NON-PERFORMING LOANS AND EURO AREA BANK LENDING BEHAVIOUR AFTER THE CRISIS

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The views expressed are those of the authors alone and do not necessarily reflect the view of the Eurosystem or its members. We thank Costanza Rodriguez d'Acri for making the dataset of new lending flows accessible and an anonymous referee for very helpful comments. All remaining errors are our own.

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Abstract

Non-performing loans (NPLs) remain high on the policy agenda in Europe. Their persistence at elevated levels after the financial crisis gave rise to financial stability concerns – including possible adverse impacts on financial intermediation. A commonly-held view is that NPLs impair the credit allocation mechanism. However, the literature has not so far offered a theoretical framework to support this view. This paper argues that loan demand and supply dynamics may vary over the economic cycle and that banks that are burdened with high NPLs may discriminate between households and firms in their credit allocation decisions in the recovery phase. Using a novel bank-level dataset for large euro area banks covering the period of the recent economic upswing, we find robust evidence that the stock of NPLs relative to banks' shock-absorbing capacity, measured by bank capital, has been a significant factor in explaining bank-specific loan origination. The effect is found to be more significant for corporate than for household lending. Since high NPL stocks do indeed appear to impair credit allocation, dedicated policies aimed at bringing NPL stocks down are required to avoid adverse impacts on the real economy. Our findings support the aims of the guidance that the single supervisory mechanism has given to banks on their NPL strategies. Additionally, the linkages between high NPL stocks and credit flows motivate the need for complementary measures to address impediments to NPL resolution, such as weaknesses in judicial and insolvency frameworks.

1 Introduction

One of the consequences of the global financial crisis, which erupted in 2007, and the subsequent euro area sovereign debt crisis was the accumulation of a large stock of non-performing loans (NPLs) across a large swathe of euro area banks. By 2013, some 8% of the total amount of loans extended by the euro area banking sector were non-performing. The distribution of these NPLs was not uniform across countries: peak NPL ratios varied from less than 2% in the Nordic region to as much as 50% in Greece and Cyprus. By 2015, elevated NPLs were firmly recognised as one of the key macroprudential and supervisory policy challenges for the euro area banking sector [see Aiyar et al. (2015) and Grodzicki et al. (2015)].

The subsequent policy response, formulated by the European Council in July 2017, was founded on several pillars: improved supervision; the reform of insolvency and debt recovery frameworks; the development of secondary markets for NPLs ("distressed assets"); and restructuring of the banking industry [see FSC (2017)]. Similar policies were advocated by the European Systemic Risk Board [see ESRB (2017)]. Since the 2013 peak, the aggregate NPL ratio has slowly decreased, reaching about 4.4% in the second quarter of 2018. Supported by economic tailwinds – including robust economic expansion and accommodative monetary policy – the enhanced focus of supervisors on the need to bring NPL stocks down undoubtedly played a role in this.

The case for a public policy response to persistently-elevated NPL stocks was motivated by concern over the impact that high NPLs might be having on credit supply, and, by extension, on macroeconomic performance. As discussed in the reports of the ESRB and the FSC, high NPLs are often associated with inefficient allocation of capital and funding, while also distracting scarce bank management resources from the running of lending businesses. At the same time, high NPL stocks can be seen as a symptom of balance sheet weakness among borrower sectors, especially of non-financial corporates. As the empirical evidence available at the time that these reports were finalised was limited, this

paper attempts to shed some light on the relationship between the lending behaviour of individual banks and their asset quality, which could provide further insights regarding the policy response to asset quality problems.

2 Literature Review

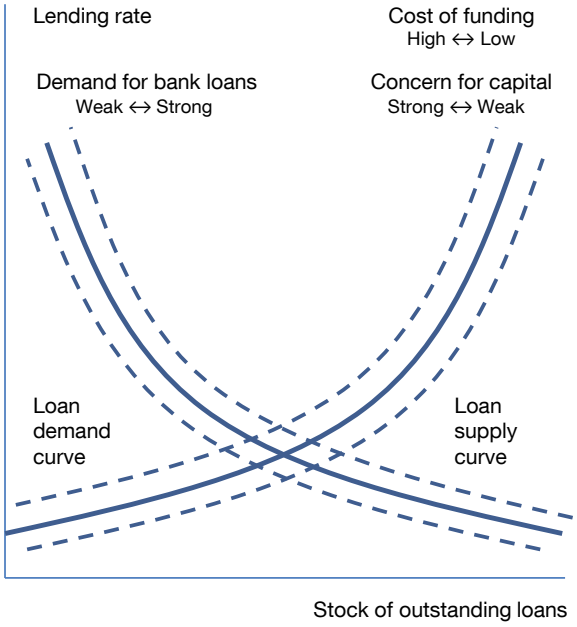
For a topic of such current policy importance, the available NPL literature is relatively sparse and almost exclusively empirical in nature. In a nutshell, the literature suggests that there may be two-way causality between bank asset quality and economic performance.

There is a large body of evidence which shows that episodes of increases in NPLs are triggered by macroeconomic shocks. Based on data from a large sample of advanced and emerging economies, it has been argued that the economic cycle is a key driver of aggregate NPL ratios, whilst lending rates, exchange rates and stock prices may also help to explain changes in NPLs [see Beck, Jakubik and Piloiu (2013)]. Similar conclusions were reached for smaller samples of countries [see Nkusu (2011), and Glen and Mondragón-Velez (2011)]. Using regional economic data, a threshold relationship between NPLs and economic growth in Italy was uncovered [see Mohaddes, Raissi and Weber (2017)]. In that paper, a GDP growth rate of more than 1.2% was found to be consistent with decreases in the NPL ratio. This leads to the conclusion that Italian economic growth would need to be significantly boosted, and structural reforms undertaken, to achieve a durable reduction in NPL levels. Evidence has also been uncovered that structural rigidities and inefficiencies in insolvency frameworks have contributed to slow down the reduction of NPLs, explaining high cross-country heterogeneity in NPL levels observed across Europe [see Cerulli et al. (2017)].

Other studies take a more micro approach, analysing the impact of bank-specific factors on NPL build-ups, in particular, bank-specific credit growth [see Espinoza and Prasad (2010), and Garrido, Kopp and Weber (2016)]. For Greek banks, it appears that low management quality – proxied by cost inefficiencies and weak profitability – contributes to poor asset quality of individual banks [see Louzis, Vouldis and Metaxas (2012)]. They interpret this relationship as evidence that poorly managed banks cannot discriminate between sound and unsound borrowers, and, more broadly, cannot manage credit risk well. On the other hand, financially weak banks may face incentives to "gamble for recovery", that is, knowing that their likelihood of survival is low, they might lend to financially unsound borrowers in the hope that an unexpected positive economic shock results in their loans being repaid. Some empirical evidence in favour of this hypothesis has been found [see Keeton and Morris (1987), and Jimenez and Saurina (2006)].

Only a few papers analyse the macroeconomic consequences of elevated NPL stocks and the associated debt overhang, or the interaction between policy responses to NPL increases and economic performance. The usual transmission channel is related to credit supply, which, arguably, may be negatively affected in the presence of high NPL stocks. In turn, lower credit supply leads to weaker credit and GDP growth. It has been argued that the literature has not so far offered a theoretical framework to support the view that high NPLs can limit banks' lending ability [see Angelini (2018)]. While the theoretical literature is indeed sparse, the existence of a relationship between credit supply and NPLs in a VAR framework has been variously supported [see Nkusu (2011), Espinoza and Prasad (2010), and Klein (2013)]. Using a large panel of countries, it has been shown that those countries which actively reduced their NPLs managed to achieve stronger macroeconomic performances than countries which did not reduce their NPLs [see Balgova, Nies and Plekhanov (2016)]. An extension of that study found that active resolution of NPLs, for example using asset management companies and publicly-funded bank recapitalisation,

LOAN DEMAND AND SUPPLY CURVE CHART 1



SOURCE: Own elaboration based on Aoki et al. (2009).

can boost GDP growth by up to 1.5 percentage points annually, in comparison to countries where high NPLs were not actively dealt with [see Balgova, Plekhanov and Skrzypinska (2018)]. On the other hand, it has been argued, on the basis of Italian borrower-level data, that only unexpected increases in NPLs have affected credit growth [see Accornero et al. (2017)]. To the extent that NPL build-ups are associated with weak fundamentals of the population of borrowers (i.e. negative credit demand shocks) and weak bank capitalisation, it is claimed to have no additional effect on credit growth.

Most of the literature which considers the consequences of high NPL stocks is focused on aggregate data. This paper harnesses bank-level data for a range of euro area countries which are part of the Single Supervisory Mechanism of the European Union. We investigate whether, within the same banking system, banks that differ in terms of their NPL ratios also differ in their volume of credit provision. We contend that this approach controls for credit demand effects, which are, by and large, common to all banks (that is, barring regional and business model variation). We contend that the presence of weak banks may adversely affect the total flow of credit and, thus, macroeconomic performance.

3 Theoretical Considerations

In the absence of a theoretical framework for the dynamic relationship between bank lending and NPLs, this paper aims to present a tentative theoretical foundation for the role that NPLs may play in the origination of credit, testing it with preliminary empirical evidence. A key element of that is distinguishing relevant phases in the NPL cycle, the periods when NPLs are building-up, when they stabilise and are being reduced.

3.1 DEMAND AND SUPPLY

A key step in answering questions concerning the role of NPLs in credit allocation is to understand the factors underlying credit demand and credit supply. Empirically, disentangling these factors is not straightforward [see, for example, Del Giovane et al. (2011), and Hempell and Kok Sørensen (2010)]. As illustrated in Chart 1, in a demand and supply context, loan supply, at a given lending rate, is impacted by banks' costs of

funding and their capital buffers; demand, at a given lending rate, is affected by macroeconomic variables impacting loan demand [see Aoki et al. (2009)].

In a static context, a rudimentary analysis highlights the role that NPLs may play in loan supply. For a given bank, an adverse shock (e.g. an unexpected macroeconomic downturn), which results in an increase of NPL stocks, depletes capital buffers and, *ceteris paribus,* results in a higher cost of funding, leading to a reduction of loan supply. The same shock will also adversely impact loan demand.

Distinguishing the effects on stocks and flows is also important in this context. In the absence of new lending, the stock of outstanding loans falls, as loans mature. The outstanding stock only remains unchanged, so long as new lending replenishes maturing loans. Empirically, therefore, the impact of NPL stocks on lending may be better observed through new lending flows than changes in the stock of loans.

In this rudimentary framework, it is clear that a potential link between NPLs and credit supply could emerge. But a further aspect of loan demand may be overlooked in such analysis. Assuming that banks only lend to solvent borrowers, the aggregate demand for new credit must decrease, all else being equal, and assuming that the system is closed: fewer solvent firms maintaining a given level of individual credit demand result in an overall lower aggregate demand. With falling demand, loan volume must decrease as well. From this perspective, it is difficult to argue that a stock of NPLs does not reduce lending.

It could be postulated that unimpaired borrowers could absorb the excess credit – and as such, loan volume does not shrink – and while such an effect may be present, one would not expect solvent borrowers to continue to increase demand to fully offset the disappearance of demand of insolvent borrowers, for all levels of impairment in an economy. This could be thought of as an "accounting identity", linking NPLs to credit origination.

On the other hand, banks are obliged to actively monitor and manage credit risk in their loan books. As part of risk management, they periodically re-estimate their internal credit risk models. Following a surge of NPLs, the probabilities of default provided by these models would increase; if bank risk appetite remains constant, fewer performing borrowers would be considered creditworthy. This would "move the goalposts" for borrowers, and result in a tightening of loan supply, even for those that are considered solvent.

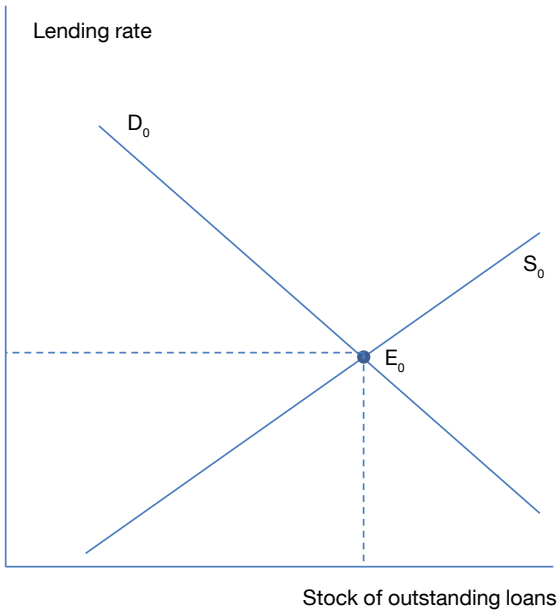
Perhaps what is missing from the static analysis presented previously, and which may impact empirical analysis, is a dynamic component that recognises the feedback loops that emerge as the economic and financial cycle turns down with NPLs rising, and then plateauing, before ultimately declining. Consider the following "cycle" analysis.

We commence with a closed banking system with equilibrium in the market for loans, and a known, small stock of NPLs across all banks (Chart 2). There is an equilibrium lending rate, in aggregate, for the economy, and an equilibrium stock of outstanding loans, where loans maturing are replaced by new credit flows.

Commencing from this equilibrium, consider the impact of an adverse macroeconomic shock which, for banks, raises the prospect of increasing losses on the outstanding stock of loans, as households and firms adjust to the shock. Concurrently, the loan supply curve will shift to the left, as banks reduce loan supply in the face of stresses to their capital

EQUILIBRIUM IN LOAN MARKET

CHART 2



SOURCE: Own elaboration.

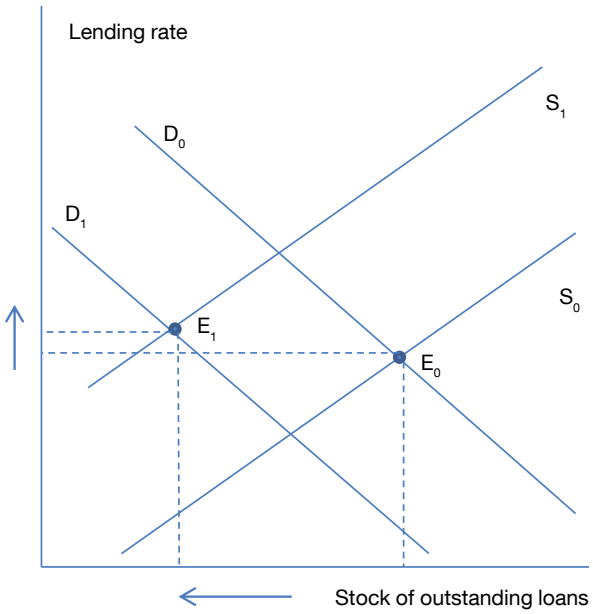
buffers and, perhaps, also their cost of funding; while the demand curve for loans will also shift to the left, as households and firms demand less credit, in light of reduced consumption and investment (Chart 3). This has the effect of decreasing the flow of new lending, and also the outstanding stock of loans, whilst the effect on lending rates would be ambiguous.

In the second phase, the impact of the macroeconomic shock has been absorbed, a cyclical recovery has set in, and NPL stocks have stabilised at an elevated level. In such circumstances, loan supply may recover, shifting to the right (Chart 4). This may result from some "strong" banks being relatively unconstrained by their capital buffers and costs of funding, given the perception that their balance sheets are strong and that expectations concerning credit risk and future losses remain contained. "Weak" banks on the other hand may continue to face lending constraints. The same too may be said of households and firms. On the demand side, unimpaired households and firms may no longer be adversely affected by negative economic sentiment, and may increase consumption and investment. On the other hand, impaired households and firms will remain unable to access credit and the market will have shrunk from its original size. Assuming the "accounting identity" approach holds, banks will supply less credit, as there is less demand from solvent borrowers. Of course, this may also lead to solvent households and firms being denied access to credit, if they are clients of "weak" banks. As such, from phase one to phase two, the market for new lending has shrunk as newly-impaired borrowers and "weak" banks are no longer active. Credit growth in this recovery phase may be impeded by "weak" banks, those with high NPLs. The combined effect of these forces on demand will depend, *inter alia,* on the relative proportion of impaired to unimpaired borrowers. So at the very minimum, credit will contract on a scale equivalent to the fall in demand, but possibly by more, if weak banks constrain credit to solvent borrowers.

Taken together, and given that it takes time to transit from one phase to the next, it may suggest that the relationship between new lending and NPL stocks varies over time. Time

DECLINING DEMAND AND SUPPLY OF LOANS

CHART 3



SOURCE: Own elaboration.

variance in the relationship between variables and heterogeneity across countries in terms of the timing of shocks may further complicate the matter. In fact, as the effects of a given shock may impact different sectors of the economy differently over time, it may even be the case that it is first seen in specific asset classes, before becoming more widespread, and therefore, first impacting those banks with higher exposures to those asset classes.

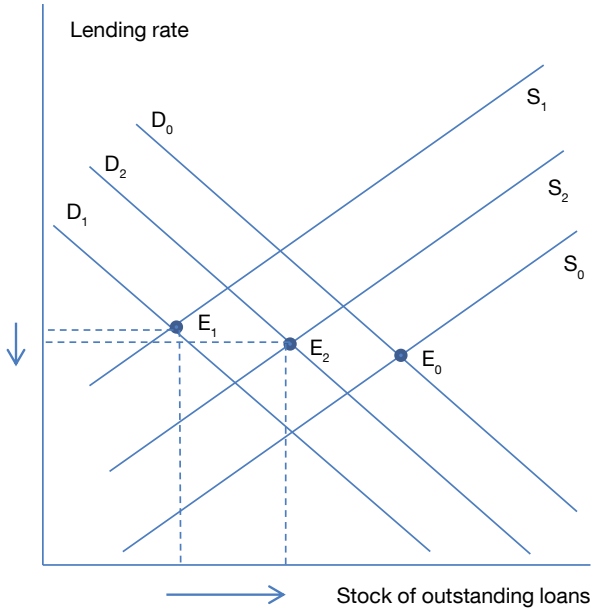
3.2 EMPIRICAL IMPLICATIONS

Empirically, the dynamics just described present some interesting challenges. In the first phase, following a macroeconomic shock which reduces both demand and supply and triggers a build-up of NPLs, NPL stocks should not explain reduced lending. On the one hand, reduced demand will play a role, while on the other, expectations for future bank losses and other uncertainties may impact supply. Including, therefore, this build-up phase of NPLs in empirical analysis may lead to inconsistent findings. NPL stock and flow dynamics may be a consequence, but not a cause, of changes in the demand and supply of loans.

In the second phase, when stocks of NPLs have built-up, but new flows have largely stabilised or decreased, a multiplicity of supply and demand factors will be at play, again making empirical investigation at the aggregate level challenging. Lending supply may increase overall, relative to the build-up phase, as strong banks resume lending while weak banks would be held back by their balance sheet and risk appetite constraints, but it is not clear what result the various forces impacting demand may have. It could be that demand also recovers somewhat, or that the effects of the shrinking market reduces credit demand further. The composition and condition of bank, firm and household balance sheets will condition the outcome.

Despite these challenges, it should nevertheless be possible to find a relationship between NPL stocks and flows of new lending through the supply channel in disaggregated, bank-level data, as “strong” banks by definition will have relatively smaller NPL stocks. While it

PARTIAL RECOVERY IN DEMAND AND SUPPLY CHART 4



SOURCE: Own elaboration.

may not be possible to disentangle the affects, high NPLs may also explain reduced demand – a high NPL bank has, by definition, a higher number of impaired clients, and is, therefore, more affected by the decreased demand of those clients. That concern should be mitigated by focusing the analysis on large banks which operate nation-wide or even in a cross-border environment, and across several industries. On the other hand, the focus on such banks may blur the relationship, for example where cross-border banks accumulated NPLs outside of the euro area and they may not consider them as a constraint in lending to euro area customers.

4 Empirical Evidence

4.1 DATA AND RELATED CONSIDERATIONS

Our empirical analysis harnesses a novel dataset, the core of which utilises the ECB's supervisory data for significant banks in the euro area.[1,2] The data are collected in the framework of statutory reporting requirements that all banks domiciled in the European Union must fulfil, and are subject to a harmonised quality assurance process. This quarterly dataset covers the period Q4 2014 to Q2 2018, which coincides with the broad-based recovery of the euro area economic activity and the decline in the aggregate NPL ratio. On average, it includes 65 significant banks over this period on a consolidated level which account for about 78% of the euro area bank assets.[3] Table 1 provides an overview of the data coverage across 14 euro area countries, including the frequency, or observations per country, the number of banks captured in the sample, the total assets of those banks as a

1 See https://www.bankingsupervision.europa.eu/banking/statistics/html/index.en.html.

2 A significant bank is a bank directly supervised by the European Central Bank in the framework of the Single Supervisory Mechanism. Significant banks are identified based on criteria laid down in the applicable legislation: (i) total assets above €30 billion, or (ii) total assets above 20% of GDP of the country of establishment, or (iii) total assets above €5 billion and the ratio of its cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities is above 20%, or (iv) the bank is one of the three largest banks in its country of establishment.

3 The cross-section is not fixed over the period as the banks subject to direct supervision by the ECB are subject to change each year. For further details, see, for example: https://www.bankingsupervision.europa.eu/banking/list/who/html/index.en.html.

DATA DESCRIPTION TABLE 1

Country	Frequency	No. Banks	Total assets (% of total euro area assets [1])	NPL ratio (% of total loans)
Austria	81	6	2.0	3.6
Belgium	28	2	1.8	2.5
Finland	20	2	0.9	1.4
France	108	8	27.8	2.5
Germany	156	13	13.3	1.6
Greece	56	4	1.0	43.5
Ireland	36	3	0.5	12.7
Italy	119	9	8.4	11.1
Lithuania	14	1	0.0	4.7
Malta	28	2	0.1	3.4
Netherlands	42	3	7.9	2.3
Portugal	42	3	0.9	16.2
Slovenia	24	2	0.1	4.8
Spain	154	11	13.2	4.0
Euro area	908	69	77.8	3.1

NOTES: Total euro area assets refer to total assets of all significant institutions supervised by the SSM, excluding custodian banks and public sector lenders for Q1 2018; country average for Q1 2018.

ratio of all euro area assets, and their NPL ratio, as a percentage of total loans. The table also shows the dispersion of NPL rates across the euro area, from a low of 1.36% of total loans in Finland, to more than 43% in Greece. With the focus on large banks, a question of representativeness arises, as the large banks may be better equipped to handle high stocks of NPLs and maintain loan supply than smaller banks. While it is difficult to fully overcome this limitation of the dataset, we control for bank size in the regression analysis.

For reasons of their business model a number of banks in the dataset may be better excluded. We focus on banks which engage in lending to the private non-financial sector on a substantial scale, which we define to mean that loans to that sector exceed 10% of a bank's total assets. Other banks are also removed from the sample. For instance, one which is undergoing a long-term wind-down process and several government-sponsored development banks are also excluded. This is because most of their lending business is tightly regulated, often subject to quantitative limits and limits on pricing, and the associated credit risk is often transferred to the government, for example through guarantee schemes. NPLs are usually very low or non-existent, owing to such structural considerations. After exclusion of the affected banks, the sample is reduced from about 120 to an average of 65 financial institutions per period.

We combine this sample with the individual monetary and financial institutions' (MFI) balance sheet statistics, collected by the ECB for monetary policy purposes. These individual MFI data are available for a selection of euro area banks, on a sub-consolidated level. Often, one consolidated banking group operates via several MFI subsidiaries which may be active in different countries. We aggregate the individual MFI observations to the level of consolidated banking groups in order to obtain the corresponding data

on new lending flows.[4] This aggregation procedure leads to a result which, by definition, cannot be fully consistent with consolidated data. While the data sources do not allow for the calculation of NPL ratios at a more granular, sub-consolidated level, which would be consistent with the data on lending flows, it was checked where the NPLs held by banks represented in the dataset were originated, and found that – depending on the time period – only about 10 to 15% of NPLs reflected exposures to non-euro area customers and in no case did non-domestic NPLs represent the majority of total NPLs. In practice, therefore, the loan flows and the NPL ratio are computed on the basis of a broadly aligned geographical perimeter.

While the time dimension for this dataset may appear short, there are some advantages of its limited time-span. First, given our focus on NPLs, the data reported throughout this period relies on the ECB's implementation of the European Banking Authority's harmonised definition of NPLs.[5] This provides much-needed consistency across banks and countries. Earlier data reporting by banks suffers from heterogeneity in the definition of NPLs.

Second, we know that the build-up phase of NPLs largely preceded 2014, our dataset arguably excludes the NPL build-up phase, which is desirable. However, in light of the balance sheet-bolstering activities, it is likely that data for 2014 and 2015 could prove unreliable, as banks' lending decisions – especially the weakest ones which failed the Comprehensive Assessment – may have been influenced less by their capital buffers and costs of funds, and more by their need to take the remedial action specified by the Comprehensive Assessment.[6] As the stocks of NPLs also stabilised in 2014 and declined only slowly in 2015, it may be argued that, from the cyclical perspective discussed earlier in Section 3, this period may still belong to the first phase that precedes a partial recovery in credit supply. The empirical analysis is therefore performed separately for the full sample (2014-2018) and a reduced sample, starting in Q1 2016.

A rudimentary review of the data provides some indication that NPLs impact credit origination. Charts 5 and 6 show a direct correlation between lending growth and NPL rates. Chart 5 displays the distribution of average new corporate and household lending across NPL ratio deciles for the full sample period on the left, while the distribution per NPL ratio decile of the changes in the stock of corporate and household lending is shown on the right-hand-side. The same exercise is conducted for a reduced sample period which omits the post-Comprehensive Assessment period (2016-2018) in Chart 6. While that relationship is not monotonous and may be affected by bank and country-specific factors, only the group of banks with an NPL ratio below the 60th percentile of the sample – which corresponds to about 5% – have a positive mean lending growth rate. New lending is also negatively correlated with the NPL ratio.

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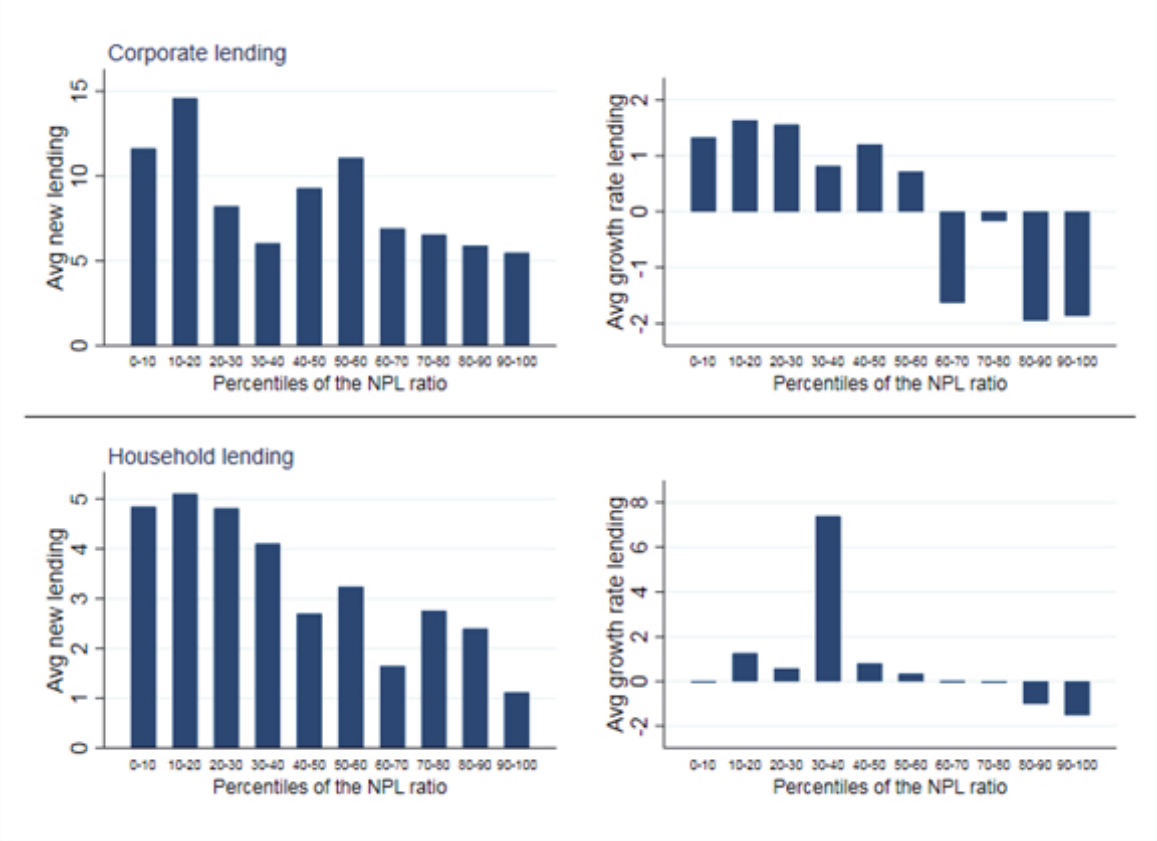
4 These data include genuine new lending as well as refinancings and renegotiations of existing loans. Although not ideal, no better proxy for new lending is currently available.

5 For further details, see: https://www.eba.europa.eu/documents/10180/449824/EBA-ITS-2013-03+Final+draft+ITS+on+Forbearance+and+Non-performing+exposures.pdf.

6 The sample period covers data reported after the ECB's 2014 Comprehensive Assessment – the asset quality review and stress test which was conducted on all banks in advance of their direct supervision by the ECB when it assumed its supervisory responsibilities. Two possible impacts could be seen in banking data around this time. In the months before and after the Comprehensive Assessment, there was likely to have been dispersion in the quality and consistency of banking data across the euro area, which the exercise significantly reduced. Perhaps more importantly, in the period before the Comprehensive Assessment, many euro area banks underwent a period of deleveraging and capital-building, in anticipation of the exercise and with a view to front-loading any possible requirements stemming from it: "… significant banking groups in the euro area have bolstered their balance sheets by over €95 billion through equity issuance" and by the second quarter of 2014 "euro area monetary financial institutions… have reduced total assets by €4.3 trillion since peaking in May 2012" [see ECB (2014)].

LENDING GROWTH BY NPL "BUCKET", 2014-2018 CHART 5
LHS: Quarterly flow of new lending (percentage of stocks), RHS: Quarterly growth rate of loans (percentages)



NOTE: Buckets are defined as deciles of the NPL ratio over the full sample of banks and time periods.

4.2 SPECIFICATION

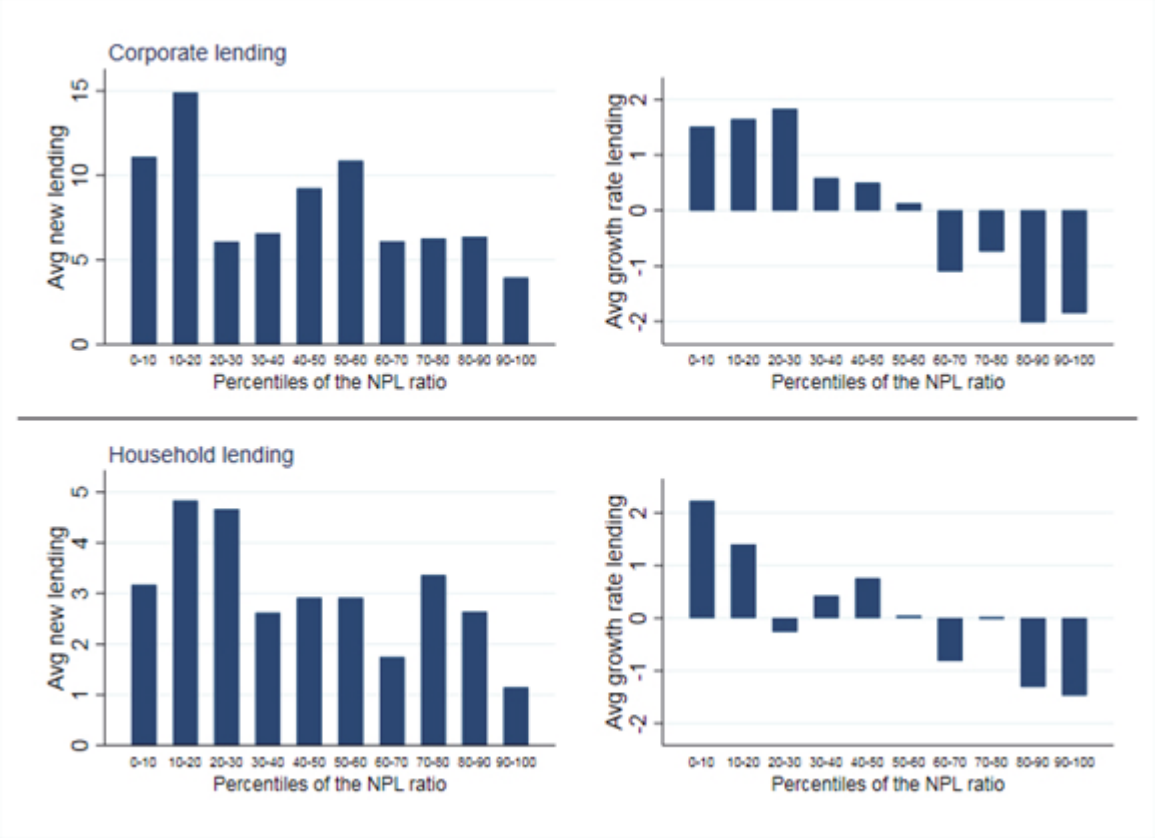
To explore the role of NPLs in credit dynamics, and to harness the novel dataset, a range of panel data techniques is employed. This approach builds on the specification proposed in the literature [see Bending et al. (2014)], although, providing additional insights into the robustness of the results due to the use of two different dependent variables and a broader range of bank-specific controls. In contrast with Bending et al. (2014), the NPL variable here is defined as the gross volume of NPLs over Tier 1 capital, with a view to normalising the NPL stock by the available loss absorption capacity.[7]

The first dependent variable used in the specification is a measure of the quarterly change in lending to non-financial corporates or to households. As that variable may be affected by changes that are not directly related to provision of new credit – such as loan sales, or mergers and acquisitions – an alternative dependent variable is defined as the quarterly sum of all new loans to, respectively, non-financial corporations and households, normalised by the total stock of such loans.[8] Table 2 provides details of the variables employed and their respective definitions.

7 The NPL stock is related mainly to lending to non-financial corporates and households. We do not distinguish between cases where high NPLs are related to corporate or to household lending, as both kinds of NPLs may serve as a constraint on new lending.

8 Quarterly corporate lending flows show pronounced seasonal fluctuations, being higher in the second and the fourth quarter of the year, and lower in the first and third quarter. Seasonal dummies are included in regressions with this dependent variable to correct for seasonal effects.

LENDING GROWTH BY NPL "BUCKET", 2016-2018 CHART 6
LHS: Quarterly flow of new lending (percentage of stocks), RHS: Quarterly growth rate of loans (percentages)



NOTE: Buckets are defined as deciles of the NPL ratio over the full sample of banks and time periods.

The rationale for using non-financial corporate and household lending as a separate dependent variable stems from the demand and supply considerations outlined in the previous section. It is postulated that banks may differentiate lending decisions, and in particular, their decisions to deny applications for credit, amongst different borrower classes. A bank's credit assessment may be more bespoke in the case of loans to non-financial corporations, which may require diligent financial analysis, than in the case of granular household loans, for which lending decisions are often supported by statistical tools. Restricting credit supply to households may then take place through price terms rather than the rejection of credit applications. Empirically, therefore, changes in loans to non-financial corporates may be more sensitive to any bank credit supply constraint. If households are willing and able to absorb the increased cost of lending imposed by banks, the pass-through of credit supply limitations will only be partially effective. This will not be true for lending to firms.

The fixed/random-effects specification is:

$$\Delta L_{i,t} = \beta_1 \left(\frac{NPL}{Tier1} \right)_{i,t} + \beta_2 \mathbf{b} + \beta_3 \mathbf{c} + \beta_4 \mathbf{s} + u_{i,t}$$

The specification for the dynamic panel model is:

$$\Delta L_{i,t} = \beta_1 \Delta L_{i,t-1} + \beta_2 \left(\frac{NPL}{Tier1} \right)_{i,t} + \beta_3 \mathbf{b} + \beta_4 \mathbf{c} + \beta_5 \mathbf{s} + u_{i,t}$$

VARIABLE DEFINITIONS TABLE 2

Variable name	Definition	Source
Dependent variables		
New corporate/household lending	Quarterly flow of new lending to non-financial corporates/households, percentages	ECB supervisory statistics
Growth in corporate / household loan stock	Quarterly growth rate of loans to non-financial corporates/households, percentages	ECB supervisory statistics
Independent variables		
NPL / Capital	Ratio of total NPLs to Tier1 capital at end-quarter, percentages	ECB supervisory statistics
Assets	Total assets at end-quarter, euro, logarithm	ECB supervisory statistics
Tier1 ratio	Tier 1 capital ratio at end-quarter, percentages	ECB supervisory statistics
L-t-D ratio	Ratio of total loans to total deposits at end-quarter, percentages	ECB supervisory statistics
LCR	Liquidity coverage ratio (liquidity buffer / net liquidity outflow) at end-quarter, percentages	ECB supervisory statistics
EONIA	Euro Overnight Index Average money market interest rate, average during the quarter, percentages	ECB statistical data warehouse
Yield slope	Spread between yield on 10-year sovereign bonds and EONIA, average during the quarter, percentages	ECB statistical data warehouse
GDP	Growth rate of real GDP of the bank's home country, percentages	ECB statistical data warehouse
Recovery rate	Recovery of debt in insolvency, calculated based on the time, cost and outcome of insolvency proceedings in each economy	World Bank doing business report
Resolving insolvency	Time, cost, outcome and recovery rate for a commercial insolvency and the strength of the legal framework for insolvency	World Bank doing business report
Q2 dummy / Q4 dummy	Seasonal dummy for second/fourth quarter	

where $\Delta L_{i,t}$ is the dependent variable which, depending on the specification, measures the quarterly growth rate of loans or the quarterly flow of new lending, by bank i in time t; $\left(NPL/Tier1\right)_{i,t}$ is the ratio of total NPLs to Tier 1 capital for bank i in tine t; **b, c** and **s** are vectors of bank, country-specific variables, and seasonal dummies, respectively; and $u_{i,t}$ are bank-specific fixed effects. The bank-specific vector of variables **b** comprises measures of bank size (total assets), capitalisation (Tier 1 capital or leverage ratio) and funding structure (loan-to-deposit ratio or liquidity coverage ratio).[9] The country-specific vector of variables **c** comprises measures of economic output (GDP growth) and short- and long-term interest rates (EONIA rate and the spread between yield on 10-year sovereign bonds and EONIA, respectively).[10] Seasonal dummy variables for the second and fourth quarter of each year are included in the vector **s.**

Where used, the bank-specific variables are intended to control for the impact of potential capital or liquidity constraints that a bank may face when lending. In particular, low risk-weighted capital ratios and higher leverage could be associated with weaker credit expansion. Highly leveraged banks may constrain lending more than those with lower

9 Note that not all of these variables are used in all estimations.

10 Loan supply may also be affected by structural factors, such as quality of institutions and the degree of protection of creditor rights.

leverage, owing to capital constraints. On a similar note, a weak liquidity position, measured through a high loan-to-deposit ratio or a low liquidity coverage ratio, could restrain a bank from expanding its lending business. It can be hypothesised, for example, that banks with a lower proportion of deposit funding may be more sensitive to market conditions and perceptions of risk impacting their cost of funding, and could, therefore, lend less than banks with a higher proportion of deposit funding. Country-specific controls are intended to reflect the differences in macroeconomic conditions that may influence both loan demand and supply.

4.3 METHODOLOGICAL APPROACH

Standard fixed effects and random effects panel data methods are used to estimate the proposed model. In addition, to ensure robustness of the results to any potential autoregressive effects in the data, a difference generalized method-of-moments estimator is used [see Arellano and Bond (1991)]. This approach is frequently used for dynamic panel data regression as it allows for unbiased estimations with short time periods and many individuals. Hence, it includes a dynamic independent variable, depending on its own lagged values, and independent variables that are not strictly exogenous but might be correlated with past and current realizations [see Roodman (2009)]. The Arellano-Bond estimator uses transformations of the endogenous variables via differencing and then applies a generalized method-of-moments (GMM), which in this case is preferred over system GMM [see Blundell and Bond (1998)], as the latter adds more instruments by introducing an additional level equation and, therefore, poses the threat of over-identification of the endogenous variables [see Roodman (2008)].

In order to maintain consistency of the estimators it is essential to test for serial correlation of the instrumental variables, using, for example, the Sargan and the Hansen test of over-identifying restrictions as well as a Difference-in-Hansen test for validity of instruments [see Sargan (1958) and Hansen (1982)].

Reducing the time dimension of the sample to 2016-2018 may be unproblematic from an econometric perspective, as the remaining number of observations is large in comparison with the total number of instruments used in the GMM estimation. Given the cross-sectional dimension, small values of T are considered sufficiently large [see Arellano and Bond (1991)].

4.4 RESULTS

As a first step, empirical results for the full sample period 2014-2018 were estimated, using the fixed effects, random effects, and difference-GMM approach. It should be noted that this data sample period coincides with the second phase introduced in Section 3.2, where stocks of NPLs have already built-up, but new flows have largely stabilised or decreased. The specification outlined previously was estimated, along with variants that included or excluded bank- and country-specific variables. In the dynamic specification, all of the right-hand-side variables were included as possible instrumental variables, with lag lengths constrained to a maximum of 2, to limit the number of instruments. Difference-in-Hansen tests of exogeneity of the instruments suggest that endogeneity is well-controlled for [see Hansen (1982)]. Sargan and Hausman specification test statistics indicate robustness of the estimators.

The results, outlined in Table 3, show that, effectively, the only bank-specific variable that is consistently related to the lending growth is the ratio of the NPL stock to capital. As expected, the sign of that relationship is negative; the estimated coefficients are higher for corporate lending than for lending to households (Table 4). All other things being equal, an

EMPIRICAL RESULT FOR THE FULL SAMPLE OF DATA, CORPORATE LENDING

TABLE 3

	New corporate lending			Growth in corporate loan stock		
	(1)	(2)	(3)	(4)	(5)	(6)
	RE	FE	AB	RE	FE	AB
NPL/capital	-0.0048**	-0.0038***	-0.0025**	-0.0103***	-0.0104**	-0.0133***
	(-2.96)	(-4.73)	(-2.73)	(-13.24)	(-2.89)	(-4.15)
Assets	-0.540	-2.611	0.135	0.340	15.710*	44.290*
	(-1.00)	(-1.24)	(0.05)	(1.64)	(2.18)	(2.44)
GDP	2.57E-06	2.17E-05	-6.01E-07	1.26E-07	9.23E-06	4.65E-05
	(0.75)	(1.90)	(-0.02)	(0.13)	(0.53)	(1.71)
EONIA	4.478	6.256*	5.086	1.940	1.005	-1.173
	(1.62)	(2.06)	(1.64)	(1.02)	(0.33)	(-0.27)
Yield slope	-0.210	-0.082	0.027	0.093	-0.766	0.445
	(-1.48)	(-0.51)	(0.09)	(0.66)	(-1.70)	(0.83)
Q2 dummy	1.323***	1.216***	1.654***			
	(5.24)	(5.19)	(3.32)			
Q4 dummy	1.579*	1.354	1.117*			
	(2.22)	(1.94)	(2.04)			
L. New corp. lending			-0.020			
			(-1.96)			
L. Growth in corp loans						-0.076
						(-1.35)
Constant	11.840***	15.100		0.076	-73.580*	
	(4.31)	(1.49)		(0.05)	(-2.06)	
Observations	897	897	759	889	889	751
R-squared	0.027	0.031		0.012	0.043	
Hansen test			0.014			0.461
Sargan test			0.000			0.029
Difference-in-Hansen			0.094			0.461

NOTES: Columns (1)-(6) refer to different specifications of the estimation: (1) regresses new corporate lending per period on NPL/capital, the log of total assets, GDP, EONIA, the yield slope and seasonal dummies in a random effects (RE) model with robust standard errors and a constant, (2) is the same specification for a fixed effects (FE) model with robust standard errors and a constant, (3) extends the independent variables by a lag of new corporate lending and applies the difference generalized method-of-moments estimator (AB) [see Arellano and Bond (1991)]. Columns (4)-(6) repeat the estimations using period-by-period growth of the stock in corporate lending as the independent variable. T-statistics are reported below the coefficients in parenthesis. R-squared and p-values obtained in Hansen/Sargan tests of overidentifying restrictions and Difference-in-Hansen tests of exogeneity of instruments are displayed below the estimation outcome. *** = significance at the 0.1% level, ** = significance at the 1% level, * = significance at the 5% level.

increase in the stock of NPLs by 1% of capital[11] would reduce the quarterly flow of new corporate lending by between 0.0025% and 0.0048%[12] of total loans (see columns 1 to 3 of Table 3). The quarterly growth rate of corporate loans (i.e. the change in the stock of loans) would deviate downwards by about 0.010 to 0.013 percentage points in the event of an increase in the NPL stock by 1% of capital (see columns 4 to 6 of Table 3). For loans

11 An increase in the NPL stock by 1% of capital would correspond to an absolute increase by slightly over EUR 10 billion, which is rather small in comparison with the total stock of NPLs held by significant institutions in the euro area, which amounted to EUR 722 billion (69% of Common Equity Tier 1 capital) at the end of June 2018, down from EUR 988 billion (96% of CET1 capital) at mid-2015. It should also be noted that the growth rates in loans are calculated over a horizon of one quarter. For annual growth rates, the effects would be about four times higher than those reported here.

12 To put this into perspective, the total stock of outstanding corporate loans in the euro area stood at about EUR 4.4 trilion at end-September 2018. The estimated impact would be equivalent to a reduction in the flow of new corporate loans by between 110 and 211 million euro per quarter.

EMPIRICAL RESULTS FOR THE FULL SAMPLE OF DATA, HOUSEHOLD LENDING

TABLE 4

	New household lending			Growth in household loan stock		
	(1)	(2)	(3)	(4)	(5)	(6)
	RE	FE	AB	RE	FE	AB
NPL/capital	-0.0030	-0.0020	0.0003	-0.0078*	-0.0078	-0.0049**
	(-1.35)	(-1.20)	(0.70)	(-2.09)	(-1.30)	(-2.63)
Assets	-0.546*	1.600	-0.619	-0.324	24.040*	91.650***
	(-2.08)	(0.22)	(-0.28)	(-0.56)	(2.13)	(3.41)
GDP	3.00E-06*	-2.18E-05	6.76E-06	1.76E-06	-1.51E-04	-2.21E-05
	(2.24)	(-1.11)	(0.64)	(0.37)	(-1.12)	(-0.23)
EONIA	4.932	2.417	4.389	11.210	-5.230	-3.067
	(1.36)	(1.01)	(1.38)	(0.90)	(-1.06)	(-0.34)
Yield slope	-0.220	-0.106	-0.575	-0.126	-0.569	-1.137
	(-1.72)	(-0.43)	(-0.71)	(-0.64)	(-1.24)	(-1.10)
Q2 dummy	-0.050	0.069	-0.166			
	(-0.18)	(0.26)	(-0.38)			
Q4 dummy	-0.504	-0.201	-0.962			
	(-1.41)	(-0.56)	(-1.16)			
L. New hh lending			0.197			
			(0.88)			
L. Growth in hh loans						-0.021
						(-0.79)
Constant	7.061**	4.357		5.874	-59.910	
	(3.03)	(0.15)		(1.11)	(-1.72)	
Observations	897	897	759	889	889	751
R-squared	0.012	0.019		0.002	0.019	
Hansen test			0.001			0.316
Sargan test			0.000			0.204
Difference-in-Hansen			0.003			0.419

NOTES: Columns (1)-(6) refer to different specifications of the estimation: (1) regresses new household lending per period on NPL/capital, the log of total assets, GDP, EONIA, the yield slope and seasonal dummies in a random effects (RE) model with robust standard errors and a constant, (2) is the same specification for a fixed effects (FE) model with robust standard errors and a constant, (3) extends the independent variables by a lag of new corporate lending and applies the difference generalized method-of-moments estimator (AB) [see Arellano and Bond (1991)]. Columns (4)-(6) repeat the estimations using period-by-period growth of the stock in household lending as the independent variable. T-statistics are reported below the coefficients in parenthesis. R-squared and p-values obtained in Hansen/Sargan tests of overidentifying restrictions and Difference-in-Hansen tests of exogeneity of instruments are displayed below the estimation outcome. *** = significance at the 0.1% level, ** = significance at the 1% level, * = significance at the 5% level.

to households, these relationships are somewhat weaker, as indicated by lower coefficients for the NPL/capital variable in Table 4, compared to those for corporate lending in Table 3. The size of a bank is also statistically significant in some regressions.

These results are consistent with the hypothesis presented in Section 3 that, at least during economic recoveries when credit demand has recovered, high stocks of NPLs would weigh on bank credit supply. Once again, these results are consistent across the specifications used, regardless of the country and/or bank-specific variables considered.

Interestingly, these results differ substantially from those previously found using a similar specification [see Bending et al. (2014)]. In that case, almost all explanatory variables were found to have statistically significant coefficient estimates. That dataset was substantially smaller in cross-section, however, than that employed here, with just 42 banks, and covered a much longer period, from 2004 to 2013, which arguably includes a period of NPL build-up, and more generally, a period of crisis for the euro area.

EMPIRICAL RESULTS FOR THE RESTRICTED SAMPLE OF DATA, CORPORATE LENDING

TABLE 5

	New corporate lending			Growth in corporate loan stock		
	(1)	(2)	(3)	(4)	(5)	(6)
	RE	FE	AB	RE	FE	AB
NPL/capital	-0.0042***	-0.0037***	-0.0023***	-0.0111***	-0.0127***	-0.0153***
	(-5.16)	(-6.72)	(-4.74)	(-12.90)	(-6.84)	(-10.84)
Assets	-0.512	-1.805	0.997	0.415	28.360**	49.760*
	(-0.95)	(-0.83)	(0.31)	(1.52)	(3.41)	(2.24)
GDP	3.64E-06	2.26E-04	-1.04E-05	7.75E-08	2.00E-05	2.44E-05
	(1.01)	(1.42)	(-0.60)	(0.07)	(0.71)	(0.57)
EONIA	-3.529	0.581	-32.550	-0.003	-1.072	1.668
	(-0.74)	(0.09)	(-1.43)	(-0.00)	(-0.11)	(0.04)
Yield slope	-0.093	-0.054	-0.101	0.099	-1.346*	-0.960
	(-0.58)	(-0.26)	(-0.21)	(0.63)	(-2.42)	(-1.03)
Q2 dummy	1.181***	1.111***	1.480***			
	(4.10)	(4.37)	(3.77)			
Q4 dummy	0.727**	0.542	1.250**			
	(2.66)	(1.89)	(2.79)			
L. New corp lending			-0.197			
			(-1.10)			
L. Growth in corp loans						-0.025
						(-0.59)
Constant	8.488***	9.175		-0.799	-135.100**	
	(3.50)	(0.85)		(-0.34)	(-3.19)	
Observations	655	655	517	652	652	514
R-squared	0.050	0.055		0.019	0.090	
Hansen test			0.087			0.609
Sargan test			0.000			0.520
Difference-in-Hansen			0.260			0.317

NOTES: Columns present regression results in the same order as in Table 3. T-statistics are reported below the coefficients in parenthesis. *** = significance at the 0.1% level, ** = significance at the 1% level, * = significance at the 5% level.

In a second step, the sample period is reduced, excluding the years 2014 and 2015. In light of the arguments outlined in Section 3, it is expected that the reduced sample period should give more clear results. Again, the specifications outlined previously were estimated, along with variants that included or excluded bank- and country-specific variables. The results shown in Tables 5 and 6 resemble those in Tables 3 and 4, despite the reduced sample period.

These results are consistent regardless of the choice of dependent variable: growth in lending or new lending flows as a ratio of total loans. Sensitivity analysis is carried out using three bank-specific variables, representing capital and funding constraints that banks might face: the loan-to-deposit ratio, the leverage ratio, and the Tier 1 capital ratio, as well as two structural variables that capture the ease of resolving NPLs in a specific country. These five variables are added, one at a time, to the specification reported in Table 3.

EMPIRICAL RESULTS FOR THE RESTRICTED SAMPLE OF DATA, HOUSEHOLD LENDING

TABLE 6

	New household lending			Growth in household loan stock		
	(1)	(2)	(3)	(4)	(5)	(6)
	RE	FE	AB	RE	FE	AB
NPL/capital	-0.0012	-0.0007*	0.0020	-0.0067**	-0.0053***	-0.0055***
	(-1.72)	(-2.53)	(0.40)	(-2.97)	(-4.13)	(-8.15)
Assets	-0.405*	-2.654*	-1.559	0.117	29.080**	81.050***
	(-2.05)	(-2.07)	(-0.84)	(0.43)	(2.86)	(4.16)
GDP	1.81E-06*	-3.93E-06	1.17E-05	-1.49E-06	-8.33E-05	1.87E-05
	(2.09)	(-0.36)	(0.73)	(-0.52)	(-1.12)	(0.78)
EONIA	-0.769	-1.522	16.800	-5.405	-31.690	-48.950
	(-0.43)	(-0.60)	(1.38)	(-0.72)	(-1.70)	(-0.95)
Yield slope	-0.162	0.074	-0.019	-0.124	-0.975	-1.081
	(-1.57)	(0.72)	(-0.14)	(-0.71)	(-1.85)	(-1.02)
Q2 dummy	0.010	0.048	0.161			
	(0.07)	(0.39)	(0.74)			
Q4 dummy	-0.185	-0.137	-0.292			
	(-0.89)	(-0.82)	(-0.66)			
L. New hh lending			0.088***			
			(5.82)			
L. Growth in hh loans						-0.046
						(-1.69)
Constant	4.482***	16.160*		-0.777	-114.000**	
	(3.40)	(2.18)		(0.29)	(2.89)	
Observations	655	655	517	652	652	514
R-squared	0.004	0.012		0.001	0.040	
Hansen test			0.628			0.647
Sargan test			0.001			0.017
Difference-in-Hansen			0.674			0.553

NOTES: Columns present regression results in the same order as in Table 4. T-statistics are reported below the coefficients in parenthesis. *** = significance at the 0.1% level, ** = significance at the 1% level, * = significance at the 5% level.

Table 7 reports the outcome of this sensitivity analysis for corporate lending for the fixed effects estimator.[13] It is notable that, in all of the considered regressions, bank capital and funding constraints, proxied by the Tier 1 capital ratio, the leverage ratio, and the loan-to-deposit ratio, are found to be statistically insignificant (see Table 7). This may be attributed to the macro-financial conditions prevailing in the period covered by the data. Capitalisation of significant institutions was found to be broadly sufficient in the 2014 ECB Comprehensive Assessment, and nevertheless, the aggregate Tier 1 capital ratio continued to increase throughout the sample period, reaching 15.6% by end-2017. That implies a very sizeable buffer with respect to 10%, the approximate level of the ratio that banks are expected to hold, on average, by the ECB in its supervisory capacity. This high level of the ratio, and insignificance of the capital ratio in our regressions, may be an indication that capital constraints were far from binding for most of the banks in the sample, even if a small group of banks might have been close to the minimum requirements. Similarly, and as discussed earlier, liquidity and funding constraints were relaxed by monetary policy measures; in

13 Table 7 provides a selection of these regression results. Owing to space constraints, detailed sensitivity analysis using all of the considered bank controls and removing bank-specific controls altogether is available from the authors upon request.

SENSITIVITY ANALYSIS FOR ADDITIONAL INDEPENDENT VARIABLES, FIXED EFFECTS MODEL

TABLE 7

	New corporate lending					Growth in household loan stock				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NPL ratio	-0.0031***	-0.0039***	-0.0038***	-0.0037***	-0.0037*	-0.0141***	-0.0102**	-0.0104**	-0.0103**	-0.0128**
	(-4.70)	(-4.81)	(-4.75)	(-4.83)	(-2.38)	(-10.36)	(-2.80)	(-2.88)	(-2.86)	(-3.31)
Assets	-3.377	-2.794	-2.616	-2.597	-2.574	34.740**	15.900*	15.610*	15.620*	14.950*
	(-1.38)	(-1.29)	(-1.24)	(-1.23)	(-1.23)	(3.37)	(2.21)	(2.18)	(2.18)	(2.13)
GDP	1.67E-05	2.07E-05	2.14E-05	1.95E-05	2.17E-05	-9.95E-06	2.33E-06	3.90E-07	3.54E-07	1.21E-06
	(0.93)	(1.85)	(1.90)	(1.77)	(1.90)	(-0.31)	(0.15)	(0.03)	(0.02)	(0.08)
EONIA	-64.950**	6.252*	6.206*	5.600	6.326	-9.839	0.462	0.380	0.330	-0.809
	(-2.84)	(2.05)	(2.03)	(1.85)	(1.84)	(-0.20)	(0.16)	(0.13)	(0.11)	(0.28)
Yield slope	-1.181	-0.125	-0.077	-0.051	-0.080	-0.353	-0.638	-0.695	-0.697	-0.738
	(-1.55)	(-0.74)	(-0.47)	(-0.32)	(-0.49)	(-0.51)	(-1.58)	(-1.66)	(-1.66)	(-1.77)
Q2 dummy	1.243***	1.227***	1.219***	1.228***	1.217***	0.811	0.053	0.074	0.072	0.056
	(4.18)	(5.16)	(5.13)	(5.12)	(5.17)	(1.03)	(0.10)	(0.14)	(0.13)	(0.10)
Q4 dummy	0.835*	1.347	1.357	1.372	1.350*	1.587	0.771	0.764	0.764	0.834
	(2.59)	(1.95)	(1.95)	(1.96)	(2.00)	(1.75)	(1.04)	(1.03)	(1.03)	(1.10)
LCR	0.001					0.002				
	(0.65)					(0.68)				
L-t-D ratio		0.006					-0.010			
		(0.83)					(-1.28)			
Recovery rate			-0.006					-0.009		
			(-0.41)					(-0.47)		
Resolving insolvency				-0.041					-0.008	
				(-1.57)					(-0.29)	
Tier1 ratio					0.016					-0.288
					(0.12)					(-1.62)
Constant	-3.365	15.640	15.690	18.840	14.690	-160.300***	-71.560*	-69.870*	-70.040*	-63.490
	(-0.24)	(1.53)	(1.59)	(1.91)	(1.40)	(-3.53)	(-2.10)	(-2.03)	(-2.03)	(-1.93)
Observations	493	897	897	897	897	492	889	889	889	889
R-squared	0.099	0.031	0.031	0.032	0.031	0.099	0.045	0.045	0.045	0.047

NOTES: T-statistics are reported below the coefficients in parenthesis. *** = significance at the 0.1% level, ** = significance at the 1% level, * = significance at the 5% level.

particular through targeted, long-term refinancing operations and full allotment in regular policy operations. At the same time, it is reassuring that the coefficients estimated for the capital/NPL variable seem stable across these additional specifications.

At this juncture, it is appropriate to comment on the validity of the interest rates included as country-specific explanatory variables. The period included in the sample used here covers a period of extraordinary monetary policy accommodation by the European Central Bank, which heavily impacted the EONIA rate, through full-allotment credit operations and a zero interest rate since 2016, and sovereign yields, through various asset purchase programmes. It is, therefore, perhaps to be expected that these variables have little explanatory power during this period, as the cost and quantity of funding may not have been a binding constraint for the vast majority of euro area banks.

5 Conclusions

This paper analysed the relationship between bank asset quality and lending, providing evidence that, for large euro area banks, this relationship was in line with expectations during the economic recovery which developed between 2014 and 2018. This confirms that, in periods when loan demand is strong and improving, and banks are not facing

regulatory capital and liquidity constraints, the presence of high NPL stocks may hinder individual banks' lending. This is even more relevant when NPLs are not only high in absolute terms, but also high in comparison to the available loss-absorbing capital. This finding could be associated with risk perceptions and appetite. High realised credit risk may influence individual banks' assessment of future credit risk, as partly prompted by existing bank regulation. The nature of that mechanism would require further study, taking into account, in particular, risk profiles and pricing behaviour of individual banks.

This paper, being focused on bank-specific data, does not attempt to quantify the aggregate credit supply effect of elevated NPL stocks; to the extent that strong banks are present in the credit market, or new entrants are willing to step in, a reduction of credit supply by weaker banks may not necessarily lead to credit crunches. That being said, in the context of the euro area, where cross-border banking shrank significantly during the financial crisis, and many national banking markets are dominated by a small number of domestically-focused banks that all face similar asset quality issues, the presence of such non-trivial aggregate effects appears likely. Further analysis in that direction would be welcome.

From a macroeconomic and policy perspective, our findings support the view that high NPL stocks should be decisively resolved. When banks are burdened with high NPLs, adequate capitalisation and more resilient funding in the banking sector may not be sufficient to restore loan growth. Once NPLs stocks have been accumulated, it cannot be expected that monetary or macroprudential policy can address them. Policies that target NPL stocks directly are needed. In addition to supervisory action, such policies should include structural reforms that speed up enforcement of loan collateral and insolvency proceedings, or facilitate NPL disposals to non-bank investors. Well-designed asset management companies, which can be set up to carve out NPLs from going-concern banks, could also contribute to a swift reduction in NPL stocks [see Fell et al. (2017) and Balgova et al. (2018)].

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