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How Banks Respond to NPLs? Evidence from the Euro Area

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

Abstract
We study how deterioration in asset quality influenced the way euro area banks adjusted their balance sheets in 2010-2015. Fixed-effect analysis finds strong evidence of a negative correlation between asset quality and the growth in assets and lending. To determine the direction of causality, we exploit the 2014 ECB Asset Quality Review exercise in a diff-in-diff framework. We uncover a strong direct negative effect of higher NPLs on banks' credit supply. AQR banks plagued by high levels of problem loans reacted more sharply than reviewed banks with a low level of troubled assets.

JEL Classification: G20, G21, G01

Keywords: NPLs, non-performing loans, bank lending, asset quality, AQR

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1 Introduction

As of the end of 2016, non-performing loans (NPLs) in banks under the supervision of the European Central Bank (ECB) still amounted to €900 billion, equivalent to nearly 9% of gross domestic product (GDP) and 6% of all loans in the euro area, with considerable variation across banks and countries.[1] It is well known that high NPLs are likely to have various adverse micro effects (Aiyar and Monaghan 2015). But what has made the NPL question a macro prudential issue is the European perspective.

NPLs have recently come to the attention of macro prudential authorities in Europe because of the potential negative externalities to financial and economic stability (ESRB 2019). Among these externalities, the ECB President has mentioned the impact on credit supply and, via this channel, on the monetary policy transmission mechanism (Draghi 2017). Negative externalities may stem from the repercussions of an unresolved stock of NPLs on perceptions of the health of the financial system, making bank funding more expensive and discouraging banks from new lending. Moreover, lending can be impeded as banks with poorer asset quality may seek to regain adequate capital ratios by deleveraging and cutting back on lending rather than by raising new equity. High NPL ratios can also distort managers' incentives, if troubled loans, by eroding bank capital, heighten moral hazard and favor excessive risk taking.

Although European authorities have motivated the recent initiatives on NPLs by reference to these externalities, no clear-cut evidence is available to date of a causal relationship between more NPLs and lower credit supply. Most studies on NPLs are either descriptive or focused on the determinants, rather than the consequences, of problem loans (see among others Nkusu 2011 and Klein 2013). Much of the evidence that NPLs impair the lending channel comes from the Japanese crisis more than twenty years ago (Peek and Rosengren 2005); recent empirical evidence on the effect of NPLs on credit supply is scant and to the most part focused on single countries; all this undermines the general validity of these analyses. Whether a greater volume of NPLs actually restrains banks from lending, and why, remain empirical questions.[2]

To fill this gap, we use micro-level bank data to see how banks adjusted their balance sheets and supply credit when NPLs increased. We focus on euro area banks because in this

[1] We use NPLs, impaired, troubled, and problem loans as synonyms, although we are aware that, across jurisdictions and even across banks, different meanings may be associated with these terms (BCBS 2017).

[2] See Angelini (2018) who casts doubt on the thesis that NPLs have a direct causal effect on credit growth.

sphere they compare unfavorably with their international peers: NPLs in euro area banks skyrocketed in the wake of the global financial crisis, making them more vulnerable than US or Japanese institutions to the repercussions of poor asset quality (IMF 2015).

We proceed in two steps. In the first part of our research, we measure how asset quality is associated with the growth of assets, lending and securities, and to changes in the ratios of loans and securities to assets. We use several gauges of asset quality: the share of NPLs in total assets (our preferred indicator), the Texas ratio, and the share of NPLs in total loans. We interpret our results in light of plausible mechanisms (channels) through which NPLs may influence banks' behavior.

We find that lower asset quality is associated with reduced asset, loan and (to a lower extent) securities growth. In economic terms, a one percentage point increase in the share of NPLs in total assets reduces the annual growth of assets, loans and securities by 17%, 23% and 10%, respectively, to their average values. This evidence supports the presence of both a regulatory capital and a market discipline channel. To explain the mechanism, it is plausible that riskier banks are exposed to more severe scrutiny by regulators and/or the market; they react by deleveraging and pruning risky assets (such as loans) more sharply than safe assets (such as securities), in order to improve asset quality, restore market confidence, and raise their capital ratios.

To better identify the mechanisms whereby NPLs affect the way banks adjust their balance sheets, we look at the differential behavior of outliers when asset quality deteriorates. We find that when asset quality falls, weak (poorly capitalized) banks tend to shrink their assets by cutting back securities more sharply than loans; the composition effect is a larger share of assets allocated to loans. We also find that low profitable banks tend to increase lending more than the average sample bank. This behavior is consistent with a risk taking/reach-for-yield strategy.

We also aim to understand how banks buffered by high levels of provisions and common equity (in relation to NPLs) adjusted their balance sheets as asset quality deteriorated. We find some evidence of the effectiveness of these buffers in shielding lending. Precisely, we uncover that unlike the average sample bank, the well provisioned banks deleveraged at the expense of the securities and not the lending portfolio. This offers support for the view that adequate provisioning can mitigate the negative effect of bad loans on credit supply (Constâncio 2017).

In the second part of our research, we take the analysis a step further investigating the direction of causality between asset quality and banks' behavior. In principle, the causality could run from banks' credit supply to their stock of NPLs rather than the other way. In many European countries, high levels of NPLs are the legacy of prolonged recession, which may have reduced credit demand as well as supply.[3] Reduced credit supply could have triggered defaults, which could in turn have produced the rise of NPLs.

To address this issue, we exploit the first ECB Asset Quality Review (AQR) exercise as a quasi-natural experiment. The AQR was one of the two pillars of the comprehensive assessment undertaken by the ECB for the first time in 2014 in preparation for the SSM. This was a new initiative, unprecedented in its European scale that concentrated on those elements of individual banks balance sheets that were believed to be most risky or non-transparent (ECB 2013). The asset quality review was conducted with reference to harmonized definitions and entailed an assessment of the accuracy of banks asset valuation. Precisely, reviewed banks were required to apply a new and harmonized definition of non-performing exposures (NPEs) and were subjected to a data integrity validation and on-site reviews of their credit files. The exercise resulted in additional NPEs by nearly €140 billion (+18.4%) and additional provisions of €48 billion (+12%) as an effect of the consistent application of the EBA simplified approach to defining NPEs and the credit file review (ECB 2014).

To determine the impact of the exogenous variations in NPLs induced by the AQR, we use a diff-in-diff strategy and compare AQR banks with non-AQR banks over the years just before the AQR (2010-2012) and just after (2014-2015). This enables us to see whether reviewed banks adjusted their balance sheets differently from similar un-reviewed banks.

For identification, for better comparability between treated and untreated banks we include country, year, and bank size fixed effects, thus controlling for time-varying unobserved differences at country and year level (e.g., variation in credit demand), and also for heterogeneity induced by bank size. We consider size for two main reasons. First, the ECB's criteria for subjecting banks to the AQR are based primarily on dimensional factors. Second, in the theoretical and empirical literature bank size is notoriously a powerful explanatory factor for funding and resources allocation policies (see Kashyap and Stein 1995, and Kishian and Opiela 2000 among others). To mitigate the concern that the results could be driven by characteristics other than size, we also use several additional control variables at the bank

[3]See Mohaddes et al. (2017) and the references therein for a review of the literature on the role of cyclical factors affecting NPLs.

level.

The diff-in-diff analysis shows first that the AQR banks shrank their balance sheets more than non-AQR banks, primarily by downsizing securities portfolios. In line with Eber and Minoiu (2016), we find that resources allocated to lending increased at the expense of securities in proportion to total assets.

To isolate the impact of increased NPLs as induced by the AQR, we examine the interactive effects of several measures of asset quality in treated versus untreated banks. First, we find evidence that a deterioration in asset quality at AQR banks had size and composition effects, leading to reduced lending growth and loan to asset ratio. This evidence is confirmed when we compare AQR banks that have a large stock of NPLs to reviewed banks with low level of troubled assets. The reaction to low asset quality seems to be more pronounced in high-NPL banks from high-NPL countries, possibly because risky banks from risky countries are more exposed to funding constraints and regulatory pressure.

The findings are confirmed in two further tests on a smaller sample of AQR banks, excluding those with a capital shortfall and those making larger adjustments to provisions, as a consequence of the ECB comprehensive assessment.

Our paper generally contributes to the literature on the effect of regulation and supervision on the way banks adjust their balance sheets. Gropp et al. (2019) use the 2011 EBA capital exercise as an exogenous shock to bank capital to show that the treated banks increased capital ratios by more than the untreated, and again by reducing lending rather than increasing equity. Using stress tests on US banks, Acharya et al. (2018) study the credit supply effects of stress tests and show that stress tested institutions reduced lending, particularly to relatively risky borrowers.

Abbassi et al. (2017) exploit a discrepancy between the date of the announcement of the 2014 AQR and the start date of the exercise to test whether German banks dressed up for regulators by changing their risk profile. They find that after the announcement, reviewed banks temporarily decreased the share of riskier assets but partly reloaded their risk back at the end of the AQR. Eber and Minoiu (2016), exploiting a discontinuity in the assignment mechanism of the ECB comprehensive assessment, find that banks adjusted to stricter supervision by reducing leverage. They also find that most of the adjustments consisted in asset shrinkage rather than equity expansion and that securities were adjusted more sharply than loans. Fiordelisi et al. (2017) exploit the launch of the single supranational

supervisor to see whether the banks that expected to fall under the direct ECB supervision acted differently from smaller banks that would remain under the national supervisor. They find that the former reduced lending more than the latter, an undesired effect of stricter regulation.

In this strand of literature, we are more closely related to studies exploiting the advent of the single supervisory mechanism in Europe. Unlike these studies, we take advantage of the adoption of a new definition of NPLs and stricter scrutiny in the 2014 AQR to study the direct response of banks to an exogenous deterioration in their asset quality. In a work most closely related to our own, Accornero et al. (2017) exploit the supervisory interventions associated to the 2014 AQR to identify exogenous variations in Italian banks' NPLs and measure their impact on lending. They find that the emergence of new troubled loans caused a reduction in credit, probably motivated by stepped-up provisioning. We differentiate from this study in several ways. First, our paper looks at a large sample of banks in the euro area, not a single country. This enables us to exploit country as well as bank heterogeneity and address concerns on the limited external validity of their analysis. Second, we do not investigate only bank lending, but also how banks choose to adjust the overall asset side. Third, we include several extensions and analyze outliers' behavior to gain insights on the mechanisms through which NPLs influence banks' behavior.

Overall, our study provides broad new evidence on how low asset quality influences banks' resource allocation. For the benefit of current debate, we show that our main results are not driven by outliers, i.e., undercapitalized and unprofitable banks. Our findings challenge the thesis that NPLs impair lending only in weak banks (Angelini 2018) and provide support for the view that "NPLs are less of a risk if they are adequately buffered"(Constâncio 2017). We also demonstrate the direct causal nexus between higher NPLs and balance sheet adjustments. Results are stronger for banks with high level of NPLs compared to non-high NPL banks. If these institutions are domiciled in high-NPL countries, low asset quality has a size effect, reducing asset and credit growth. If high-NPLs banks are domiciled in low-NPL countries, low asset quality has a composition effect, resulting into a smaller share of loans in total assets.

As to policy implications, from a macro prudential perspective our results confirm the need for comprehensive and pan-European measures to resolve troubled assets. Micro-prudential measures like prudential provisioning backstops or higher capital requirements

are important, but they may be insufficient to set bank lending in motion again in a context of high NPLs.

The paper proceeds as follows. Section 2 illustrates the mechanisms by which NPLs can affect banks behavior and presents our empirical predictions. Section 3 describes the data and sets out some stylized facts about asset quality in euro area banks in 2010-2015. Sections 4 and 5 discuss our two-step empirical approach and present the results. Section 6 concludes.

2 How NPLs affect banks' behavior

In this section, we illustrate the channels through which higher levels of NPLs may affect banks' behaviour, formulating predictions derived from these channels on the effects on asset size and composition.

2.1 The regulatory capital channel

As in the bank capital crunch in the US in the early 1990s (Peek and Rosengren 1995; Woo 2003), the regulatory capital channel involves a more severe scrutiny in response to increased concern over bank risk. Such a shift in regulatory policy, if occurred, would impose an additional charge on risky business and oblige banks to adjust their balance sheets to comply with the stricter requirements.

Banks facing binding capital constraints, as a result, say, of large loan losses and low earnings, have two options: raise new capital or shrink both assets and liabilities. Plausibly, they will prefer to shrink their balance sheet by reducing lending in favor of safer assets such as securities (Berger and Udell 1994). Major reasons for banks to deleverage rather than issue new equity are asymmetric information and the lemons problem (Myers and Majluf 1984). Peek and Rosengren (1995) argue that, as managers have no incentive to disclose problems in their asset portfolio, potential equity purchasers, worried that only risky banks would be willing to dilute their equity, will refuse new issues unless rewarded by higher than "normal" returns. So, because new equity cannot be issued at a price deemed reasonable by bank managers and current shareholders, asset shrinkage remains the only feasible alternative. In the same vein, Admati et al. (2018) show that with debt in place, shareholders resist lowering leverage; if forced to reduce leverage, however, they are biased toward selling assets

as against such potentially more efficient alternatives as pure recapitalization.

Recent empirical works confirm these predictions. Among others, De Jonghe at al. (2016) find that increases in required and actual bank capital ratios shrink balance sheets and produce compositional changes, with a relative scaling-back of assets subject to higher capital charges. Gropp et al. (2019) show that banks subjected to the 2011 EBA capital exercise responded to higher capital requirements by reducing risk-weighted assets rather than raising new equity.

At micro level, the major reason why a larger stock of NPLs can activate this channel is the mechanical negative impact of troubled loans on risk-based capital ratios. First, troubled loans have higher risk weights than performing loans, which, *ceteris paribus*, increases automatically the denominator of capital ratios (i.e., risk-weighted assets). Second, by comparison with performing positions, large NPL portfolios tend to generate lower fees and interest revenues, with greater operating and provisioning costs and, overall, higher losses. The combination of reduced sources of revenue and increased expenses depresses profits and may erode available capital (the numerator of the ratios).

What is more, the years under analysis here comprise a period of considerable tightening of the regulatory framework in Europe in a number of respects. The Basel III rules, requiring more and higher quality capital, were released in 2010 and phased in from the beginning of 2013. Simoultanesly, in 2011 the European Banking Authority required a subset of European banks to raise their core Tier 1 capital ratio well above the minimum. Meanwhile, national central banks conducted asset quality reviews of domestic banks with a view to the first ECBs broad asset quality assessment and the Single Supervisory Mechanism (SSM), whose introduction in October 2014 was, practically by definition, a decisive step towards stricter supervision (Eber and Minoiu 2016).

At the same time, European central authorities have undertaken a series of initiatives designed explicitly to strengthen banks' ability to cope with NPLs. For example, in 2013 the EBA adopted harmonized but, all in all, stricter definition of non-performing exposures;[4] more recently, in 2017, the ECB published guidance to significant institutions subject to SSM on how to recognize, provision and manage troubled loans. Although formally they were addressed to large banks only, a side effect of these measures was a generalized tightening

[4]A simplified version of this harmonized definition was firstly applied to banks under the 2014 asset quality review. The ECB, in commenting the application of the new metric, claim that "on average banks' internal definitions were less conservative than the simplified EBA approach" (ECB 2014, p. 67).

of supervisory practices and legal frameworks for all banks in Europe (ECB 2016). These circumstances suggest that in response to more severe regulatory and supervisory scrutiny in the euro area, banks with lower asset quality are more likely to shrink their assets more sharply than banks with better asset quality. To improve capital ratios, the former banks are more likely to cut back riskier assets more intensively than safer assets, i.e., to shift resources from assets with high risk weights (loans) to low risk-weighted assets (securities).

2.2 The funding (market discipline) channel

A second way in which poor asset quality can affect banks' balance sheet adjustment is what we may call a "funding" channel.

Generally speaking, a large stock of opaque assets in institutions featuring high leverage poses problems of information asymmetry and moral hazard, entailing agency costs in the form of a higher external funding premium (Bernanke and Gertler 1989). Thus, NPLs may exacerbate information asymmetry both by worsening risk profile and by increasing opacity. Investors may see a heavy burden of troubled loans as a sign of poor management and idiosyncratic risk, which explains why a high NPL ratio has traditionally been regarded as a key predictor of bank failure (see Kaminsky and Reinhart 1999, among others). It follows that a high level of NPLs can worsen market valuation and drive up the cost of funding.

Moreover, NPLs increase banks' opacity because the cash flows associated with problem loans are uncertain in both amount and timing (Kishan and Opiela 2012). The NPL aggregate embraces exposures with different risk levels. In the absence of a detailed breakdown, two banks reporting the same NPL ratio may be facing quite different levels of credit risk, depending on the actual composition of the NPL portfolio. In addition, some of the exposures labeled as "non-performing" may be adequately collateralized and others not, which affects the expected loss from the NPL portfolio. The actual recovery rate on NPLs will depend not only on the amount and quality of collateral, but also on the efficacy of the enforcement procedure and, overall, on the strength of the legal framework (ECB 2016). All these factors may vary across banks and countries, and discrepancies exist even within each country.[5]

On the whole, due to the intrinsic opacity of problem loans, it can be cumbersome or

[5]See Bholat et al. (2016) on the divergences in the definitions of NPLs. See Schiantarelli et al. (2016) for an analysis of the effect of the different degrees of local judicial efficiency in Italy.

costly for investors to assess a bank's net worth or exercise market discipline in a context of high NPLs. More NPLs will also raise bank risk and, hence, the cost of funding. Both these circumstances may discourage banks with higher NPL ratios from growing and expanding their credit.

2.3 The reach-for-yield channel

Another plausible mechanism, however, is that more NPLs induce banks to expand, rather than reduce, credit supply. This may occur if moral hazard concerns arise and a risk taking/reach-for- yield strategy is at work. High leverage and information asymmetries produce agency problems and moral hazard (Jensen and Meckling 1976). This gives borrowers an incentive for risk taking, say by trying to switch to riskier assets, unless the expected profits from safer assets are sufficiently high.

All things being equal, high NPLs may aggravate moral hazard by increasing the opacity and weakening profits and the capital position of the bank. Higher NPL ratios depress profitability owing to lower fees and less interest revenue, higher operating costs for loan workout and stepped-up provisioning. With declining profits, available capital deteriorates. Large realized losses on NPL disposals may ultimately engender a capital shortage. This mechanism implies that banks with more NPLs increase their risks. Hence, they increase their loans by more (or reduce them by less) than securities and revamp their portfolio by replacing less profitable/less risky assets (securities) with riskier and more profitable ones (loans).

3 The data and some stylized facts

This section reports our data and offers some stylized facts about asset quality and the allocation strategies of euro area banks from 2007 to 2015. These facts will help us to understand the data correlations at aggregate level, plus the additional insights gained by exploiting the variations at bank-level.

Our main source of bank-level data is ORBIS Bank Focus, a comprehensive commercial database of financial statements provided by Bureau van Dijk Electronic Publishing (BvD). We start with the full sample of euro area banks, collecting consolidated balance sheet

information for 2007-2015.[6] We collect information on a range of bank characteristics: size, funding structure, capitalization, liquidity, loan quality, loan volume, and asset composition. The ORBIS data are suitable for international comparisons because BvD harmonizes the data. Then we identify the banks subjected to the first AQR, using the results published by the ECB in October 2014 (ECB 2014).

Our initial sample consists of all 130 AQR banks and 1,080 non-AQR euro area commercial, cooperative and savings banks. Since the AQR was conducted at the highest level of consolidation, we consider banks that are classified as: GUO (global ultimate owner), independent companies, or single location banks. In the sample of non-AQR banks we exclude small banks (average total assets, in 2007-2015, below the national median), and banks with a ratio of gross loans to total assets lower than 10%.

Figure 1 tracks the evolution of total assets, NPLs and the NPL to asset ratio over the entire period. The top graph shows how total assets increased overall between 2007 and 2015. Banks deleveraged in the immediate aftermath of the crisis in 2009, then 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 held practically constant after 2012 at about 20% above the 2010 level. The dynamics of the two variables is shown in the bottom graph, which depicts a dramatic increase in the NPL to total asset ratio between the global financial crisis and the euro sovereign crisis. Figure 2 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 the negative contemporaneous correlation between credit growth and NPL to asset ratio.

Our empirical analysis focuses on the period from 2010 through 2015. The sample comprises 872 banks: 105 AQR and 767 non-AQR banks.

Table 1 shows the average asset and loan growth rates over 2010-2015 at 3.5 and 2.9%, respectively, with medians of 3.0 and 2.5%. On average, loans amounted to 63% of total assets and securities to 26%. As such, the average sample bank is a traditional commercial bank, whose core business is lending and whose main source of funds is customer deposits (which average nearly 59% of total assets). This average bank is medium-sized, with assets amounting to €12 billion. There is considerable cross-sectional variability, as indicated by

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

the large standard deviation of total assets (the median bank is small, with total assets less than €1 billion).

As for 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%.[7] These numbers are comparable to those reported in aggregate statistics (IMF 2015; ECB 2016).

Figure 3 reports the average ratios of NPLs to total assets and gross loans by country. The horizontal red line corresponds to 10% level. Like several ECB reports, 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, as well as the significant heterogeneity of asset quality across banks and countries.

Turning to soundness, the coverage ratio averages nearly 47%, but with large discrepancies across banks. The Tier 1 regulatory capital ratio averages close to 14%, well above the 8.5% fully loaded capital requirement, including the capital conservation buffer, set by Basel III. Note that since the onset of the euro debt crisis the EU banking industry has taken good many steps to strengthen its resilience. Finally, average ROE and ROA (3.3% and 0.3%, respectively) confirm that low profitability is a major concern aggravated by the large volume of NPLs; particularly, an average return-on-equity equal to just half the cost of bank equity raises concern over banks ability to raise capital on the market (Detragiache et al. 2018).[8]

[7] Precisely, 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.

[8] "The return on equity remains below the cost of equity with legacy assets, cost-efficiency and banks' business models still being some of the main obstacles towards reaching sustainable profitability levels" (EBA, Risk Dashboard as of Q1 2018).

4 Asset quality and banks behaviour: Preliminary investigation

4.1 Model specification

We first look at euro area banks to test whether and how larger stocks of NPLs (in proportion to total assets) affect asset size and composition. We specify the outcome for bank i in country j at time t in the following linear form:

$$y_{ij,t} = \alpha_0 + \beta_1 NPL_{ij,t-1} + \theta_1 X_{ij,t-1} + \mu_{ij,t} + \lambda_{ij} + \epsilon_{ij,t} \quad (1)$$

where $y_{ij,t}$ is the bank balance sheet item, i.e., the growth of assets, loans, and securities, and the share of gross loans and securities in total assets and $NPL_{ij,t-1}$ is the percentage of NPLs in total assets in the balance sheet of bank i in year $t-1$. The key coefficient of interest, β_1, indicates how banks with higher NPL/TA ratios adjusted their balance sheets between 2010 and 2015, controlling for other significant time-varying bank characteristics.[9]. The regression also includes several bank-level controls $X_{ij,t-1}$: the one year lagged explanatory variables, country-sizeBin-year fixed effects $\mu_{ij,t}$, and bank fixed effects λ_{ij}. Except for the fixed effects, the controls are lagged to mitigate feedback effects.

Our key explanatory variable is gross NPLs over total assets. By comparison with the NPL to loan ratio, this is more comprehensive, capturing the riskiness of lending as well as the balance sheet opacity. Both are relevant factors, owing to their regulatory and market discipline implications. In robustness checks, we replace our preferred asset quality measure first with the NPL ratio and then with the Texas ratio.

We include a strong set of controls for the main factors affecting credit supply in a context of high NPLs. We measure capitalization by the Tier 1 regulatory capital ratio. There is good empirical evidence that bank capital is important in the propagation of shocks to credit supply (see 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 is, by construction, more sensitive to risk; this helps to motivate a substitution effect between securities and (risky) loans, in the spirit of the regulatory capital channel.

[9]In untabulated results, we replicate our fixed-effect analysis over a longer time span (2007-2015). The results, available upon request, are qualitatively similar to those reported here.

To capture the role of funding structure, we focus on the ratio of customer deposits to total assets to gauge the importance of stable sources of funds. Theory predicts that largely inelastic core deposits are stable funding sources that have historically insulated bank funding cost against economic shocks, including exogenous credit risk shocks (Berlin and Mester 1999). In matching assets and liabilities, theory also maintains that banks may enjoy synergies when 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 like marketable securities (Song and Thakor 2007).[10] The global financial crisis, in fact, indicated that banks that relied more heavily on core deposits were less prone to contract lending than banks that depended on unstable wholesale sources of funding (Millon Cornett et al. 2011; Ivashina and Scharfenstein 2010). We use this indicator (also interacted with our measure of asset quality) to explore the relevance of the funding channel.

To control for profitability, we use ROE that has proven to be a key indicator for attracting external funds and as such may affect the way banks adjust their balance sheet in response to each channel.

We also include the coverage ratio because, as we will explain in next sections, an adequate coverage ratio may mitigate the concern provoked by a high level of NPLs and thus help explain different results at different banks.

In addition, we check one-year lagged measures of our dependent variables on asset composition and for bank characteristics that the lending channel literature commonly posits as drivers of 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 view of the relevance of asset liquidity, because banks with more illiquid assets hoarded liquidity and reduced lending more than liquid banks (Millon Cornett et al. 2011). We elected to use a restrictive measure of liquid assets because securities that were readily marketable in ordinary times (including government bonds), may turn illiquid during a crisis.

Finally, we include a set of fixed effects to allow for unobserved country-specific events that in a given year may have played a particular role in determining lending and/or asset

[10] Core deposits are an attractive funding source for relationship lending because the bank provides liquidity services to core depositors and this diminishes the likelihood of premature withdrawals, thereby facilitating the continuity of relationship loans (Song and Thakor 2007).

composition (e.g. the differential severity of the sovereign debt crisis in 2010-2012) and for structural factors that can influence credit supply, including changes in credit demand.[11] The cross-country feature of our analysis involves a comparison between different size distributions across countries. To adjust for this heterogeneity, we assign each bank to its appropriate size-bin in the country (above or below the national median), and control for country-sizeBin-year fixed effects.

4.2 Main results

Table 2 presents the basic results of the preliminary inquiry into the relation between asset quality and balance sheet adjustments. The estimates show that banks with poorer asset quality reduce both asset growth and, more sharply, the loan growth (columns 1 and 2). Economically, a one percentage point increase in the NPL to asset ratio implies a 0.5 percentage points lower annual asset growth and total loan growth (-15% and -17%, respectively), relative to their average values. This is evidence for both the regulatory capital and the funding channel: when asset quality deteriorates, banks may have to shrink balance sheets, preferably by reducing riskier assets, owing to stricter funding constraints and/or more severe scrutiny by either the market or regulators.

Consistent with our expectations and with the literature, we also find a strong positive correlation between profitability (ROE) and capitalization (Tier1Ratio) and asset and lending growth, with limited or no relation to the change in the asset mix. Not surprisingly, we also uncover that larger banks tend to deleverage and reduce lending by more (with no asset composition effect).

4.3 How NPLs affect banks' behavior? Main channels

We now turn to the question why NPLs influence banks behavior. Precisely, we seek to determine which of the channels illustrated in section 2 are more likely in relation to various balance sheet characteristics that can influence the way banks react to an increase of NPLs.

A bank's capital position can influence its response to a rise in NPLs. On the one hand,

[11] To control for the sovereign crisis more explicitly, in untabulated tests, we include the euro crisis (2010-2012) dummy. This is important, because European banks might have altered the asset mix by increasing their exposure to government bonds for reasons unrelated to asset quality consideration (see Altavilla et al. 2017 among others). The results, available upon request, are qualitatively similar to those reported here.

the resulting strains on profits and capital adequacy, may exert greater pressure on banks with low capital ratios to deleverage and reduce risk. These banks, accordingly, may conform better to the regulatory capital channel. On the other hand, higher NPLs can increase moral hazard and induce weaker (i.e., undercapitalized and unprofitable) banks to gamble for resurrection through reach-for-yield strategies. This may involve lending expansion (not reduction) and asset substitution, replacing securities with riskier, more profitable loans.[12]

Banks' funding structure may also affect the way they adjust their balance sheet to poorer asset quality. According to the market discipline mechanism, bankers that take on excessive risk or manage assets poorly will find it difficult to sell their (subordinated) wholesale debt, and will be forced to shrink their risky assets or to issue new capital to satisfy private uninsured debtholders (Calomiris 1999). Accordingly, we expect the NPL problem to promote greater discipline concerns in banks with a larger base of (subordinated) wholesale funding than in those that rely more on (insured) customer deposits. More exposed to market discipline and facing more stringent funding constraints, wholesale-fund-based banks will shrink assets more sharply than deposit-based banks. In choosing the portfolio mix, the former will be also more prone to shift from loans to securities.

In support of this background theory, there is ample evidence that core deposits are more sluggish that purchased money. Findings from the global financial crisis, in particular, show that wholesale-funded banks reacted to the liquidity shock by cutting back lending and increasing asset liquidity by more than deposit-based banks (Millon Cornett et al. 2011; Ivashina and Scharfenstein 2010).

To test which channels are at work and how more explicitly, we enrich the baseline model by including (Table 3) the interaction terms between our measure of asset quality and the "low capitalization", "low profitability", and "low deposits" bank dummies, equal to 1 when the Tier 1 ratio, ROE, and customer deposit to total asset ratio, respectively, are in the bottom quartile of the national distribution.[13]

First, we find that even with these controls, the coefficient between the NPL to total asset

[12]Taken to extremes, such behavior can also be accompanied by evergreening and zombie lending, as in Japan during the 1990s where banks (favored by supervisory forbearance) had the perverse incentive to continue making credit available to the weakest firms (Peek and Rosengren 2005).

[13]To further investigate the non-linearity of the effect of these three channels, in untabulated results, we run separate regressions including "High capitalization" and "Low capitalization", "High profitability" and "Low profitability", and "High deposits" and "Low deposits" bank dummies. The results confirm that only banks in the bottom quartile of the Tier 1 distribution behave differently from the average bank in the national distribution.

ratio and the change in gross loans (column 1) remains strongly negative and significant at the 1% level, being only slightly lower in magnitude. Lending slows significantly more than asset growth; the effect on the portfolio mix is a contraction of the share of the riskier asset class (column 4). These results are consistent with the regulatory capital channel as well as with a market discipline motive, as discussed in section 2.

We next look at the differential behavior of weak banks when asset quality deteriorates (NPL/TAxLowCap and NPL/TAxLowProf). We find that poorly capitalized institutions shrink their assets significantly more than the average; in economic terms, they decrease assets by 0.7 percentage points more than the average. This produces lower lending and, particularly, securities portfolio growth, in accord with the thesis that in weak (undercapitalized) banks lower funding capacity impinges on asset growth, while a reach-for-yield strategy may explain why credit growth does not slow as sharply as asset growth. Consistently, the portfolio mix of banks in the bottom quartile of the Tier 1 ratio distribution shows that poorer asset quality is associated with a larger rise of the share of loans in total assets significant at the 10% level (columns 4), whereas the coefficient for correlation with the change in the loan to total asset ratio for the average sample bank is negative and statistically significant at the 5% level.

Turning to LowProf banks, Table 3 shows a positive and statistically significant coefficient of lower asset quality on loan growth and the loan to total asset ratio (columns 1 and 4). We interpret this as supportive of the reach-for-yield channel. Against to our expectations, we find no differential behavior of banks in the bottom quartile of the distribution of the ratio of customer deposits to total asset (LowDep banks).

On the whole, the data reported in Table 3 support the view that a higher share of NPLs is associated with a cutback in credit supply and only marginally with deleveraging strategies. This fits better with regulatory and market discipline mechanisms, than with a simple funding capacity issue. For the more vulnerable banks, an additional channel seems to be at work. Weak banks (especially the least capitalized) shrink their balance sheet by reducing securities more sharply than lending; the effect on asset composition is to shift resources to the advantage of the riskier and (hopefully) more profitable assets, consistent with the search for yield.

4.4 The role of protection tools

We next address whether the level of loan loss reserves and common equity tier 1 (CET1), in proportion to NPLs, influences the way banks adjust their balance sheets. Because both instruments can attenuate or even neutralize the adverse effect of NPLs, we argue that, whichever channel is at work, the better buffered banks should have less incentive to deleverage or cut back loans than the less well protected.[14]

As is contended in many quarters (see Constâncio 2017 and references in there), NPLs may not be such a severe threat to the balance sheet if they are adequately covered.[15]

Loan loss provisions are periodical accounting deductions, corresponding to the amount the bank expects to lose on a given loan. In general, provisioning should be commensurate with the expected recovery value of loans. Should this not be the case, the risk is that larger-than-expected losses will reduce net profitability and drive capital down below the minimum requirement. It follows that the extent to which NPLs are covered by loan loss reserves should reflect the banks underlying capital strength (Woo 2003). Moreover, higher coverage ratios tend to reduce opacity.[16]

One may expect banks with higher ratios of loan loss reserves to NPLs to cope better with the potential negative externalities of higher problem loans.[17]

Likewise, one may expect banks with more common equity Tier 1 (CET1) capital in proportion to NPLs to be in a more comfortable position to absorb shocks deriving from the deterioration of the loan portfolio. As is well known, the ability to absorb unexpected losses makes common equity the highest quality and most costly component of banks' regulatory capital. It follows that more strongly protected institutions are less likely to be affected by concerns associated with regulatory and market scrutiny and, as such, will feel less pressure to deleverage and reduce lending.

[14] Likewise, Angelini (2018) claims that NPL stocks can influence the credit supply indirectly, via a cost of funds/capital channel. Such an argument should not work for safer banks, such as those that are adequately profitable and/or capitalized.

[15] Collateral does not provide such protection; the collateral can be hard to assess or even to take possession of, the enforcement procedure depending on the efficiency of the judicial system (Constâncio 2017).

[16] By construction, the coverage ratio of an NPL is the complement to one of the loans book value. Because the net present value of a problem loan is hard to assess, it follows that the higher the coverage ratio, the lower the carrying amount of the loan. The coverage ratio also provides a measure of the greatest possible loss due to a non-performing exposure, in the extreme case in which nothing is recovered.

[17] It could also be, however, that lower information asymmetry and stronger capital positions make it easier for banks with high coverage ratios to resolve NPLs through, say, asset disposals. If so, the overall effect might be negative loan growth and a reduced loan to total asset ratio.

To test this assumption, in Table 4, Panel A, we first extend our baseline analysis by including the interaction term between our measure of asset quality and the "high coverage ratio" bank dummy (equal to 1 for banks in the top quartile of the coverage ratio distribution). We also include (Panel B) the interaction term between the asset quality variable with the "high common equity" bank dummy (equal to 1 for banks in the top quartile of the CET1/NPL ratio distribution).

Both panels show that a reduction in the asset quality of the average bank is associated with reduced asset and especially loan growth rates and with a larger share of securities in total assets. Institutions with coverage ratios in the top quartile seem to behave even more prudently, reducing asset growth more sharply than the average bank when asset quality worsens (column 2, Panel A). Unlike that of the average bank, this strategy is at the expense of securities (rather than loans): the coefficient for the securities growth rate is negative and statistically significant at the 5% level. Consistently, the resulting portfolio mix shows a higher loan to total asset ratio and a lower securities to total asset ratio, both significant at 10% level (column 4 and 5, Panel A). Interestingly, these findings do not hold for banks in the top quartile of the CET1/NPL distribution, which overall behave similarly to the average sample bank. On the whole, our results suggest that when NPLs increase, prudent provisioning shields lending more effectively than a large capital buffer.

4.5 Robustness checks

Tables 17-19 report several tests of the sensitivity of our results. Tables 17 and 18 check robustness to alternative indicators of asset quality: the NPL ratio (NPLs over gross loans) and the Texas ratio. The NPL ratio, in fact, is the most widely used measure of loan portfolio quality, while the Texas ratio gauges credit risk net of the protection (buffer) afforded either by capital (Tier 1) or by loan loss reserves. In both cases, the results remain consistent with our main findings and statistically significant.

Table 19 reports additional robustness exercise to mitigate concern about confounding credit demand effects. Lacking borrower-level data, we control for country GDP growth and replace country-sizeBin-year fixed effects with country-sizeBin fixed effects. The standard assumption is that the GDP variable is a straightforward measure of aggregate demand with a direct impact on credit growth, insofar as more buoyant economic activity positively boosts borrowers' income and profits (Kashyap and Stein 2000). As such, this variable should

capture demand effects on the observed volume of loans. Here, results for the loan growth and the portfolio mix are even stronger than in baseline specification.[18]

5 Asset quality and banks' behaviour: exploiting the 2014 AQR

Our results to this point show that poorer asset quality is associated with more deleveraging and less lending. The results are robust to different control variables, the inclusion of outliers and other robustness checks.

Now we go another step forward to investigate the direction of causality between poor asset quality and banks' behavior. To this end, we exploit the ECBs Asset Quality Review in 2014 as a quasi-natural experiment leading to an exogenous increase of 18% in the stock of NPLs at the banks reviewed. We consider the change in NPLs (in proportion of total assets) induced by the AQR as exogenous, in that it stemmed from the first-time application of a uniform, stricter definition of "non-performing exposure" (NPE) as well as from closer, direct scrutiny by the ECB.[19] We employ a diff-in-diff strategy to examine how the banks subjected to the exercise adjusted their balance sheets by comparison with a control group of banks that were not reviewed.

The AQR is also an appropriate setting to further explore the mechanisms by which NPLs affect banks behavior, specifically those relying on the assumption that banks with lower asset quality are more sensitive to the scrutiny of supervisors and markets alike. The evidence confirms that ECB comprehensive assessments and Federal Reserve stress tests provide valuable information to the market (Georgescu et al. 2017; Flannery et al. 2017) and change the dynamics of banks risk management by strengthening supervision of bank capital (see Millon Cornett et al. 2018 and the literature cited therein; Acharya et al. 2018). We accordingly expect that owing to the intensification of market and regulatory scrutiny during the AQR, higher NPLs should prompt a stronger reaction in the treated than in the untreated banks.

[18] We are aware that this test is not conclusive and that tests at the loan rather than the bank level would better disentangle credit supply and demand.

[19] "NPL" is generally used as shorthand, although, technically, the EBA introduced the term NPE. Here, we use the two interchangeably.

Before specifying the model and presenting the results, let us first set out the institutional background and some descriptive statistics.

5.1 Institutional arrangements and descriptives

With the stress test, the AQR is one of the two pillars of the comprehensive assessments (CAs) that the ECB has carried out periodically since 2013 to enhance the transparency of balance sheets and improve comparability across banks. The first CA was conducted from November 2013 to October 2014, preparatory to the Single Supervisory Mechanism (SSM). It covered 130 institutions, accounting for about 85% of the euro area banking system and selected according to significance criteria that were disclosed in December 2012, when the SSM was agreed on. These criteria were primarily based on asset size, with a threshold of €30 billion.[20] On the 23^{rd} October 2013, the ECB announced details of the CA and published the list of banks subjected to the review that were selected according to the significance criteria[21]; either the timing and the criteria of the AQR were unexpected as reflected by the stock market reaction on the day of the AQR announcement[22].

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, as a result of the findings of the AQR. Building on these results, supervisory authorities conducted a stress test exercise to check the banks shock-absorption capacity under stress. 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 4 presents a timeline of events and shows the definition of the before and the after period that we use in the econometric analysis. Due to the discrepancy between the date of the AQR announcement (23 October 2013) and the AQR reporting due date (31 December

[20]Two additional asset-related criteria were applied: (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.

[21]In fact, the list released in October 2013 includes all banks that could plausibly be regarded as significant at the time the full and final list compiled in 2014 when updated statistics became available (ECB 2013).

[22]See Abassi et al. 2017 for further details on the AQR and references to media outlets released in the weeks immediately before the AQR announcement.

2013) we exclude the year 2013 to rule out window dressing in reviewed banks[23]. We define the years between 2010 and 2012 as the pre-AQR period and the period between 2014 and 2015 as the post-AQR period.

In detail, the 2014 AQR was a point-in-time assessment of the accuracy of the carrying value (including the adequacy of asset and collateral valuation and related provisions) of banks' assets as of 31 December 2013. The process involved over 6,000 experts who performed detailed asset-level reviews for more than 800 specific portfolios, making up 57% of the banks' risk-weighted assets and resulting in the examination of more than 119,000 borrowers. In order to maintain consistency and equal treatment across both the AQR and stress test, central ECB teams independently performed quality assurance on the work of the banks and national supervisors.[24]

To unsure a satisfactory degree of standardization, the participating banks were required to apply, for the first time, the EBAs simplified, harmonized definition of NPE, which went into force in September 2014, with first reporting on 31 December. This was a major step towards transparency and comparability, in that definitions of NPLs had notoriously varied between European banks and countries.[25] The change in the NPE definition was verified through the data integrity validation process, and then checked on a file-by-file basis during the credit file review for residential real estate and all non-retail asset classes. Any changes to NPE status were then projected to the unsampled portion of the portfolio.

Because the banks' internal definitions were, on average, less prudent than the simplified EBA approach, the latters application resulted in an increase in the NPE stock of €54.6 billion (ECB 2014). The credit file review and projection led to an additional increase of €81.3 billion, for a total increase of €136 billion (from €743 billion to €879 billion, or over 18%, according to the ECB aggregate report on the comprehensive assessment) for the

[23]Abbassi et al. (2017) show that after the AQR announcement, reviewed banks dressed up for supervisors and adjusted their balance sheet by decreasing the share of riskier assets; they undo this change in July 2014 at the end of the phase 2 of the AQR.

[24]The ECB was in close contact with the national authorities, responding to over 8,000 methodology and process questions. The ECB reviewed and challenged outcomes from an SSM-wide perspective using comparative benchmarking, as well as engaged with national supervisors to investigate specific issues that arose. The quality assurance activity involved over 100 experts from the ECB along with external support professionals (ECB 2014).

[25]According to the EBA's simplified approach, any exposure meeting any of the following criteria was marked as non-performing: every material exposure that is 90 days past-due even if it is not recognized as defaulted or impaired; every exposure that is impaired (respecting specifics of GAAP vs. IFRS banks); every exposure that is in default according to the capital requirements regulation (i.e., the debtor is "unlikely to pay").

participating banks due to the AQR. The impact varied according to debtor geography, with overall increases among locations ranging from 7% to 116%.

Table 5 presents descriptive statistics for banks from the AQR and non-AQR sample (see section 3 for details on sample construction). "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. Although our sample already consists of banks, by selection, larger than their national median, in any case AQR banks are bigger than non-AQR banks. To account for this difference between treated and control groups, we include in our diff-in-diff specification country-sizeBin-year fixed effects. This strategy allows us to isolate not only time-varying unobserved differences at country and year level, but also bank heterogeneity induced by size levels. Specifically, as the comparison is within a given sizeBin, the results cannot be driven by country-specific factors or size-driven bank characteristics.

The two groups also differ in business model: their smaller share of loans and deposits in relation to total assets, makes the AQR banks relatively less oriented to traditional commercial banking than non-AQR banks. In economic terms, this difference moderates, since lending is the prevalent business of both groups, 61% in AQR and 64% in non-AQR banks. And while there are no significant differences in loan portfolio and asset quality (as proxied by the NPL to total loan and NPL to total asset ratios, respectively), AQR banks report higher coverage ratios.

AQR banks' capital position is weaker: their Tier 1 regulatory capital ratio is significantly lower. This may explain why the Texas ratio shows the 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 are on average more profitable in terms of ROE, while there are no significant differences in 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 securities portfolios less (or reduced them more intensively) than loans. Hence, the AQR banks decreased the share of securities in total assets more sharply than the non-AQR banks, although the difference is not particularly marked.

5.2 Identification strategy

We first determine whether AQR bank balance sheet did indeed show higher NPLs in response to the new definition of NPEs and stricter regulatory scrutiny. We use a diff-in-diff (DD) strategy with the NPL to total asset ratio and the NPL to gross loans ratios as dependent variables. Table 6 reports basic differences in our preferred measure of asset quality (NPL/TA) between AQR and non-AQR banks, before and after the AQR. The DD coefficient indicates that, regardless of whether banks, and country-sizeBin-time fixed effects are included, the NPL/TA has increased by 52% more of the sample average NPL/TA ratio in the treated than in the control group.[26]

The estimates rely on the assumption of parallel trends prior to the AQR. This assumption is tested formally by checking the statistical significance of the interaction term AQRxYear in a model in which our preferred indicator of asset quality (NPL/TA) is regressed on: a linear trend, the AQR dummy, bank level controls, and the interaction term; in the sample before the AQR (2010-2012). Columns 1 and 3 in Table 7 report that the estimated coefficients of the interaction terms are small and not statistically significant, this suggesting that the parallel trend assumption is not rejected. We also test for anticipated effects of the policy, estimating a model in which the AQR dummy is interacted with all year dummies. Columns 2 and 4 report the estimated coefficients on the leads and lags. These estimates rule out possible anticipated effects of the supervision, consistent with the parallel trend assumption. Further, the lack of anticipation effects suggests that any other changes in regulation that affected AQR and non-AQR banks differently were not crucial to NPL/TA patterns.

We take the change in NPL/TA induced by the 2014 AQR as an exogenous shock to only a portion of our sample banks. For bank-level outcomes (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) the treatment is defined as the bank subject to the AQR. For each bank-level outcome, we estimate the following econometric model:

$$y_{ij,t} = \alpha_0 + \beta_1 AQRbank_{ij} X PostAQR_t + \beta_0 PostAQR_t + \theta_1 X_{ij,t-1} + \mu_{ij,t} + \lambda_{ij} + \epsilon_{ij,t} \quad (2)$$

[26]The Table reports also basic differences in the NPL/GL ratio, which has increased by 39% more of the average NPL/GL ratio in the treated than in the control group.

where β_1 is the relevant coefficient, the indicator variable AQR is absorbed by the bank fixed effects, and $PostAQR_t$ indicates the years after 2013. We include bank fixed effects and fixed effects at country-sizeBin-year level, where each sizeBin is defined as above/below the national median.[27]As discussed in the institutional section, this method controls for unobserved differences induced by country, size and year heterogeneity. In particular, the sizeBin fixed effect is comparable to a matching procedure to filter out the influence of observed characteristics linked to bank size.[28] As we compare banks in the same sizeBin, country, and year, we can rule out that the results are driven by country-year-specific events or factors driven by bank size. Standard errors are clustered at bank level.

5.3 The diff-in-diff results

Table 8 reports the estimation results for equation (2) where the DD term, AQRbankx-PostAQR, captures the effect of the treatment. We find that after the review, the AQR banks deleveraged more than the others. The effect of AQR is significant in economic terms. The diff-in-diff coefficient of column (2) indicates a reduction of 2.35 percentage points per year in AQR banks. Asset growth in AQR banks declines by 63% relative to the average, which is 3.7% in the period before the AQR. Asset shrinkage come at the expense of the securities rather than the loan portfolio, as the coefficients for the DD term are negative and significant at the 1% level for the change in securities and in the share of securities in total assets, and positive and significant at the 1% level for the change in the loan to asset ratio. These results are consistent with previous empirical studies (as Eber and Minoiu

[27]This strategy compares banks within the same sizeBin. We proceed as follows: 1) define a dummy sizeBin within each country and compute median total assets; 2) assign a value equal to 1 to the sizeBin dummy if a bank's average total asset value is above this threshold, 0 otherwise. We thus end up with different distributions within each country of AQR dummies and sizeBin dummies. In most of the 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 find 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 all 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).

[28]In our framework, owing to the small size of the treated group (105 AQR vs. 767 non-AQR banks), a matching procedure would not be optimal as it would lose most of untreated observations. Moreover, propensity score matching à la Gropp et al. (2019) is not feasible in our setting because the common support requirement fails when we include more than one covariable. And theory and empirical research indicate that bank size is a major driver of funding structure and lending (Kashyap and Stein 1995, and Kishian and Opiela 2000 among others).

2016), who also found that the banks subjected to the first ECB comprehensive assessment, reduced their assets by adjusting securities more sharply than loans as an effect of stricter supervision. Examining the effect of the AQR on credit supply by Italian banks, Accornero et al. (2017) also find that lending growth was higher at AQR banks.

To explore the role played by NPLs in treated banks more explicitly, we use the following regression model:

$$\begin{aligned} y_{ij,t} = \alpha_0 + \beta_4 AQRbank_{ij} X PostAQR_t X NPL/TA_{ij,t-1} + \beta_3 AQRbank_{ij} X NPL/TA_{ij,t-1} + \\ \beta_2 PostAQR_t X NPL/TA_{ij,t-1} + \beta_1 AQRbank_{ij} X PostAQR_t + \beta_0 PostAQR_t + \\ \theta_1 X_{ij,t-1} + \mu_{ij,t} + \lambda_{ij} + \epsilon_{ij,t} \end{aligned} \tag{3}$$

The main explanatory variable is the triple-interacted term AQRbankxPostAQRxNPL/TA, where AQR banks is a dummy equal to 1 for banks subjected to the review. PostAQR is a dummy equal to 1 in 2014-2015, and 0 before that. NPL/TA is a time-varying measure of asset quality.

Table 9 gives the results for equation (3). The previous test is confirmed, in that AQR banks reduced securities portfolios (column 3) and increased the lending business (columns 1 and 4) by more than untreated banks. The estimated coefficients on the triple interactions are not generally significant, except for the change in gross loans and for the share of loans in total assets, which are both negative and strongly significant at the 1% level. This confirms that asset quality deterioration in 2014-2015 had a stronger negative impact on lending in AQR than non-AQR banks.

To acquire additional evidence on the effect of asset quality deterioration, we take advantage of differences in asset quality across banks and countries. We explore two additional asset-quality-related sources of heterogeneity across banks. First, we split our sample in banks in high-NPL countries (those with average NPL/GL above 10% in 2010-2015) and non-high NPL countries. Second, we identify high vs. non-high NPL banks by different indicators for high-NPL banks, and we estimate the following regression model:

$$y_{ij,t} = \alpha_0 + \beta_5 AQRbank_{ij} X PostAQR_t X HighNPLbank_{ij} + \beta_1 AQRbank_{ij} X PostAQR_t + \beta_0 PostAQR_t + \theta_1 X_{ij,t-1} + \mu_{ij,t} + \lambda_{ij} + \epsilon_{ij,t} \quad (4)$$

Table 10 presents aggregate estimates for the entire sample (Panel A), then splits the sample into banks in high-NPL countries (Panel B) and in other countries with normal levels of troubled loans (Panel C).

We focus on high-NPL banks to exploit heterogeneity in banks' asset quality (Table 10, Panel A). Owing to the multiple negative effects of problem loans on profit and loss accounts and available capital, AQR banks afflicted by a large stock of NPLs should be more prone to adjust their balance sheet, as a consequence of stricter scrutiny by supervisors and the market. To capture the differential impact of holding a large stock of NPLs, we include the DDD term AQRbankxPostAQRxHighNPLbank, where HighNPLbank is a dummy equal to 1 if the banks average NPL to asset ratio in 2010-2015 is greater than the sample average. Again, the results for the DD term confirm that treated banks cut back securities (columns 3 and 5) while preserving lending (columns 1 and 4). The results for the DDD term show that asset quality indeed matters, as the coefficients for the change in total loans and in the share of loans are negative and significant at the 5% level. This suggests that AQR banks with a large volume of NPLs behave differently from AQR banks with few bad loans: namely, the former banks contract the lending business while the latter do not.

Further, we aim to investigate whether the way AQR banks with low asset quality adjust their balance sheets differs according to the relative importance of the NPL issue of a given country/banking system. There are several possible reasons why the response may vary between the two country groups. For example, in high-NPL countries, problem loans may be more difficult to resolve due to, say, the weak institutional framework or the paralysis of secondary market for troubled loans. In this case, the scrutiny of AQR banks in high-NPL countries by the central supervisor and/or the market is likely to be more severe. So, coeteris paribus, AQR banks in high-NPL countries may react more forcefully than those in countries where problem loans are less of a concern.

We find some evidence of such a difference. In both Panels B and C, the results on

the DD are broadly comparable to those in Panel A. Conversely, in Panel B the coefficients on the triple interaction AQRxPostAQRxHighNPL (columns 1, 2, and 3) are negative and statistically significant, i.e., AQR banks afflicted by high NPLs deleveraged by reducing both the lending business and the securities portfolios, with no significant differences in the portfolio mix. In Panel C, AQR banks with low asset quality tend to expand more their balance sheet (column 2) but reduce by more the share of loans in total assets (column 4). Thus, there is evidence of an adverse effect of low asset quality in treated banks from both high and non-high NPL countries. Such an effect seems to be more comprehensive in banks from high-NPL countries, inducing deleveraging and lower credit growth. This is plausible because risky banks from risky countries tend to be more exposed to funding constraints and regulatory pressure.

To check the robustness of our main results, Table 20 applies a more restrictive definition of high-NPL banks, namely those whose average NPL to loan ratio is above the 10% threshold during the sample period. The results are qualitatively similar to those reported in Table 10.

5.4 Additional checks: accounting for capital shortfall banks and adjustments to provisions

Table 11 tests the sensitivity of our results excluding from the sample those AQR banks with a capital shortfall during the stress test that followed the 2014 review. As noted in the institutional section, during the PostAQR period reviewed banks were also subjected to stress test, the second step in the ECBs comprehensive assessment. Based on the AQR-adjusted balance sheet, the test gauged resilience in a baseline and in an adverse scenario. In both, the banks' solvency was analysed to determine their sensitivity under certain stressed economic conditions (ECB 2014). Precisely, 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.[29]

The overall capital impact on the 130 banks covered by the comprehensive assessment was €262.7 billion. Taking capital buffers into account, the assessment found a capital

[29]This comprises the impact of both the AQR and the stress test. See ECB 2014 and particularly section 5.1 on the aggregate outcomes of the CA.

shortfall of €24.6 billion in 25 participating banks (see the list in Figure 5) with respect to the thresholds in the baseline and adverse scenarios. Twelve of the 25 banks covered the shortfall by increasing 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 the next nine months (ECB 2014). All these adjustments come during what we have defined as the post-AQR period (2014-2015).

The restoration of capital adequacy may involve different strategies, from capital expansion to asset shrinkage. Deleveraging or cutting back risky assets such as loans is less costly than issuing new equity or retaining a higher proportion of earnings, especially for very weak banks.[30] Thus, we would expect a common strategy by which shortfall banks regained capital adequacy by deleveraging rather than issuing new equity.

To make sure that our results in the DD analysis are not driven by these outliers, we ran our main regressions again, this time excluding from the treated group the 25 banks that the CA found to be undercapitalized.

In Table 11, we include the DD term AQRbankxPostAQR to test the effect of the treatment on this restricted sample. Tables 12 and 13 show the differential effect of asset quality on the subsample of AQR banks by including a DDD term. Again, we interact the DD term with the time-varying NPL to asset ratio, to account for asset quality deterioration (Table 12), and with the dummy HighNPL bank variable indicating banks with lower than average asset quality (Table 13, Panel A).

The results confirm the significant differential effect of changes in asset quality on AQR banks' lending behaviour. By comparison with the control group, treated banks have greater tendency to reduce lending growth and the share of loans in total assets when asset quality deteriorates (Table 12, columns 1 and 4) and also if they have an above average NPL to asset ratio (Table 13, Panel A, columns 1 and 4). In Panels B and C of Table 13 we split the subsample of AQR banks (net of those with capital shortfalls) by country group, to look at the differential effects on AQR banks with high NPLs in high-NPL countries (Panel B) as against non-high NPL countries (Panel C). We find that those in high-NPL countries react to low asset quality by decreasing the loan growth and the share of loans in total assets by more than the average AQR bank in the same country group (Panel B, columns 1 and

[30]For example, the stock prices of the weaker banks performed significantly worse than those of the stronger banks after the release of the CA results, possibly reflecting the likely dilution of equity at the banks that would need to raise capital (Georgescu et al. 2017).

4). For non-high NPL countries, low asset quality has mainly a composition effect, as AQR banks with high-NPLs in the post-treatment period significantly reduce the share of loans in total assets (Panel C, column 4).

In addition to the effect on NPLs, a further official outcome of the AQR was the aggregate adjustments of €47.5 billion to bank asset carrying values as of 31 December 2013. These adjustments originated primarily from accrual-accounted assets, particularly adjustments to specific provisions on non-retail exposures. Given the potential effect of provisioning on credit supply (see Jimenez et al. 2017, among others), we run a further robustness check by excluding from the AQR sample those banks that made larger adjustments to provisions than the average AQR bank.

Specifically, using official information contained in the ECB report on the comprehensive assessment (ECB 2014), we compute the average adjustment to provisions in the treated banks (34 basis points) and manually identify those with greater adjustments. Figure 6 lists the 30 excluded banks and report their adjustments. Table 14 presents basic DD estimates net of banks with above average adjustment to provisions. Tables 15 and 16 measure the differential effect of asset quality in the subsample of AQR banks by including a DDD term. The results are overall similar to those in the baseline diff-in-diff regressions.

6 Conclusions

We have conducted two analyses of the effect of asset quality change on banks balance sheet adjustments. In the fixed-effect analysis, we find a strongly negative and statistically significant association between banks' asset quality deterioration and asset and loan growth. Credit contraction is sharper than asset reduction. These results are strong and hold for various specifications, regardless of the asset quality indicator used and of the inclusion of outliers.

All in all, our findings constitute support for the theses of both regulatory capital channel and of the funding channel. The examination of weak banks appears to uncover an additional channel. Owing to capital and funding constraints, when asset quality deteriorates undercapitalized banks shrink assets by more than the average sample bank; in reallocating their assets, they tend to increase, rather than decrease, the riskier and presumably more profitable asset class, keeping with a reach-for-yield strategy. Likewise, low profitable

banks tend to increase the lending business relatively by more than the average sample bank, suggesting that the same mechanism is in motion.

We also investigate the role of protection instruments in mitigating the negative externalities of reduced asset quality, particularly on credit supply. We find that when asset quality deteriorates, banks with high coverage ratios shield lending more effectively than those with high levels of CET1 (in proportion to NPLs).

Our diff-in-diff analysis investigates the nexus of causality between lower asset quality and bank behavior by exploiting the exogenous shocks induced by the 2014 AQR exercise in reviewed banks compared to banks not subjected to the ECB review. Consistent with previous research, we find that after the ECB review, AQR banks deleveraged more than non-AQR banks and that the asset shrinkage came at the expense of the securities rather than the loan portfolio.

Focusing explicitly on the role played by asset quality deterioration in AQR vis-*à*-vis non-AQR banks, we find evidence that asset quality deterioration has a stronger negative impact on lending in the former than in the latter. This evidence is confirmed when the examination is restricted to AQR banks with NPL ratios above the sample average. If these institutions are domiciled in high-NPL countries, low asset quality has a size effect as it leads to deleveraging and reduced lending and securities growth. If high-NPLs banks are domiciled in low-NPL countries, low asset quality has a composition effect, resulting into a smaller share of loans in total assets.

Our main results are also confirmed when the analysis excludes AQR banks that had a capital shortfall or those that made larger provisioning adjustments following the ECBs comprehensive assessment.

Overall, our findings support the thesis that regardless of bank characteristics such as profitability, capitalization, and funding structure, a larger volume of NPLs is indeed detrimental to lending business, because it induces banks either to cut credit growth (the size effect) or to shift resources at the expense of the loan portfolio (the composition effect). The evidence of the positive role played by high coverage ratios is consistent with recent measures to strengthen provisioning policies across banks (see, for example, the ECB addendum and the European Commissions rules issued in March 2018).

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Appendix

Figures

Figure 1: Non-performing loans and total assets

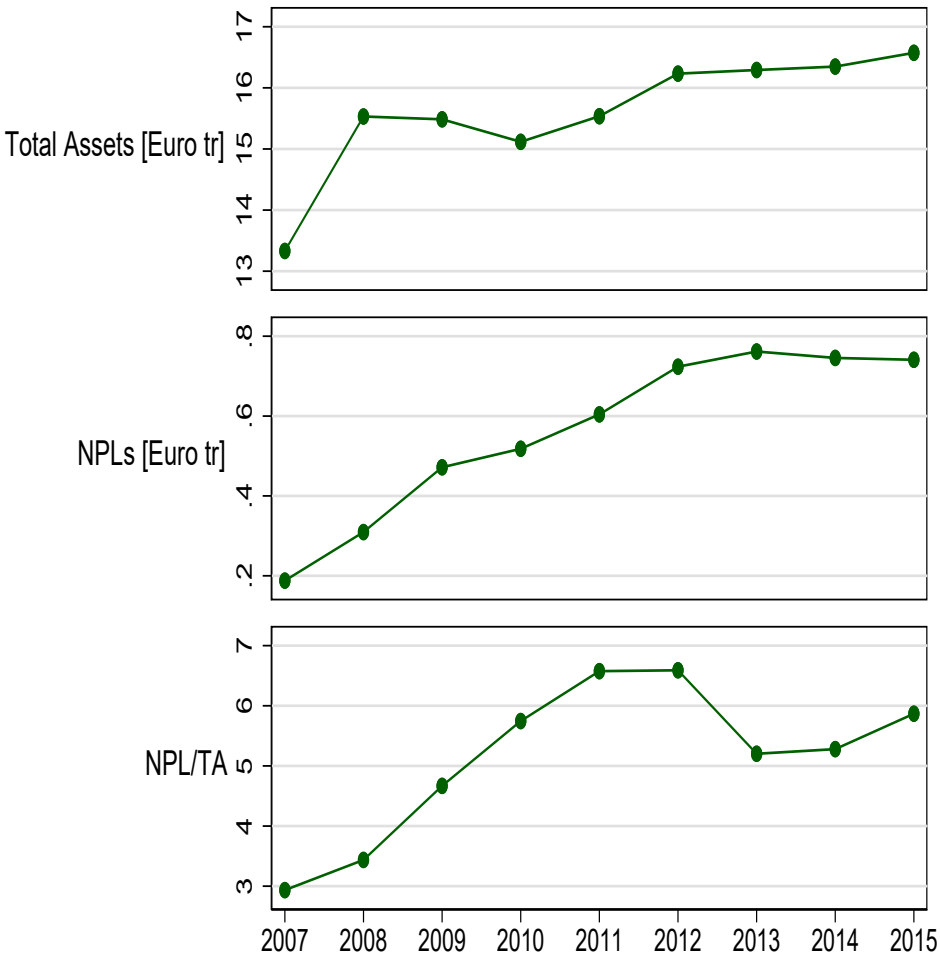

Figure 1 tracks the evolution of total assets, NPLs and NPL total asset ratio in our sample over the entire period 2007-2015.

Figure 2: Growth of loans and non-performing loans (as % of total assets)

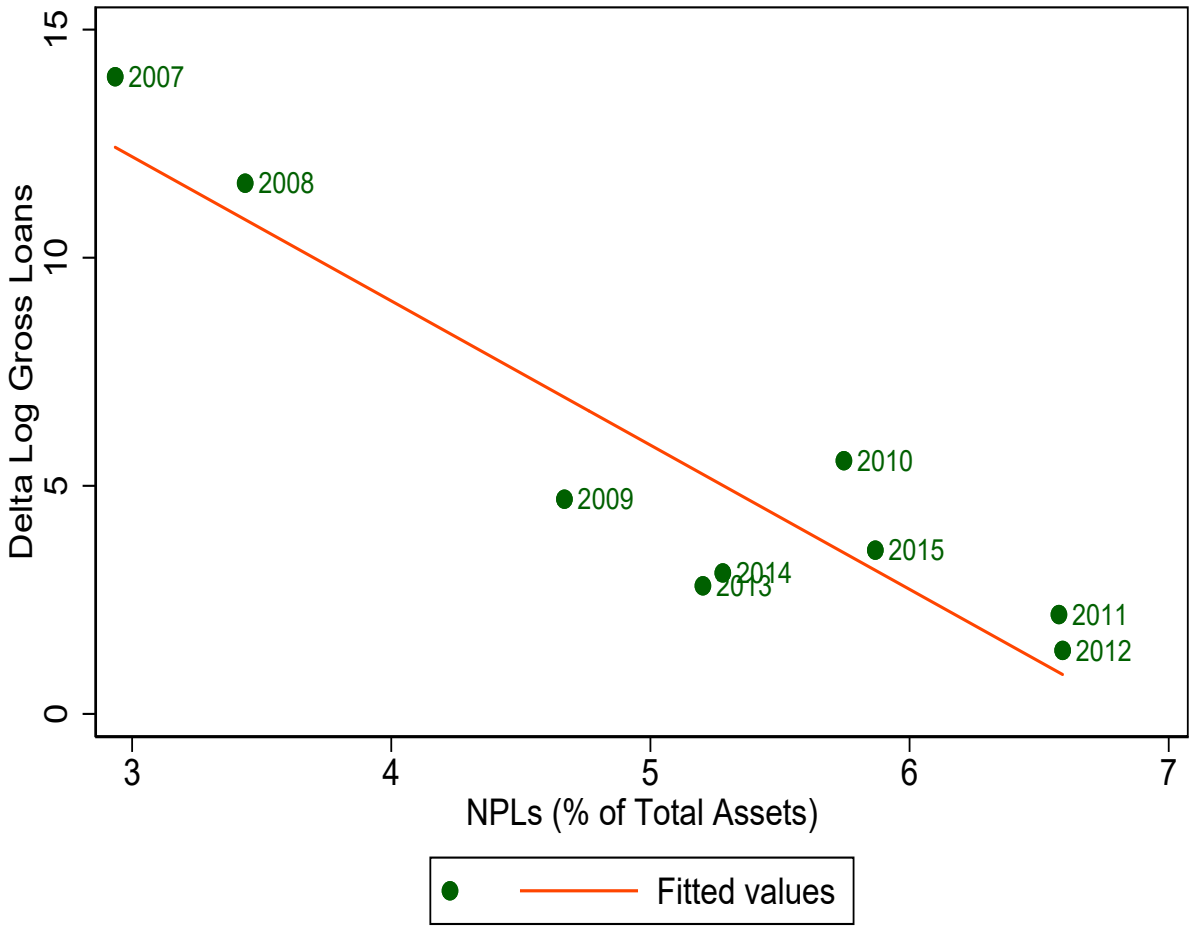

Figure 2 shows the correlation between growth of gross loans and the incidence of non-performing loans on total assets. Each dot represents the average of national NPL/TA ratios in a year.

Figure 3: Heterogeneity of bank-level NPL ratios in European countries (2010-2015)

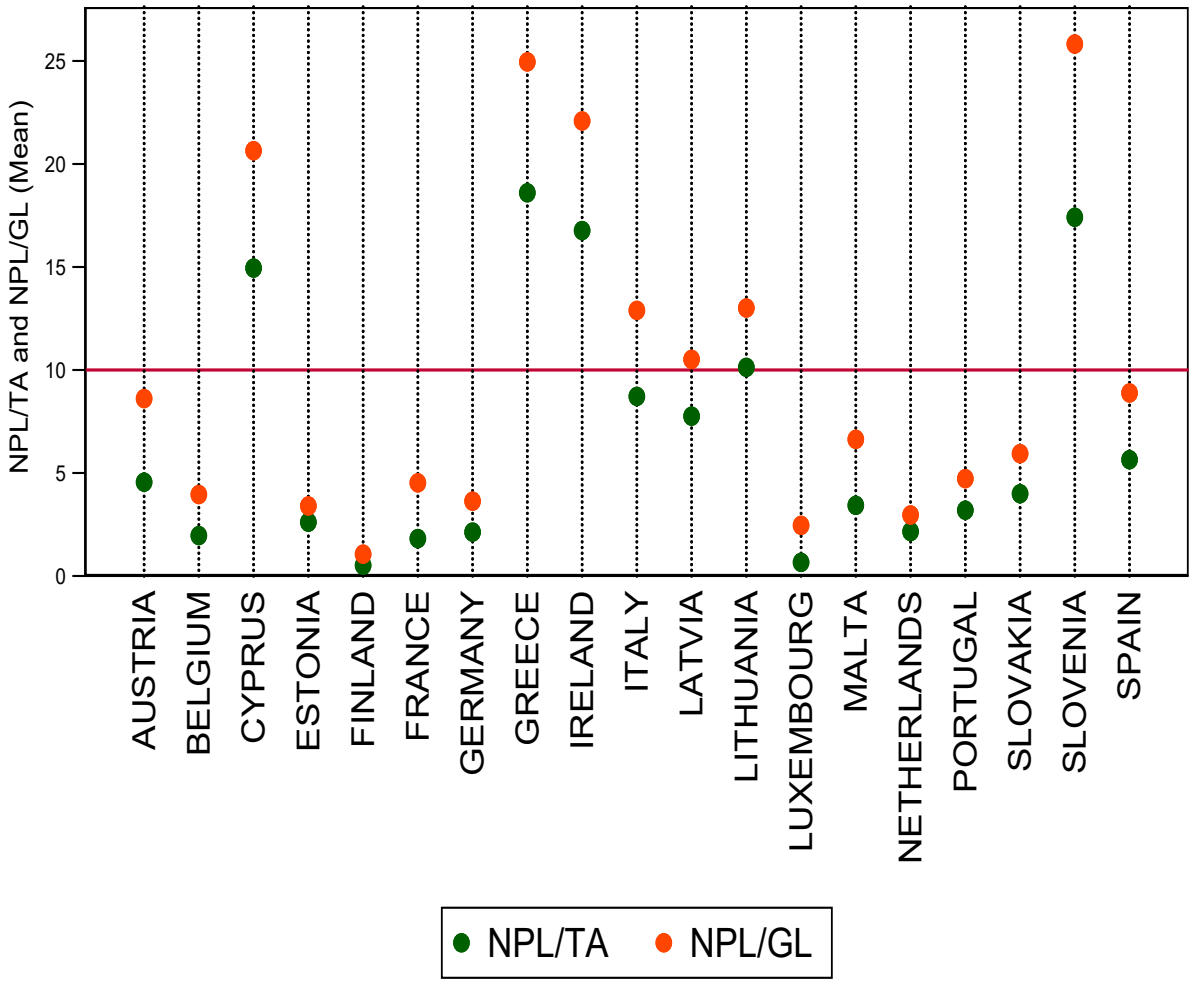

Figure 3 shows the average NPL ratios (NPL/TA and NPL/GL) of euro area banks by country in 2010-2015. The figure illustrates the construction of our indicator for identification as a high-NPL countries. An NPL ratio of 10% is the threshold.

Figure 4: AQR timeline

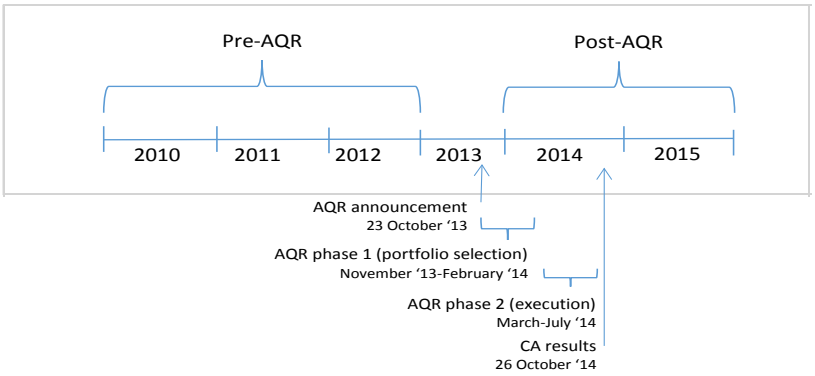

Figure 5: AQR banks with a capital shortfall

Bank Name	CET1 ratio starting point	CET1 ratio post AQR	CET1 ratio baseline scenario	CET1 ratio adverse scenario	Capital shortfall (€ billion)	Net eligible capital raised (€ billion)	Capital shortfall post net capital raised (€ billion)
Eurobank[1]	10.6%	7.8%	2.0%	-6.4%	4.63	2.86	1.76
Monte dei Paschi di Siena	10.2%	7.0%	6.0%	-0.1%	4.25	2.14	2.11
National Bank of Greece[1]	10.7%	7.5%	5.7%	-0.4%	3.43	2.50	0.93
Banca Carige	5.2%	3.9%	2.3%	-2.4%	1.83	1.02	0.81
Cooperative Central Bank	-3.7%	-3.7%	-3.2%	-8.0%	1.17	1.50	0.00
Banco Comercial Português	12.2%	10.3%	8.8%	3.0%	1.14	-0.01	1.15
Bank of Cyprus	10.4%	7.3%	7.7%	1.5%	0.92	1.00	0.00
Oesterreichischer Volksbanken-Verbund	11.5%	10.3%	7.2%	2.1%	0.86	0.00	0.86
permanent tsb	13.1%	12.8%	8.8%	1.0%	0.85	0.00	0.85
Veneto Banca	7.3%	5.7%	5.8%	2.7%	0.71	0.74	0.00
Banco Popolare	10.1%	7.9%	6.7%	4.7%	0.69	1.76	0.00
Banca Popolare di Milano	7.3%	6.9%	6.5%	4.0%	0.68	0.52	0.17
Banca Popolare di Vicenza	9.4%	7.6%	7.5%	3.2%	0.68	0.46	0.22
Piraeus Bank	13.7%	10.0%	9.0%	4.4%	0.66	1.00	0.00
Credito Valtellinese	8.8%	7.5%	6.9%	3.5%	0.38	0.42	0.00
Dexia[2]	16.4%	15.8%	10.8%	5.0%	0.34	0.00	0.34
Banca Popolare di Sondrio	8.2%	7.4%	7.2%	4.2%	0.32	0.34	0.00
Hellenic Bank	7.6%	5.2%	6.2%	-0.5%	0.28	0.10	0.18
Münchener Hypothekenbank	6.9%	6.9%	5.8%	2.9%	0.23	0.41	0.00
AXA Bank Europe	15.2%	14.7%	12.7%	3.4%	0.20	0.20	0.00
C.R.H. - Caisse de Refinancement de l'Habitat	5.7%	5.7%	5.7%	5.5%	0.13	0.25	0.00
Banca Popolare dell'Emilia Romagna	9.2%	8.4%	8.3%	5.2%	0.13	0.76	0.00
Nova Ljubljanska banka[3]	16.1%	14.6%	12.8%	5.0%	0.03	0.00	0.03
Liberbank	8.7%	7.8%	8.5%	5.6%	0.03	0.64	0.00
Nova Kreditna Banka Maribor[3]	19.6%	15.7%	12.8%	4.4%	0.03	0.00	0.03
Total	**10.0%**	**8.4%**	**7.2%**	**2.1%**	**24.62**	**18.59**	**9.47**

Source: ECB Aggregate report on the comprehensive assessment, October 2014. "25 banks just failed Europe's biggest ever health tests" http://www.businessinsider.com.

Figure 6: AQR banks with larger than average adjustments to provisions

Bank Name	Adj. to provisions (bps)
Caixa Geral de Depósitos, SA	35.4
Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A.	37
Société de Financement Local	38.1
Banca Popolare Di Milano - Società Cooperativa A Responsabilità Limitata	38.8
KfW IPEX-Bank GmbH	39.3
AS SEB Pank	40.1
Banca Popolare Dell'Emilia Romagna - Società Cooperativa	42.6
Banca Popolare di Vicenza - Società Cooperativa per Azioni	44.2
AB DNB bankas	46.3
Raiffeisenlandesbank Niederösterreich-Wien AG	54.9
National Bank of Greece, S.A.	55.3
Norddeutsche Landesbank-Girozentrale	60.7
Erste Group Bank AG	62.7
Bank of Cyprus Public Company Ltd	67.8
Swedbank AS	68.6
Banca Popolare di Sondrio, Società Cooperativa per Azioni	68.9
Mediobanca - Banca di Credito Finanziario S.p.A.	69.4
HSBC Bank Malta plc	72.4
Raiffeisenlandesbank Oberösterreich AG	74.5
AB SEB bankas	80.5
Alpha Bank, S.A.	83.5
Banco Popolare - Società Cooperativa	85.5
Banca Piccolo Credito Valtellinese, Società Cooperativa	91.1
Banca Carige S.P.A. - Cassa di Risparmio di Genova e Imperia	93.8
Nova Ljubljanska banka d. d., Ljubljana	98.6
Eurobank Ergasias, S.A.	105.1
Veneto Banca S.C.P.A.	109.7
Banco Comercial Português, SA	117
Hellenic Bank Public Company Ltd	123
Banca Monte dei Paschi di Siena S.p.A.	135.3
SID - Slovenska izvozna in razvojna banka, d.d., Ljubljana	150.5
Piraeus Bank, S.A.	160.3
AS SEB banka	177.1
Nova Kreditna Banka Maribor d.d.	226.3
HSH Nordbank AG	230.7
AS DNB Pank	537.3

List of reviewed banks with adjustment to provisions higher than that made by the average bank (34 bps) in the AQR period. Source: ECB - Results of the 2014 comprehensive assessment. Country-by-country results overview.

Tables

Table 1: Descriptive statistics

	(1) Mean	(2) St.Dev	(3) p10	(4) p50	(5) p90	(6) Observations
Total Assets [Euro MM]	11,722	24,854	423.0	982.5	61,263	3,151
Gross Loans [Euro MM]	7,101	14,859	261.4	619.0	37,056	3,151
Total Securities [Euro MM]	2,571	5,480	84.70	256.4	13,438	3,151
Gross Loans/TA	63.25	13.60	42.61	64.52	80.48	3,151
Total Securities/TA	26.26	11.50	10.92	26.16	43.53	3,151
DeltaLogTA	3.462	6.137	-4.767	3.058	11.36	3,151
DeltaLogGL	2.872	5.760	-4.470	2.503	9.698	3,151
DeltaLogSec	8.099	20.89	-15.76	5.199	40.14	3,151
DeltaGL/TA	-0.360	5.479	-8.674	-0.126	6.696	3,151
Delta Sec/TA	6.039	19.38	-14.58	2.162	35.84	3,151
NPL/TA	5.373	4.250	0.797	4.022	12.65	3,151
NPL/GL	8.315	6.303	1.560	6.440	19.57	3,151
CoverageRatio	46.12	17.76	26.23	43.30	68.60	3,151
TexasRatio	47.07	31.60	9.955	39.98	99.43	3,151
Tier1RegulatoryCapitalRatio	13.65	3.616	9.420	13.07	19.12	3,151
ROE %	3.340	3.242	-1.650	3.050	7.210	3,151
ROA%	0.281	0.268	-0.140	0.250	0.610	3,151
Cash and due from banks/TA	1.429	1.100	0.346	1.190	2.915	3,151
Total customer deposits/TA	58.60	17.83	35.65	58.63	81.25	3,151

Table 1 presents the descriptive statistics for the entire sample of banks over the period of our empirical analysis (2010-2015). The dependent variables are *DeltaLogGL*, *DeltaLogTA*, *DeltaLogSec*, *DeltaGL/TA*, and *DeltaSec/TA*. *NPL/TA* and *NPL/GL* are our main indicators of asset quality; *CoverageRatio* is the ratio loan loss reserve to NPLs. *TexasRatio* is computed as the ratio of loan loss reserves plus regulatory Tier 1 capital to NPLs. *Tier1RegulatoryCapitalRatio* is our measure of capitalization, *ROE* our measure of profitability, *Cash and due from banks/TA* our measure of liquidity, and *Total customer deposits/TA* our proxy for the business model.

Table 2: Basic regression

	(1) Delta LogGL	(2) Delta LogTA	(3) Delta LogTS	(4) Delta GL/TA	(5) Delta SEC/TA
NPLs/TA	-0.652***	-0.591***	-0.834**	-0.033	0.203
	(0.096)	(0.122)	(0.420)	(0.109)	(0.353)
	Bank controls (t-1)				
CoverageRatio	0.002	-0.004	0.031	-0.012	0.043
	(0.012)	(0.015)	(0.047)	(0.013)	(0.042)
GL/TA	-0.195***	0.243***	-0.748***	-0.498***	-1.143***
	(0.067)	(0.056)	(0.191)	(0.063)	(0.166)
TS/TA	0.088*	0.042	-2.681***	0.022	-3.145***
	(0.049)	(0.054)	(0.180)	(0.052)	(0.159)
Size	-14.509***	-16.177***	-17.285**	0.839	6.636
	(2.806)	(2.749)	(7.635)	(2.156)	(4.320)
Tier1Ratio	0.340***	0.220**	-0.129	0.173	-0.208
	(0.100)	(0.111)	(0.371)	(0.106)	(0.292)
ROE	0.142***	0.181***	0.033	-0.084	-0.152
	(0.053)	(0.060)	(0.194)	(0.056)	(0.170)
Liquidity	-0.057	-0.439*	-0.567	0.293	-0.412
	(0.205)	(0.233)	(0.716)	(0.222)	(0.631)
CustomerDeposits	0.006	-0.007	0.054	0.019	0.125
	(0.034)	(0.044)	(0.157)	(0.037)	(0.144)
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	3,151	3,151	3,151	3,151	3,151
Banks	872	872	872	872	872
MeanY	2.871	3.461	8.101	-0.361	6.043
St. Dev.Y	5.760	6.138	20.89	5.480	19.38

Table 2 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 total 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 asset quality indicator is the NPLs/TA ratio. Bank fixed effects and country-sizeBin-year fixed effects are included. Mean and St. Dev. refer to each dependent variable. Standard errors are clustered at bank level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level respectively.

Table 3: Basic regression: Low Prof, Low Cap, Low Dep (bottom 25%)

	(1) Delta LogGL	(2) Delta LogTA	(3) Delta LogTS	(4) Delta GL/TA	(5) Delta SEC/TA
NPLs/TA	-0.602***	-0.259*	-0.199	-0.328**	0.282
	(0.124)	(0.148)	(0.521)	(0.132)	(0.444)
NPLs/TAxLowCap	-0.351**	-0.703***	-1.829***	0.340*	-0.697
	(0.136)	(0.178)	(0.702)	(0.177)	(0.638)
NPLs/TAxLowProf	0.262*	-0.108	0.390	0.435***	0.523
	(0.141)	(0.151)	(0.530)	(0.159)	(0.481)
NPLs/TAxLowDep	-0.137	-0.132	-0.564	-0.031	-0.253
	(0.127)	(0.157)	(0.587)	(0.163)	(0.524)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	3,151	3,151	3,151	3,151	3,151
Banks	872	872	872	872	872
MeanY	2.871	3.461	8.101	-0.361	6.043
St. Dev.Y	5.760	6.138	20.89	5.480	19.38

Table 3 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 total 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 asset quality indicator is the NPL/TA ratio. We include the interaction of our asset quality indicator with three indicator variables: LowCap (=1 if bank's Tier1 regulatory capital ratio is below the 25th percentile of the distribution), LowProf (=1 if bank's ROE is below the 25th percentile of the distribution), LowDep (=1 if bank's Customer deposits to total asset ratio is below the p25 of the distribution). Bank fixed effects and country-sizeBin-year fixed effects are included. Mean and St. Dev. refer to each outcome variable. Standard errors are clustered at bank level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 4: Basic regression: Protection instruments

	(1) Delta LogGL	(2) Delta LogTA	(3) Delta LogTS	(4) Delta GL/TA	(5) Delta SEC/TA
Panel A: High Coverage Ratio (top 25%)					
NPLs/TA	-0.633***	-0.322**	0.059	-0.219	0.806*
	(0.110)	(0.139)	(0.498)	(0.147)	(0.443)
NPLs/TAxHighCov	-0.023	-0.450***	-1.502**	0.314**	-1.004*
	(0.119)	(0.157)	(0.585)	(0.158)	(0.519)
Panel B: High CET1/NPLs (top 25%)					
NPLs/TA	-0.615***	-0.701***	-0.580	0.067	0.832*
	(0.131)	(0.176)	(0.590)	(0.149)	(0.495)
NPLs/TAxHighCET	-0.053	0.188	-0.421	-0.166	-1.039*
	(0.128)	(0.179)	(0.646)	(0.161)	(0.550)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	3,151	3,151	3,151	3,151	3,151
Banks	872	872	872	872	872
MeanY	2.871	3.461	8.101	-0.361	6.043
St. Dev.Y	5.760	6.138	20.89	5.480	19.38

Table 4 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 total 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 asset quality indicator is the NPL/TA ratio. We include the interaction of our asset quality indicator with the dummy variables: HighCov (=1 if bank's coverage ratio – measured as the ratio of loan loss reserves to non performing loans – is above the 75th percentile of the distribution) and HighCET1 (=1 if bank's CET1/NPL ratio is above the 75th percentile of the distribution). Bank fixed effects and country-sizeBin-year fixed effects are included. Mean and St. Dev. refer to each dependent variable. Standard errors are clustered at bank level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 5: AQR vs. Non-AQR Banks

	Non AQR (1)		AQR (2)		AQR-Non-AQR	
	Mean	St.Dev.	Mean	St.Dev.	Diff	T-stat
Total Assets [EuroMM]	2571.01	8546.27	57202.31	28990.57	54631.30***	(42.93)
Gross Loans [Euro MM]	1613.20	5144.66	34374.63	17120.12	32761.43***	(43.58)
Total Securities [Euro MM]	617.60	1987.85	12280.24	6813.38	11662.65***	(39.00)
DeltaLogTA	4.04	5.69	0.57	7.34	-3.47***	(-10.26)
DeltaLogGL	3.33	5.47	0.60	6.56	-2.73***	(-8.96)
DeltaLogSec	9.12	20.59	3.00	21.64	-6.12***	(-5.98)
DeltaGL/TA	-0.44	5.41	0.05	5.80	0.49	(1.79)
Delta Sec/TA	6.40	19.52	4.25	18.61	-2.15*	(-2.41)
GL/TA	63.76	12.97	60.71	16.16	-3.04***	(-4.07)
TS/TA	26.27	11.32	26.18	12.38	-0.10	(-0.17)
NPL/TA	5.35	4.18	5.50	4.57	0.15	(0.70)
NPL/GL	8.22	6.24	8.76	6.59	0.54	(1.71)
CoverageRatio	44.10	16.90	55.33	18.65	11.22***	(12.64)
Texas Ratio	45.42	31.26	54.62	32.04	9.20***	(5.96)
Tier1RegCapitalRatio	13.82	3.57	12.81	3.73	-1.01***	(-5.64)
ROE	3.10	2.70	4.51	4.98	1.41***	(6.30)
ROA	0.28	0.24	0.30	0.39	0.02	(1.17)
Cash and due from banks/TA	1.28	0.92	2.19	1.52	0.91***	(13.26)
Total customer deposits/TA	61.17	16.77	45.81	17.41	-15.36***	(-18.61)
Observations	2624		528		3,151	

Descriptive statistics for banks from the AQR and Non-AQR samples. Difference 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 6: The effect of AQR on asset quality

	NPL/TA	**NPL/GL**
AQR-Non-AQR[pre-treatment]	-0.945*	-0.693
AQR-Non-AQR[post-treatment]	1.870***	2.527***
DD	2.816***	3.220**

Table 6 reports basic differences in our measures of asset quality NPL/TA and NPL/GL between AQR and non-AQR bank (before and after the AQR exercise). DD is the diff-in-diff coefficient.

Table 7: Common trend and anticipation

	NPL/TA		**NPL/GL**	
	(1)	(2)	(3)	(4)
AQR*2010		0.006		1.131
		(0.616)		(0.934)
AQR*2011		-0.457		0.063
		(0.504)		(0.662)
AQR*2012		-0.310		-0.089
		(0.472)		(0.612)
AQR*2014		0.521		0.810*
		(0.329)		(0.483)
AQR*2015		0.861		0.439
		(0.644)		(0.862)
AQR*Year	-0.075		-0.399	
	(0.191)		(0.280)	
Observations	1,523	2,606	1,523	2,606
Number of bankid	675	789	675	789
Sample	Before	All	Before	All
p-val leads		0.570		0.171

The table reports estimates of the effects of the AQR on the average annual NPL/TA and NPL/GL ratios. 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 (2010-2012) 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 8: The effect of AQR

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
AQRbankXPostAQR	1.195	-2.345**	-14.147***	4.883***	-10.764***
	(0.986)	(1.141)	(3.980)	(1.130)	(3.381)
PostAQR	-3.703	-0.407	-3.161	-0.581	-1.721
	(2.730)	(2.946)	(7.057)	(1.979)	(5.373)
NPLs/TA	-0.678***	-0.635***	-0.823*	-0.016	0.227
	(0.111)	(0.134)	(0.446)	(0.118)	(0.379)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,466	2,466	2,466	2,466	2,466
Number of Bankid	851	851	851	851	851
MeanY(pre-AQR)	3.012	3.704	8.027	-0.440	5.830
St. Dev.Y(pre-AQR)	5.655	6.171	21.21	5.484	19.82

Table 8 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 and second row contain the DD coefficients and the coefficients for the change in the dependent variables between the pre-treatment (2010-2012) and the post-treatment (2014-2015) period for control group banks respectively. AQRbank is a dummy equal to 1 for banks subject to the first AQR exercise; PostAQR is an indicator variable for the period 2014-2015. We include in all specifications bank fixed effects (FE), lagged bank level controls 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 9: The effect of NPL/TA during the AQR

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
AQRbank X PostAQR X NPL/TA	-0.565**	0.304	-0.219	-1.187***	-0.101
	(0.254)	(0.276)	(1.035)	(0.181)	(0.838)
AQRbankXPostAQR	4.889***	-1.240	-8.591*	9.275***	-6.616*
	(1.823)	(1.585)	(4.457)	(1.732)	(3.777)
PostAQR X NPL/TA	0.171	-0.144	-0.354	0.326**	-0.034
	(0.110)	(0.150)	(0.486)	(0.128)	(0.391)
AQRbank X NPL/TA	0.193	-1.335***	-2.058	1.616***	-1.788
	(0.355)	(0.475)	(1.971)	(0.273)	(1.567)
PostAQR	-4.478	-2.144	-5.301	0.373	-4.559
	(2.749)	(2.868)	(7.368)	(1.978)	(5.961)
NPLs/TA	-0.742***	-0.519***	-0.476	-0.157	0.391
	(0.135)	(0.151)	(0.519)	(0.133)	(0.449)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,248	2,248	2,248	2,248	2,248
Banks	777	777	777	777	777
MeanY(pre-AQR)	3.011	3.669	8.408	-0.395	6.352
St. Dev.Y(pre-AQR)	5.737	6.314	21.68	5.589	20.25

Table 9 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. We augment Table 8 with a triple interaction AQRbankXPostAQRXNPL/TA. AQRbank is a dummy equal to 1 for banks subject to the first AQR exercise; PostAQR is an indicator variable for the period 2014-2015; NPL/TA is the time-varying NPL/TA variable. The first row contains the DDD coefficients for the change in the dependent variables before the AQR treatment (2010-2012) 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.

Table 10: The effect of High-NPL bank status during AQR

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
			Panel A: All countries		
AQRbank X PostAQR X HighNPLbank	-3.544**	-1.691	-4.751	-3.490**	-3.461
	(1.677)	(1.802)	(4.816)	(1.467)	(3.928)
AQRbankXPostAQR	3.469**	-1.505	-12.613***	7.063***	-9.888***
	(1.441)	(1.356)	(3.606)	(1.419)	(3.055)
PostAQR	-3.550	-0.052	-1.865	-0.582	-0.575
	(2.522)	(2.961)	(7.233)	(1.945)	(5.610)
NPLs/TA	-0.669***	-0.625***	-0.778*	0.013	0.276
	(0.118)	(0.141)	(0.472)	(0.122)	(0.404)
			Panel B: High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-9.259***	-6.032**	-14.816**	-6.030	-7.549
	(2.413)	(2.332)	(7.511)	(4.044)	(7.061)
AQRbankXPostAQR	7.558***	-0.391	-9.830*	10.597***	-10.731**
	(2.302)	(2.188)	(5.665)	(3.993)	(5.371)
PostAQR	-7.775***	4.689*	55.121***	-16.776***	46.717***
	(2.116)	(2.659)	(13.242)	(2.464)	(14.806)
NPLs/TA	-0.579***	-0.486***	-0.667	0.083	0.191
	(0.122)	(0.147)	(0.517)	(0.132)	(0.456)
			Panel C: Non-High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-0.601	4.799**	7.544	-5.724***	1.539
	(2.505)	(2.390)	(5.277)	(1.663)	(4.001)
AQRbankXPostAQR	2.849	-0.863	-13.432***	5.536***	-9.216***
	(1.807)	(1.619)	(3.679)	(1.419)	(3.271)
PostAQR	-4.114	-0.850	-0.829	-1.669	-1.221
	(3.190)	(2.949)	(7.498)	(1.566)	(5.506)
NPLs/TA	-1.122***	-1.266***	-0.635	-0.361	1.337*
	(0.353)	(0.346)	(1.059)	(0.253)	(0.741)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,248	2,248	2,248	2,248	2,248
Banks	777	777	777	777	777

Table 10 HighNPLbank=1 if the bank's average NPL/TA over 2010-2015 is greater than the sample average NPL/TA over the same period.

Table 11: The effect of AQR net of banks with capital shortfall

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
AQRbankXPostAQR	1.959*	-0.807	-8.273***	4.346***	-5.926**
	(1.073)	(1.075)	(2.836)	(1.235)	(2.361)
PostAQR	-4.003	-2.263	-10.391*	0.557	-7.348
	(2.849)	(2.872)	(5.977)	(1.945)	(4.640)
NPL/TA	-0.517***	-0.426***	-0.440	-0.042	0.391
NPLs/TA	-0.633***	-0.530***	-0.470	-0.033	0.414
	(0.105)	(0.128)	(0.436)	(0.118)	(0.379)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,383	2,383	2,383	2,383	2,383
Banks	832	832	832	832	832
MeanY(pre-AQR)	3.107	3.792	8.108	-0.427	5.802
St. Dev.Y(pre-AQR)	5.605	6.083	21.05	5.469	19.72

We exclude 25 banks that experienced a capital shortfall in the AQR period. Table 11 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 and second rows contain the DD coefficients and the coefficients for the change in the dependent variables between the pre-treatment (2010-2012) and the post-treatment (2014-2015) period for control group banks respectively. AQRbank is a dummy equal to 1 for banks subject to the first AQR exercise; PostAQR is an indicator variable for the period 2014-2015. We include in all specifications bank FE, lagged bank level controls 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 12: The effect of NPL/TA during AQR net of banks with capital shortfall

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
AQRbank X PostAQR X NPL/TA	-0.559*	0.285	-0.793	-1.192***	-0.521
	(0.304)	(0.309)	(1.020)	(0.242)	(0.863)
AQRbankXPostAQR	4.818***	-1.156	-7.093	9.176***	-5.358
	(1.848)	(1.614)	(4.387)	(1.797)	(3.703)
PostAQR X NPL/TA	0.195*	-0.121	-0.353	0.321**	-0.039
	(0.110)	(0.149)	(0.489)	(0.129)	(0.395)
AQRbank X NPL/TA	0.365	-0.804	1.209	1.200***	0.807
	(0.451)	(0.525)	(1.999)	(0.286)	(1.775)
PostAQR	-4.387	-2.648	-6.422	0.688	-5.264
	(2.940)	(3.012)	(6.910)	(1.954)	(5.606)
NPLs/TA	-0.734***	-0.475***	-0.277	-0.149	0.454
	(0.133)	(0.147)	(0.518)	(0.133)	(0.460)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,166	2,166	2,166	2,166	2,166
Banks	758	758	758	758	758
Mean	3.116	3.765	8.511	-0.379	6.339
St. Dev.	5.685	6.224	21.52	5.576	20.16

We exclude 25 banks that experienced a capital shortfall in the AQR period. Table 12 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. We augment Table 8 with a triple interaction AQRbankXPostAQRXNPL/TA. AQRbank is a dummy equal to 1 for banks subject to the first AQR exercise; PostAQR is an indicator variable for the period 2014-2015; NPL/TA is the time varying NPL/TA variable. The first row contains the DDD coefficients for the change in the dependent variables before (2010-2012) and after (2014-2015) the AQR exercise for treated banks induced by a change in the volume of NPLs. We include in all specifications bank 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: The effect of High-NPL bank status during AQR net of banks with capital shortfall

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
			Panel A: All		
AQRbank X PostAQR X HighNPLbank	-3.037*	0.022	1.530	-4.491***	1.951
	(1.734)	(1.885)	(4.212)	(1.548)	(3.254)
AQRbankXPostAQR	3.737***	-0.855	-10.017***	6.638***	-7.827***
	(1.407)	(1.337)	(3.181)	(1.475)	(2.758)
PostAQR	-3.759	-2.047	-9.573	0.869	-6.658
	(2.702)	(2.950)	(6.254)	(1.884)	(4.851)
NPLs/TA	-0.640***	-0.542***	-0.509	-0.003	0.391
	(0.115)	(0.134)	(0.467)	(0.121)	(0.410)
			Panel B: High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-8.368***	-3.797	-4.677	-7.567*	2.036
	(2.373)	(2.456)	(6.788)	(4.233)	(6.234)
AQRbankXPostAQR	7.174***	-0.461	-8.450	10.450**	-9.337*
	(2.217)	(2.417)	(5.400)	(4.135)	(4.932)
PostAQR	-6.775***	2.266	31.709***	-15.366***	19.392***
	(1.992)	(2.574)	(8.719)	(2.633)	(7.362)
	(2.373)	(2.456)	(6.788)	(4.233)	(6.234)
NPLs/TA	-0.601***	-0.474***	-0.470	0.048	0.376
	(0.126)	(0.151)	(0.522)	(0.133)	(0.461)
			Panel C: Non-High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-1.099	4.601*	7.619	-6.016***	2.834
	(2.606)	(2.520)	(5.236)	(1.756)	(4.001)
AQRbankXPostAQR	3.076*	-0.673	-13.469***	5.691***	-9.852***
	(1.815)	(1.637)	(3.722)	(1.437)	(3.265)
PostAQR	-4.241	-1.400	-2.588	-1.801	-1.654
	(3.325)	(3.045)	(7.256)	(1.609)	(5.412)
NPLs/TA	-0.878***	-1.030***	-0.212	-0.214	1.159
	(0.307)	(0.317)	(1.056)	(0.230)	(0.797)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,166	2,166	2,166	2,166	2,166
Banks	758	758	758	758	758

We exclude 25 banks that experienced a capital shortfall in the AQR period. HighNPLbank=1 if the bank's average NPL/TA in 2010-2015 is higher than the sample average NPL/TA over the same period.

Table 14: The effect of AQR net of banks making large adjustments to provisions

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
AQRbankXPostAQR	2.452**	-0.473	-7.513**	4.561***	-5.359**
	(1.135)	(1.163)	(3.150)	(1.273)	(2.626)
PostAQR	-4.755*	-1.810	-8.293	-0.450	-5.990
	(2.684)	(2.832)	(6.432)	(2.017)	(4.919)
NPLs/TA	-0.688***	-0.613***	-0.665	-0.016	0.375
	(0.114)	(0.135)	(0.441)	(0.119)	(0.378)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,329	2,329	2,329	2,329	2,329
Banks	822	822	822	822	822
MeanY(pre-AQR)	3.191	3.877	8.139	-0.448	5.705
St. Dev.Y(pre-AQR)	5.627	6.087	21.02	5.494	19.66

We exclude 30 banks that made larger adjustments to provisions than the average bank in the AQR period. Table 14 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 and second rows contain the DD coefficients and the coefficients for the change in the dependent variables between the pre-treatment (2010-2012) and the post-treatment (2014-2015) period for control group banks respectively. AQRbank is a dummy equal to 1 for banks subject to the first AQR exercise; PostAQR is an indicator variable for the period 2014-2015. We include in all specifications bank FE, lagged bank level controls 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 15: The effect of NPL/TA during AQR net of banks making large adjustments to provisions

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
AQRbank X PostAQR X NPL/TA	-0.932***	0.138	-0.506	-1.450***	0.103
	(0.301)	(0.316)	(1.382)	(0.241)	(1.175)
AQRbankXPostAQR	6.103***	-0.697	-7.820*	9.933***	-7.129*
	(1.806)	(1.612)	(4.737)	(1.754)	(4.170)
PostAQR X NPL/TA	0.177	-0.150	-0.364	0.329**	-0.014
	(0.111)	(0.151)	(0.494)	(0.130)	(0.398)
AQRbank X NPL/TA	0.958**	-0.334	1.385	1.238***	0.392
	(0.442)	(0.565)	(2.363)	(0.243)	(2.099)
PostAQR	-3.650	-1.520	-3.816	0.920	-4.829
	(2.952)	(3.198)	(7.648)	(1.892)	(6.319)
NPLs/TA	-0.790***	-0.554***	-0.518	-0.151	0.369
	(0.138)	(0.154)	(0.524)	(0.135)	(0.452)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,111	2,111	2,111	2,111	2,111
Banks	748	748	748	748	748
MeanY(pre-AQR)	3.209	3.858	8.557	-0.401	6.248
St. Dev.Y(pre-AQR)	5.712	6.235	21.50	5.607	20.10

We exclude 30 banks that made larger adjustments to provisions than the average bank in the AQR period. Table 15 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. We augment Table 8 with a triple interaction AQRbankXPostAQRXNPL/TA. AQRbank is a dummy equal to 1 for banks subject to the first AQR exercise; PostAQR is an indicator variable for the period 2014-2015; NPL/TA is the time varying NPL/TA variable. The first row contains the DDD coefficients for the change in the dependent variables before (2010-2012) and the after (2014-2015) the AQR exercise for treated banks induced by a change in the volume of NPLs. We include in all specifications bank 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 16: The effect of High-NPL bank status during AQR net of banks making large adjustments to provisions

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
			Panel A: All		
AQRbank X PostAQR X HighNPLbank	-3.907**	-0.962	-1.121	-4.188***	0.375
	(1.904)	(1.956)	(5.814)	(1.591)	(4.664)
AQRbankXPostAQR	4.469***	-0.025	-8.134**	6.442***	-6.813**
	(1.435)	(1.384)	(3.298)	(1.550)	(2.924)
PostAQR	-3.847	-2.120	-9.673	0.775	-6.721
	(2.728)	(3.042)	(6.420)	(1.882)	(5.044)
NPLs/TA	-0.659***	-0.548***	-0.553	0.006	0.363
	(0.116)	(0.136)	(0.471)	(0.123)	(0.413)
			Panel B: High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-5.920**	-1.964	-9.337	-7.934*	-5.117
	(2.582)	(3.073)	(9.276)	(4.761)	(7.809)
AQRbankXPostAQR	6.760***	-0.906	-6.912	11.160**	-6.729
	(2.267)	(2.559)	(5.717)	(4.622)	(5.171)
PostAQR	-8.651***	0.792	33.794***	-15.457***	22.926***
	(1.927)	(2.800)	(10.040)	(2.263)	(8.354)
NPLs/TA	-0.597***	-0.472***	-0.506	0.055	0.337
	(0.127)	(0.152)	(0.527)	(0.135)	(0.464)
			Panel C: Non-High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-3.721	2.294	5.853	-5.835***	3.075
	(3.191)	(3.140)	(8.204)	(1.744)	(6.172)
AQRbankXPostAQR	3.753**	-0.073	-11.946***	5.450***	-8.979***
	(1.871)	(1.719)	(3.913)	(1.434)	(3.389)
PostAQR	-3.239	-0.499	-3.706	-2.052	-3.748
	(3.320)	(3.134)	(7.546)	(1.589)	(5.747)
NPLs/TA	-0.996***	-1.078***	-0.172	-0.178	1.347
	(0.313)	(0.350)	(1.107)	(0.229)	(0.831)
Bank controls	Yes	Yes	Yes	Yes	Yes
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,093	2,093	2,093	2,093	2,093
Banks	742	742	742	742	742

We exclude from 30 banks that made larger adjustments to provisions than the average bank in the AQR period. HighNPLbank=1 if the bank's average NPL/TA over 2010-2015 is greater than the sample average over the same period.

Robustness

Table 17: Basic regression: NPL/GL

	(1) Delta LogGL	(2) Delta LogTA	(3) Delta LogTS	(4) Delta GL/TA	(5) Delta SEC/TA
NPL/GL	-0.439***	-0.367***	-0.496*	-0.049	0.167
	(0.063)	(0.075)	(0.275)	(0.072)	(0.237)
GL/TA	-0.247***	0.197***	-0.810***	-0.502***	-1.124***
	(0.064)	(0.055)	(0.192)	(0.062)	(0.165)
TS/TA	0.090*	0.042	-2.675***	0.021	-3.139***
	(0.048)	(0.054)	(0.180)	(0.052)	(0.159)
Size	-14.688***	-16.219***	-17.373**	0.774	6.668
	(2.665)	(2.639)	(7.502)	(2.121)	(4.364)
Tier1Ratio	0.318***	0.207*	-0.150	0.168	-0.203
	(0.099)	(0.111)	(0.373)	(0.105)	(0.295)
ROE	0.139***	0.183***	0.039	-0.088	-0.146
	(0.053)	(0.060)	(0.194)	(0.057)	(0.170)
Liquidity	-0.044	-0.433*	-0.550	0.294	-0.405
	(0.208)	(0.235)	(0.717)	(0.221)	(0.628)
CustomerDeposits	0.002	-0.011	0.053	0.017	0.133
	(0.034)	(0.044)	(0.157)	(0.037)	(0.144)
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	3,151	3,151	3,151	3,151	3,151
Banks	872	872	872	872	872
Mean	2.871	3.461	8.101	-0.361	6.043
St. Dev.	5.760	6.138	20.89	5.480	19.38

Table 17 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 total 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 asset quality indicator is the NPL/GL ratio. Bank fixed effects and country-sizeBin-year fixed effects are included. Mean and St. Dev. refer to each dependent variable. Standard errors are clustered at bank level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 18: Basic regression: Texas ratio

	(1) Delta LogGL	(2) Delta LogTA	(3) Delta LogTS	(4) Delta GL/TA	(5) Delta SEC/TA
Texas	-0.084***	-0.081***	-0.073	-0.002	0.044
	(0.012)	(0.014)	(0.050)	(0.013)	(0.041)
GL/TA	-0.217***	0.223***	-0.780***	-0.500***	-1.137***
	(0.066)	(0.055)	(0.192)	(0.063)	(0.165)
TS/TA	0.086*	0.041	-2.684***	0.019	-3.140***
	(0.048)	(0.053)	(0.180)	(0.052)	(0.158)
Lly	-13.409***	-15.174***	-15.880**	0.933	6.208
	(2.700)	(2.613)	(7.553)	(2.180)	(4.369)
Tier1Ratio	0.261***	0.142	-0.177	0.175	-0.161
	(0.099)	(0.113)	(0.368)	(0.106)	(0.293)
ROE	0.145***	0.180***	0.064	-0.081	-0.140
	(0.053)	(0.058)	(0.195)	(0.056)	(0.172)
Liquidity	-0.068	-0.448**	-0.587	0.287	-0.402
	(0.204)	(0.228)	(0.715)	(0.222)	(0.629)
CustomerDeposits	0.006	-0.008	0.058	0.018	0.132
	(0.034)	(0.044)	(0.159)	(0.037)	(0.144)
C*Sb*Y FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	3,151	3,151	3,151	3,151	3,151
Banks	872	872	872	872	872
Mean	2.871	3.461	8.101	-0.361	6.043
St. Dev.	5.760	6.138	20.89	5.480	19.38

Table 18 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 total 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 asset quality indicator is the Texas ratio. Bank fixed effects and country-sizeBin-year fixed effects are included. Mean and St. Dev. refer to each dependent variable. Standard errors are clustered at bank level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 19: Basic regression: controlling for GDP growth

	(1) Delta LogGL	(2) Delta LogTA	(3) Delta LogTS	(4) Delta GL/TA	(5) Delta SEC/TA
NPL/TA	-0.438***	-0.163	1.073**	-0.194*	1.629***
	(0.098)	(0.117)	(0.473)	(0.111)	(0.399)
CoverageRatio	-0.008	-0.027	-0.001	-0.012	0.025
	(0.016)	(0.017)	(0.057)	(0.018)	(0.050)
GL/TA	-0.204***	0.320***	-0.582***	-0.544***	-1.030***
	(0.063)	(0.059)	(0.199)	(0.064)	(0.180)
TS/TA	0.100*	0.051	-2.649***	-0.025	-3.230***
	(0.055)	(0.059)	(0.218)	(0.062)	(0.190)
Size	-15.801***	-14.537***	-6.241	1.739	10.644*
	(2.614)	(2.598)	(7.145)	(2.525)	(5.615)
Tier1Ratio	0.319***	0.249**	0.113	0.113	-0.034
	(0.096)	(0.102)	(0.352)	(0.112)	(0.335)
ROE	0.149**	0.153**	0.183	-0.065	-0.034
	(0.067)	(0.066)	(0.212)	(0.075)	(0.204)
Liquidity	0.126	-0.633**	-0.859	0.569*	-0.686
	(0.270)	(0.311)	(0.967)	(0.304)	(0.800)
CustomerDeposits	-0.014	-0.049	-0.059	0.034	-0.022
	(0.036)	(0.044)	(0.152)	(0.041)	(0.136)
GDP growth (annual %)	0.597***	-0.337***	-2.777***	0.913***	-2.637***
	(0.092)	(0.093)	(0.318)	(0.100)	(0.298)
C*Sb FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	3,151	3,151	3,151	3,151	3,151
Banks	872	872	872	872	872
Mean	2.871	3.461	8.101	-0.361	6.043
St. Dev.	5.760	6.138	20.89	5.480	19.38

Table 19 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 total 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 asset quality indicator is the NPL/TA ratio. Bank fixed effects and country-sizeBin fixed effects are included. Mean and St. Dev. refer to each dependent variable. Standard errors are clustered at bank level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level.

Table 20: The effect of High-NPL bank status during AQR

	(1) DeltaLogGL	(2) DeltaLogTA	(3) DeltaLogSec	(4) DeltaGL/TA	(5) Delta Sec/TA
			Panel A: All		
AQRbank X PostAQR X HighNPLbank	-5.054***	-4.272**	-6.778	-2.144	-3.013
	(1.608)	(1.696)	(5.271)	(1.567)	(4.537)
AQRbankXPostAQR	4.032***	-0.245	-11.857***	6.109***	-10.362***
	(1.399)	(1.285)	(3.434)	(1.450)	(2.990)
PostAQR	-3.969	-0.369	-2.426	-0.816	-0.862
	(2.423)	(2.880)	(7.279)	(2.021)	(5.578)
NPLs/TA	-0.649***	-0.590***	-0.751	-0.008	0.268
	(0.117)	(0.141)	(0.472)	(0.122)	(0.404)
			Panel B: HighNPL countries		
AQRbank X PostAQR X HighNPLbank	-8.771***	-5.646**	-17.755**	-6.627	-11.871
	(2.659)	(2.600)	(8.139)	(4.697)	(7.261)
AQRbankXPostAQR	7.155***	-0.709	-7.385	11.095**	-7.140
	(2.454)	(2.335)	(5.607)	(4.517)	(5.033)
PostAQR	-7.932***	4.575*	55.500***	-16.723***	47.389***
	(2.120)	(2.662)	(13.234)	(2.459)	(14.776)
NPLs/TA	-0.578***	-0.485***	-0.647	0.088	0.216
	(0.123)	(0.148)	(0.519)	(0.133)	(0.458)
			Panel C: Non-High-NPL countries		
AQRbank X PostAQR X HighNPLbank	-4.259	0.989	8.531	-4.659***	6.794
	(2.614)	(2.768)	(6.424)	(1.644)	(5.178)
AQRbankXPostAQR	3.314*	0.426	-12.463***	4.526***	-9.784***
	(1.745)	(1.557)	(3.517)	(1.433)	(3.117)
PostAQR	-4.113	-0.694	-0.619	-1.837	-1.203
	(3.166)	(2.953)	(7.305)	(1.746)	(5.507)
NPLs/TA	-0.920***	-1.039***	-0.666	-0.438*	1.049
	(0.355)	(0.356)	(1.113)	(0.241)	(0.813)
C*Sb*Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Observations	2,248	2,248	2,248	2,248	2,248
Banks	777	777	777	777	777

Table 20. HighNPLbank=1 if the banks' average NPL/GL>10%