 13.8%.

because of more limited mark-to-market exposure, Column 3 implies that the PSPP announcement triggered the sale of only €21 million in eligible securities (i.e., about 1% of the total holdings of mark-to-market eligible securities), or about 10% of the €214 million increase in lending.

Columns 5 and 6 show that, in 2015, banks more exposed based on mark-to-market PSPP-eligible securities did not sell their holdings of available-for-sale securities—which were valued at historical cost at that time—in comparison to less exposed banks. We also find that banks with more holdings of available-for-sale securities did not engage in more sales of such securities.[39] An important remark about this result is that, as the 2015 PSPP announcement elicited an increase in the market value of available-for-sale securities, one might think that banks had an incentive to sell them—so that the price increase triggered by the PSPP could be recorded as profit and could increase regulatory capital. Yet, empirically, we do not observe these effects in either the trading activity or the lending response analyzed in Section 4.2. These results have a few possible explanations. First, banks are subject to supervisory scrutiny, and an increase in trading activity in the available-for-sale portfolio could be flagged and trigger corrective actions, as discussed in Section 2. Second, the argument that a bank could record a profit and increase its regulatory capital by selling a PSPP-eligible security valued at historical cost hinges on the assumption that, just before the PSPP announcement, the security had a market price at least as large as the purchase price, that is, an unrealized gain. In this case, a sale would have resulted in a profit and, thus, an increase in the regulatory capital. But if the pre-announcement market price was substantially lower than the purchase price, the bank would have had an unrealized loss on its balance sheet, and the price increase generated by the PSPP might not have been sufficient to turn the unrealized loss into a gain. As a result, the sale of such securities would have actually generated an accounting loss and *reduced* regulatory capital. This argument is further supported by the observation that, if Italian banks did have available-for-sale securities with unrealized gains before the PSPP announcement, they could have sold them *before* the PSPP announcement to boost their regulatory capital and increase lending supply. Third, banks might have decided not to sell securities to reflect a preference for profit smoothing—that limits banks' willingness to sell securities with unrealized gains—or for related preferences over tax smoothing. For

[39] This result is available from the author upon request.

comparison, note that under MMA, government securities in the available-for-sale portfolio would directly affect regulatory capital, but not the profit and loss statement.

Table E.1: Trading activity of banks

	2019 announcement, mark-to-market securities			2015 announcement, mark-to-market securities		2015 announcement, available-for-sale securities	
	(1)	(2)		(3)	(4)	(5)	(6)
[2019m3-m5] × QE_b	-0.059	-3.299	[2014q2] × QE_b	0.093	0.056	-2.394	-4.863
	[0.102]	[2.778]		[0.062]	[0.270]	[5.034]	[25.577]
[2019m9-m11] × $\boldsymbol{QE_b}$	-0.144	-1.972	**[2015q1]** × $\boldsymbol{QE_b}$	0.071	0.117	-3.497	11.916
	[0.106]	[2.600]		[0.103]	[0.303]	[4.423]	[30.424]
[2019m12-2020m2] × QE_b	-0.280***	-3.823*	[2015q2] × QE_b	-0.089*	-0.282	1.235	0.156
	[0.076]	[2.183]		[0.053]	[0.188]	[2.847]	[16.476]
QE_b exposure measure	Continuous	Dummy		Continuous	Dummy	Continuous	Dummy
Bank FEs	Yes	Yes		Yes	Yes	Yes	Yes
Security-time FEs	Yes	Yes		Yes	Yes	Yes	Yes
Size	Yes	Yes		Yes	Yes	Yes	Yes
ECB lending	Yes	Yes		Yes	Yes	Yes	Yes
Reserves	Yes	Yes		Yes	Yes	Yes	Yes
Observations	530,592	530,592		476,580	476,580	205,212	205,212
Number of securities	501	501		433	433	184	184
R-squared	0.013	0.013		0.011	0.011	0.013	0.013

The dependent variable is the value traded (in EUR) for security s by bank b in month t and normalized by total assets (in EUR million), where a security is defined at the ISIN level. Columns 1-4 include only mark-to-market securities that are PSPP eligible throughout the entire sample (i.e., the 12-month window around the announcement), and Column 5 includes only available-for-sale securities. The variable QE_b is the mark-to-market PSPP exposure of bank b calculated as of August 2019 (Columns 1-2) or December 2014 (Columns 3-6). In Columns 1, 3, and 5, $QE_b$is defined as the ratio of mark-to-market eligible securities to total assets (in percentages). In Column 2, the variable QE_b is a dummy equal to one for banks in the top tercile of the distribution of mark-to-market PSPP-eligible securities relative to total assets, and results are reported relative to banks in the bottom tercile. In Columns 4 and 6, QE_b is a dummy equal to one for banks in the top 15% of the distribution of mark-to-market PSPP-eligible securities relative to total assets. Standard errors are clustered at the bank and ISIN level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

F. Interest rate data and intensive margin results

This appendix repeats the baseline intensive margin analysis of the 2019 and 2015 PSPP announcements (i.e., Columns 2 and 4 of Table 3 and Columns 2 and 4 of Table 4) using only the subset of banks for which interest rate data are available. Table F.1 presents the results. Columns 1 and 3 use the continuous measure of exposure, and Columns 2 and 4 use the dummy. The outcome is essentially unchanged in comparison to the full sample in Tables 3 and 4.

Table F.1: Intensive margin, subsample of banks with interest rate data

	2019 announcement			2015 announcement	
	(1)	(2)		(1)	(2)
[2019m3]× QE_b	0.006	0.971	[2014m7]× QE_b	0.027	-0.096
	[0.096]	[1.017]		[0.150]	[0.711]
[2019m4] × QE_b	0.139	-0.233	[2014m8] × QE_b	0.233	0.805
	[0.206]	[1.846]		[0.219]	[0.640]
[2019m5] × QE_b	0.080	0.850	[2014m9] × QE_b	0.331	0.664
	[0.081]	[0.728]		[0.268]	[0.556]
[2019m6] × QE_b	0.083	1.547	[2014m10] × QE_b	-0.138	-1.252
	[0.159]	[1.636]		[0.291]	[1.057]
[2019m7] × QE_b	0.059	0.064	[2014m11] × QE_b	0.261	-0.286
	[0.190]	[1.821]		[0.354]	[1.018]
[2019m9] × QE_b	0.292**	2.808**	**[2015m1] × QE_b**	0.497**	1.787**
	[0.144]	[1.113]		[0.232]	[0.816]
[2019m10] × QE_b	-0.135	0.875	[2015m2] × QE_b	0.217	0.057
	[0.185]	[1.554]		[0.215]	[0.747]
[2019m11] × QE_b	0.150	2.108	[2015m3] × QE_b	0.066	0.169
	[0.145]	[1.579]		[0.204]	[0.522]
[2019m12] × QE_b	0.419***	3.581***	[2015m4] × QE_b	0.054	-0.489
	[0.127]	[0.748]		[0.200]	[0.589]
[2020m1] × QE_b	0.086	-0.327	[2015m5] × QE_b	0.067	-0.444
	[0.185]	[1.873]		[0.245]	[0.845]
[2020m2] × QE_b	0.029	-0.140	[2015m6] × QE_b	0.041	0.159
	[0.061]	[0.385]		[0.160]	[0.536]
Bank FEs	Yes	Yes		Yes	Yes
Firm-time FEs	Yes	Yes		Yes	Yes
Size, ECB lending, and reserves	Yes	Yes		Yes	Yes
Observations	8,194,090	8,194,090	Observations	5,506,803	5,506,803
R-squared	0.371	0.371	R-squared	0.401	0.401

The dependent variable is the change in the log of disbursed loans from bank *b* to firm *f* at time *t* (in percentages). The variable QE_b is the PSPP exposure of bank *b* calculated as of August 2019 (Columns 1-2) or December 2014 (Columns 3-4). In Columns 1 and 3, QE_b is the ratio of mark-to-market eligible securities to total assets (in percentages). In Column 2, the variable QE_b is a dummy equal to one for banks in the top tercile of the distribution of mark-to-market PSPP-eligible securities relative to total assets, and results are reported relative to the bottom tercile. In Column 4, QE_b is a dummy equal to one for banks in the top 15% of the distribution of marked-to-market PSPP-eligible securities relative to total assets. Standard errors are clustered at the bank level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

G. More lending, substitution, and spillovers

The evidence in Sections 4 and 5 shows that banks that are more exposed to QE via their holdings of mark-to-market sovereign securities increased their loan supply in comparison to less exposed banks. These results, however, do not tell us whether exposed banks simply replace lending from non-exposed banks or if they provide additional credit to the economy. Distinguishing between these two scenarios is important to understand the broad effects of QE and macroprudential accounting regulation and to draw adequate policy implications. If there is simply substitution from less exposed to more exposed banks, the aggregate supply of credit in the economy through this channel would be unchanged, with an effect only on banks' competitive positions. However, we find that this is not the case. That is, the accounting-based macroprudential regulation affect the transmission of QE to total lending.

We show these results in two ways. In Section G.1, we focus on how the PSPP affected lending in local banking markets by using provinces as the relevant geographic area; most firms borrow from bank branches located in the same province.[40] In Section G.2, we follow Berg et al. (2021) and show that there are no spillovers that affect the lending supply of less exposed banks.

G.1 Province-level analysis and substitution

We now study how lending by non-exposed banks is affected by the degree of exposure of local competitors, that is, other banks that operate in the same province. To explain our approach, consider a bank that has branches in two provinces, A and B. Suppose further that the market share of PSPP-exposed banks in province A is higher than in province B. This means that for the same bank, its branches in province A will face more competition from PSPP-exposed banks relative to its branches in province B. If substitution features in the data, loan growth at branches in province A should become lower relative to province B on account of the greater competition in province A when the ECB announces the PSPP. Note that because the unit of analysis is at the branch level, we can hold constant the time-varying bank-level factors.

Let C_p denote the market share of PSPP-exposed banks in province p, where by "exposed" we mean a bank with an exposure dummy equal to one. We define the market share as the ratio of the sum of loans to firms made by PSPP-exposed banks in province p, as a fraction of total

[40] There were 110 provinces in Italy in 2015 and 107 in 2019; the difference is due to some administrative changes.

loans to firms in the province in the month before the PSPP was announced: $C_p = \frac{\sum_{b(p)}[L_{b(p)} \times QE_b]}{\sum_{b(p)} L_{b(p)}}$. The term $L_{b(p)}$ denotes the total amount of loans extended as of August 2019 or December 2014 by the branches of bank b that operate in province p, and QE_b is, as before, our dummy that equals 1 for banks with high exposure to the PSPP, as described in Section 4. Then our province-level estimating equation is

$$\Delta \log \mathrm{L}_{\mathrm{b,p,t}} = \sum_{\tau \neq 2019\mathrm{m}8} \eta_\tau \times I_\tau \times C_p + \psi_{\mathrm{b,t}} + \psi_{\mathrm{p}} + \varepsilon_{b,p,t}.$$

The dependent variable is the monthly loan growth rate by the branches of bank *b* in province *p* in month *t*. We consider only banks that are not exposed, to check if lending by these banks was crowded out by more exposed banks. As defined in Sections 4.1 and 4.2, a bank is not exposed if it is in the bottom tercile of the mark-to-market exposure distribution in 2019 and in the bottom 85% of the mark-to-market exposure distribution in 2015.

The coefficient of interest is η_τ, which is interacted with monthly dummies around the PSPP window, I_τ, and the market share of PSPP-exposed banks, C_p. If there is substitution between banks, then η_τ should be negative immediately after the PSPP is announced, as PSPP-exposed banks displace the lending of their competitors. Standard errors are clustered at the bank and province level. Our key identification assumption is that shocks to loan growth at the bank-province level do not vary around the announcement window with the province-level PSPP market share variable and by whether a bank itself is exposed to the PSPP.

Tables G.1 and G.2 present the results for 2019 and 2015, respectively. Column 1 shows that the total lending growth at branches of non-exposed banks is not affected by the degree of exposure of local competitors in 2019. However, in 2015, we find a reduction in lending by the branches of non-exposed banks when facing higher competition from more exposed ones. To shed light on this difference, Columns 2 and 3 analyze the effects on lending to existing and new customers (i.e., intensive and extensive margin), respectively. We now obtain similar results for 2019 and 2015. That is, when the PSPP was announced, the branches of non-exposed banks contracted lending to new customers in provinces in which their local competitors were highly exposed, but we observe no effect on lending to existing customers.

To reduce the possible noise associated with the lag in new loan disbursement, Column 4 of Tables G.1 and G.2 repeat the analysis of Column 3 (i.e., the extensive margin) by interacting the province-level market share of exposed banks with quarterly dummies, rather than monthly dummies, confirming the results.[41] A 1% increase in the market share of exposed banks reduces the growth rate of loans to new customers by non-exposed banks by about 3.2 and 0.9 percentage points per month in 2019 and 2015, in the three months after the announcement.

The results of this section show that no substitution occurred for existing credit relationships (i.e., at the intensive margin) but did occur for new ones (i.e., at the extensive margin). This finding reflects the fact that existing credit relationships are sticky in the short run. Importantly, because lending relationships are long lasting and most of the stock of banks' loans are in ongoing lending relationships, the impact of the extensive margin substitution on overall lending is small. Indeed, when analyzing all loans of non-exposed banks (i.e., Column 1 of Tables G.1 and G.2), we do not detect any substitution in 2019 and only a small effect in 2015. These results suggest that the effect of the PSPP announcements—mediated by the macroprudential accounting regulation—lead to a net increase in credit supply through the bank lending channel.

G.2 Spillovers on lending supply

Berg et al. (2021) show that spillovers from treated units could bias the estimates of a difference-in-difference specification. In our setting, the behavior of PSPP-exposed banks might affect the lending supply of non-exposed banks. However, we find that this issue is not a concern.

For 2019, we focus on the lending response immediately after the announcement, interacting the QE exposure with a dummy that equals 1 in September 2019 and 0 otherwise. We estimate

$$\Delta \log L_{b,f,t} = \beta[\text{Sept2019}]QE_b + \beta^{\text{C}}[\text{Sept2019}](1 - QE_b)C_p + \beta^{\text{T}}[\text{Sept2019}]QE_bC_p + \gamma[\text{Sept2019}]\boldsymbol{Y}_b + \delta Z_{b,t} + \psi_b + \psi_{f,t} + \varepsilon_{b,f,t} \ .$$

For 2015, we use a similar approach. The variable C_p denotes the market share of QE-exposed banks in province p in which bank b is located (i.e., with an exposure dummy equal to one). As in Berg et al. (2021), we compute the market share of exposed banks excluding bank b itself.

Table G.3 presents the results. The coefficient β captures the direct effect of exposure on bank lending and has a magnitude and significance similar to that of the baseline estimate. The

[41] In Section 6.2, we consider a loan application to be approved if a new loan is disbursed up to three months after the application, following Jiménez et al. (2012).

coefficients β^{C} and β^{T}, which capture spillovers on non-exposed and exposed banks in the same province, respectively, are very small and not significant. Thus, the results show that spillovers in the sense of Berg et al. (2021) do not affect our main estimates and results.

Table G.1: Bank-by-province evidence, 2019

	(1) All loans	(2) Intensive margin loans	(3) Extensive margin loans		(4) Extensive margin loans
[2019m3] × C_p	-0.025	-0.052	-1.211		
	[0.059]	[0.064]	[3.222]		
[2019m4] × C_p	-0.070	-0.064	-4.391	[2012m3-5] × C_p	-2.262
	[0.063]	[0.065]	[2.796]		[1.430]
[2019m5] × C_p	-0.088	-0.094	-3.255		
	[0.055]	[0.061]	[3.567]		
[2019m6] × C_p	-0.029	-0.067	-2.555		
	[0.088]	[0.088]	[3.357]		
[2019m7] × C_p	0.018	-0.012	0.167		
	[0.069]	[0.077]	[3.998]		
[2019m9] × C_p	-0.012	0.006	-8.696*		
	[0.080]	[0.083]	[4.437]		
[2019m10] × C_p	-0.083	-0.103	-4.309	[2019m9-11] × C_p	-3.198*
	[0.082]	[0.083]	[3.497]		[1.838]
[2019m11] × C_p	-0.048	-0.040	-0.269		
	[0.059]	[0.060]	[3.066]		
[2019m12] × C_p	-0.043	-0.040	-5.140		
	[0.071]	[0.073]	[3.330]		
[2020m1] × C_p	-0.087	-0.110	-0.589	[2019m12-2020m2] × C_p	-0.660
	[0.103]	[0.105]	[3.204]		[1.098]
[2020m2] × C_p	-0.018	-0.023	0.581		
	[0.080]	[0.083]	[3.110]		
Bank-month FEs	Yes	Yes	Yes		Yes
Province FEs	Yes	Yes	Yes		Yes
Observations	4,184	4,154	2,067		2,067
R-squared	0.272	0.259	0.145		0.134

The dependent variable is the percentage change in the log of disbursed loans for the branches of bank *b* in province *p* in month *t*. The sample includes only non-exposed banks, that is, those in the bottom tercile of the distribution of mark-to-market PSPP-eligible securities over total assets as of August 2019 (in percentages). The variable C_p is the competition index, defined as the loan market share of PSPP-exposed banks in province *p* (in percentages). Standard errors are clustered at the bank and province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table G.2: Bank-by-province evidence, 2015

	(1) All loans	(2) Intensive margin loans	(3) Extensive margin loans		(4) Extensive margin loans
[2014m7] × C_p	-0.002	0.024	-0.588		
	[0.035]	[0.036]	[1.216]		
[2014m8] × C_p	-0.018	0.007	0.871	[2014q3] × C_p	0.505
	[0.030]	[0.032]	[0.913]		[0.181]
[2014m9] × C_p	-0.004	0.018	-2.506		
	[0.031]	[0.034]	[1.608]		
[2014m10] × C_p	-0.041	-0.007	-1.617		
	[0.048]	[0.051]	[2.050]		
[2014m11] × C_p	0.004	0.031	-0.725		
	[0.051]	[0.055]	[0.887]		
[2015m1] × C_p	-0.054*	-0.024	-2.553*		
	[0.032]	[0.031]	[1.265]		
[2015m2] × C_p	-0.024	0.001	-0.544	[2015q1] × C_p	-0.943**
	[0.037]	[0.043]	[1.190]		[0.359]
[2015m3] × C_p	0.002	0.024	-1.952***		
	[0.023]	[0.026]	[0.690]		
[2015m4] × C_p	-0.003	0.026	-1.717		
	[0.040]	[0.040]	[1.434]		
[2015m5] × C_p	-0.001	0.025	-0.758	[2015q2] × C_p	-0.089
	[0.032]	[0.039]	[0.564]		[0.130]
[2015m6] × C_p	-0.064***	-0.041	-0.051		
	[0.017]	[0.025]	[1.500]		
Bank-month FEs	Yes	Yes	Yes		Yes
Province FEs	Yes	Yes	Yes		Yes
Observations	14,313	14,304	9,066		9,066
R-squared	0.145	0.133	0.135		0.134

The dependent variable is the percentage change in the log of disbursed loans for the branches of bank *b* in province *p* in month *t*. The sample includes only non-exposed banks, that is, those in the bottom 85% of the distribution of mark-to-market PSPP-eligible securities over total assets as of December 2014 (in percentages). The variable C_p is the competition index, defined as the loan market share of PSPP-exposed banks in province *p* (in percentages). Standard errors are clustered at the bank and province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table G.3: Ruling out spillovers on lending supply

	(1)		(2)
[2019m9] × QE_b	1.868***	[2015m1] × QE_b	1.841***
	[0.443]		[0.573]
[2019m9] × $(\mathbf{1} - \boldsymbol{QE_b}) \times \boldsymbol{C_p}$	0.017	**[2015m1]** × $(\mathbf{1} - \boldsymbol{QE_b}) \times \boldsymbol{C_p}$	0.031
	[0.033]		[0.110]
[2019m9] × $QE_b \times C_p$	0.010	[2015m1] × $QE_b \times C_p$	0.010
	[0.012]		[0.014]
Bank FEs	Yes		Yes
Firm-time FEs	Yes		Yes
Size	Yes		Yes
ECB lending	Yes		Yes
Reserves	Yes		Yes
Observations	8,302,689		5,867,308
R-squared	0.369		0.394

The dependent variable is the change in the log of disbursed loans from bank b to firm f in month t (in percentages). In Column 1, the variable QE_b is a dummy equal to one for banks in the top tercile of the distribution of mark-to-market PSPP-eligible securities relative to total assets as of August 2019, and results are reported relative to banks in the bottom tercile. In Column 2, QE_b is a dummy equal to one for banks in the top 15% of the distribution of mark-to-market PSPP-eligible securities relative to total assets as of December 2014. The variable C_p denotes the market share of QE-exposed banks (i.e., those with QE_b dummy equal to one) in province p in which bank b is located, computed by excluding bank b itself. Standard errors are clustered at the province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

H. HCA and time-varying capital requirements: calculations

Italian banks in 2014. Banks held 11% of assets in sovereign securities valued at HCA, with an average maturity of approximately 6.2 years (which we use as a proxy for duration), and banks' Tier 1 capital was, on average, 6.0% of total assets. We use the Macaulay-based duration formula to estimate the impact of a 3 percentage point increase in interest rates on the market value of capital: 0.03×(duration)×(value of HCA sovereign securities), and we divide the result by the value of Tier 1 capital to obtain the impact on capital requirements.

US banks in 2022. We use two simple approaches to estimate the impact of HCA on capital requirements—yielding nearly the same results. We mostly rely on aggregate US banking industry data from the FDIC Quarterly Banking Profile. At the end of 2021, HCA covered securities amounting to 16.6% of assets, and Tier 1 capital was 8.6% of assets. The 16.6% figure is obtained as the sum of held-to-maturity assets (8.94% of total assets) and available-for-sale ones that we estimate to be held by banks with less than $250 billion in assets (7.64%). The latter is obtained using total available-for-sale securities (17.3%) and removing those estimated to be held by large banks. Such banks account for 55.85% of total US assets, and we assume the same proportion applies to available-for-sale securities. We use an average duration of 4.1 years, as estimated by Fuster and Vickery (2018) using security-level holdings data; a similar estimate is provided by Jiang et al. (2023). The approximately 3 percentage points increase in US Treasury yields at the 5-year maturity in 2022 are equivalent to an average decrease in capital requirements by roughly 23.7%. The second approach uses unrealized losses on security holdings at the end of 2022, which amounted to $620 billion or 2.6% of assets, from which we deduct $155 billion, which we estimate to be included in regulatory capital by the largest banks. The resulting figure is nearly identical at 23%.