4 Do Nonperforming Loans Matter for Bank Lending and the Business Cycle in Euro Area Countries?

Ivan Huljak, Reiner Martin, Diego Moccero, and Cosimo Pancaro[1]

4.1 Introduction

Nonperforming loans (NPLs) were a key policy issue in the euro area for most of the 2010s. As Chapter 1 details, NPLs in the euro area increased from around 3% at the onset of the global financial crisis in 2008 to a peak of around 8% in 2014. A key driver of this substantial growth in NPLs was the severe and protracted recession in parts of the euro area. At the same time, as Chapter 7 discusses, several market failures and structural problems slowed the speed at which distressed assets in the euro area were resolved. The recovery of economic activity in the second half of the decade and a range of policy measures to tackle NPLs saw the euro area NPL ratio decline to 3.6% at the end of 2019. At the time of writing, however, the COVID-19 pandemic is expected to result in a renewed increase.

High NPL ratios in bank balance sheets can undermine the soundness of the banking system and its ability to lend to the real economy through three main channels. First, NPLs reduce bank profits. They require higher provisions, lead to lower interest income, generate higher expenses associated with their management and resolution, and increase funding costs, as risk-averse investors are less willing to lend to institutions with asset quality problems.[2]

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[2] For example, Pancaro, Zochowski, and Arnould (2020) find that lower credit quality seems associated with higher banks' senior bond yields.

Second, NPLs have higher risk weights, resulting in higher capital needs. To maintain or boost capital adequacy, banks may need to deleverage, leading to a contraction in credit supply. Finally, managing large NPL stocks can divert important managerial resources away from banks' more profitable core activities.[3] Given the importance of bank lending for the functioning of the euro area economy—as well as for most Asian economies—there is a clear need to study the feedback loop between NPLs, bank credit, and the real economy.

Empirical literature in this field can be grouped into three main strands: (i) the determinants of NPLs, (ii) the impact of NPLs on the real economy, and (iii) the feedback loops between NPLs and the macroeconomy. The first strand has identified three main groups of NPL determinants: bank-level, industry-specific, and macroeconomic. Bank-level determinants include exogenous factors such as a sudden drop in economic activity, poor management, excessive risk-taking, and a scarcity of resources allocated to underwriting and monitoring loans. The literature found support for all these factors, with bad management playing the most prominent role. Industry-specific drivers point mainly to the impact of competition on risk-taking, but there seems to be no consensus in the literature on whether bank competition increases or decreases stability in the banking system (Beck, De Jonghe, and Schepens 2013; Goetz 2018). Finally, regarding macroeconomic drivers, the literature has focused on economic activity, inflation, interest rates, and the exchange rate as the most relevant drivers of NPLs (Anastasiou, Dimitrios, and Tsionas 2016; Jimenez and Saurina 2006; Louzis, Vouldis, and Metaxas 2012).

The second strand of the literature studies the impact of NPLs on bank lending and economic activity, using both bank- and country-level data and deploying mainly single-equation estimation techniques. Balgova and Plekhanov (2016), using data for a global sample of 100 countries, quantified the (positive) effects of policy-induced declines in NPLs on the real economy. The authors find that foregone growth due to the overhang of NPLs can be large. Accornero et al. (2017), coupling bank-level data for Italy with borrower-based information for nonfinancial corporations, examine the influence of NPLs on the supply of bank credit. The study finds that the exogenous accumulation of new NPLs and an associated increase in provisions impair bank lending, although the impairment is not causally affected by the level of NPL ratios.

[3] Grodzicki et al. (2015), Fell et al. (2016), and Fell et al. (2017) elaborate extensively on the challenges for banking systems stemming from the accumulation of NPLs, and illustrate macroeconomic and microeconomic policies that could be adopted to resolve the issue.

The third strand of literature estimates the impact of NPL shocks using structural time series models, where aggregate NPL ratios and economic activity are included in a vector autoregression (VAR) together with a broader set of banking and macroeconomic variables. For example, Espinoza and Prasad (2010), Nkusu (2011), De Bock and Demyanets (2012), and Klein (2013) estimate panel VAR models for various groups of countries and use country-level data to investigate feedback interactions between NPLs and macroeconomic performance.[4] In addition to the expected countercyclical behavior of NPLs, these studies find significant feedback effects from NPLs to the real economy.

This chapter contributes to the empirical literature on the feedback effects between NPLs, the banking sector, and the macroeconomy by estimating a panel Bayesian VAR model with hierarchical priors (Jarocinski 2010). The analysis aims at estimating the impact of exogenous shocks to NPL ratios on bank lending and the macroeconomy. Exogenous shocks to NPL ratios, i.e., shocks that are not due to changes in economic fundamentals and the repayment capacity of borrowers, occur rather frequently—for example, due to regulatory and legal changes, including reporting requirements for distressed loans, sales of defaulted loans to investors, the creation of asset management companies, or when banks' risk appetites shift.

The chapter finds that exogenous increases in NPL ratios tend to depress bank lending (notably for company loans), widen lending spreads, lead to a fall in real gross domestic product (GDP) growth and residential real estate prices, and—as a consequence—an easing of monetary policy. Forecast error variance decomposition shows that exogenous shocks to NPLs explain a relatively large share of the variance of the variables in the VAR, particularly for countries with large increases in NPL ratios during the euro area sovereign debt crisis. Finally, a 3-year, structural out-of-sample scenario analysis assesses the impact of a decline in NPL ratios for the euro area countries with the most sizable increases in NPL ratios during the debt crisis.[5] The exercise shows that reducing NPL ratios can produce significant macroeconomic and financial benefits.

[4] These groups of countries include the Gulf Cooperative Council countries; a group of 26 advanced economies; a large sample of emerging markets; and Central, Eastern, and Southeastern Europe, respectively.

[5] These countries are Cyprus, Greece, Ireland, Italy, Portugal, and Spain.

In the next section, the chapter presents the empirical approach and the data used, followed by discussions of the various empirical analyses: the impulse response analysis, the forecast error variance decomposition, and the out-of-sample structural counterfactual analysis.

4.2 Empirical Approach and Data

The analysis here estimates a panel VAR model for 12 euro area countries[6] and 10 variables for the first quarter of 2006 until the third quarter of 2017.[7] The model allows for cross-subsection heterogeneity, hence capturing country-specific dynamics. More specifically, the analysis estimates the impact of exogenous shocks to changes in NPL ratios and real GDP growth on bank lending and economic developments, using the following panel VAR(p) model:

$$y_{i,t} = C_i + A_i^1 y_{i,t-1} + ...+ A_i^p y_{i,t-p} + \varepsilon_{i,t} \qquad (1)$$

where i is an individual country (i = 1, ..., N), t is time (t = 1, ... , T), $y_{i,t}$ is a column vector of the 10 endogenous variables, C_i is a vector of constants, and $A_i^1, ..., A_i^p$ are matrices of coefficients for a different order of lags until lag p which are country-specific.

The panel VAR contains a larger set of variables than included in other related studies.[8] The variables included are the policy interest rate, economic activity, inflation, residential real estate prices, bank lending volumes and spreads (for mortgages and loans to nonfinancial corporations), ratio of capital and reserves over total assets, and change in NPL ratios. Employing a panel VAR with aggregate data allows us to estimate the dynamic interaction and feedback loops between NPLs, macroeconomic variables, and banking variables.

Table 4.1 provides information on data sources and summary statistics.

[6] These countries are Austria, Belgium, Cyprus, Estonia, France, Greece, Ireland, Italy, Lithuania, Spain, Netherlands, and Portugal.

[7] The estimations in this chapter were implemented relying on the BEAR toolbox and MATLAB codes developed by Dieppe, van Roye, and Legrand (2016).

[8] For example, the model in Espinoza and Prasad (2010) includes up to four variables, De Bock and Demyanets (2012) and Klein (2013) include five variables, and Nkusu (2011) includes nine variables.

Table 4.1: Summary Statistics

Variable	Source	Obs	Mean	Std. Dev.	Min	Max
Real GDP growth	ECB SDW	564	1	4	-17.5	12
Inflation	ECB SDW	564	1.6	1.6	-3.1	10.6
RRE prices	ECB SDW	564	1.8	10.5	-40.3	57.5
Euribor	ECB SDW	564	1.4	1.7	-0.3	5.0
Corporate loans	ECB SDW	564	4.6	12.0	-20.2	67.5
Mortgage loans	ECB SDW	564	5.7	12.3	-33.0	87.4
Corporate spread	ECB SDW	564	2.5	1.4	0.2	6.6
Mortgage spread	ECB SDW	564	2.3	1.1	-0.3	5.0
Capital and reserves ratio	ECB SDW	564	12.3	10.9	2.7	68.8
Change in NPL ratio	See other sources below.	564	0.8	3.3	-8.2	27.2

ECB SDW = European Central Bank's Statistical Data Warehouse, GDP = gross domestic product, NPL = nonperforming loan, RRE = residential real estate.
Sources: International Monetary Fund Financial Soundness Indicators, Banque de France, Banco de España, Central Bank of Cyprus, Irish Central Statistics Office, Bankscope, and ECB SDW database.

Economic activity is measured by the annual rate of real GDP growth (adjusted for calendar and seasonal effects).[9] Inflation is defined as the annual rate of growth in the Harmonised Index of Consumer Prices, working day and seasonally adjusted. The 3-month Euribor rate is used as a proxy for the euro area policy interest rate.

Bank lending is defined as the annual rate of growth in bank lending to nonfinancial corporations and households (for house purchases). Originally, these two variables were defined as an index of notional stocks.[10] Bank lending spreads are defined as the difference between bank lending rates and Euribor. The lending rates used to compute the spreads are the interest rates on new business loans granted in euros, all maturities combined.[11] Including bank lending spreads among the endogenous variables in the VAR is important because the exogenous shocks might lead to a repricing of bank loans, and so affect the quantity of loans provided to the economy.

Residential real estate prices refer to new and existing dwellings for the whole country and are computed as the annual growth rate of the

[9] For Ireland, economic growth is computed as the annual growth rate of the nominal modified gross national income, deflated using the deflator of the modified domestic demand.

[10] Data for Estonia for nonfinancial corporation loans before 2008 is provided by the Central Bank of Estonia.

[11] The exception is lending rates to nonfinancial corporations in Greece, where the rates based on outstanding amounts are used because data on new business loans is not available.

underlying index. The series of residential real estate prices is included to account for the role that real estate markets play in business cycle fluctuations. Changes in real estate prices can have large real effects and welfare implications (Hartmann 2015).[12]

The ratio of bank capital and reserves over total assets is an index of notional stocks. Capital and reserves (the numerator) include total equity capital; non-distributed benefits or funds; and specific or general provisions against loans, securities, and other types of assets. The capital and reserves to assets ratio is then computed as the ratio between this series and total assets.[13]

Finally, the analysis includes in the VAR the annual change in NPL ratios, which is the most relevant variable in the analysis. NPL ratios are defined as nonperforming loans divided by total gross loans. The main source for this variable is the IMF Financial Soundness Indicators database.[14] For most countries covered in this chapter, however, the Financial Soundness Indicators series had to extended backward until the first quarter of 2006, using either bank-level information extracted from Bankscope (Austria, Belgium, Estonia, Greece, Ireland, Lithuania, and Portugal) or central bank data (Cyprus, France, and Spain).

Figure 4.1 displays the series of NPL ratios per country.

The set of countries in the sample exhibits rather different NPL dynamics over time. In some countries, the NPL ratio increased during the crisis and decreased thereafter, although to different degrees and from different starting levels (Austria, Belgium, and the Netherlands). In some countries, the NPL ratio increased significantly during the crisis and declined substantially afterward (Ireland and Spain), even to levels close to those before the crisis (Estonia and Lithuania). In other countries, the NPL ratio increased significantly without a significant subsequent decline (Greece), or with only a very recent reversal (Cyprus, Italy, and Portugal). In France, the NPL ratio remained unchanged throughout this period.

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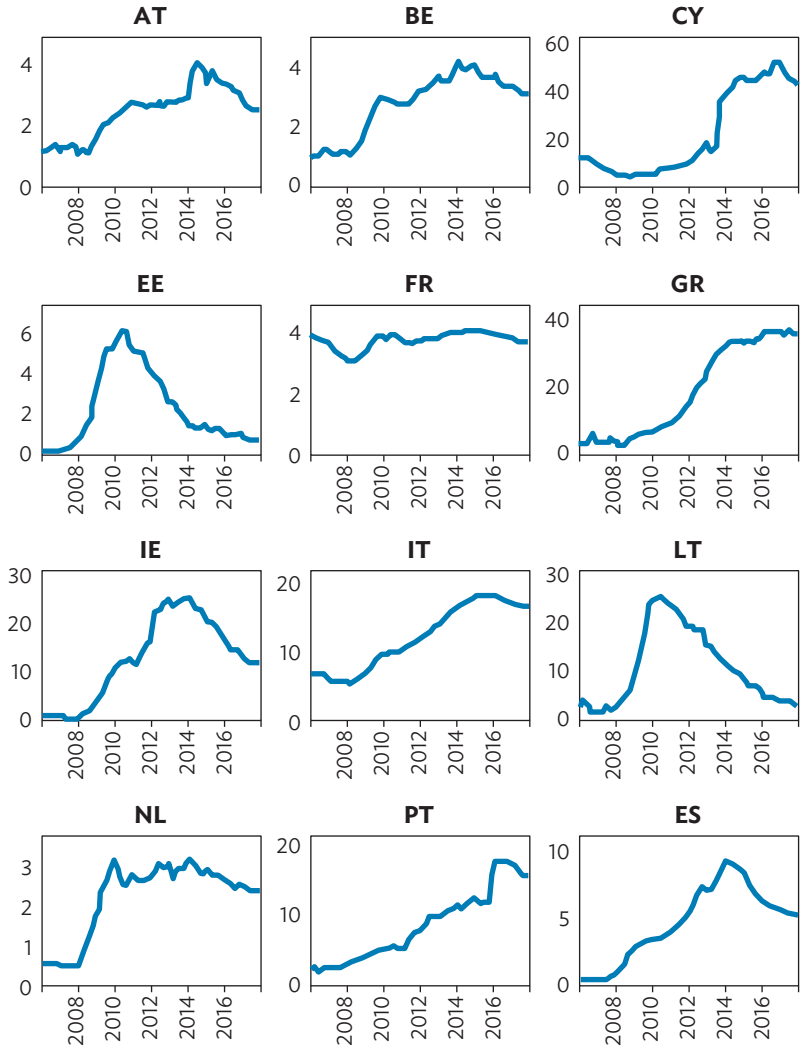
[12] Other studies that have included house prices in a VAR framework similar to this analysis include Bjornland and Jacobsen (2010), Iacoviello (2005), and Meeks (2017).

[13] Pre-2008 data for Estonia has been compiled by the Central Bank of Estonia and shared with the authors.

[14] The IMF recommends that loans be classified as nonperforming especially when: (i) payments of the principal and interest are past due by 1 quarter (90 days) or more; or (ii) the interest payments equal to 1 quarter (90 days) interest or more have been capitalized (reinvested into the principal amount), refinanced, or payment has been delayed by agreement (IMF 2006).

Figure 4.1: NPL Ratios in Euro Area Countries



AT = Austria, BE = Belgium, CY = Cyprus, EE = Estonia, ES = Spain, FR = France, GR = Greece, IE = Ireland, IT = Italy, LT = Lithuania, NL = Netherlands, NPL = nonperforming loan, PT = Portugal.
Note: The data sample spans from the first quarter (Q) of 2006 to 2017 Q3.
Sources: International Monetary Fund Financial Soundness Indicators, Banque de France, Banco de España, Central Bank of Cyprus, and Bankscope.

Table 4.2 presents contemporaneous correlations among the variables in the panel VAR.

Table 4.2: Correlation Matrix among Variables Included in the Panel Vector Autoregression

	Real GDP Growth	Inflation	RRE Prices	Euribor	Corporate Loans	Mortgage Loans	Corporate Spread	Mortgage	Capital and Reserves Ratio	Change in NPL Ratio
Real GDP growth	1									
Inflation	0.15***	1								
RRE prices	0.79***	0.26***	1							
Euribor	0.15***	0.52***	0.25***	1						
Corporate loans	0.35***	0.57***	0.59***	0.69***	1					
Mortgage loans	0.40***	0.49***	0.62***	0.52***	0.78***	1				
Corporate spread	-0.29***	-0.30***	-0.32***	-0.47***	-0.36***	-0.27***	1			
Mortgage	-0.33***	-0.42***	-0.39***	-0.74***	-0.55***	-0.44***	0.69***	1		
Capital and reserves ratio	0.01	-0.27***	-0.11**	-0.37***	-0.26***	-0.25***	0.61***	0.42***	1	
Change in NPL ratio	-0.55***	-0.19***	-0.47***	-0.09*	-0.18***	-0.16***	0.39***	0.33***	0.15***	1

GDP = gross domestic product, NPL = nonperforming loan, RRE = residential real estate.
Note: The data sample spans the first quarter (Q) 2006 to Q3 2017. (***), (**) and (*) denote statistical significance at the 1%, 5%, and 10% levels, respectively.
Sources: Data based on the International Monetary Fund, European Central Bank, Banque de France, Banco de España, Central Bank of Cyprus, Central Statistics Office of Ireland, and Bankscope.

Looking first at the banking sector variables, bank lending volumes are procyclical, while they are negatively associated with countercyclical bank lending spreads. Bank capital and reserves over total assets appears to be countercyclical only for lending, whereas the correlation with real GDP growth is not significant. Real estate prices move positively together with economic activity, inflation, monetary policy, and bank lending. By contrast, they are negatively related to the remaining variables. The change in NPL ratios, the variable of interest, correlates negatively with economic activity and bank lending. Finally, an increase in the change in NPL ratios is associated with a widening in bank lending spreads.

These simple correlations between changes in NPL ratios, macroeconomic, and banking sector variables do not allow disentangling the source of variation of these variables. On the one hand, an exogenous increase in economic activity is expected to boost bank lending, narrow spreads, and reduce NPLs (due to an improvement in the repayment capacity of economic agents). On the other, an exogenous decrease in NPL ratios may lead banks to boost lending and lower lending spreads, hence also boosting economic activity.

The next section uses Cholesky decomposition to disentangle the shocks to real GDP growth and the exogenous changes to NPL ratios (De Bock and Demyanets 2012, Espinoza and Prasad 2010, Klein 2013). This recursive identification approach implies that variables appearing earlier in the ordering are considered more exogenous than those appearing later.

The identifying assumptions are as follows. First, monetary policy is assumed to respond to many indicators (Bernanke and Boivin 2003; Ciccarelli, Maddaloni, and Peydró 2013; ECB 2011). Hence, this analysis ranks the monetary policy rate last in the VAR. Second, bank lending and lending spreads affect the capital and reserves-to-asset ratio within the same quarter. This assumption reflects the impact of the profit and loss account on capital in the same period as when the result was generated. Hence, the capital and reserves-to-asset ratio is ranked second-to-last in the system. Third, the analysis assumes that bank lending spreads move faster than macroeconomic variables (GDP and inflation). It thus ranks spreads after macroeconomic variables but before the capital and reserves-to-asset ratio. Fourth, the analysis follows Bjornland and Jacobsen (2010) in assuming that real estate prices react to macroeconomic developments within the same quarter. Fifth, the analysis assumes that macroeconomic variables do not simultaneously react to the policy rate, while policy reacts to the macroeconomic environment simultaneously. Also, it assumes that inflation

is impacted simultaneously by a shock to economic activity (Bernanke and Gertler 1995; Christiano, Eichenbaum, and Evans 1996). Sixth, the analysis assumes that although it takes time to obtain a loan, it affects macroeconomic variables instantaneously once it is granted. The analysis thus places the macroeconomic variables (real GDP growth and inflation) after the lending variables and the change in the NPL ratio. Seventh, the change in the NPL ratio is placed after the loans because a shock to loans affects this ratio contemporaneously (through a change in its denominator). Last, the analysis assumes that changes in NPL ratios move slowly, meaning that GDP growth and inflation affect NPLs only with a lag.[15] Hence, the change in the NPL ratio is placed before the macroeconomic variables.[16]

In sum, the analysis uses the following ordering: growth in bank lending to nonfinancial corporations, growth in bank lending for mortgages, change in the NPL ratio, real GDP growth, inflation rate, real estate prices, lending spreads to nonfinancial corporations, lending spreads to households for house purchase, bank capital and reserves to assets ratio, and finally, monetary policy interest rate.

4.3 Empirical Findings

This section illustrates the impact of shocks to changes in NPL ratios, relying on three sets of results. First, the analysis presents impulse response functions. Second, it reports the share of the forecast error variance to assess the degree to which variables are driven by this shock. Third, the analysis implements an out-of-sample structural conditional forecast analysis to assess and quantify the macroeconomic and financial benefits stemming from a decline in NPL ratios.

4.3.1 Impulse Responses to Shocks in Nonperforming Loans and Real Gross Domestic Product

Based on the estimated VAR model in Equation (1) above, the analysis generates impulse responses of the endogenous variables to two structural shocks. More specifically, it reports the impulse responses to a (positive) one-standard-deviation shock to the change in the NPL ratio and to a (negative) one-standard-deviation shock to real GDP growth, respectively. For each variable, the analysis looks at the maximum impact recorded across

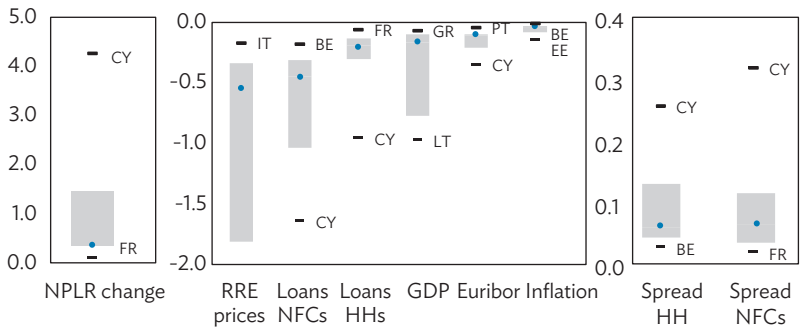
[15] As noted, loans are usually classified as nonperforming 1 quarter after the customer defaults.

[16] This ordering is similar to the ones used by Hancock, Laing, and Wilcox (1995); Klein (2013); and De Bock and Demyanets (2012).

countries over a 4-year horizon (16 quarters) and reports the maximum, minimum, median, and the interquartile range of this distribution. Insignificant responses are excluded, based on 16% and 84% Bayesian credibility bands.[17]

The impulse responses to a one-standard-deviation positive shock to the change in NPL ratios are displayed in Figure 4.2. The size of the instantaneous shock ranges between 0.1 percentage point (for France) and 4.3 percentage points (Cyprus). While the median of the impact is relatively modest (0.3 percentage point), the countries hit hardest by the crisis (Cyprus, Greece, Ireland, Italy, Lithuania, Portugal, and Spain), not surprisingly, exhibit much larger shocks.

Figure 4.2: Response to a Shock to the Change in the NPL Ratio



BE = Belgium, CY = Cyprus, EE = Estonia, FR = France, GDP = gross domestic product, GR = Greece, HH = households, IT = Italy, LT = Lithuania, NFC = nonfinancial corporations, NPL = nonperforming loan, NPLR = nonperforming loan ratio, PT = Portugal, RRE = residential real estate.
Note: The chart shows standard statistics for the maximum or minimum impact (depending on the variable) recorded across countries. The strongest response to the shock over a 16-quarter horizon is taken for all countries. Then the maximum, minimum, median, and interquartile range of this distribution across the 12 euro area countries are reported. Insignificant responses are excluded, based on 16% and 84% Bayesian credibility bands. The size of the shock considered is a one-standard-deviation shock to the relevant variable. Loans (to HHs and NFCs), real GDP growth, and RE prices are defined as annual percentage changes, while spreads (to HHs and NFCs) are defined in percentage points. The minimum impact on residential real estate prices is recorded for Cyprus at –3.4% but it is not reported in the chart.
Source: Authors' estimations.

[17] The analysis does not estimate impulse responses for the variable "capital and reserve ratios". The two components of this variable are expected to move in opposite directions when NPLs increase and GDP growth decreases, preventing a meaningful interpretation of the results.

The increase in the change in NPL ratios leads to a decline in bank lending. The annual growth of lending to nonfinancial corporations declines by up to 1.7 percentage points, while it decreases by up to 1 percentage point for mortgages. Also, the median response is stronger for nonfinancial corporations.[18] These responses suggest that banks materially deleverage their balance sheets following a negative shock to the change in the NPL ratio. The NPL shock also leads to a slight widening in bank lending spreads for nonfinancial corporations and mortgages (of up to around 0.3 percentage point in both cases) and to a decline in residential property prices (of up to 3.4 percentage points). The median impact for the spreads is very small, while that for residential real estate prices is 0.6 percentage point. For all these variables, the maximum impact is recorded for Cyprus, but strong effects can also be seen in Estonia, Ireland, and Lithuania.

The increase in the change in the NPL ratio also leads to a decline in real GDP growth in most countries (by between 0.07 and 1 percentage point), with a median response of 0.2 percentage point. The response to inflation is rather heterogeneous across countries. These findings are in line with those of other empirical papers like Klein (2013) and Espinoza and Prasad (2010),[19] as well as theoretical models like Curdia and Woodford (2010).[20]

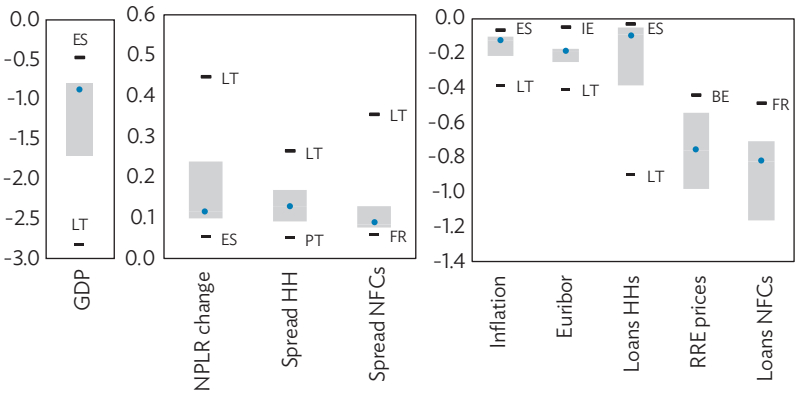
Figure 4.3 reports the size of an exogenous negative one-standard-deviation shock to GDP growth. The absolute size of this shock varies across countries between −0.4 and −2.9 percentage points, with a median of −0.8 percentage point. The minimum impact is recorded for Lithuania, but some other smaller economies, which were strongly affected by the crisis (notably Estonia, Greece, Ireland) also record large, negative shocks.

[18] This result is consistent with Fell et al. (2018). Using bank-level data, the authors find a significant negative relationship between the ratio of NPLs over Tier 1 capital and loan origination. This relationship appears to be stronger for lending to nonfinancial corporations than for mortgages.

[19] These authors estimate the impact of much larger shocks, but their relative impact is comparable. Klein (2013) estimates that a 3-percentage-point instantaneous shock to the change in the NPL ratio leads to a decline in real GDP growth of about 2 percentage points after 1 year. Espinoza and Prasad (2010) find a relatively stronger impact.

[20] Curdia and Woodford (2010) develop a dynamic stochastic general equilibrium model with credit frictions and find that an increase in the loss rate of loans (i.e., the equivalent to nonperforming loans in the empirical model) leads to a widening in credit spreads, a contraction in credit, and to a substantial fall in real activity.

Figure 4.3: Response to a Shock to Real GDP Growth



BE = Belgium, ES = Spain, FR = France, GDP = gross domestic product, HH = households, IE = Ireland, LT = Lithuania, NFC = nonfinancial corporation, NPLR = nonperforming loan ratio, PT = Portugal, RRE = residential real estate.
Note: The exogenous negative one-standard-deviation shock to GDP growth results in a change in the repayment capacity of borrowers. The chart shows standard statistics for the maximum or minimum impact (depending on the variable) recorded across countries. The strongest response to the shock over a 16 quarter horizon is taken for all countries. Then the maximum, minimum, median and interquartile range of this distribution across the 12 euro area countries is reported. Insignificant responses are excluded, based on 16% and 84% Bayesian credibility bands. The size of the shock considered is a negative one-standard-deviation shock to the relevant variable. Loans (to HHs and NFCs), real GDP growth and RRE prices are defined as annual percentage changes, while spreads (to HHs and NFCs) are defined in percentage points. The minimum impact for real estate prices and loans to NFCs is recorded for Lithuania (4.65% and 2.5%, respectively, not reported in the chart).
Source: Authors' estimations.

Our results suggest a clear link between the exogenous negative one-standard-deviation shock to GDP growth and NPL ratios, with the latter increasing between 0.05 percentage point for Spain and 0.45 percentage point for Lithuania. The median increase in the change to the NPL ratio is 0.1 percentage point. These findings are consistent with a large body of empirical literature on the determinants of NPLs and the feedback loop between changes in NPLs and the economy.[21]

The negative shock to GDP growth negatively impacts annual inflation, which decreases between 0.06 and 0.4 percentage point. It also results in a decline of residential real estate prices of between −0.1 and −5 percentage

[21] See Quagliariello (2007); Louzis, Vouldis, and Metaxas (2012); and Anastasiou, Dimitrios, and Tsionas (2016) regarding the former. For the latter, Klein (2013) finds that a 3-percentage-point shock to real GDP growth is associated with a 0.5-percentage-point decline in the change in NPL ratios for Central, Eastern, and Southeastern European countries.

points, with a median response of −0.8 percentage point.[22] The negative shock to GDP growth also leads to a decline in bank lending. The response to the shock is again stronger for loans to nonfinancial corporations than for mortgage loans. The former declines between −0.5 and −2.5 percentage points (for France and Lithuania, respectively) with a median response of −0.8 percentage point. Mortgage loans decline only between −0.01 percentage point (for Spain) and -0.9 percentage point (for Lithuania), with a median response of −0.1 percentage point.[23] The stronger impact for corporate lending is likely to reflect the more flexible nature and on average shorter duration of nonfinancial corporation loans.

The negative shock to GDP growth increases lending spreads for nonfinancial corporations by between 0.07 percentage point (in France) and 0.35 percentage point (in Lithuania). Lending spreads for mortgages increase between 0.05 percentage point (in Portugal) and 0.26 percentage point (in Lithuania). The median responses in both cases are close to 0.1 percentage point.

4.3.2 Forecast Error Variance Decomposition

This section presents a forecast error variance decomposition (FEVD) to uncover further details about the relationships among variables included in the model. The FEVD shows for each variable the share of the forecast error variance that is explained by exogenous shocks to other endogenous variables. The results of this analysis are shown in Figures 4.4 and 4.5, which report the FEVD for shocks to the change in the NPL ratio and real GDP growth, respectively.[24] In both cases, the analysis presents the share of the variance for each variable and country over a 16-quarter horizon.

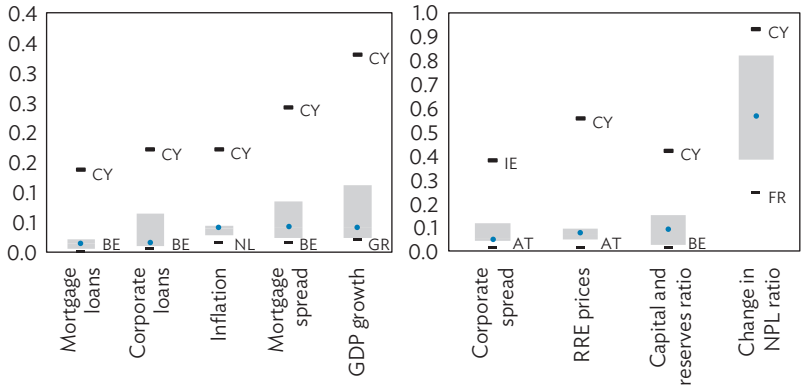
The FEVD suggests that exogenous shocks to changes in the NPL ratio are a powerful driver of real GDP growth, explaining between 10% and 33% of the forecast error variance in Cyprus, Estonia, Ireland, and Lithuania. For inflation, the share is below 7%, except for Cyprus.

[22] Bjornland and Jacobsen (2010) also find a stronger impact of monetary policy shocks on real estate prices than on inflation in Norway, Sweden, and the United Kingdom.

[23] Similar results are found by Kanngiesser, Martin, Maurin, and Moccero (2017) and Klein (2013) when estimating the impact of an aggregate demand shock in the euro area and the impact of a shock to GDP growth in Central, Eastern, and Southeastern Europe, respectively.

[24] Unlike the impulse responses above, FEDV analysis does not depend on the sign of the shock. Hence the analysis does not define shocks as "positive" or "negative" in this subsection.

Figure 4.4: Forecast Error Variance Decomposition
(Shock to Change in NPL Ratio)



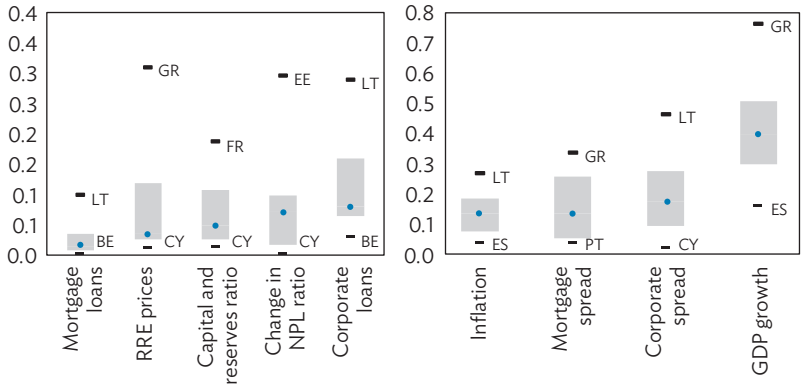
AT = Austria, BE = Belgium, CY = Cyprus, FR = France, GDP = gross domestic product, GR = Greece, NL = Netherlands, NPL = nonperforming loan, RRE = residential real estate, VAR = vector autoregression.
Note: The figure reports the share of the variance of the variables in the VAR which is explained by an exogenous shock to the NPL ratio over a horizon of 16 quarters. The median of the accepted draws of the variance decomposition from the posterior distribution is reported.
Source: Author's estimations.

For some countries, the shock to the change in the NPL ratio also explains a non-negligible share of the variance of other variables included in the VAR. For lending to nonfinancial corporations, the NPL shock explains, for example, up to 17% of the variance for Cyprus. Relatively large values are also recorded for Ireland, Italy, Lithuania, and Portugal. For mortgage lending, the share is large for Cyprus, but less than 3% for the other countries. For corporate and mortgage spreads, the explained share of the forecast variance is above 10% for Cyprus, Ireland, Italy, and Lithuania.[25] For residential real estate prices, the share is large for Cyprus, Estonia, and Ireland (between 12% and 56%).

These findings are broadly in line with those of previous related empirical studies. Over long horizons (between 5 and 10 years), shocks to the change in NPL ratios explain about 6% of the variance of GDP growth seen in the sample of countries in Espinoza and Prasad (2010), 8% in De Bock and Demyanets (2012), and 20% in Klein (2013). For the credit-to-GDP ratio (the equivalent variable to bank lending in the model), the estimated share stands at 13% in De Bock and Demyanets (2012) and at 8% Klein (2013). Finally, Klein (2013) and De Bock and Demyanets (2012) find that 70% and 90% of the variance of the change in the NPL ratio is exogenously explained.

[25] For Italy, the share is larger than 10% only for spreads on corporate lending.

Figure 4.5: Forecast Error Variance Decomposition
(Shock to Real GDP Growth)



BE = Belgium, CY = Cyprus, EE = Estonia, ES = Spain, GDP = gross domestic product, GR = Greece, LT = Lithuania, NPL = nonperforming loan, RRE = residential real estate, VAR = vector autoregression.
Note: The figure reports the share of the variance of the variables in the VAR which is explained by a shock to real GDP growth over a horizon of 16 quarters. The median of the accepted draws of the variance decomposition from the posterior distribution is reported.
Source: Authors' estimations.

Figure 4.5 shows that shocks to real GDP growth explain in some euro area countries a large share of the forecast error variance for bank lending, residential real estate prices, lending spreads, and inflation. For bank lending, the share is larger for nonfinancial corporation lending than for mortgage. For the former, it explains between 3% and 8% for most countries. However, the shock to GDP growth explains about 13% of the forecast error variance for Estonia and Italy, and more than 24% for Austria, Greece, and Lithuania. For mortgage loans, the shares are below 3% for most countries, except for Estonia, Greece, and Lithuania, for which the shares are between 6% and 10%.

For residential real estate prices, shocks to real GDP growth play the largest role in Lithuania and Greece, where they explain about 30% of the variance at the end of the forecast horizon. For France and the Netherlands, the shocks explain about 12%, and for other countries less than 7%. The variation is more homogeneously distributed for bank lending spreads (between 4% and 34% for nonfinancial corporation loans and 2% to 47% for mortgages). The same applies to inflation. Finally, for eight countries in the sample, the shock to real GDP growth explains more than 5% of the NPL forecast error variance.

These results are also broadly in line with the related empirical literature. De Bock and Demyanets (2012) find that shocks to real GDP growth explain 4% of the growth rate in the ratio of private credit over GDP. Klein (2013) and De Bock and Demyanets (2012) find that over a long forecast horizon, shocks to real GDP growth explain between 5% and 7% of the variance in the change of the NPL ratio in Central, Eastern, and Southeastern European countries, as well as a large group of emerging economies. Hristov, Hülsewig, and Wollmershäuser (2012) find that demand shocks explain 13% of the variance of the GDP deflator and 16% of lending volumes over a 4-year horizon in a sample of euro area countries.

4.3.3 Structural Out-of-Sample Scenario Analysis

This section reports the results of a structural out-of-sample scenario analysis to assess the impact of two different paths of NPL ratios over the fourth quarter (Q) of 2017 to Q3 2020. This exercise provides a quantitative illustration of the possible economic and financial benefits associated with a decline in NPL ratios in euro area countries. For brevity, the analysis focuses on the six countries that exhibited the most sizable increase in NPL ratios during the crisis (Cyprus, Greece, Ireland, Italy, Portugal, and Spain) and the six most relevant variables in the VAR.

Under a "baseline scenario", the out-of-sample change in the NPL ratio for each country is assumed to equal the average change during the last 4 quarters of historical data.[26] Under an adverse scenario, the out-of-sample change in the NPL ratio is assumed to equal 0. Under both scenarios, the remaining variables in the VAR are projected conditional on the assumed evolution of the change in the NPL ratio, following the methodology proposed by Antolin-Diaz, Petrella, and Rubio-Ramirez (2018).[27] This approach implies assessing the most likely set of circumstances under which the change in the NPL ratio evolves.

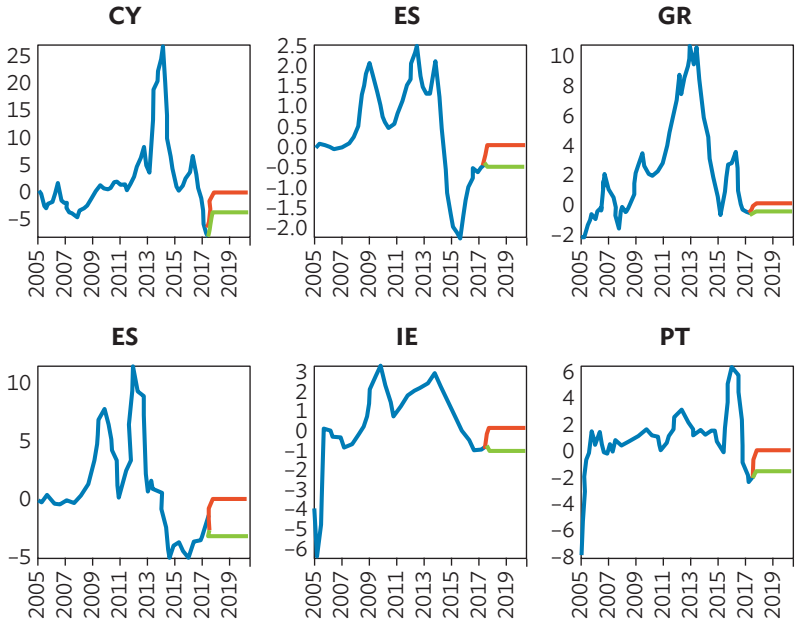
The observed and out-of-sample evolution of the change in NPL ratios for the two paths and the six countries are depicted in Figure 4.6.

By construction, the gap between the baseline and the adverse changes in the NPL ratio depends on how strongly the variable evolved in the last

[26] This implies an out-of-sample reduction in the NPL ratio of 3.6% for Cyprus, 0.5% for Greece, 3.2% for Ireland, 1.1% for Italy, 1.7% for Portugal, and 0.5% for Spain.

[27] The forecasts are computed assuming that only the structural shock to the change in the NPL ratio adjusts to ensure the new path for the conditioning variable. See Dieppe, van Roye, and Legrand (2016) for more details.

Figure 4.6: Observed and Assumed Out-of-Sample Baseline and Adverse Change in NPL Ratios for the Structural Scenario Analysis



CY = Cyprus, ES = Spain, GR = Greece, IE = Ireland, IT = Italy, NPL = nonperforming loan, PT = Portugal.
Note: The data covers Q1 2006 to Q3 2017. The out-of-sample assumptions for the baseline and adverse paths for the change in NPL ratios span from Q4 2017 to Q3 2020.
Sources: International Monetary Fund Financial Soundness Indicators, Bank of France, Bank of Spain, Central Bank of Cyprus, Bankscope and authors' estimations.

4 quarters of the historical sample. This gap is the widest for Cyprus, followed by Ireland, Portugal, Italy, and then Spain and Greece. These assumptions result in different levels of the NPL ratio at the end of the forecast horizon.

The out-of-sample deviation between the baseline and adverse conditional forecasts of the variables is reported in Figure 4.7. The countries are reported in the columns, while the variables are depicted in the rows. A positive value implies that the baseline forecast exhibits a higher value than the adverse one.

The results show, as expected, that a further reduction in NPL ratios would have a positive impact on both the macroeconomic and the banking variables. At the end of the forecast horizon, the annual rate of growth of

Figure 4.7: Difference in Structural Scenario Forecasts between Baseline and Adverse Path for Main Variables in the Panel Vector Autoregression

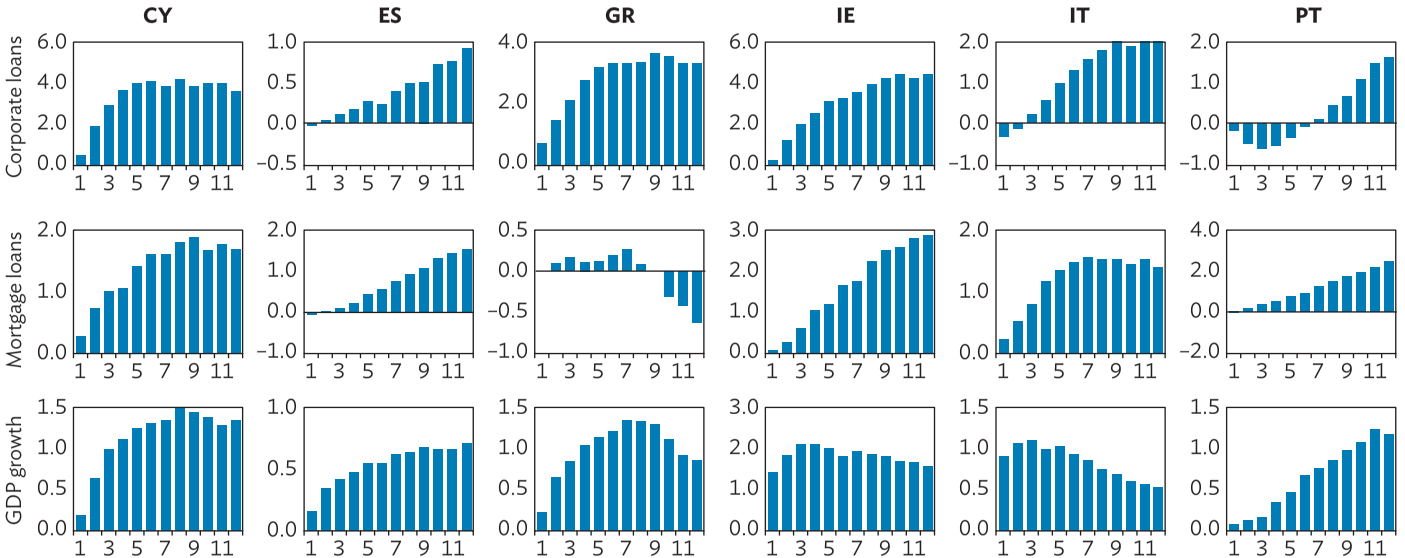


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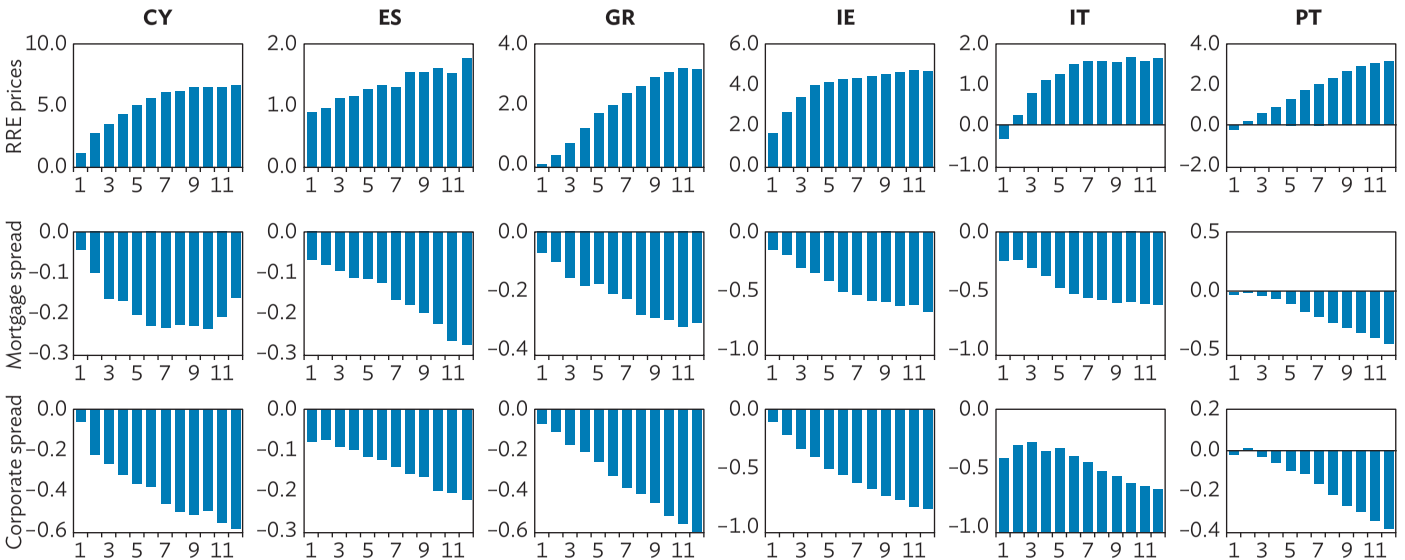
Figure 4.7 (continued)



CY = Cyprus, ES = Spain, GDP = gross domestic product, GR = Greece, IE = Ireland, IT = Italy, PT = Portugal, RRE = residential real estate.
Note: The figure reports the difference between the baseline and the adverse structural scenario forecasts of the main variables in the panel VAR. Under both assumptions, the forecasts are computed assuming that only the structural shock to the change in NPL ratios adjusts to ensure the conditioning path for this variable. Real GDP growth, headline inflation, residential real estate prices, and corporate and mortgage loans are expressed in annual growth rates. The Euribor, bank lending spreads, change in NPL ratios, and capital and reserves-to-asset ratio are expressed in percentage points.
Source: Authors' estimations.

mortgage lending under the baseline scenario is between 1.4 (Italy) and 2.9 (Ireland) percentage points higher than under the adverse scenario, while the annual rate of growth of corporate lending increases faster by between 0.9 percentage point (Spain) and 4.4 percentage points (Ireland). Bank lending spreads are narrower, by between 0.2 percentage point and 0.6 percentage point for mortgages, and by between 0.2 and 0.8 for loans to nonfinancial corporations under the baseline scenario. Stronger lending and lower spreads lead to higher residential real estate prices, with annual rates of growth being between 1.6 percentage point (Italy) and 6.7 percentage points (Cyprus) higher under the baseline scenario than under the adverse. Finally, the rate of real GDP growth is higher by between 0.5 percentage point (Italy) and 1.6 percentage points (Ireland). Overall, this structural out-of-sample forecast illustrates that a further reduction in NPL ratios can generate significant economic benefits in euro area countries.

4.4 Conclusion

NPL ratios increased substantially in many euro area countries from the onset of the global financial crisis. At the time of writing, NPL ratios remain an important problem in several euro area countries, despite a gradual decline from their peak in 2014. Moreover, the economic implications of the global COVID-19 pandemic are likely to undo recent successes in dealing with the stock of NPLs in the euro area.

High NPL ratios can impair the stability of the banking system and its ability to lend to the real economy. For highly bank-dependent economies such as the euro area, the necessity to deal with elevated NPL ratios is thus unquestionable, even as empirical papers analyzing the interlinkages between NPLs, bank lending, and economic growth are in short supply.

Given the relatively short time series available for NPLs and the large number of parameters to be estimated, a panel Bayesian VAR model with hierarchical priors, allowing for country-specific coefficients, was used in this chapter. The variables included in the panel VAR are those typically used in monetary policy analysis, supplemented by residential real estate prices and some aggregate banking sector variables.

The chapter illustrates the impact of an exogenous positive shock to the change in NPL ratio and an exogenous negative shock to real GDP growth through three sets of results. Looking first at impulse response functions, it finds that an exogenous increase in the change in NPL ratios depresses bank

lending, widens lending spreads, and leads to a fall in real GDP growth and residential real estate prices. An exogenous decrease in GDP growth leads to an increase in the change in NPL ratios, reduction in bank lending, lower real estate prices, and increase in bank lending spreads. Forecast error variance decomposition shows that shocks to the change in NPL ratios, while being less relevant than shocks to GDP growth, explain a large share of the variance of the variables in the VAR, particularly for countries that exhibited a large increase in NPL ratios during the crisis. A 3-year structural out-of-sample forecast analysis clearly illustrates that a further reduction of NPL ratios can produce significant economic and financial benefits for euro area countries.

Overall, the results presented in this chapter provide clear empirical evidence for the economic merits associated with effective prudential and structural policy measures to speed up NPL resolution. Given the COVID-19 induced, expected rise in defaulting loans in the years ahead, the economic argument for the implementation of such policies is stronger than ever before.

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