CSEF

Centre for Studies in Economics and Finance

WORKING PAPER NO. 513

How Do Banks Respond to Non-Performing Loans?

Brunella Bruno and Immacolata Marino

November 2018

This version January 2020

University of Naples Federico II

University of Salerno

Bocconi University, Milan

CSEF - Centre for Studies in Economics and Finance
DEPARTMENT OF ECONOMICS – UNIVERSITY OF NAPLES
80126 NAPLES - ITALY
Tel. and fax +39 081 675372 – e-mail: csef@unina.it
ISSN: 2240-9696

CSEF
Centre for Studies in Economics and Finance

WORKING PAPER NO. 513

How Do Banks Respond to Non-Performing Loans?

Brunella Bruno* **and Immacolata Marino****

Abstract
We exploit the first ECB Asset Quality Review (AQR) as a quasi-experiment to investigate the effect of changes in non-performing loans (NPLs) on banks' balance sheets. We show that AQR banks with higher unexpected changes to their NPLs deleverage and reduce lending more than non-AQR banks. The effect is non-linear, and stronger in AQR banks located in high-NPL countries. If we focus only on AQR banks, we find that larger NPL adjustments have negative compositional effects on lending in the sample of reviewed banks from low-NPL countries, and negative size effects in the sample from high-NPL countries.

JEL Classification: E55, G21, G01

Keywords: NPLs, asset quality, bank lending, AQR

Acknowledgments. This research was partially funded by the Baffi Carefin Centre, Università Bocconi. Earlier drafts of this paper were circulated with the titles "The missing link: exploring the role of asset quality on Euro area banks' behavior" and "How Banks Respond to NPLs? Evidence from the Euro Area". We thank Antonio Acconcia, Elena Carletti, Paolo Colla, Francesco Corielli, Claudio Deiana, Carlo Favero, Nicola Gennaioli, Tullio Jappelli, Tommaso Oliviero, Marco Pagano, Fulvio Ortu, Andrea Resti, Sam Rosen, Stefano Rossi, Annalisa Scognamiglio, Saverio Simonelli, Andrea Sironi and participants in seminars at Bocconi University, the Macro Banking and Finance Workshop (Alghero), the Applied Economics Workshop (Petralia Sottana), the Panorisk Conference (Audencia Business School, Nantes), the CefES Conference (Bicocca University), the EEA Conference (Manchester) for helpful comments. Any remaining errors are our own.

* Università Bocconi. Address: Department of Finance, Università Bocconi, Via Roentgen 1, 20136 Milan (Italy). Phone: +39 0258365954. E-mail: brunella.bruno@unibocconi.it

** Università di Napoli Federico II and CSEF. Corresponding author. Department of Economics and Statistics, Università di Napoli Federico II, Via Cinthia, Monte S.Angelo, 80126 Naples (Italy). Phone: +39 081675020. E-mail: immacolata.marino@unina.it.

Table of contents

1 Introduction

Non-performing loans (NPLs) are commonly considered a microprudential issue. Recently, however, the significant rise of problem loans throughout Europe has made the problem relevant to policy makers, who are concerned that high levels of NPLs will increase systemic risk and impair core functions, such as the supply of credit to the real economy (Draghi, 2017; ESRB, 2019).[1]

In this paper, we study how banks adjust their balance sheets when asset quality deteriorates. Do banks shrink their assets in response to higher NPLs? Do they reduce lending or change the asset mix at the expense of the loan portfolio?

Addressing these questions is important because existing research has not been able to establish a credible causal link from asset quality deterioration to adverse effects on lending. In principle, the causality between asset quality and bank behavior could run from the banks credit supply to its stock of NPLs rather than in the other direction. Reduced credit supply can trigger defaults, which in turn can increase the volume of NPLs. Moreover, banks with high NPLs tend to have weak balance sheets, which in fact also may impair their ability to make loans. In this case, one would need to disentangle NPLs and balance sheet factors that may affect lending.

We provide evidence that banks react to higher NPLs by deleveraging and reducing lending. To study how banks respond to NPLs, we use micro level bank data for the euro area during the period 2010-2015. Focusing on the euro area provides an interesting laboratory, given the high level of NPLs in the region and the large discrepancies across banks and countries. Troubled loans skyrocketed in the wake of the global financial and euro debt crises. Despite policy actions aimed to resolve the issue, in September 2018 they accounted for over 700 billion euros; the average NPL ratio in the euro area remains at twice the average ratio in US banks, and ranges between nearly 1% in Germany to over 40% in Greece (EBA,

[1] We use the terms NPLs, impaired, troubled, problem loans and non-performing exposures interchangeably, although we are aware that across jurisdictions and banks these terms can mean different things (BCBS, 2017).

2018; ESRB, 2019).

To identify an exogenous variation in NPLS, we employ the first Asset Quality Review (AQR) conducted by the European Central Bank (ECB) as a quasi-experiment. The AQR was an unprecedented initiative undertaken in 2014 on a subset of European banks that were subjected to stricter classification criteria and in-depth credit file scrutiny. We show that the shock to asset quality induced by the AQR led the reviewed banks to reduce their asset growth by 1.65 percentage points more that non-AQR banks and reduce their lending growth by 1.5 percentage points more than non-AQR banks. These results are estimated in a triple difference-in-differences (DDD) framework in which we compare the effect of the shock to NPLs in reviewed and un-reviewed banks, conditional on the magnitude of the shock.

The institutional features of the AQR lend themselves to empirically investigate how an exogenous shock to NPLs may impact banks for a number of reasons. First, the consistent application in the reviewed banks of a new, harmonized definition of non-performing exposures, and the credit file scrutiny resulted in an increase in NPLs of nearly Euro 140 billion (+18.4%) (ECB, 2014). Second, we found large variation among the reviewed banks in terms of the adjustments to NPLs required by the ECB. For example, the share of debtors reclassified as non-performing ranges from 0 to over 40% of the total debtors originally classified by banks as performing. This is important because banks with larger changes in their NPLs should react more fiercely than banks with few or no changes to their NPLs. Third, only a subset of European banks was subjected to review which allows us to use non-reviewed banks as the control group. Fourth, although our sample of reviewed banks was selected on the basis of an observable non-random characteristic (i.e. asset size), this could not be manipulated strategically around the threshold in order to avoid the treatment, because banks were identified for review on the basis of their total assets at end 2012, i.e. a year before the AQR.

We conduct several tests to check the robustness of our results. Since selection into the AQR was based on bank asset size, in the baseline specification our identification strategy includes country, year and bank-size fixed effects. This allows us to control for time-varying

unobserved differences at the country and year levels (e.g. business cycle and variation in demand for credit), and for heterogeneity induced by bank size. To further mitigate concern that the results are driven by size and other (size related or not) characteristics, we control also for several time-varying bank characteristics. As an additional check, following Gropp et al. (2019), we implement a number of matching strategies. Independent of the matching strategy, the results confirm that AQR banks reacted to the exogenous shock to NPLs by reducing lending growth more strongly than non-reviewed banks.

We also show that the reaction to increased NPLs is non-linear and more pronounced in banks in high-NPL countries. This result is unaffected by differences in economic and credit demand conditions between high- and low-NPL countries. A plausible explanation for our finding is that riskier banks from risky countries are more exposed to funding constraints and supervisory pressure, and therefore, react by deleveraging and pruning risky assets such as loans more than banks from low-NPL jurisdictions.

We then restrict our analysis to AQR banks and measure their differential reaction to the shock to asset quality induced by the review. Excluding the control group of non-reviewed banks enables us to use official information and to replace our asset quality shock proxy with the actual NPL adjustments reported by the ECB (ECB, 2014). This alternative measure of asset quality has the advantage of being not only exogenous to banks but also unrelated to changes in macroeconomic conditions, borrowers' creditworthiness and demand for credit. We find that larger changes to NPLs in the before-after AQR period, forced the reviewed banks to reduce asset and lending growth (in the case of banks located in high-NPL countries), or reduce the share of loans to total assets (in the case of banks located in less risky jurisdictions).

Finally, we compare our control group to two smaller treatment groups by excluding (i) banks with a capital shortfall and (ii) banks with large (i.e. above the mean) adjustments to their provisions as a consequence of the AQR. Our main results are confirmed in both tests. This rules out the possibility that our findings on balance sheet adjustments are driven by severe capital constraints, or large provisioning which has been shown to apply in prior

research (Blattner et al., 2019; Gropp et al., 2019; Wheeler, 2019).

This paper makes several contributions. We contribute to the NPL literature by establishing a credible causal chain from low asset quality to the way banks adjust their balance sheets. Most work on NPLs is either descriptive, or focuses on the micro (Berger and DeYoung, 1997) and macro (Nkusu, 2011; Klein, 2013; Beck et al., 2015) determinants rather than the consequences of problem loans. Much of the evidence showing that NPLs impair lending channels is related to the Japanese crisis which occurred over twenty years ago (Peek and Rosengren, 2005; Caballero et al., 2008). Moreover, these studies investigate the effects of weak (undercapitalized) banks, without directly addressing the question of how NPLs affect banks' behavior. More recent research on the effects of NPLs finds a negative correlation between NPLs and lending (Bending et al., 2014) or economic growth (Balgova et al., 2016), but it is not able to establish a causal nexus from the former to the latter.

Conceptually, we also build on a large literature on the effect of regulation and supervision on banks' behavior. Gropp et al. (2019) use the 2011 European Banking Authority (EBA) capital exercise to show that the treated banks increased their capital ratios by more than the untreated banks, by reducing lending rather than increasing equity. By exploiting the same EBA capital exercise, Blattner et al. (2019) find reduced lending and misallocation in weak Portuguese banks. Acharya et al. (2018) study the credit supply effects of stress tests in US banks and show that stress tested institutions reduced lending, particularly to relatively risky borrowers.

Within this literature, our work is more closely related to the recent stream of studies that exploit different institutional features associated with the introduction of the single supervisor in Europe. Abbassi et al. (2018) found that after the AQR was announced, the reviewed banks temporarily reduced their shares of riskier assets but after the review partly reloaded with risky securities. Eber and Minoiu (2016) found that banks adjusted to the advent of the single supervisor by reducing their leverage. Most of the adjustments consisted of asset shrinking rather than equity expansion, and securities were adjusted more radically than loans. Fiordelisi et al. (2017) investigate whether banks that expected to come under

the ECB supervision acted differently from smaller banks which would remain under the national supervisor. They found that the former reduced their lending more than the latter.

Unlike these studies, the main objective of our analysis is to assess the effect of the shock to NPLs induced by the AQR. By doing so, we are close in spirit to Accornero et al. (2017) who study the causal nexus of NPLs and lending in Italian banks after the 2014 AQR. These authors found that lending was not affected by the level of NPL ratios but rather by the emergence of new NPLs, possibly due to the associated increase in provisions.

Our work differs from their research in several ways. First, we study a large sample of banks in the euro area, not a single country. This enables us to exploit the cross section of banks and countries in Europe. It allows us also to corroborate our results using several samples of reviewed and non-reviewed banks, and to address selection bias concerns by including various matching procedures. Second, our DDD identification strategy enables us to better exploit the institutional features of the AQR (including the wide variation in NPL adjustments among reviewed banks). Third, we investigate both bank lending and also how banks choose to adjust their overall asset sides as a result of the exogenous (and heterogeneous) shock induced by the AQR.

Finally, we contribute to the current debate on the effects of NPLs. We show that our findings are not driven by undercapitalized institutions which challenges the thesis that NPLs impair lending only for weak banks or when bad loans do not have adequate provisioning (Angelini, 2018; Constâncio, 2017). In terms of policy implications, our findings suggest that micro prudential measures such as provisioning backstops or higher capital requirements are important but may be insufficient to revive bank lending in a context of high NPLs. From a macro prudential perspective, our results confirm the need for comprehensive measures to resolve troubled assets, and their urgency in those countries most affected by NPL problems.

2 Institutional background and data

2.1 The 2014 AQR

We start by providing background information on the objective and institutional details of the AQR. In combination with the stress test, the AQR is one of the pillars of the comprehensive assessments (CAs) conducted by the ECB periodically since 2013. The first CA occurred between November 2013 and October 2014, preparatory to implementation of the single supervisory mechanism (SSM). The AQR (the first step in the CA) started in November 2013 with a process of portfolio selection and ended in July 2014 with the adjustments to balance sheet items and risk-weights based on of the findings of the AQR. The supervisory authorities used these results for their stress test exercise (the second step in the CA) to check banks' shock-absorption capacity under stress. The final CA results were published at end of October 2014, along with the supervisory measure to be undertaken. On November 4, 2014, the ECB assumed supervisory responsibility for the euro area banks. Figure 1 depicts a timeline of these events, and defines the before and after period we use in the econometric analysis.

The ECB 2014 AQR was the largest supervisory review ever undertaken (Abbassi et al., 2018). It involved over 6,000 experts who carried out detailed asset-level reviews of more than 800 specific portfolios, representing 57% of the banks' risk-weighted assets, and resulting in the examination of more than 119,000 borrowers. The exercise included 130 institutions, accounting for about 85% of the euro area banking system and selected according to significance criteria published in December 2012 when the SSM was approved. These criteria relate primarily to asset size, and a threshold of €30 billion.[2] On October 23, 2013, the ECB announced details of the AQR and published the list of banks that would be subject to review. The banks were included on the basis of their asset size one year before the start

[2]The asset-related criteria included: (i) rank among the three largest credit institutions in the home country (rank condition) and (ii) ratio of bank's assets to national GDP above 20%, provided that the assets also exceed €5 billion.

of the exercise (i.e. total assets at year-end 2012, taken at the highest level of consolidation at or above the significance thresholds).[3]

The objective of the AQR was to enhance balance sheet transparency and comparability across banks in preparation for the operational start of the SSM in late 2014. It focused on the asset side of banks' balance sheets, and on those elements believed to be the most risky or least transparent. Specifically, the AQR was a point-in-time assessment of the accuracy of assets' carrying values (including the adequacy of asset and collateral valuation and related provisions) at December 31, 2013. To ensure a satisfactory degree of standardization, banks were required for the first time to apply the simplified, harmonized definition of non-performing exposure (NPE) introduced by the EBA.[4] This was a major step towards greater transparency and comparability, in that European banks and countries were notorious for their various definitions of non-performing assets. The NPL change was verified through the data integrity validation process, and checked on a file-by-file basis during the credit file review. Any changes to NPL status were projected onto the unsampled portion of the portfolio. In order to maintain consistency and equal treatment across both the AQR and the stress test, central ECB teams performed independent quality assurance on the work of the banks and national supervisors.

Because the banks' internal classifications, on average, were less strict than the simplified EBA definition, application of the latter resulted in an increase in NPL stock of €54.6 billion (ECB, 2014). The credit file review and projection led to an additional increase of €81.3 billion, to a total increase of €136 billion (from €743 billion to €879 billion, or over 18%). The impact varied according to the debtors location, with overall increases among locations ranging from 7% to 116%. Over 12% of total debtors originally reclassified as performing

[3]Since total assets can fluctuate between two reporting periods, a 10% margin of deviation was applied to the thresholds which led to the inclusion of institutions with total assets between 27 billion and 30 billion or 18% and 20% of GDP as of year-end 2012 (ECB, 2013).

[4]"NPL" is the accepted shorthand term, although the EBA used the term "NPE". In the present paper, we use these terms interchangeably. According to the EBA, any exposure meeting any of the following criteria was defined as non-performing: every material exposure that was 90 days past its due date even if not recognized as defaulted or impaired; every exposure that was impaired; and every exposure that was in default according to capital requirements regulation (i.e. debtor "unlikely to pay").

required reclassification as non-performing. The country average proportion of reclassified debtors ranged from 6% to 32%. At the bank level average, the range was 0% to 43%.

2.2 Descriptive statistics

Our main source of bank-level data is ORBIS Bank Focus, a comprehensive commercial database of financial statements provided by Bureau van Dijk (BvD) Electronic Publishing. We start with the full sample of euro area banks, collecting consolidated balance sheet information for 2010-2015.[5] We then identify banks subjected to the first AQR, using the results published by the ECB in October 2014 (ECB, 2014).

Figure 2 tracks the evolution of total assets, NPLs and the NPL to asset ratio over the entire period. The top graph shows that overall total assets increased between 2010 and 2015. Banks expanded their balance sheets before reducing their assets again following the euro sovereign crisis in 2012. The middle graph shows that total NPLs increased during the crisis years but remained practically constant after 2012 at about 20% above 2010 levels. The dynamics of the two variables are depicted in the lower graph which shows an increase in the NPL/TA ratio during the euro sovereign crisis and a decline immediately after 2012 . Figure 3 reports evidence on the relationship between the growth of gross loans (delta log of gross loans) and the NPL to asset ratio. The initial evidence is of a negative contemporaneous correlation between credit growth and the NPL to asset ratio.

Our analysis focuses on the period 2010 through 2015. The sample includes 872 banks: 105 AQR and 767 non-AQR. Since the AQR was conducted at the highest level of consolidation, we consider banks classified as: GUO (global ultimate owner), independent companies or single location. In the sample of non-AQR banks we exclude small banks (i.e. with average total assets in 2010-2015 below the national median) and banks with a gross loans to total assets ratio lower than 10%.

[5]All data are from the ORBIS Bank Focus web interface; they comprise consolidated balance sheets (C1, C2 and U1) of commercial, cooperative and savings banks (using the specialization variable available in the dataset).

Table 1 presents the 2010-2015 average asset and loan growth rates, 3.5% and 2.9%, respectively, with medians of 3.0% and 2.5%. The average sample bank is a traditional commercial bank whose core business is lending (63% of total assets on average) and whose main source of funds is customer deposits (nearly 59% of total assets on average). This average bank is medium-sized with assets amounting to €12 billion. However, there is considerable cross-section variability, as indicated by the large standard deviation for total assets (the median bank is small with total assets of less than €1 billion).

In the case of asset quality, the NPL to asset ratio averages about 5%, and the NPL to total loan ratio 8%; the average Texas ratio (a measure of credit risk net of any coverage provided by capital and loan loss allowances) is above 44%.[6] These numbers are comparable to those reported in aggregate statistics (ECB, 2016).

Figure 4 depicts the average NPL to total assets and gross loans ratios by country. The horizontal red line corresponds to 10%, a critical level according to the European authorities (Enria, 2017; ESRB, 2017). We label as "high NPLs" those countries whose average NPL ratio is above this threshold. The NPL ratio ranges from under 1% (Finland) to nearly 20% (Slovenia), with seven countries at or above the threshold. This shows the importance of the NPL question in Europe, and also the significant heterogeneity of asset quality across banks and countries.

In the case of bank soundness, the coverage ratio averages nearly 47% but with large differences across banks. The tier 1 regulatory capital ratio averages close to 14%, well above the 8.5% fully loaded capital requirement set by Basel III. Note that since the onset of the euro debt crisis the European banking industry has taken many steps to increase its resilience. Finally, average return on equity (ROE) and return on assets (ROA) (3.3% and 0.3%, respectively) confirm that low profitability is a major concern that is plausibly aggravated by the large volume of NPLs (Altavilla et al., 2018).

[6]The Texas ratio is commonly calculated as the ratio of NPLs to loan loss reserves plus tangible equity. Due to lack of data on tangible equity, we use a revised version of Tier 1 capital in lieu of tangible equity.

Table 2 presents summary statistics for banks in the AQR and non-AQR sample. "Diff"is the average difference between the second column (balance sheet items at AQR banks) and the first column (balance sheet items at non-AQR banks). We use the t-statistic to test the statistical significance of the difference . Although our sample already consists of banks that are larger than the national medians, AQR banks are shown to be bigger than non-AQR banks. The two groups differ also in their business models: their smaller share of loans and deposits in relation to total assets makes AQR banks relatively less oriented to traditional commercial banking compared to non-AQR banks. In economic terms, this difference moderates since lending is the main business for both groups, 61% in AQR and 64% in non-AQR banks. Also, while there are no significant differences in their loan portfolios and asset quality (proxied respectively by NPL to total loan and NPL to total asset ratios), AQR banks report higher coverage ratios. AQR banks' capital position (proxied by the tier1 regulatory capital ratio) is weaker. This may explain why the Texas ratio shows non-AQR banks in a stronger position than AQR banks: their level of troubled loans net of the coverage afforded by capital and loan loss reserves is significantly lower. The lower level of capital may also explain why AQR banks on average are more profitable in terms of ROE, while there are no significant differences for ROA. Between 2010 and 2015, the AQR banks expanded their assets by less (or deleveraged by more) than the non-AQR banks. In deleveraging, they increased their securities portfolios less (or reduced them more intensively) than their loans. Hence, the AQR banks reduced the share of securities in total assets more sharply than the non-AQR banks, although the difference is not particularly marked.

3 Empirical strategy

3.1 Identification

We exploit the 2014 ECB AQR to investigate banks responses to an exogenous shock to asset quality. The setup of the AQR enables us to implement a DDD strategy to study the

effect of an exogenous change in NPLs on lending and asset composition. We identify treated banks and control banks according to ECB criteria, and define the years between 2010 and 2013 as the pre-AQR period and the period between 2014 and 2015 as the post-AQR period.

Our main hypothesis is that the change in NPLs induced by the AQR is exogenous in that it stemmed from the first-time application in the reviewed banks of a uniform, stricter definition of NPLs, and the succeeding close scrutiny from the ECB to check balance sheet data accuracy. Within treated institutions, the intensity of the shock to asset quality was heterogeneous, e.g., because banks already adopting stringent NPL classification criteria were required to make smaller changes than less prudent banks.

We measure the shock to asset quality in two ways. In our main specification on the whole sample of treated vis-à-vis untreated banks, we use bank balance sheet data to calculate the change in NPLs over total assets in 2013-2014 ($\triangle NPL$). To better capture the exogenous component of asset quality variation, we restrict the time span between the first reporting dates immediately before and after the treatment (i.e. year-end 2013 and year-end 2014, see figure 1). Owing to the relatively short time frame, we assume that the change in asset quality captured by this variation is the effect of the ECB review rather than the effect of confounding factors such as physiological loan quality deterioration.

For the sample of AQR banks, we use official information provided by the ECB in the final CA report (ECB, 2014) to construct a measure of exposure to the shock *within* treated banks and replace our proxy for change in asset quality with the actual "AQR-adjusted NPE ratio" ($\triangle NPE$). This should further alleviate concerns that our preferred measure of change in asset quality is not fully exogenous but is driven by e.g. increased borrowers' defaults or changes in credit demand.

The box plot in figure 5 presents the full range of variation (from min to max), the likely range of variation (the IQR), and the median (the diamond) of the two measures of exogenous change in NPLs adopted in the paper. The figure shows that both variables display enough variation across banks and are comparable in terms of medians. We take advantage of this heterogeneity to identify the differential effect of an unexpected shock to NPLs. Accordingly,

we expect a stronger reaction from banks that needed larger NPL adjustments.

We first address concern that the change in NPLs in the reviewed banks is determined by the euro sovereign debt crisis that run during the pre-AQR period (2010-2012). In most countries affected by system-wide increases in NPLs, these were linked to the severe economic recession that followed the global financial crisis and the European sovereign debt crisis (ESRB, 2019; figure 2). The euro crisis affected banks and countries differently, with the most exposed banks domiciled in peripheral countries (Greece, Ireland, Italy, Portugal, and Spain - the GIIPS) and holding large amounts of domestic government bonds, perhaps as an effect of moral suasion exercised by national governments (Altavilla et al., 2017; Becker and Ivashina, 2018), or as a consequence of risk shifting/carrying trade strategies (Acharya and Steffen, 2015). In table 3 we regress our measures of changes to asset quality ($\triangle NPL$ and $\triangle NPE$) on a proxy for exposure to the sovereign crisis (interaction between the GIIPS dummies and the HGov variables, accounting for banks located in GIIPS countries with a large holding of government bonds in the pre-AQR years). We find that the change in asset quality is not explained by large exposure to the sovereign debt crisis.[7]

A potential concern in our identification setting is that selection into the AQR was not random but was based on dimensional factors resulting in AQR banks on average being larger than untreated banks (table 2). Moreover, the cross-country feature of our analysis involves comparison between different size distributions across countries. The theory and existing empirical research indicate that size is strongly related to banks' ability to raise funds and make loans (Kashyap and Stein, 1995, and Kishian and Opiela, 2000 among others). Any causal inference would be compromised if large banks behaved differently from small banks even in the absence of a change in NPLs. We address this concern in several ways. First, in all specifications we include country-sizeBin-year fixed effects which allows us to isolate the "bank size" effect and to account for cross-country differences such as regulatory interventions and business cycles. We assign each bank to its appropriate country size-bin;

[7]Unfortunately, we cannot calculate the actual share of domestic sovereign bonds held by the AQR sample banks. However, Gennaioli et al. (2018) found that some 75% of European banks bond holdings consist of domestic bonds. Given the home bias of European banks, we use the government bonds to total asset ratio as a plausible proxy for exposure to domestic public bonds.

each sizeBin is defined as above/below the national median.[8]

Then, as in Gropp et al. (2019), we implement various matching strategies and estimate the average treatment effect on the treated (ATT) on banks' outcomes using the bias-corrected Abadie and Imbens (2011) matching estimator. The advantage of matching strategies is that they allow comparison of more similar banks than in the full sample, although at the cost of a smaller sample size. This approach provides an estimate of the differential effect of the exogenous changes in NPLs across treated and untreated banks. The simplest matching procedure requires that for every non-reviewed bank, we identify four AQR matches in the same size category and in the same country. The procedure then estimates the mean differences in AQR banks relative to the control group, conditional on matching on the selected characteristics. We next include an additional matching covariate (total customer deposit to total asset ratio) to proxy for funding strategy. Finally, in the full sample matching procedure, we select size and country, customer deposit to total asset ratio and other bank characteristics as pre-treatment matching covariates to account for the dominant business model (loan to total asset ratio and net interest margin), capitalization (tier 1 ratio) and profitability (ROE).

Another potential issue related to the selection criteria is the discrepancy between the date of the AQR announcement (October 23, 2013) and the AQR cut-off date (December 31, 2013). In principle, banks could have manipulated their balance sheets strategically in preparation for the AQR.[9] We argue that this is less of a concern in our setting where

[8]To compare banks in the same sizeBin, we : 1) defined a dummy sizeBin for each country and computed median total assets; 2) assigned a value equal to 1 to the sizeBin dummy if the bank's average total asset value was above this threshold and 0 otherwise. This resulted in different distributions within each country of AQR dummies and sizeBin dummies. In most cases we have counterfactual observations only above the median (e.g. in Austria 245 out of 440 non-AQR banks have no comparable treated banks; our strategy only compares 195 non-AQR observations with 51 AQR observations). In a few cases we have counterfactual banks only below the median (e.g. in Belgium 38 out of 54 AQR banks have no comparable untreated banks above the median; our strategy only compares 16 AQR observations with the 23 non-AQR observations below the median). In other cases we have counterfactual observations both above and below the median (e.g. in Luxembourg 39 out of 48 non-AQR banks have 10 comparable treated observations below the median and 9 non-AQR banks also have comparable treated banks above the median).

[9]E.g. Abbassi et al. (2018) exploit the discrepancy between the announcement and the start of the AQR and show that after the announcement, the reviewed banks decreased the share of riskier loans and securities,

the shock to NPLs is the result of application of stricter classification criteria and closer supervisory scrutiny. Thus, any attempts to "dress up for supervisors" would result in more precise classifications and possibly higher (rather than lower) NPLs. If this were the case, one could consider our measures of changes to asset quality as the lower bound of the shock in the absence of anticipation of scrutiny.

Table 4 shows the effect of the AQR on NPLs by reporting basic differences in two measures of asset quality (NPL/TA and NPL/GL) between AQR and non-AQR banks, before and after the review. It also reports basic differences in the volume of NPLs and gross loans (log NPLs and log GL) between the two groups. The difference-in-differences (DD) coefficients show higher NPLs in the treated than in the control group, regardless of the indicator used. Our preferred measure of asset quality (NPL/TA) increased by 24% more in the treated group compared to the control group. Interestingly, while the volume of NPLs (in log) increased by 7%, we did not find any differences in lending volume between the two groups, suggesting that the AQR *per se* had no impact on the supply of bank credit.

The estimates rely on the assumption of parallel trends prior to the AQR. In table 5 we test this assumption parametrically by checking the statistical significance of the interaction term AQR*Year in a model where asset quality (NPL/TA and NPL/GL) is regressed on: a linear trend, the AQR dummy, bank level controls and the interaction term in the sample before the AQR (2010-2013). Table 5 columns 1 and 3 show that the estimated coefficients of the interaction terms are small and not statistically significant, suggesting that the parallel trend assumption is not rejected. We test also for anticipated effects of the treatment, estimating a model where the AQR dummy is interacted with all the year dummies. Columns 2, 4 and 6 report the estimated coefficients of the leads and lags. These estimates rule out possible anticipated effects of the review, consistent with the parallel trend assumption. Further, the lack of anticipation effects suggests that any other changes in the institutional framework that affected AQR and non-AQR banks differently were not crucial for the NPLs patterns.

and then reverted at the end of the phase 2 of the AQR, in July 2014, by purchasing riskier securities.

3.2 Model specification

For each bank-level outcome (growth of loans, growth of assets, growth of securities, change in the ratio of gross loan to total assets and change in the ratio of securities to total assets) of bank i in country j at time t, we estimate the following econometric model:

$$\begin{aligned} y_{ij,t} = \alpha_0 + \beta_4 AQR_{ij} * Post_t * \triangle NPL_{ij,13-14} + \\ \beta_3 AQR_{ij} * \triangle NPL_{ij,13-14} + \beta_2 Post_t * \triangle NPL_{ij,13-14} + \\ \beta_1 AQR_{ij} * Post_t + \beta_0 Post_t + \theta_1 X_{ij,t-1} + \mu_{ijt} + \lambda_{ij} + \epsilon_{ij,t} \end{aligned} \tag{1}$$

where the coefficient of interest is β_4. AQR is a dummy equal to 1 for reviewed banks, $Post$ is a dummy equal to 1 in 2014-2015 and 0 otherwise, $\triangle NPL$ is a time-invariant indicator measuring bank-specific asset quality variation (change in NPL/TA) in 2013-2014, and the indicator variable AQR is absorbed by the bank fixed effects. Standard errors are clustered at the bank level.

To alleviate concerns that the results are determined by factors related to bank size or by country-year specific events, we include bank fixed effects (λ_{ij}) and country-sizeBin-year fixed effects (μ_{ijt}), where each sizeBin is defined as above/below the national median. By comparing banks in the same sizeBin, same country and same year, we mitigate concerns that the results are determined by bank specific factors related to size, or by country-year-specific events. Controlling for this set of fixed effects at country level is crucial to isolate unobserved events which in a given jurisdiction in a given year might play a particular role in determining lending and/or asset composition (e.g. the differential severity of the sovereign debt crisis in 2010-2012), and structural factors that might influence the credit supply. For example, although they belong to the same monetary area, euro countries differ in several respects including stringency of their institutional frameworks (Aiyar et al., 2015), and presence of government interventions to clean up bank balance sheets (Brei et al., 2019). Both factors might affect the way banks resolve NPLs and reactivate their credit channels.

We also include a strong set of lagged time varying controls for the main bank specific factors affecting credit supply in a context of high NPLs. We control for capitalization by including the tier 1 regulatory capital ratio. There is ample empirical evidence showing that bank capital is important for the propagation of shocks to the credit supply (see Peek and Rosengren, 1995, Kishan and Opiela, 2000 and Gambacorta and Mistrulli, 2004, among others). We use the tier 1 ratio rather than a pure (non-risk-based) leverage ratio because the former by construction, is more sensitive to risk; this helps to motivate a substitution effect between e.g. (safe) securities and (risky) loans.

To capture the role of the funding structure, we focus on the ratio of customer deposits to total assets to gauge the importance of stable sources of funds. The theory predicts that largely inelastic core deposits are stable funding sources which historically have insulated bank funding costs against economic shocks, including exogenous credit risk shocks (Berlin and Mester, 1999). The theory related to matching assets and liabilities maintains also that banks may enjoy synergies if they engage in both deposit taking and lending (Kashyap et al., 2002), and that it is efficient for banks funded mainly by core deposits to invest in loans rather than informationally transparent assets such as marketable securities (Song and Thakor, 2007). The global financial crisis showed that banks that rely more heavily on core deposits are less prone to contract lending than banks that rely on unstable wholesale sources of funding (Millon Cornett et al., 2011; Ivashina and Scharfstein, 2010).

To control for profitability, we use ROE which has been shown to work to attract external funds and affect bank risk taking (Altavilla et al., 2019).

We also include coverage ratio i.e. the share of loan loss reserves (or loan loss allowances) in NPLs. In general, the level of loan loss reserves should be commensurate with the expected loan recovery value. If not, the risk is that larger-than-expected losses will drive capital down below the minimum requirement. Therefore, an adequate coverage ratio should mitigate concern provoked by a high level of NPLs, and help to explain the different results related to different banks.

In addition, we check the one-year lagged measures of our dependent variables on asset

composition, and for bank characteristics which the lending channel literature generally considers to be drivers of the credit supply (see Bruno et al., 2018 for a review of this literature), namely bank size (log of total assets) and liquidity (cash and due from banks over total assets). In this last respect, the global financial crisis reinforced the relevance of asset liquidity because banks with more illiquid assets hoarded liquidity and reduced their lending more than liquid banks (Millon Cornett et al., 2011). We elected to use a restrictive measure of liquid assets because securities that are readily marketable in normal times (including government bonds), may turn illiquid during a crisis.

4 Results

Table 6 reports the estimation results for equation (1) where the DDD term, $AQR * Post * \triangle NPL$ is our key explanatory variable capturing the differential effect of the AQR exposure by "NPL adjustments". In line with prior research (e.g. Eber and Minoiu, 2016), when we look at the estimated coefficients of the DD term $AQR * Post$, we find that banks increased their loan portfolios at the expense of securities, with both size and composition effects. The coefficients of the DD term is positive and significant at the 1% level for a change to loans and the loan to asset ratio, and is negative (significant at the 5% level) for the change in securities to total assets ratio.

In the DDD interaction, we isolate the impact of the exogenous shock to NPLs in treated versus untreated banks. We find that a larger shock to asset quality in the reviewed banks results in lower asset and lending growth. Lending slows more than asset growth, suggesting that banks react to asset quality deterioration by deleveraging, and pruning risky assets (loans) more than securities. To alleviate concern that our results are driven by size and other bank characteristics, or by country specific factors, we replicate the analysis on AQR banks and a matched sample of untreated banks. In the spirit of Gropp et al. (2019), we adopt three matching strategies and implement the bias-corrected Abadie and Imbens (2011) matching estimator. Table 7 reports the estimation results for the three matched samples

(panels A, B and C) described in section 3.1. The results of our previous tests are confirmed. Regardless of the matching procedure, a shock to asset quality induces AQR banks to reduce lending growth significantly. In two out of the three matched samples (panels B and C) we find also that asset quality deterioration has a marked negative effect on asset growth.

4.1 Exploiting asset quality heterogeneity across countries

To obtain additional evidence on the effect of asset quality deterioration, we take advantage of differences in asset quality across countries. We split our sample into banks from high-NPL countries (i.e. those with average NPL/GL above 10% in 2010-2015) and low-NPL countries.[10]

Table 8 presents aggregate estimates for the sample of banks in high-NPL countries (panel A) and in countries with normal levels of problematic loans (panel B). There are several reasons why the responses of these two country groups might vary. For example, most countries affected by high NPL levels have illiquid secondary markets for their troubled loans, or weak institutional frameworks that make foreclosure procedures particularly lengthy and costly (Aiyar et al., 2015; ECB, 2016). This could translate into reduced ability to resolve NPLs, and thus, stricter market discipline and supervisory scrutiny. As a result, banks domiciled in high-NPL countries may be tempted to react more radically than those located in countries where problem loans are less of a concern.

We find evidence of such difference. In panel A, the coefficients of the triple interaction $AQR * Post * \triangle NPL$ in columns 1 and 2 are negative and statistically significant at the 1% and 5% levels respectively, i.e. AQR banks reacted to the shock in NPLs by deleveraging at the expense of their lending business, with no significant differences in portfolio mixes. In panel B, the coefficients of the triple interaction in columns 1 and 2 are negative but statistically insignificant.

[10] According to the ECB (ESRB, 2017), this is a meaningful threshold for high-NPL countries. For robustness we identify high-NPL countries as those with NPL ratios above the sample mean and the sample median. The results are identical because the sample of high-NPL countries remain unchanged.

Another reason why the two country groups might differ are their respective macroeconomic conditions including credit demand. The economic recessions that followed the global financial crisis and the European sovereign debt crisis were particularly severe in high-NPL jurisdictions (ESRB, 2019). The negative business cycle may have affected credit demand more severely in those countries compared to low-NPL countries.

To mitigate concerns that our results are driven by aggregate credit demand, in table 9 we replace country-year fixed effects with GDP growth-country fixed effects. We use GDP growth as a credit demand control because credit demand tends to decline if macroeconomic conditions worsen (Kashyap and Stein, 2000). As a further robustness check, in table 10, we introduce an alternative proxy based on survey data by interacting the measure of credit demand with the respective country dummy. The euro area Bank Lending Survey (BLS) provides quarterly information on European bank perceptions of credit demand conditions during the previous three months. In both tests we find that a shock to NPLs has a more negative effect on lending growth in reviewed banks from high-NPLs countries. The magnitude of this effect is similar to the baseline model with country-time fixed effects.

4.2 Exploiting heterogeneous shock reactions in AQR banks

In this section we focus on the sub-sample of AQR banks. As discussed above, supervisors imposed a number of adjustments to the balance sheets of reviewed banks; on average, NPLs increased by 18%, with large variety in the magnitude of the adjustment. We exploit this heterogeneity to test whether before-after the AQR, reviewed banks with larger changes to their NPLs reacted differently from those with smaller NPL adjustments. Focusing on AQR banks has three main advantages. First, it enables us to further address concern that the results are driven by dimensional factors or other characteristics related to bank size. Second, it allows us to measure the intensity of the shock to NPLs triggered by the AQR by using the exact "NPE adjustment" as recorded by the ECB after the review (ECB, 2014). This addresses concerns over miscalculation of the proxy ($\triangle NPL$) used in our main test. Third, by using the actual AQR adjustment, we alleviate concern that the change in NPLs

is driven by factors unrelated to the supervisory exercise such as changes in macroeconomic conditions and/or credit demand. The regression model thus becomes:

$$y_{ij,t} = \alpha_0 + \beta_2 Post_t * \triangle NPE_{ij,13-14} + \theta_1 X_{ij,t-1} + \mu_{ij,t} + \lambda_{ij} + \epsilon_{ij,t} \quad (2)$$

The key explanatory variable is $Post * \triangle NPE$ where $\triangle NPE$ is the first difference between the AQR adjusted NPE ratio and the unadjusted NPE ratio (as a percentage) at year-end 2013, and as reported by the ECB. Post is a dummy equal to 1 in the post treatment period (2014-2015). As in the previous tests, we include one-year lagged controls for the bank, and two sets of fixed effects (bank and country-sizeBin-year fixed effects). The interacted term captures the effect of the treatment after its implementation.

Panel A in table 11 presents the results of equation (2) for the whole sample of AQR banks. We find that larger adjustments to NPLs have a negative impact on bank lending. The estimated coefficients of the interacted term in columns 1 and 4 are negative and significant at the 10% level. This suggests that a larger shock to the NPLs has both a size and composition effect since banks with more extensive adjustments to their NPLs reduced lending growth and share of loans to total assets in the post treatment period. Panels B and C present the estimation results for the subsample of AQR from high- and low-NPL countries, respectively. The results show a strong negative effect of increased NPLs in both samples. Specifically, table 11 panel B shows a size effect for banks from riskier countries which reacted to larger NPL adjustments by deleveraging and reducing lending growth. In our main specification, banks reduced lending more sharply than asset growth (the estimated coefficients of the interacted term in columns 1 and 2 are negative and significant at the 1% and 5% levels, respectively). For banks from low-NPL countries, we find evidence of a composition effect; they react to the shock on NPLs by reducing the share of resources allocated to their loan portfolios. The coefficient of the change in the share of loans to total asset is negative and significant at the 1% level (panel C, column 4).

4.3 Additional checks excluding banks with capital shortfalls and large adjustments to provisions

Table 12 tests the sensitivity of our results excluding from the sample AQR banks with a capital shortfall during the period of the stress test that followed the 2014 review.

As noted in the institutional section, during the post-AQR period the reviewed banks were subjected to a stress test, the second step in the ECB comprehensive assessment. Based on the AQR-adjusted balance sheet, the test gauged resilience in a baseline and an adverse scenario. In both cases, bank solvency was analyzed to determine sensitivity under certain stressful economic conditions.[11] The overall capital impact on the 130 banks covered by the CA was €263 billion. Taking account of capital buffers, the CA identified a capital shortfall of €25 billion in 25 participating banks with respect to the thresholds in the baseline and adverse scenarios. Twelve of the 25 banks covered the shortfall by increasing their capital by a total of €15 billion in 2014; the rest were required to prepare capital plans within two weeks of the announcement of the results in October 2014, and to cover the capital shortfall within nine months (ECB, 2014). All these adjustments occurred what we define as the post-AQR period (2014-2015).

The restoration of capital adequacy can involve different strategies from capital expansion to asset shrinkage. Deleveraging or cutting back on risky assets such as loans is less costly than issuing new equity or retaining a higher proportion of earnings, especially for very weak banks (Berger and Udell, 1994).[12] Asymmetric information and the lemons problem (Myers and Majluf, 1984; Peek and Rosengren, 1995) can also explain why banks prefer to deleverage rather than issue new equity. Admati et al. (2018), among others, show that with debt in

[11] Banks were required to have an 8% CET1 ratio after accounting for the effect of asset quality review on their year-end 2013 balance sheet and to maintain the 8% ratio at each year-end during the baseline stress test scenario, and a 5.5% CET1 ratio at each year-end under the adverse scenario. This comprises the impact of both the AQR and the stress test. See ECB (2014) and particularly the section on the aggregate outcomes of the CA.

[12] E.g. following publication of the CA results, the stock prices of the weaker banks performed significantly worse than those of the stronger banks, possibly reflecting a likely dilution of equity at those banks that needed to raise capital (Georgescu et al., 2017).

place, shareholders are biased toward selling assets against pure recapitalization. Recent empirical works confirm that binding capital requirements induce banks to shrink balance sheets and reduce assets subject to higher capital charges in preference to raising new equity (De Jonghe at al., 2016; Gropp et al., 2019). Thus, we would expect a common strategy among shortfall banks of regaining capital adequacy by deleveraging rather than issuing new equity.

To ensure our results are not driven by these outliers, we replicate our analysis excluding from the treated group the 25 banks that the CA found were undercapitalized.[13] Excluding very weak institutions is also important because undercapitalization may expose banks to risk taking and distorted lending incentives, by which reduced (overall) amount of lending is combined with credit reallocation from healthy to zombie firms (Blattner et al., 2019).

As in the previous tests, we split the sample into banks in high-NPL countries (panel B) and banks in other countries with normal levels of troubled assets (panel C). The results confirm the significant differential in AQR banks' responses to changes in asset quality. Compared to the control group, treated banks located in high-NPL countries have a greater tendency to reduce lending growth and the share of loans in total assets (panel B, columns 1 and 4). In the case of AQR banks from low-NPL countries, the coefficients of interest of asset and lending growth are negative but statistically insignificant. However, these banks tend to increase the share of securities by relatively more compared to non-reviewed banks (Panel B, column 5).

In a further test, given the potential effect of provisioning on credit supply (Jimenez et al., 2017; Wheeler, 2019), we exclude from the AQR sample those banks that made larger adjustments to provisions than the average AQR bank.[14] As before, we use the ECB's official

[13]List of banks with capital shortfall (ECB, 2014): Eurobank, Monte dei Paschi di Siena, National Bank of Greece, Banca Carige, Cooperative Central Bank, Banco Comercial Portugues, Bank of Cyprus, Oesterreichischer Volksbanken-Verbund, Permanent Tsb, Veneto Banca, Banco Popolare, Banca Popolare di Milano, Banca Popolare di Vicenza, Piraeus Bank, Credito Valtellinese, Dexia, Banca Popolare di Sondrio, Hellenic Bank, Munchener Hypothekenbank, AXA Bank Europe, CRH-Caisse de Refinancement de l'Habitat, Banca Popolare dell'Emilia Romagna, Nova Ljubljanska Banka, Liberbank, Nova Kreditna Banka Maribor.

[14]In addition to the effect on NPLs, a second official outcome of the AQR was the aggregate adjustments of €48 billion to bank asset carrying values as of December 31, 2013.

information to compute the average adjustment to provisions for the treated banks (34 basis points) and manually identify those with larger adjustments.[15] Interestingly, adjustments to provisions do not exactly track adjustments to NPLs - some banks were found to be underprovisioned although they were required to make no or very small changes to their NPLs.

Table 13 presents the results for the differential effect of a change in asset quality for the subsample of AQR banks net of those with above average adjustment to provisions (panel A). We split the sample by relevance of the NPL issue at country level (panels B and C). As in the previous tests, the differential effect of the shock to NPLs in AQR banks is more marked in banks from riskier countries which reduce their lending and asset growth by more than the non-reviewed banks in the same country group (panel B, columns 1 and 2). In relation to the subsample of banks from low-NPL countries, the coefficients of the DDD on lending and asset growth, and on share of loans to total assets are negative but statistically insignificant. In line with the results in panel B, we find some evidence of a composition effect also in reviewed banks from less risky countries which increase their share of securities more than do non-reviewed banks (the coefficient, column 5, Panel C, is positive and significant at the 5% level).

[15]List of excluded banks: Caixa General de Depositos SA, Cooperative Centrale Raiffeisen-Boerenleenbank BA, Societe de Financement Local, Banca Popolare di Milano, KfW IPEX-Banks GmbH, AS SEB Pank, Banca Popolare dell'Emilia Romagna, Banca Popolare di Vicenza, AB DNB Bankas, Raiffeisenlandesbank Niederosterreich-Wien AG, National Bank of Greece, Norddeutsche Landesbankk-Girozentrale, Erste Group Bank AG, Bank of Cyprus, Swedbank AS, Banca Popolare di Sondrio, Mediobanca, HSBC, Raiffeisenlandesbank Oberosterreich AG, AB SEB Bankas, Alpha Bank, Banco Popolare, Banca Piccolo Credito Valtellinese, Banca Carige SPA, Nova Ljubljanska Banka, Eurobank Ergasias SA, Veneto Banca, Banco Comercial Portugues, Hellenic Bank Public Company, Banca Monte dei Paschi di Siena, SID, Piraeus Bank, AS SEB Banka, Nova Kreditna Banka Maribor, HSH Nordbank AG, AS DNB Pank.

5 Conclusions

We exploit the ECB 2014 AQR as a quasi-experiment to investigate the nexus of causality between changes in NPLs and the way banks shape their balance sheets. We show that in response to a shock to their NPLs AQR banks deleveraged and reduced lending more than non-reviewed banks. The effect on lending is non-linear, and is stronger in reviewed banks from high-NPL countries. Analysis of the sub-sample of AQR banks confirms that lending contracted more in reviewed banks with larger adjustments to NPLs. We found size effects for banks from high-NPL countries, and composition effects for banks from less risky jurisdictions.

Overall, all our findings highlight that regardless of bank characteristics such as capitalization or provisioning, an increase in NPLs is detrimental to lending because it induces banks either to cut credit growth (size effect) or to shift resources at the expense of the loan portfolio (composition effect). In terms of policy implications, from a macro prudential perspective our results confirm the need for comprehensive measures to resolve troubled assets which seems to be more urgent in the case of banks from high-NPL countries. Micro prudential measures such as prudential provisioning backstops and higher capital requirements are important but may be insufficient to restart bank lending in a context of high NPLs.

References

Abadie, A. and Imbens, G.W. (2011). Bias-Corrected Matching Estimators for Average Treatment Effects. Journal of Business & Economic Statistics, 29(1), pp.1-11.

Abbassi, P., Iyer, R., Peydró, J., and Soto, P.E. (2018). Dressing Up for the Regulators: Evidence from the Largest-Ever Supervisory Review. Working Paper.

Accornero, M., Alessandri, P., Carpinelli, L., and Sorrentino, A.M. (2017). Non-Performing Loans and the Supply of Bank Credit: Evidence from Italy. Bank of Italy Occasional Paper No. 374.

Acharya, V.V., Berger, A.N., and Roman, R.A. (2018). Lending Implications of U.S. Bank Stress tests: Costs or Benefits? Journal of Financial Intermediation, 34, pp. 58-90.

Acharya, V.V., and Steffen, S. (2015). The "Greatest" Carry Trade Ever? Understanding Eurozone Bank Risks. Journal of Financial Economics 115(2), pp.215236.

Admati, A.R., DeMarzo, P.M., Hellwig, M.F., and Pfleiderer, P. (2018). The Leverage Ratchet Effect. The Journal of Finance, 73(1), pp. 145-198.

Aiyar, S., Bergthaler, W., Garrido, J.M., Ilyina, A., Jobst, A., Kang, K., Kovtun, D., Liu, Y., Monaghan, D., and Moretti, M. (2015). A Strategy for Resolving Europes Problem Loans. IMF Staff Discussion Note 15/19.

Altavilla, C., Pagano, M., and Simonelli, S. (2017). Bank Exposures and Sovereign Stress Transmission. Review of Finance, 21(6), pp. 2103-2139.

Altavilla, C., Desislava, C.A., Boucinha, M., and Holton, S. (2019). Monetary Policy, Credit Institutions and the Bank Lending Channel in the Euro Area. ECB Occasional Paper Series 222/2019.

Angelini, P. (2018). Do High Levels of NPLs Impair Banks' Credit Allocation? Bank of Italy, Notes on Financial Stability and Supervision, 12, April 2018.

Balgova, M., M. Nies and Plekhanov, A. (2016). The economic impact of reducing non-performing loans, European Bank for Reconstruction and Development Working Paper, 193.

BCBS (2017). Prudential Treatment of Problem Assets Definitions of Non-Performing Exposures and Forbearance. Guidelines, 4 April.

Beck, R., Jakubik, P. and Piloiu, A. (2015). Key Determinants of Non-Performing Loans: New Evidence from a Global Sample. Open Economies Review, Vol. 26(3), pp. 525550.

Becker, B., and Ivashina, I. (2018). Financial Repression in the European Sovereign Debt Crisis. Review of Finance. 22 (1), pp. 83115.

Bending, T., M. Berndt, F. Betz, P. Brutscher, O. Nelvin, D. Revoltella, T. Slacik, and Wolski, M. (2014), Unlocking lending in Europe, European Investment Bank.

Berger, A. and DeYoung, R. (1997). Problem Loans and Cost Efficiency in Commercial Banks. Journal of Banking and Finance (21), pp. 849870.

Berger, A. N., and Udell, G. F. (1994). Did Risk-Based Capital Allocate Bank Credit and Cause a "Credit Crunch" in the United States? Journal of Money, Credit and Banking, 26(3), pp. 585-628.

Berlin, M., and Mester, L.J. (1999). Deposits and Relationship Lending. The Review of Financial Studies, 12(3), pp. 579-607.

Blattner, L., Farinha, L., and Rebelo, F. (2019). When losses turn into loans: the cost of undercapitalized banks. ECB Working Paper Series 2228/January.

Brei, M., Gambacorta, L., Lucchetta, M. and Parigi, B.M. (2019). Bad bank resolutions and bank. Working Paper.

Bruno, B., D'Onofrio, A., and Marino, I. (2018). Determinants of Bank Lending in Europe and the United States: Evidence from Crisis and Post-Crisis Years. In "Finance and Investment: the European Case", Edited by C. Mayer, S. Micossi, M. Onado, M. Pagano, and A. Polo. Oxford University Press.

Caballero, R.J., Hoshi, T. and Kashyap, A.K. (2008). Zombie Lending and Depressed Restructuring in Japan. American Economic Review, 98(5), pp.1943-77.

Constâncio V. (2017). Resolving Europe's NPL Burden: Challenges and Benefits. Keynote speech at Bruegel Event: Tackling Europe's Non-Performing Loans Crisis: Restructuring Debt, Reviving Growth, 3, February 2017.

De Jonghe, O., Dewachter, H., and Ongena, S. (2016). Bank Capital (Requirements) and Credit Supply: Evidence from Pillar 2 Decisions, Working Paper Research, 303.

Draghi, M. (2017). European Banking Supervision Three Years on. Welcome Remarks by Mario Draghi, President of the ECB, at the Second ECB Forum on Banking Supervision, Frankfurt am Main, 7 November.

EBA (2018). Risk Dashboard Data as of Q3 2018.

Eber, M., and Minoiu, C. (2016). How Do Banks Adjust to Stricter Supervision? Mimeo.

ECB (2013). Note on the Comprehensive Assessment, October.

ECB (2014). Aggregate Report on the Comprehensive Assessment, October.

ECB (2016). Stocktake of National Supervisory Practices and Legal Frameworks Related to NPLs, September.

Enria (2017). Introductory statement of the Chairperson of the European Banking Authority (EBA), Committee on Economic and Monetary Affairs (ECON) of the European Parliament, 9 October.

ESRB (2017). Resolving Non-Performing Loans in Europe.

ESRB (2019). Macroprudential Approaches to Non-Performing Loans. January.

Fiordelisi, F., Ricci, O., and Lopes, F.S.S. (2017). The Unintended Consequences of the Single-Supervisory Mechanism Launch in Europe. Journal of Financial and Quantitative Analysis, 52 (6), pp. 2809-2836.

Gambacorta, L., and Mistrulli, P.E. (2004). Does Bank Capital Affect Lending Behavior? Journal of Financial Intermediation, 13(4), pp. 436-457.

Gennaioli, N., Martin, A., and Rossi, S. (2018). Banks, Government Bonds, and Default: What do the data Say? Journal of Monetary Economics 98 (2018), 98-113.

Georgescu, O.-M., Gross, M., Kapp, D., and Kok, C. (2017). Do Stress Tests Matter? Evidence from the 2014 and 2016 Stress tests. Working Paper, ECB.

Gropp, R., Mosk, T., Ongena, S., and Wix, C. (2019). Banks Response to Higher Capital Requirements: Evidence from a Quasi-Natural Experiment. The Review of Financial Studies, 32(1), pp. 266-299.

Ivashina, V., and Scharfstein, D. (2010). Bank Lending during the Financial Crisis of 2008. Journal of Financial Economics, 97(3), pp. 319-338.

Kashyap, A. K., and Stein, J.C. (1995). The Impact of Monetary Policy on Bank Balance Sheets. Carnegie-Rochester Conference Series on Public Policy, 42, pp. 151-195.

Kashyap, A. K., and J. C. Stein (2000). What Do A Million Observations on Banks Say about the Transmission of Monetary Policy? American Economic Review 90, pp. 407-428.

Kashyap, A.K., Rajan, R., and Stein, J.C. (2002). Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and DepositTaking. The Journal of Finance, 57(1), pp. 33-73.

Kishan, R.P., and Opiela, T.P. (2000). Bank Size, Bank Capital, and the Bank Lending Channel. Journal of Money, Credit and Banking, pp. 121-141.

Klein, N. (2013). Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance. IMF WP 13/72.

Millon Cornett, M., McNutt, J.J., Strahan, P.E., and Tehranian, H. (2011). Liquidity Risk Management and Credit Supply in the Financial Crisis. Journal of Financial Economics, 101(2), pp. 297-312.

Myers, S.C., and Majluf, N.S. (1984). Corporate Financing and Investment Decisions When Firms Have Information that Investors do not Have. Journal of Financial Economics, 13(2), pp. 187-221.

Nkusu, M. (2011). Non-Performing Loans and Macrofinancial Vulnerabilities in Advanced Economies. IMF Working Paper 1/27.

Peek, J., and Rosengren, E. (1995). The Capital Crunch: Neither a Borrower nor a Lender Be. Journal of Money, Credit and Banking, 27(3), pp. 625-638.

Peek, J. and, Rosengren, E. (2005). Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan. American Economic Review, 95(4), pp. 1144-1166.

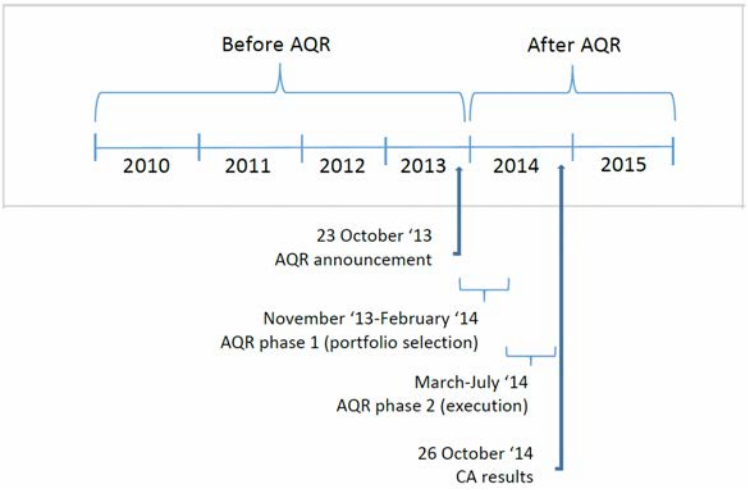
Schivardi, F., Sette, E., and Tabellini, G. (2017). Credit misallocation during the European financial crisis. BIS Working Paper 669.

Song, F., and Thakor, A.V. (2007). Relationship Banking, Fragility, and the Asset-Liability Matching Problem. The Review of Financial Studies, 20(6), pp. 2129-2177.

Wheeler, P.B. (2019). Loan loss accounting and procyclical bank lending: The role of direct regulatory actions. Journal of Accounting and Economics, forthcoming.

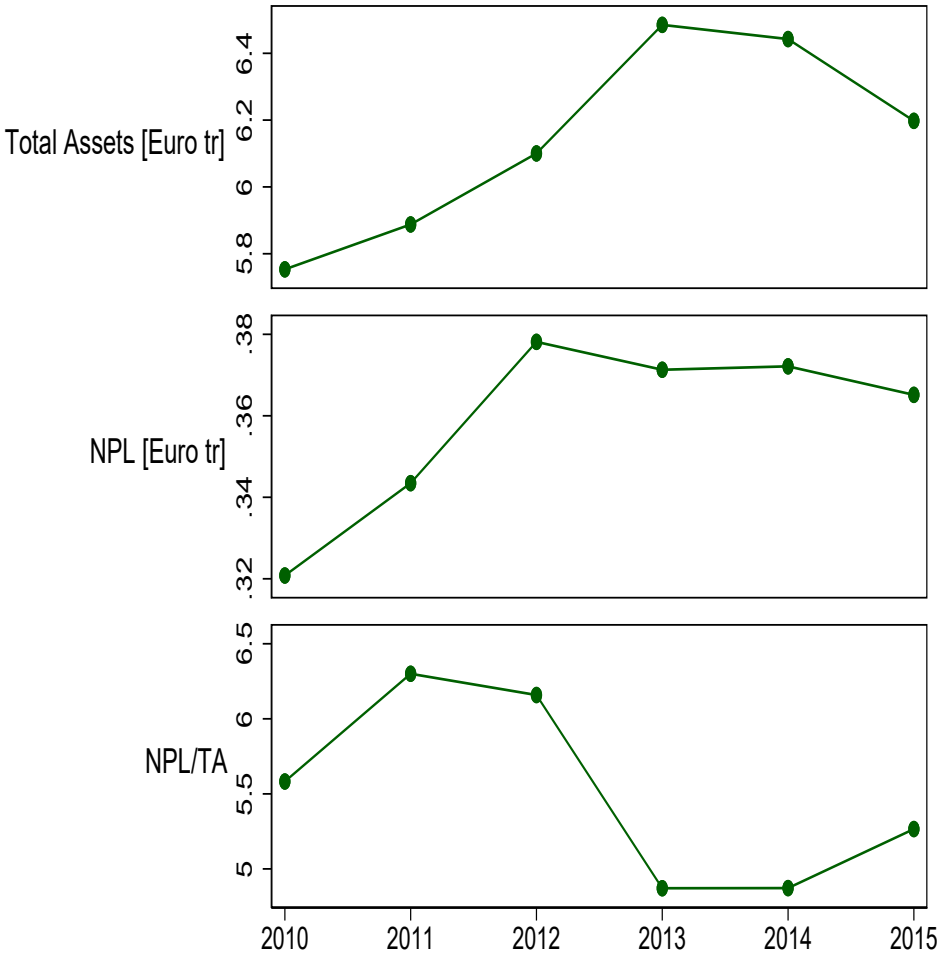
Figures

Figure 1: AQR timeline and phases



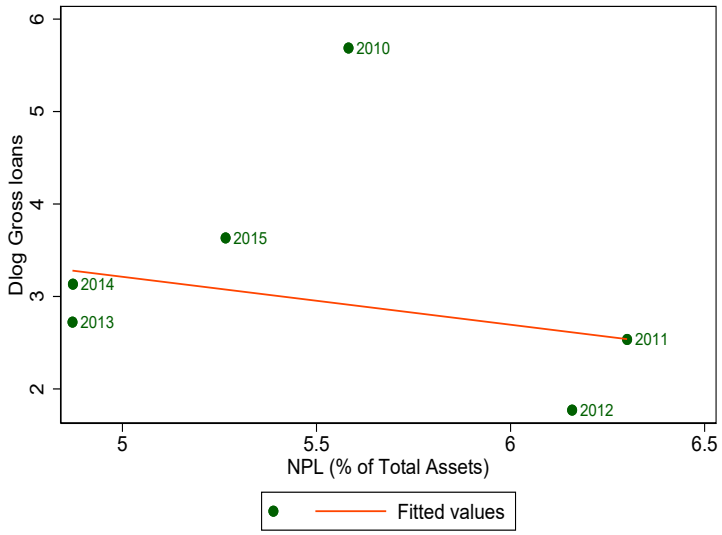
This figure displays the phases of the AQR exercise. On the 23th October 2013, the ECB announced details of the CA and published the list of banks subjected to the review. The banks selected were first subjected to the AQR that started in November 2013 with a process of portfolio selection (phase 1); following the completion of this phase in mid-February 2014, banks were subjected to the actual review of their asset quality (the so called execution or phase 2). The process ended in July 2014 with the adjustment of risk-weights. Building on these results, supervisory authorities conducted a stress test exercise. As of the end of October 2014, the CA final results were disclosed and recommendations for supervisory measure to be undertaken were released. On the 4th November 2014, the ECB assumed responsibility for the supervision of euro area banks.

Figure 2: Trends in NPLs and total assets



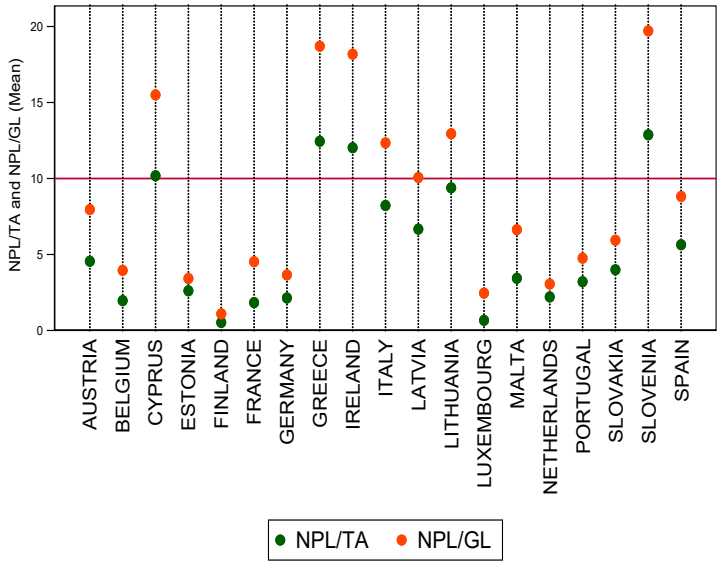
This figure tracks the evolution of total assets, NPLs and NPL to total asset ratio over 2010-2015.

Figure 3: Growth of gross loans and NPLs (as % of total assets)



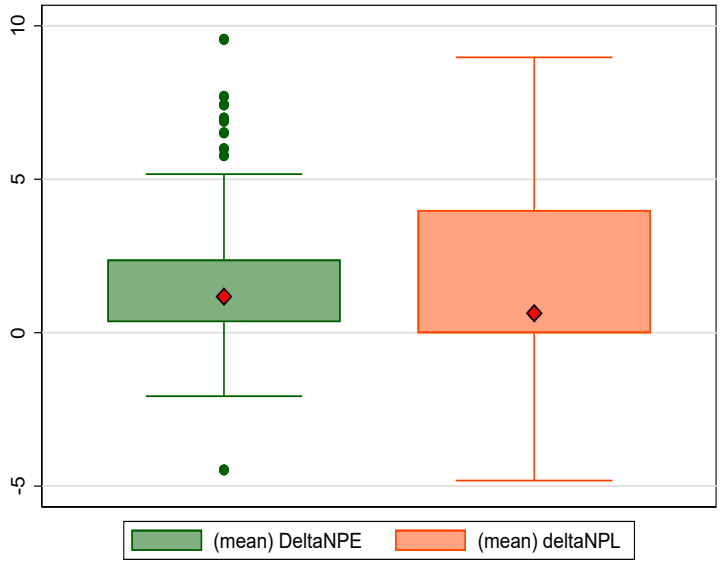
This figure shows the correlation between the growth of gross loans ($\triangle logGL$) and the share of NPLs on total assets. Each dot represents the average of country NPL/TA ratios in a year.

Figure 4: Heterogeneity of bank-level NPL ratios



This figure displays the average NPL ratios (NPL/TA and NPL/GL) of euro area banks by country in 2010-2015. The figure illustrates the construction of our indicator for identification as a high-NPL country. An NPL ratio of 10% is the threshold.

Figure 5: $\triangle NPE$ and $\triangle NPL$ distributions



This figure plots the $\triangle NPE$ (left figure) and $\triangle NPL$ (right figure) by AQR banks involved in the empirical analysis. $\triangle NPE$ variable is available for AQR banks only. Each dot represents the difference between the "un-adjusted NPE level as of year 2013"and the "AQR-adjusted NPE"as reported in the final report on the comprehensive assessment (ECB, 2014). $\triangle NPL$ is the change in the NPL/TA ratio over 2013-2014 computed from balance sheet information.

Tables

Table 1: Descriptive statistics

	(1) Mean	(2) St.Dev	(3) p10	(4) p50	(5) p90	(6) N
Total assets(Euro MM)	11,722	24,854	423.0	982.5	61,263	3,152
Gross loans (Euro MM)	7,101	14,859	261.4	619.0	37,056	3,152
Total securities (Euro MM)	2,571	5,480	84.70	256.4	13,438	3,152
Gross loans/TA	63.25	13.60	42.61	64.52	80.48	3,152
Total securities/TA	26.26	11.50	10.92	26.16	43.53	3,152
Growth rate total assets	3.462	6.137	-4.767	3.058	11.36	3,152
Growth rate gross loans	2.872	5.760	-4.470	2.503	9.698	3,152
Growth rate total securities	8.099	20.89	-15.76	5.199	40.14	3,152
Change in Gross loans/TA	-0.360	5.479	-8.674	-0.126	6.696	3,152
Change in Total securities/TA	6.039	19.38	-14.58	2.162	35.84	3,152
NPL/TA	5.373	4.250	0.797	4.022	12.65	2,895
NPL/Gross loans	8.315	6.303	1.560	6.440	19.57	2,895
Coverage ratio	46.12	17.76	26.23	43.30	68.60	2,892
Tier1 regulatory capital ratio	13.65	3.616	9.420	13.07	19.12	3,025
ROE	3.340	3.242	-1.650	3.050	7.210	3,151
ROA	0.281	0.268	-0.140	0.250	0.610	3,152
Cash and due from banks/TA	1.429	1.100	0.346	1.190	2.915	3,152
Total customer deposits/TA	58.60	17.83	35.65	58.63	81.25	3,151
Number of Banks	872	872	872	872	872	872

This table provides the summary statistics for all dependent and explanatory variables used in the paper over 2010-2015.

Table 2: AQR vs non-AQR banks

	Non-AQR (1)		AQR (2)		AQR-Non-AQR (3)	
	Mean	St.Dev.	Mean	St.Dev.	Diff	T-stat
Total assets(Euro MM)	3084.60	9934.82	57042.50	29050.19	53957.90***	(34.12)
Gross loans/TA	66.24	13.22	61.50	16.23	-4.74***	(-5.05)
Total securities/TA	23.62	11.30	25.42	12.40	1.80*	(2.47)
Gov.securities/Total Assets	10.84	9.53	9.49	6.20	-1.35**	(-3.03)
Change in Gross loans/TA	-0.99	5.76	0.09	5.89	1.08**	(3.09)
Change in Total securities/TA	10.20	22.51	5.29	19.16	-4.91***	(-4.13)
NPL/TA	5.66	3.85	5.32	4.30	-0.34	(-1.34)
NPL/Gross loans	8.36	5.42	8.35	6.02	-0.01	(-0.03)
Reserves for NPL/NPL	41.55	16.50	54.93	18.11	13.38***	(12.42)
Tier1 regulatory capital ratio	13.34	3.70	11.84	3.46	-1.50***	(-7.04)
ROE	3.12	2.89	4.28	5.11	1.15***	(4.05)
ROA	0.28	0.25	0.27	0.38	-0.01	(-0.68)
Texas ratio	48.74	29.40	55.41	30.26	6.67***	(3.66)
Liquidity Coverage Ratio %	121.50	85.56	154.43	52.39	32.93	(0.51)
Cash and due from banks	1.19	0.94	2.14	1.48	0.94***	(11.32)
Total customer deposits/TA	56.40	16.52	44.62	16.86	-11.78***	(-11.72)
Observations	1437		347		1784	

This table reports the descriptive statistics for banks from the AQR and non-AQR samples. Diff is the average difference between the second column (balance sheet items at AQR banks) and the first column (balance sheet items at non-AQR banks). We test the statistical significance of the difference using the t-statistic (T-stat). *, **, *** indicate statistically significant at the 1%, 5% and 10% level.

Table 3: Sovereign risk exposure and NPLs

	(1)	(2)	(3)	(4)	(5)	(6)
			Dep.var. $\triangle NPL$			
GIIPS*HGov	0.102	-0.204	0.190	0.072	-0.309	0.326
	(0.436)	(0.505)	(0.451)	(0.470)	(0.528)	(0.557)
GIIPS	-0.159	0.166	-0.318	-0.121	0.334	-0.391
	(0.668)	(0.637)	(0.569)	(0.679)	(0.648)	(0.577)
HGov	-0.131	-0.324	0.302	-0.174	-0.255	0.302
	(0.333)	(0.320)	(0.346)	(0.359)	(0.370)	(0.343)
			Dep.var. $\triangle NPE$			
GIIPS*HGov	0.575	0.344	-0.076	0.606	0.659	0.467
	(0.967)	(0.846)	(1.247)	(1.005)	(0.910)	(1.395)
GIIPS	-2.603**	-2.481*	-2.163*	-2.612**	-2.868**	-2.465**
	(1.140)	(1.257)	(1.118)	(1.138)	(1.204)	(1.154)
HGov	0.106	0.152	0.345	0.121	0.202	0.386
	(0.541)	(0.487)	(0.884)	(0.563)	(0.536)	(0.854)
Observations	229	229	229	229	229	229
Country*Size*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes

This table reports results from the regression of our measures of the change in asset quality ($\triangle NPL$ and $\triangle NPE$) on a proxy of the exposure to the sovereign crisis (the interaction between the dummies GIIPS and HGov). GIIPS is an indicator variable for banks domiciled in peripheral countries (Greece, Ireland, Italy, Portugal, and Spain). HGov is a dummy equal to 1 for banks with large share of government bonds to total assets in the pre-AQR period. Columns (1)-(6) report estimates from different definitions of HGov. In columns (1)-(3) a bank is considered as HGov if its average share of government bonds to total assets in the pre-AQR period is respectively above the mean, the median, and the 75-percentile in its own country. In columns (4)-(6) a bank is considered as HGov if its median share of government bonds to total assets in the pre-AQR period is respectively above the mean, the median, and the 75-percentile in its own country. We include in all specifications banks' time-varying characteristics (lagged one period) and country-sizeBin-year FE. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 4: The effect of AQR on NPLs

	NPL/TA	**NPL/GL**	**LogNPLs**	**LogGL**
AQR-Non-AQR[pre-treatment]	-0.342	-0.012	3.832***	3.663***
AQR-Non-AQR[post-treatment]	0.927***	1.513***	4.155***	3.757***
DD	**1.269*** **	**1.524** **	**0.323** **	**0.094**

This table reports basic differences in NPL/TA, NPL/GL, log NPLs and log GL between AQR and non-AQR bank (before and after the AQR exercise). DD is the difference in difference coefficient.

Table 5: Common trend and anticipation test

	NPL/TA		NPL/GL	
	(1) Common Trend Assumption	(2) Leads&Lags	(3) Common Trend Assumption	(4) Leads&Lags
AQR*2010		-1.433***		-0.821
		(0.436)		(0.578)
AQR*2011		-1.643***		-1.189*
		(0.496)		(0.674)
AQR*2012		-0.500		-0.408
		(0.529)		(0.729)
AQR*2014		**1.202** **		**1.916** **
		(0.558)		(0.834)
AQR*2015		0.609		1.052
		(0.579)		(0.878)
AQR*Year	0.124		-0.029	
	(0.139)		(0.196)	
Observations	1,072	2,895	1,072	2,895
Banks	447		447	
Bank controls	Yes	Yes	Yes	Yes
Sample	2010-2012	All	2010-2012	All
P-val leads		3.54e-06		0.0648

This table reports estimates of the effects of the AQR on the average annual NPL/TA, and NPL/GL. In each row, AQR is an indicator variable for banks subjected to the AQR supervision. In columns 1 and 3 the sample is pre-AQR (2010-2013) and the regression includes a linear trend as a control. In columns 2 and 4 P-value Leads is the p-value for the joint statistical significance of the leads effect of the AQR.

Table 6: Shock to NPLs and banks' behavior

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
AQR*Post*$\triangle NPL$	-1.521**	-1.650*	-2.406	0.245	-0.194
	(0.760)	(0.990)	(3.285)	(0.526)	(2.515)
Post*$\triangle NPL$	0.693**	-0.299	-1.602*	1.003***	-1.781***
	(0.287)	(0.283)	(0.888)	(0.215)	(0.637)
AQR*Post	2.515***	0.808	-3.100	2.381***	-4.762**
	(0.779)	(0.756)	(2.427)	(0.838)	(2.022)
Observations	3,135	3,135	3,135	3,135	3,135
Banks	856	856	856	856	856
Bank FE	Yes	Yes	Yes	Yes	Yes
Country*Size*Year FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes

This table presents the estimates of the change in the log of gross loans, the log of total assets, the log of total securities, the change in the ratio of gross loans to total assets and in the ratio of total securities to total assets. AQR is a dummy equal to 1 for banks subject to the first AQR exercise; Post is an indicator variable for the period 2014-2015; $\triangle NPL$ is the change in NPL/TA between 2013 and 2014. We include in all specifications bank fixed effects, banks' time-varying characteristics (lagged one period) and country-sizeBin-year FE. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 7: Shock to NPLs and banks' behavior: Matching

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
Panel A: Full matching					
AQR*Post*$\triangle NPL$	-1.678***	-0.845	0.058	-0.714	1.447
	(0.522)	(0.713)	(2.956)	(0.581)	(2.616)
Post*$\triangle NPL$	1.496***	-0.180	-1.461	1.857***	-1.967**
	(0.357)	(0.458)	(1.391)	(0.397)	(0.978)
AQR*Post	1.282	-0.544	-3.651	2.444**	-3.400
	(0.923)	(1.063)	(4.028)	(1.049)	(3.740)
Observations	704	704	704	704	704
Banks	127	127	127	127	127
Panel B: Within size, funding structure and country					
AQR*Post*$\triangle NPL$	-1.588*	-1.889**	-2.647	0.618	-0.286
	(0.821)	(0.942)	(4.370)	(1.146)	(3.781)
Post*$\triangle NPL$	1.253*	0.834	1.392	0.473	-0.016
	(0.703)	(0.743)	(3.527)	(1.051)	(2.941)
AQR*Post	2.734**	-1.110	-9.578**	4.902***	-9.436**
	(1.179)	(1.373)	(4.730)	(1.334)	(4.293)
Observations	563	563	563	563	563
Banks	101	101	101	101	101
Panel C: Within size and country					
AQR*Post*$\triangle NPL$	-2.543**	-2.983***	-7.279	1.198	-3.413
	(1.059)	(0.972)	(4.707)	(1.638)	(4.188)
Post*$\triangle NPL$	2.238**	1.985**	6.291	-0.138	3.323
	(0.978)	(0.794)	(4.045)	(1.596)	(3.560)
AQR*Post	2.898**	-0.933	-10.691**	5.091***	-10.859**
	(1.390)	(1.465)	(5.165)	(1.525)	(4.883)
Observations	546	546	546	546	546
Banks	97	97	97	97	97
Bank FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes

This table reports the estimation results from the three matching strategies employed in the paper. The full sample includes 82 AQR banks and 42 non-AQR banks. In the full sample matching procedure we select as pretreatment matching covariates the following bank characteristics: size and country, the customer deposit to total asset ratio, the loan to total asset ratio, the regulatory Tier 1 ratio, the net interest margin and the ROE.

Table 8: Shock to NPLs and banks' behavior: High- vs. Low-NPL countries

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
Panel A: High-NPL countries					
AQR*Post*$\triangle NPL$	-3.725***	-2.388**	-3.864	-0.986	-2.104
	(0.839)	(1.055)	(6.340)	(1.256)	(6.012)
Post*$\triangle NPL$	0.847**	-0.593*	-2.567**	1.366***	-2.466***
	(0.328)	(0.356)	(1.157)	(0.220)	(0.800)
AQR*Post	3.742***	-0.805	-8.125	4.040*	-6.970
	(1.399)	(1.697)	(5.579)	(2.138)	(4.913)
Observations	1,413	1,413	1,413	1,413	1,413
Banks	279	279	279	279	279
Panel B: Low-NPL countries					
AQR*Post*$\triangle NPL$	-0.533	-0.650	1.214	-0.112	2.288
	(1.061)	(1.375)	(3.485)	(0.588)	(1.901)
Post*$\triangle NPL$	0.219	0.499	0.629	0.007	-0.388
	(0.359)	(0.421)	(1.083)	(0.268)	(0.907)
AQR*Post	2.959***	2.292**	0.725	1.916**	-1.691
	(1.111)	(1.075)	(2.762)	(0.888)	(1.937)
Observations	1,722	1,722	1,722	1,722	1,722
Banks	577	577	577	577	577
Bank FE	Yes	Yes	Yes	Yes	Yes
Country*Size*Year FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes

Table 8 presents the estimates of the change in the log of gross loans, the log of total assets, the log of total securities, the change in the ratio of gross loans to total assets and in the ratio of total securities to total assets. High-NPL countries are those with average NPL/GL above 10% in the pre-AQR period (2010-2013). AQR is a dummy equal to 1 for banks subject to the first AQR exercise; Post is an indicator variable for the period 2014-2015; $\triangle NPL$ is the change in NPL/TA between 2013 and 2014. We include in all specifications bank fixed effects, banks' time-varying characteristics (lagged one period) and country-sizeBin-year FE. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 9: Shock to NPLs and banks' behavior: Controlling for GDP growth

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
Panel A: Whole sample					
AQR*Post*$\triangle NPL$	-1.633**	-1.696*	-2.960	-0.003	-0.709
	(0.744)	(0.965)	(3.285)	(0.532)	(2.576)
Post*$\triangle NPL$	0.617**	-0.401	-1.771*	1.026***	-1.813***
	(0.289)	(0.329)	(0.974)	(0.229)	(0.660)
AQR*Post	2.508***	1.047	-1.400	2.393***	-3.027
	(0.761)	(0.698)	(2.317)	(0.806)	(2.064)
Observations	3,032	3,032	3,032	3,032	3,032
Banks	832	832	832	832	832
Panel B: High-NPL countries					
AQR*Post*$\triangle NPL$	-3.734***	-2.243**	-7.583	-1.759	-5.949
	(1.133)	(1.119)	(6.064)	(1.460)	(6.109)
Post*$\triangle NPL$	0.792**	-0.681*	-2.654**	1.398***	-2.455***
	(0.334)	(0.405)	(1.235)	(0.248)	(0.827)
AQR*Post	3.559**	-0.600	-1.303	4.456**	-0.490
	(1.712)	(1.689)	(5.455)	(2.167)	(5.498)
Observations	1,349	1,349	1,349	1,349	1,349
Banks	263	263	263	263	263
Panel C: Low-NPL countries					
AQR*Post*$\triangle NPL$	-0.599	-0.842	1.109	-0.041	2.719
	(1.069)	(1.352)	(3.486)	(0.550)	(1.893)
Post*$\triangle NPL$	0.094	0.413	0.459	-0.031	-0.508
	(0.365)	(0.405)	(1.018)	(0.273)	(0.883)
AQR*Post	2.838***	2.155**	0.406	2.168***	-1.028
	(1.080)	(1.036)	(2.730)	(0.834)	(1.940)
Bank FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes
GDPgrowth*Country FE	Yes	Yes	Yes	Yes	Yes

This table presents the estimates of the change in the log of gross loans, the log of total assets, the log of total securities, the change in the ratio of gross loans to total assets and in the ratio of total securities to total assets. High-NPL countries are those with average NPL/GL above 10% in the pre-AQR period (2010-2013). AQR is a dummy equal to 1 for banks subject to the first AQR exercise; Post is an indicator variable for the period 2014-2015; $\triangle NPL$ is the change in NPL/TA between 2013 and 2014. We include in all specifications bank fixed effects, banks' time-varying characteristics (lagged one period) and GDPgrowth*Country FE. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 10: Shock to NPLs and banks' behavior: Controlling for credit demand

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
Panel A: Whole sample					
AQR*Post*$\triangle NPL$	-1.538**	-1.540*	-2.919	0.015	-0.797
	(0.719)	(0.925)	(3.224)	(0.530)	(2.548)
Post*$\triangle NPL$	0.616**	-0.415	-1.775*	1.038***	-1.813***
	(0.289)	(0.331)	(0.984)	(0.230)	(0.663)
AQR*Post	2.120***	0.256	-2.485	2.349***	-3.523*
	(0.764)	(0.758)	(2.272)	(0.798)	(1.970)
Observations	3,087	3,087	3,087	3,087	3,087
Banks	848	848	848	848	848
Panel B: High-NPL countries					
AQR*Post*$\triangle NPL$	-2.372**	-1.030	-5.902	-1.218	-5.453
	(1.193)	(1.199)	(5.670)	(1.346)	(5.642)
Post*$\triangle NPL$	0.747**	-0.724*	-2.727**	1.392***	-2.492***
	(0.336)	(0.408)	(1.242)	(0.248)	(0.826)
AQR*Post	1.027	-2.834	-4.761	3.524*	-1.694
	(1.772)	(1.803)	(4.664)	(1.865)	(4.374)
Observations	1,393	1,393	1,393	1,393	1,393
Banks	277	277	277	277	277
Panel C: Low-NPL countries					
AQR*Post*$\triangle NPL$	-0.346	-0.690	0.916	0.009	2.251
	(1.014)	(1.312)	(3.424)	(0.549)	(1.918)
Post*$\triangle NPL$	0.041	0.370	0.493	-0.023	-0.394
	(0.367)	(0.409)	(1.034)	(0.272)	(0.899)
AQR*Post	3.400***	2.358**	0.546	2.137**	-1.648
	(1.019)	(1.017)	(2.761)	(0.881)	(2.007)
Observations	1,694	1,694	1,694	1,694	1,694
Banks	571	571	571	571	571
Bank FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes
CreditDemand*Country FE	Yes	41Yes	Yes	Yes	Yes

This table shows results from DDD regression including bank fixed effects, banks' time-varying characteristics (lagged one period) and CreditDemand*Country FE (we interact the measure of credit demand in the ECB Bank Lending Survey with the respective country dummy). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 11: Shock to NPLs and banks' behavior: AQR banks

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
			Panel A: Whole sample		
Post*$\triangle NPE$	-0.597*	-0.213	0.238	-0.431*	0.245
	(0.313)	(0.418)	(0.907)	(0.227)	(0.680)
Observations	516	516	516	516	516
Banks	102	102	102	102	102
			Panel B: High-NPL countries		
Post*$\triangle NPE$	-1.694***	-1.681**	-1.589	-0.202	-0.021
	(0.490)	(0.688)	(1.959)	(0.435)	(1.500)
Observations	155	155	155	155	155
Banks	29	29	29	29	29
			Panel C: Low-NPL countries		
Post*$\triangle NPE$	-0.253	0.442	0.663	-0.690***	0.038
	(0.374)	(0.333)	(1.005)	(0.243)	(0.898)
Observations	361	361	361	361	361
Banks	73	73	73	73	73
Bank FE	Yes	Yes	Yes	Yes	Yes
Country*Size*Year FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes

This table presents the estimates of the change in the log of gross loans, the log of total assets, the log of total securities, the change in the ratio of gross loans to total assets and in the ratio of total securities to total assets. High-NPL countries are those with average NPL/GL above 10% in the pre-AQR period (2010-2013). AQR is a dummy equal to 1 for banks subject to the first AQR exercise; Post is an indicator variable for the period 2014-2015; $\triangle NPE$ is the actual adjustment in NPLs between 2013 and 2014 as calculated by the ECB. We include in all specifications bank fixed effects, banks' time-varying characteristics (lagged one period) and country-sizeBin-year FE. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 12: Shock to NPLs and banks' behavior: Excluding AQR banks with capital shortfall

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
Panel A: Whole sample					
AQR*Post*$\triangle NPL$	-1.316	-0.619	3.556	-0.484	4.562**
	(0.851)	(1.079)	(2.780)	(0.570)	(1.853)
Post*$\triangle NPL$	0.837***	-0.453	-2.593**	1.316***	-2.533***
	(0.324)	(0.336)	(1.148)	(0.238)	(0.836)
AQR*Post	2.135**	-0.747	-8.760***	4.440***	-6.528***
	(1.029)	(1.068)	(2.938)	(1.279)	(2.420)
Observations	2,367	2,367	2,367	2,367	2,367
Banks	816	816	816	816	816
Panel B: High-NPL countries					
AQR*Post*$\triangle NPL$	-3.022**	-0.067	13.387	-3.682*	12.653
	(1.241)	(1.548)	(9.550)	(2.045)	(8.582)
Post*$\triangle NPL$	0.813**	-0.630*	-2.835**	1.423***	-2.615***
	(0.346)	(0.367)	(1.225)	(0.243)	(0.870)
AQR*Post	2.632*	-3.769*	-21.735**	7.586***	-16.182**
	(1.419)	(2.250)	(8.754)	(2.719)	(7.447)
Observations	1,115	1,115	1,115	1,115	1,115
Banks	262	262	262	262	262
Panel C: Low-NPL countries					
AQR*Post*$\triangle NPL$	-1.354	-1.656	4.864	0.215	6.647*
	(1.396)	(1.486)	(4.605)	(1.184)	(3.830)
Post*$\triangle NPL$	0.710	1.503**	-1.422	-0.600	-3.186
	(0.946)	(0.682)	(3.353)	(0.904)	(3.314)
AQR*Post	2.495	0.620	-6.516*	4.251***	-4.745
	(1.615)	(1.506)	(3.797)	(1.479)	(3.044)
Observations	1,252	1,252	1,252	1,252	1,252
Banks	554	554	554	554	554
Bank FE	Yes	Yes	Yes	Yes	Yes
Country*Size*Year FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes

This table presents the estimates of the change in the log of gross loans, the log of total assets, the log of total securities, the change in the ratio of gross loans to total assets and in the ratio of total securities to total assets. High-NPL countries are those with average NPL/GL above 10% in the pre-AQR period (2010-2013). AQR is a dummy equal to 1 for banks subject to the first AQR exercise; Post is an indicator variable for the period 2014-2015; $\triangle NPL$ is the change in NPL/TA between 2013 and 2014. We include in all specifications bank fixed effects (FE), banks' time-varying characteristics (lagged one period) and country-sizeBin-year FE (this allows us to interpret coefficients as within country-sizeBin-year effects). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 13: Shock to NPLs and banks' behavior: Excluding AQR banks with large adjustments in provisions

	(1) $\triangle logGL$	(2) $\triangle logTA$	(3) $\triangle logSEC$	(4) $\triangle GL$	(5) $\triangle SEC$
			Panel A: Whole sample		
AQR*Post*$\triangle NPL$	-0.801	0.068	4.832	-0.630	5.332**
	(0.964)	(1.092)	(3.034)	(0.549)	(2.116)
Post*$\triangle NPL$	0.833**	-0.453	-2.556**	1.304***	-2.517***
	(0.325)	(0.339)	(1.151)	(0.237)	(0.835)
AQR*Post	2.473**	-0.471	-7.661**	4.571***	-5.526**
	(1.123)	(1.173)	(3.372)	(1.321)	(2.811)
Observations	2,313	2,313	2,313	2,313	2,313
Banks	806	806	806	806	806
			Panel B: High-NPL countries		
AQR*Post*$\triangle NPL$	-3.367**	-3.663**	20.081	-0.404	21.792
	(1.497)	(1.482)	(18.532)	(2.727)	(16.306)
Post*$\triangle NPL$	0.808**	-0.631*	-2.812**	1.418***	-2.587***
	(0.345)	(0.366)	(1.214)	(0.241)	(0.857)
AQR*Post	4.061***	-1.199	-23.523**	6.819**	-20.197**
	(1.492)	(1.874)	(11.699)	(3.345)	(10.178)
Observations	1,077	1,077	1,077	1,077	1,077
Banks	253	253	253	253	253
			Panel C: Low-NPL countries		
AQR*Post*$\triangle NPL$	-1.451	-1.027	6.219	-0.854	7.939**
	(1.601)	(1.538)	(4.602)	(1.068)	(3.868)
Post*$\triangle NPL$	0.868	1.788**	-0.700	-0.601	-3.097
	(0.948)	(0.701)	(3.517)	(0.913)	(3.400)
AQR*Post	2.308	0.062	-6.552	4.154***	-3.780
	(1.701)	(1.548)	(4.081)	(1.406)	(3.414)
Observations	1,236	1,236	1,236	1,236	1,236
Banks	553	553	553	553	553
Bank FE	Yes	Yes	Yes	Yes	Yes
Country*Size*Year FE	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes

This table presents the estimates of the change in the logarithm of gross loans, the change in the logarithm of total assets, the change in the logarithm of governent securities, the change in the ratio of gross loans to total assets and the change in the ratio of total securities to total assets. The first row contains the DDD coefficients for the change in the dependent variables before the AQR treatment (2010-2013) and after (2014-2015) for treated banks induced by a change in the volume of NPLs. We include in all specifications bank fixed effects (FE), banks' time-varying characteristics (lagged one period) and country-sizeBin-year FE (this allows us to interpret coefficients as within country-sizeBin-year effects). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.