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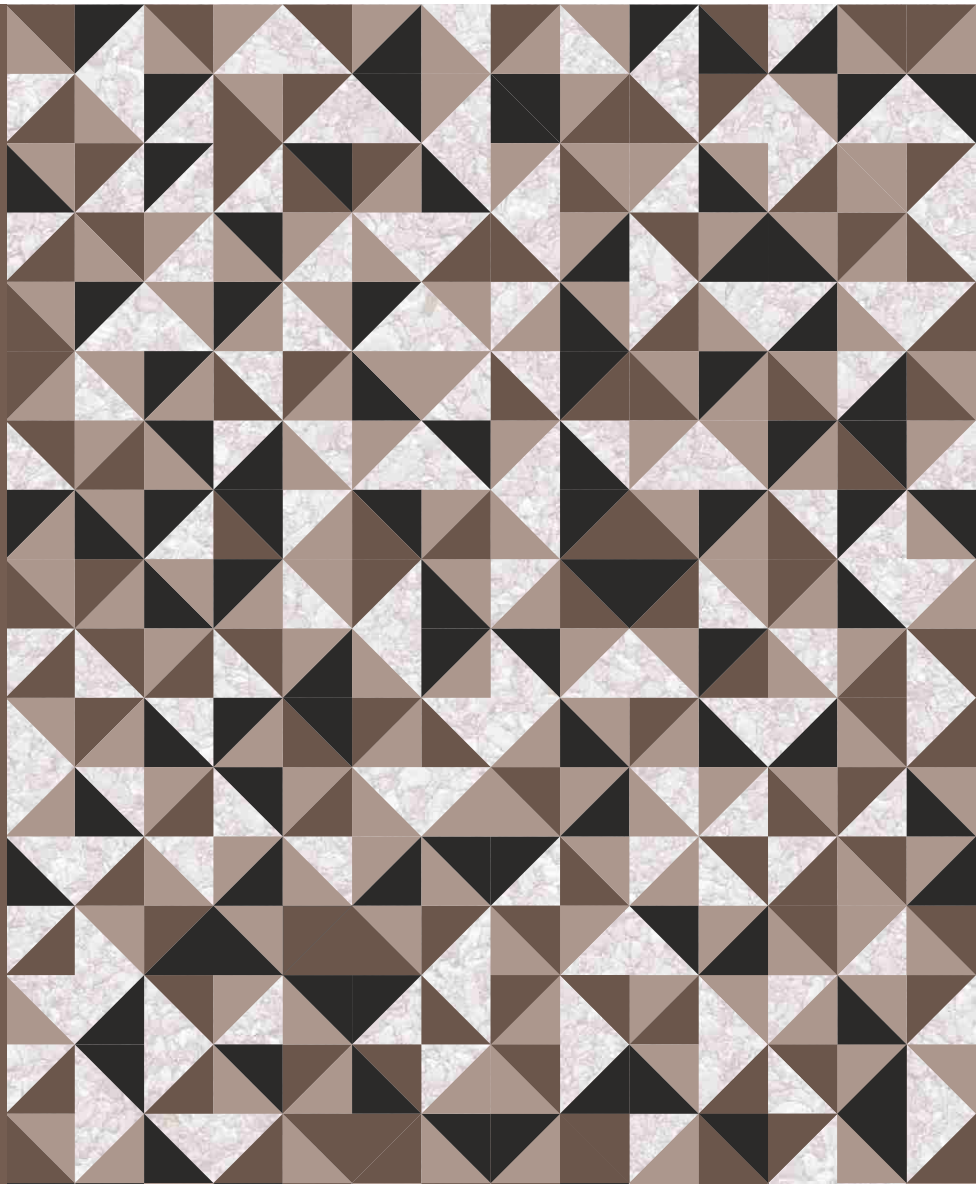

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Bank Profitability and Macroeconomic Factors

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Abstract

Since 2000 the European banking sector observed high earnings volatility both across time and among individual banks, culminating in a sharp decline in profitability in 2008, which remained thereafter at much lower levels compared to the pre-crisis norm. In this paper, we use panel data on a sample of European banks to answer the following questions: (i) how does bank profitability respond to macroeconomic variables? (ii) Is there heterogeneity in that response? To identify the effect of GDP growth on profitability, we use an instrumental variable approach with world GDP growth as an instrument. We find that there is a positive association between real GDP growth and bank profitability due to the procyclicality of impairments. We also find that, on average, European banks benefit from higher reference rates and steeper yield curves.

JEL: G21, C36, C53
Keywords: Bank profitability, business cycle, forecasting.

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1. Introduction

Since 2000 European banks have experienced high earnings volatility both across time and between individual banks, culminating in a sharp decline in profitability in 2008, which remained thereafter at much lower levels compared to the pre-crisis norm. In this paper, we use panel data on a sample of European banks to answer the following questions: (i) how does bank profitability respond to macroeconomic developments? (ii) Is there heterogeneity in that response?

These questions are especially relevant to macroprudential policymakers, given the need to capitalize banks in a context of added uncertainty about the global economy. Increased revenue generation is one of the few alternatives to deleveraging and increasing own funds via the raising of additional capital in financial markets. The viability of this option is, however, conditional on macroeconomic factors, such as GDP growth, interest rates, and investor sentiment, which differ across countries and are not determined independently of events in the financial system.

We find that macroeconomic factors explain a significant fraction of the variation in profitability. We also find some significant differences in the responses to macroeconomic variables between groups of European banks sharing similar characteristics. Going forward, we project an average profitability of 0.36% over the 2016-2018 period using the European Banking Authority's (EBA) baseline projections for the 2016 European-wide stress test. Still, 20% of European banks will have negative profitability in 2018, implying that the baseline macroeconomic outlook may not be enough to restore profitability to the entire banking system. In case the adverse scenario materializes, as many as 40% of European banks shall have negative profitability over the 2016-2018 period.

This article is organized as follows. Section 2 presents literature review. Section 3 provides a brief description of the evolution of European bank profitability. Section 4 describes the method. Section 5 discusses the results. Section 6 tests model properties in forecasting and shows model predictions. Section 7 concludes.

2. Literature review

Bank profitability has been the object of several empirical studies over the last two decades, with conflicting results. Demirguc and Huizinga (1999) study the effects of bank characteristics, macroeconomic conditions, profit taxation, deposit insurance regulation, financial structure, and underlying legal and institutional indicators on bank return on assets, as well as on the net

interest income (NII). They find a positive association between short-term interest rates and profitability. With the aim of analysing the low levels of profitability of German banks at the beginning of the last decade, Beckman (2007) assesses the effects of cyclical variables, which include real GDP growth, short and long term interest rates and interest rate volatility, and bank-specific variables, such as the ratio of credit to total assets and leverage, on bank return on assets. He also includes a number of so-called structural variables, namely banking system concentration and financial structure indicators. They find a positive impact of GDP growth on bank performance and a negative influence of interest rates. Additionally, the coefficient on the term premium is statistically insignificant which, according to the author, is due to hedging against the interest rate volatility performed by the largest banks in the sample.

The link between banking activity and macroeconomic variables was further studied by Albertazzi and Gambacorta (2009) and more recently by Kok, et al. (2015). The first two find bank ROA to be positively related to GDP growth, identifying increases in the NII and reduction in provisions as the main channels through which higher economic activity affects bank return on assets[1]. They attribute this to higher demand for financial services and lower credit risk of counterparties. Borio, et al. (2015) find evidence of a link between interest rates, the slope of the yield curve and bank profitability, with no effect of GDP growth. When it comes to the identification of the effect of interest rates, their method appears to be the most sophisticated, with the use of a weighted average of different interest rates for banks in different countries to reflect international credit flows and foreign currency financing in each country. They also uncover a positive connection between both stock index growth and house prices with return on assets and its components.

As can be seen, the results from the literature appear to be conflicting on some points, namely with respect to the impact of interest rates and real GDP growth on bank ROA. However, this observation is hardly surprising due to the differences in sample geography and reference periods between papers. The impact of interest rates, for example, is likely to be different across banks and time, given that each bank chooses the level of interest rate risk and its exposure to short and long-term interest rates. This argument will be detailed in the next section.

To curb the issue of conflicting results due to the use of multiple countries, Alessandri and Nelson (2015) take a sample of UK banks for the period between 1992Q1 and 2009Q3 and use a dynamic model to analyse the effects of short-term interest rates and the yield curve on bank

[1] Note that, in contrast to the other two papers, Kok, et al. (2015) do not control for interest rates.

ROA and NII. They find that interest rates have a negative effect on the NII in the short-run but positive in the long-run. Results are similar with respect to the effects of the slope of the yield curve on bank performance.

Most of these works use dynamic specifications to model bank profitability indicators. The motivation for this type of specification is the observed persistence of some of these variables and, in the case of Albertazzi and Gambacorta (2009), the aim of estimating the adjustment of operational costs following shocks to profitability, for example.

Additionally, Albertazzi and Gambacorta (2009) consider the lagged effects of macroeconomic variables, which may have different impacts in the short and in the medium run (e.g.: the effect of a long-term interest rate hike in the short run is to devalue existing fixed rate bonds, as opposed to its plausible long-run effect which is to enable banks to carry out maturity transformation by increasing the slope of the yield curve). In practice, Albertazzi and Gambacorta (2009) find no evidence of such effects, albeit using country-level data.

With respect to the heterogeneity in bank responses, it is likely that banks differ in their sensitivities to macroeconomic variables. In fact, the effect of interest rate shifts on bank NII, for example, is of central interest in the daily management of bank operations. Indicators such as the duration gap measure first order impacts of level changes in yield curves and are used by asset-liability committees to decide on which exposures to create and which to cut-back on. Formally, this implies that model coefficients are individual-specific and are likely to be disparate across banks which leads to miss-specification in models which assume common coefficients, an admittedly difficult assumption to relax given the limited number of observations per bank.

Moreover, the strong correlation between some factors theoretically perceived as able to explain the variation in bank profitability may render the estimates imprecise and sensitive to the introduction of different covariates. Finally, it is possible that sensitivity to macroeconomic variables has changed over time, as banks tighten their lending standards and reduce exposure to certain risks in order to comply with stricter requirements. This last point, although important, is not the focus of this project.

Table 1 – Sample Significance

Member State	% of banking system total assets	Member State	% of banking system total assets
Austria	86	Greece	100
Belgium	77	Luxembourg	NA
Denmark	83	Netherlands	90
Finland	83	Portugal	80
France	86	Spain	78
Ireland	76	Sweden	80
Italy	57	UK	45
Germany	51		

Notes: the table shows the percentage of the banking system represented by sample banks in each Member State using Moody's banking system outlook reports for 2012 and 2015.

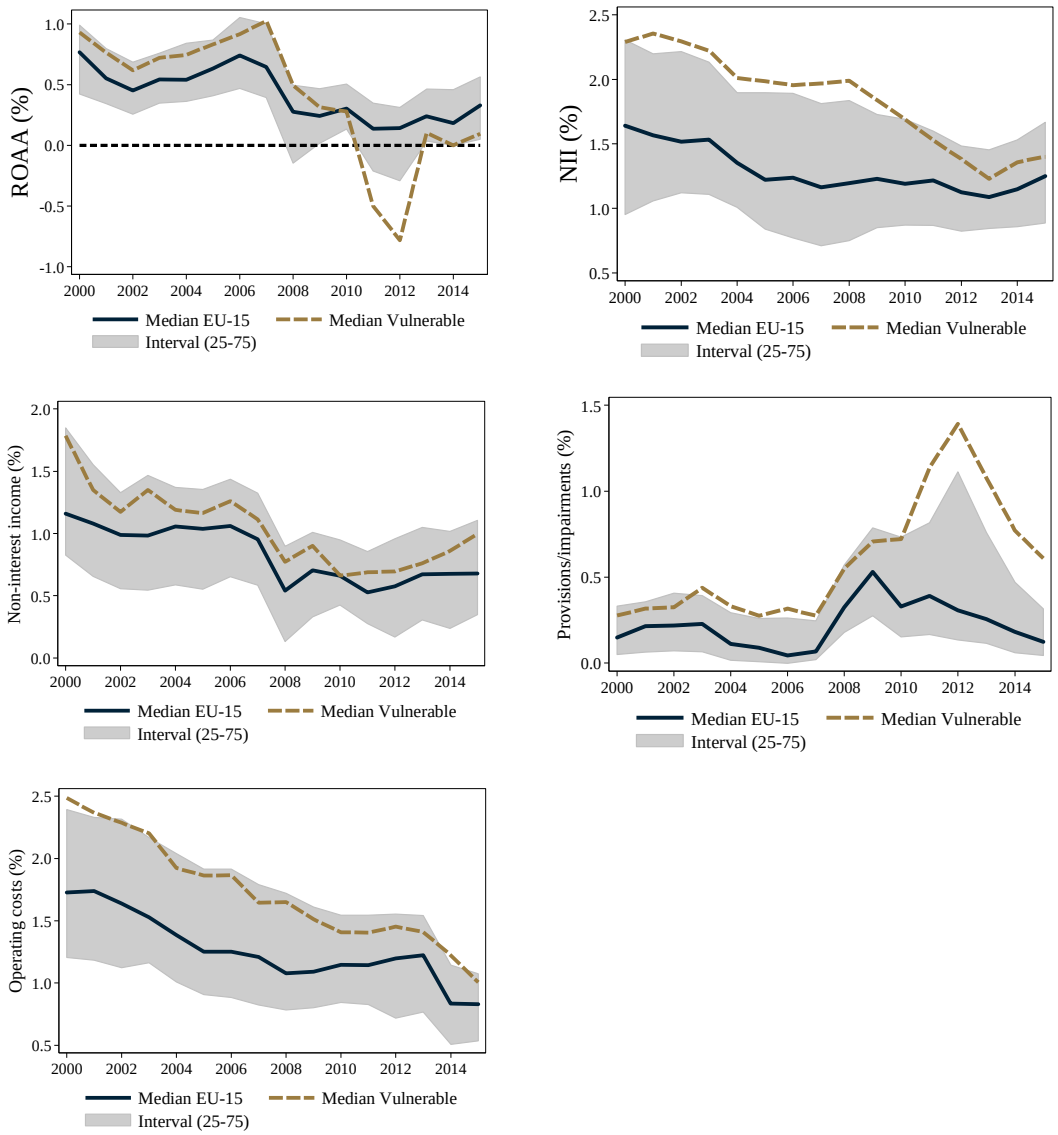
3. Analysis

The empirical analysis is conducted using banks' accounting information, drawn from Bankscope and SNL, on a sample of 110 banks from the EU-15 Member States. A model of bank profitability is estimated for the 2001-2015 period. Table 1 shows the representativeness of the selected sample in each Member State. Macroeconomic and financial variables come from Eurostat, the ECB and Bloomberg.

Figure 1 shows the evolution of European bank profitability and a breakdown into its different components. During the period under consideration, we observe a deterioration of bank profitability, with the median value of the return on average assets (ROA) dropping from 0.74% in 2006 to close to 0.33% in 2015. This descent resulted from a reduction of the net interest margin during the entirety of the period, accompanied, since 2008, by a surge in credit and securities impairment losses and a level change in non-interest income.

Of note is the divergence between the group of vulnerable Member States from the EU median: i) the higher starting point in all variables compared to the full sample and ii) the subsequent sharper changes. In particular, our work seeks to shed light on whether those changes result from grimmer materialization of adverse macroeconomic conditions or if they stem from distinct sensitivities to the variables as well. Table 1 of the Appendix displays key sample means on key variables, broken down by country and sub-period.

Figure 1 – Bank profitability indicator and its components



Notes: Non-interest income includes fees and commissions, trading income and other operational income. Provisions/impairments include provisions/impairments for loans and securities, real estate revaluations and other shifts in value. The sample is composed of 110 banks from the 15 original EU Member States for the 2000-2015 period. Vulnerable Member States include Ireland, Italy, Greece, Portugal and Spain. The shaded area displays the difference in the evolution of the 25th and 75th percentiles of the full sample.

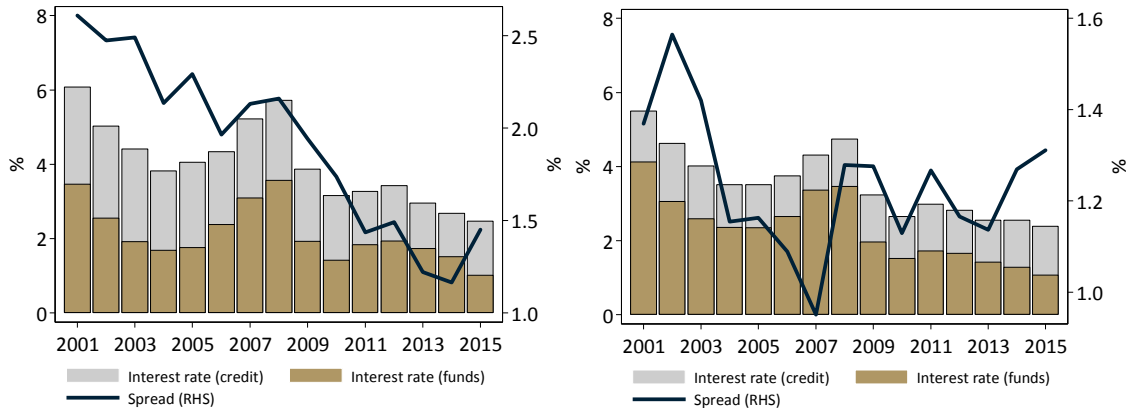
Source: Bankscope, SNL and authors' calculations.

On the subject of divergence between the two groups of economies, the gap between the NII of the vulnerable set when compared to that of the full sample is of particular interest, given its direct connection to reference interest rates and risk perception by debt-holders. In particular, one notices the steep decline of the median of the vulnerable group since 2008, in contrast to its more stable counterpart.[2] This observation may arise from multiple sources: i) Increase in non-performing loans; ii) perception of higher risk by debt-holders and iii) an endogenous

[2] Banks of vulnerable countries make up one-third of the full sample.

decision by banks to take on interest rate risk.[3] Figure 2 shows the evolution of implicit rates on assets and liabilities for the indicated period for in the two sets of economies. Table 2 quantifies.

Figure 2 – Implicit Rates and Spreads



i) Vulnerable Member States ii) Non-vulnerable Member States

Notes: Implicit interest rates are calculated as the ratio of interest revenue/expenses to average interest bearing assets. The spread is the difference between the yearly cross-sectional median of the two rates.
Source: Bankscope, SNL and authors' calculations.

Table 2 – Spread Evolution

	2001	2015	Δ
Vulnerable MS (median, p.p.)			
Spread	2.61	1.45	-1.16
Int. rate (assets)	6.08	2.47	-3.61
Int. rate (liabilities)	3.47	1.02	-2.45
Other MS (median, p.p.)			
Spread	1.37	1.31	-0.06
Int. rate (assets)	5.50	2.39	-3.11
Int. rate (liabilities)	4.13	1.07	-3.06

Source: Bankscope, SNL and authors' calculations.

Note that non-vulnerable Member States were able to recover the spread almost completely after its lowest point in 2007. In contrast, the median of vulnerable economies dropped across the sample period in near monotonic fashion. Interestingly, while the implicit rate on interest-bearing assets has the same net evolution across time for both sets of economies, the implicit rate on liabilities drops by a lower amount for vulnerable economies. This implies that the sensitivity of interest-bearing liabilities to changes in reference rates is not the same between both sets of economies, either due to endogenous funding choices by sampled banks or by

[3] Note that this type of risk, in the period under analysis, was not dealt with by Pillar I but by Pillar II capital requirements, in the case of the banking book.

different risk perceptions by debt-holders. It is precisely this kind of observation that prompts us to allow for heterogeneity in the profitability models.

4. Methodology

4.1 Modelling profitability

We propose a conceptual framework for coefficient interpretation complementary to the ones found in the literature, which rely on industrial organization and purely macroeconomic-type arguments to explain obtained estimates. If we view banks as portfolios of assets and liabilities, as in Diamond (1984), and recognize that there may be multiple risk factors to which portfolio holders may expose themselves, as in Ross (1976), we can express banks' return on assets using the following expression:

$$r_{it} = a_i + \beta_{1,i} F_{1,t} + \beta_{2,i} F_{2,t} + \ldots + \beta_{k,i} F_{k,t} + \varepsilon_{it}, \tag{1.1}$$

where a_i is a portfolio-specific constant, for generality; F_s is a systematic risk factor (of which the market portfolio is a particular example, but it can also be inflation, GDP growth and so on) and β_{si} is an individual-specific sensitivity to risk factors, also known as a factor loading.[4] This specification for portfolio return rates gives rise to the following result for each bank:

$$\beta_i^* = \arg\max_{\beta} \sum \delta^t E\left[\prod_{it}\left(\psi_{it}, x_{it}, \eta_i, \beta\right)\right], \tag{1.2}$$

where β_i^* is the vector of optimal factor loadings, δ is the discount factor and Π_{it} is the profit function, which depends on a time changing risk-aversion variable, Ψ_{it}, expectations on the future path of covariates, $E(x_{it})$, and an individual heterogeneity term η_i. This implies that banks with higher factor loadings will do better when those factors improve and worse otherwise.

The insight offered by viewing banks as bundles of idiosyncratic risk is that bank profitability is unlikely to be intrinsically either pro or counter-cyclical, but depends on, among other things, the decisions made by management on risk factor exposures, which are likely to be different across banks and time.[5]

[4] We assume time-constant sensitivities and that factors are the same for all individuals, for simplicity. In practice, given that banks are frequently geographically constrained in their operations and the impossibility of including the growth rates in every single country, we use only country-specific macroeconomic factors.

[5] For an example on how to determine factor loadings in the case of investment funds see Gungor and Sierra (2014).

A standard dynamic linear model with individual-specific intercepts is assumed:

$$Y_{it} = \alpha Y_{it-1} + \beta_i' x_{it} + \eta_i + \varepsilon_{it}, \quad (1.3)$$

where Y_{it} is the dependent variable of interest (ROA, NII, interest income, interest expenses, non-interest income, operational costs and impairments); x_{it} is the vector of covariates, which includes macroeconomic variables; η_i is the individual-specific effect and $\varepsilon_{it,}$ is the idiosyncratic error term. The choice of a dynamic model of bank profitability is motivated by the fact that it improves model fit and forecast performance, which is relevant to conduct the scenario analysis on section 6. Additionally, in a context of a relatively small T dimension to estimate various macro factors and their lags, the inclusion of the lagged dependent variable is a way, although less flexible than estimating a autoregressive distributed lag model, to allow for persistency in profitability levels (and its components). Lag selection tests on the dependent variables of interest, presented on the third column of table 3, indicate that ROA and its main components follow a first order autoregressive process.

Table 3 – Unit root tests and lag selection

	Im-Pesaran-Shin test (H_0: all panels contain unit roots)	Optimal lag and values of the information criterion
ROA	-6.72***	1
1 lag	-	-0.42
2 lags	-	-0.32
Impairments	-8.83***	1
1 lag	-	-0.61
2 lags	-	-0.50
NIM	-4.02***	1
1 lag	-	-2.90
2 lags	-	-2.88
Interest income	-3.72***	2
1 lag	-	0.14
2 lags	-	0.09
Interest expenses	-3.43***	2
1 lag	-	0.07
2 lags	-	0.04
Other income	-6.32***	1
1 lag	-	-1.96
2 lags	-	-1.85
N	71	71
T	16	16

Notes: *** p<0.01. ** p<0.05. * p<0.1. Dependent variables are expressed as percentages of average total assets for each bank.

We employ the Kullback-Leibler information criterion (KLIC), as proposed by Lee and Phillips (2015) for use in dynamic panel model lag selection. Standard information criteria are inconsistent in the presence of incidental parameters, be they fixed or random. For the purpose of implementing this test, we make the assumption that the idiosyncratic error is normally

distributed.[6] Stationarity of panels is required for consistency of the KLIC, which is confirmed by standard panel unit root tests.[7]The limited number of observation available at the bank-level implies that we cannot run regressions for each group and simultaneously include a large number of controls. However, we are also not in a small *T* environment where micro-panel estimators, such as fixed effects, are usually applied. Thus, in order to have a model that is implementable with available data, we have to assume that coefficients are common across *i* in (1.3). Homogeneity is somewhat relaxed at a later stage by estimating separate regressions for groups of banks in the same country. This is also the reason for not considering a distributed lag model, where estimation of coefficients on the lags of macroeconomic variables would reduce the time dimension by one or more units and exacerbate over-fitting for the limited number of observations of the macroeconomic variables.

We begin by using the estimator proposed in Bruno (2005) to find the parameter values for a linear dynamic panel model of the form:

$$Y_{it} = \alpha Y_{it-1} + \beta' \mathrm{x}_{it} + \eta_i + \varepsilon_{it}, \tag{1.4}$$

where the coefficients on both the autoregressive term and the exogenous regressors are assumed to be homogeneous across banks. By using the so-called corrected Least Squares Dummy Variable (LSDV) estimator, we are able to approximate the bias on the autoregressive term and obtain more accurate estimates for its coefficient. Thus, our first goal is to obtain the set of coefficients in β associated with macroeconomic variables.[8]

Under the taxonomy of Pesaran and Smith (1995), assuming common coefficients as in (1.4) and allowing for fixed or random intercepts is known as a "pooled" method, as the data for each panel is combined with others to estimate common parameters. The authors show that this category of estimators is consistent under large *N* and *T* if there is no heterogeneity in the coefficients, which would induce serial correlation in the disturbance. Alternatively, we could apply the so-called pooled mean group estimator proposed by Pesaran and Smith (1995), which is a consistent estimator for dynamic models with coefficient heterogeneity. However, this

[6] The modified BIC test is fit for balanced panels only, which implies that we remove all panels which are not observed for the full sample in order to conduct it.

[7] Table 3 shows the results of the Im-Pesaran-Shin panel unit root test, proposed by Im, et al. (2003). This test is selected due to the assumed asymptotics (i.e. *N* large and *T* fixed) which fit sample characteristics. Other standard tests which rely on alternative asymptotics also reject the existence of a unit root in all panels.

[8] A detailed overview of the dependent and explanatory variables and their sources is given in Table 2 of Appendix A.

procedure involves running separate regressions for each panel which, while the time dimension is larger than the usual micro-panel in our sample, implies that a more parsimonious model would have to be estimated to avoid over-fitting. Given that our purpose is to identify the effect of each macro variable on bank profitability, we choose to impose common coefficients to avoid reducing the number of regressors.

Given the argument made at the start of this section, it is much more likely that (1.3) and not (1.4) is the true model. As such, we relax the common coefficients assumption on a set of selected regressors for which we suspect there might be significant heterogeneity, such as the coefficients on the effect of interest rates, which embody the interest rate risk taken on by each bank. This is achieved by dividing the sample into different groups based, for example, on the type of loan contracts (fixed rate vs. floating rates) or whether banks are headquartered in Member-States whose banking systems were more adversely affected by the sovereign debt crisis.

4.2 Endogeneity of regressors

The literature on bank profitability (Albertazzi and Gambacorta (2009) and Kok, et al. (2015)) often acknowledges that the estimation of the effect of GDP growth on bank net income is problematic due to two sources of endogeneity: (i) reverse causality, in the sense that economic growth may be the result of high profitability among banks, which are better able to supply credit; (ii) omitted variable bias, to the extent that GDP growth is correlated with unobservable conditions in the country where a given bank operates, such as changes in trade openness or in regulation. This may be particularly problematic for banking systems where credit is concentrated in a very small set of banks, or where profitability is highly correlated between banking groups. Both Albertazzi and Gambacorta (2009) and Kok, et al. (2015) deal with these issues by considering GDP growth as a predetermined variable and by applying system or difference GMM. Instead, we employ a standard IV approach where the US GDP growth is used as an instrument for the country-level GDP growth. We argue that this is a suitable instrument for three reasons: (i) it is correlated with country-level GDP growth; (ii) in what concerns reverse causality, we assume that changes in US GDP growth are not caused by changes in the profitability of a single European bank, which excludes variation in country level output resulting from increased credit supply due to higher bank profitability; (iii) we assume that US GDP growth is uncorrelated to other bank-specific unobservable terms which affect profitability, such as those mentioned above. A Wu-Hausman test, conducted under the assumption that US GDP

growth is a suitable instrument, confirms the hypothesis that country-level output growth is endogenous.[9]

5. Results

Table 4 displays estimation results for the models of ROA and its components. We find that relevant macroeconomic factors contributing to the determination of ROA are GDP growth, the money market rate and the country risk premium.

Table 4 – Estimation Results - Common coefficients model

	ROA	Impairments	NII	Interest income	Interest expenses	Other income
Lagged dependent	0.109***	0.048	0.652***	0.734***	0.682***	0.524***
	(0.030)	(0.030)	(0.024)	(0.031)	(0.031)	(0.026)
GDP growth	0.082***	-0.059***	-0.016***	0.075***	-0.150***	0.021**
	(0.021)	(0.017)	(0.005)	(0.018)	(0.027)	(0.009)
Money market rate	0.072**	0.011	0.005	0.281***	0.075***	0.009
	(0.034)	(0.028)	(0.008)	(0.036)	(0.018)	(0.017)
Term premium	0.106*	0.029	-0.021	-0.096*	0.281***	0.085***
	(0.055)	(0.045)	(0.013)	(0.055)	(0.036)	(0.027)
Country risk premium	-0.186***	0.214***	-0.021***	0.015	-0.096*	-0.005
	(0.023)	(0.020)	(0.005)	(0.017)	(0.0553)	(0.010)
Credit growth	0.005***	-0.004**	0.000	-0.002	0.0149	0.001
	(0.002)	(0.001)	(0.000)	(0.001)	(0.0165)	(0.001)
Leverage	0.064***	-0.013	0.029***	0.031*	-0.00159	-0.004
	(0.020)	(0.017)	(0.005)	(0.018)	(0.00150)	(0.010)
Bank size	0.109	0.023	-0.116***	0.213**	0.0305*	-0.083*
	(0.111)	(0.092)	(0.027)	(0.106)	(0.0182)	(0.049)
Retail ratio	0.013***	-0.003	0.006***	0.010***	0.213**	0.008***
	(0.004)	(0.003)	(0.001)	(0.003)	(0.106)	(0.002)
Observations	1,377	1,377	1,367	1,349	1,355	1,369
Number of banks	110	110	110	110	110	110

Notes: Bootstrap standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1. Dependent variables are expressed as percentages of average total assets for each bank. Lags in addition to the first are supressed from the table.

We find that the positive effect of GDP growth on bank profitability stems from its impact on impairments. This result is consistent with a wide scope of literature elaborated on this topic (Albertazzi and Gambacorta (2009), Beckman (2007), Borio, et al. (2015), Kok, et al. (2015) and Mevis and Cheng (2015)). The main channels through which GDP growth affects ROA are impairment recognition and non-interest income. The effect on NII is slightly negative, possibly

[9] The residuals of the first stage regression are correlated with ROA (p-value=0.008).

owing to a compression of spreads in new loans in a context of improved prospects for economic activity and a decrease in credit risk perception.

Concerning the money market interest rate (short-term interest rate), the results outlined in Table 3 show a positive relationship with ROA. This is consistent with the one most found in the literature (Borio, et al. (2015) and Demirguc and Huizinga (1999)), with the exception of Albertazzi and Gambacorta (2009) that estimates a negative relationship between interest rates (and the term premium) and ROA, albeit for a different period. It is not possible to uncover the channels through which an increased money market rate affects ROA, given that its impact is non-significant for all ROA components. In the case of NII, there appears to be a balance between the effects on interest income and expenses which are both positive and with similar magnitudes.[10]

Although the estimated net effect of interest rates on overall profitability is positive we must keep in mind that this is a linear model, and the effects of interest rates on interest income and credit risk may be more complex in reality.[11] Moreover, the effect of a rise in the ECB policy rate on profitability will depend on how it transmits to the entire term structure. The term premium, reflecting the slope the yield curve, shows up as significant in the ROA regression, associated with an increase in other income, while the effect on NII is also non-significant on the account of balanced effects. It should not be ruled out that higher interest rates are associated with increased impairments, although no significant effect is estimated in this linear model. The low average interest rate during the analysed period is likely driving the muted effects of interest rates on impairments.

Consistent with the conceptual framework in section 4, European banks have different levels of interest rate risk, which would lead to different sensitivities to reference interest rates, which cannot be modelled efficiently in a common coefficient linear panel data model.[12] This observation is even more relevant given low average interest rates during this period, as banks are not apt at managing interest rate risk when reference rates are close to the zero lower bound. Heterogeneity in the share of demand deposits among banks (*i.e.* bearing no or residual

[10] Some caution when interpreting results for interest expenses and interest income is needed, as p-values of serial correlation tests signal residual persistency in these regressions.
[11] We tested the inclusion of a non-linear term in the model for the effects of the short-term interest rate, which yielded a non-significant estimate.
[12] In fact, the Single Supervisory Mechanism will conduct an interest rate risk assessment for European banks beginning in 2017.

interests), for which data was not available, may also contribute on some degree to bank-specific sensitivities.

An increase in the country risk premium is associated with a drop in ROA mostly through impairments and, to a lesser extent, NII. It can be the case that the regression analysis is picking up the high correlation between ROA and the sovereign spreads in vulnerable countries, during the sovereign debt crisis, which was a period of significant deterioration in profitability due to an upsurge of non-performing exposures and to a constrained access to international funding markets.

Finally, an increase in total credit-to-GDP is weakly associated to an increase in ROA, due to lower impairments (consistent with Kok, et al. (2015)). However, the lower risk materialization could plausibly be an instance of reverse causality, i.e., as impairments are low in a given year, for a given level of risk-aversion, banks are willing to expand credit supply and equilibrium credit rises that year. Alternatively, it could be the case that these variables are jointly determined, and the extension of credit to some debtors may delay the recognition of pending credit losses.[13]

With respect to the results just described, one must bear in mind i) with a short T from a macro perspective there is always a trade-off between mitigating over-fitting and accepting some omitted variables bias, which in our case poses challenges mainly in the estimation of the coefficients on interest rates and regressors that lack variability across the majority of the countries[14] and ii) the theoretical framework laid out in the previous section: coefficients of macroeconomic variables mirror bank exposures to sources of systematic risk and are unlikely to be the same across banks and time, leading us to suspect of misspecification issues. In particular, riskier banks are likely to be more procyclical. This coefficient heterogeneity may be the reason why we have difficulty in identifying the effect of interest rates, as banks take different levels of interest rate risk. Concerning this point, recall the path of implicit interest rates in Figure 2. Although reference rates dropped across the board during this period, banks in non-vulnerable Member States were able to keep interest spreads stable, especially after 2008, when reference rates fell the most. The dynamics of NII is likely to be a function of a bank's

[13] Of note is the absence of house price growth among the macroeconomic variables. We have tested its introduction but found it non-significant with no effect on other estimates.

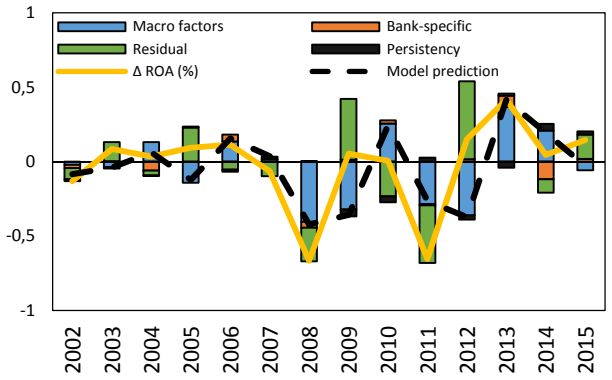
[14] The two interest rate parameters are estimated by way of 4 different time series from short-term interest rates on different currency areas, totalling 60 distinct observations. For GDP growth, the main variable of interest, there is no within country variation and, thus, its coefficient is estimated using essentially 225 observations.

own market power, rather than merely reference rate levels, and depend on the interest rate´s fixation period practiced in different jurisdictions.

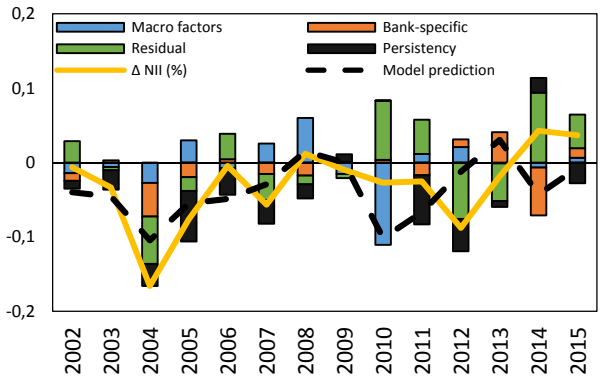
In fact, the reaction of funding and lending rates depends on whether banks chose to take interest rate risk or not and whether that risk manifests itself as a sensitivity to short or long-term indices. This is a less convincing argument in a zero interest rate context, given that some Member States have legal floors on retail deposit rates, which leads to a deterioration in implicit spreads.

Figure 3.i shows the decomposition of average change in ROA in the EU-15 based on the output of Table 3. There are two very large drops in ROA in 2008 and 2011 (totalling 1.32 p.p.), which are mostly explained by large shifts in macroeconomic factors, rather than by bank-specific indicators or other drivers. The model underestimates the decrease in ROA (negative residual), in both occasions. While in 2008 the main driver is the drop in GDP growth, in 2011 the rise in the country risk premium plays a larger role. Interestingly, in the years that followed (2009 and 2012, respectively) macro variables point to further decreases in bank profitability that in fact did not occur. It should be noted that while on a year-on-year basis GDP growth frequently explains a higher fraction of the change in ROA, the cumulated fall since 2007 is mostly attributable to interest rates, i.e. to the joint dynamics of the short-term rate and yield curve (-0.24 p.p.).

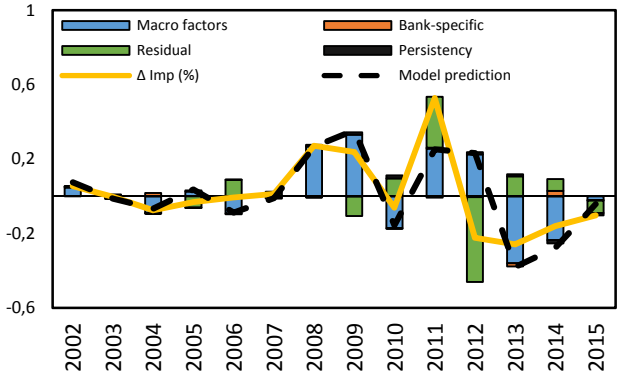
Figure 3 – Decomposition of the Average Change in Profitability Indicators (EU-15)



i) ROA



ii) NII



iii) Impairments

Notes: Figures show the average contribution of each set of variables in the model. Contributions are calculated by multiplying coefficients by variables for each set of factors and taking the cross-sectional average for each period. Model prediction: average change in predicted value for the period. Residual: average model residual.
Source: Author's calculations.

Figures 3.ii and 3.iii display the same exercise as in 3.i but conducted for NII and impairments. Even though the model has a better fit for the level of NII when looking into average changes, the residual component explains a relatively higher proportion of the NII´s variability. Average NII mostly trends downward in the period under analysis. Interestingly, the observed decrease until the 2007/2008's crisis is not explained by macroeconomic determinants, as reflected by the large residual. Regarding impairments, macroeconomic factors drive most of the observed variability, while bank-specific contributions are negligible. While the 2008 increase in impairments was fully captured by the model, the sharp increase in 2011 was not.

Table 5 – Estimation Results – ROA regressions on subsamples

	Non-vulnerable countries	Vulnerable countries	Floating-rate countries	Fixed rate countries
Lagged dependent var	0.181***	0.043	0.119***	0.023
	(0.039)	(0.048)	(0.033)	(0.058)
GDP growth	0.082***	0.077*	0.086***	0.081***
	(0.014)	(0.043)	(0.027)	(0.027)
Money market rate	0.059**	0.005	0.087**	0.093**
	(0.025)	(0.096)	(0.042)	(0.041)
Term premium	0.116***	0.069	0.100	0.224***
	(0.043)	(0.146)	(0.069)	(0.073)
Country risk premium	-0.084	-0.186***	-0.177***	-0.182
	(0.077)	(0.041)	(0.027)	(0.169)
Credit growth	0.003**	0.029***	0.005**	0.005
	(0.001)	(0.008)	(0.002)	(0.010)
Leverage	0.050***	0.094***	0.055**	0.171***
	(0.020)	(0.034)	(0.024)	(0.044)
Bank size	-0.023	0.287	0.179	0.027
	(0.087)	(0.275)	(0.130)	(0.171)
Retail ratio	0.005*	0.029***	0.017***	-0.003
	(0.003)	(0.008)	(0.004)	(0.006)
Observations	389	988	924	453
Number of banks	30	80	73	37

Notes: Bootstrap standard errors in parentheses. *** p<0.01. ** p<0.05. * p<0.1. Dependent variables are expressed as percentages of average total assets for each bank.

We now turn to the relaxation of the common coefficients assumption. This is implemented by first dividing the sample of banks by geographic location of their headquarters and grouping those which are headquartered on the so-called "vulnerable" and "non-vulnerable" countries.[15] Additionally, we split the sample between banks belonging to floating-rate and fixed-rate countries. [16]

The virtue of these approaches compared to ultimately running a single regression for each country is that we profit both from: (i) a higher number of observations and (ii) cross-country variation, which allows us to identify macroeconomic factors' coefficients more accurately than with single country data only. Results are presented in Table 5.

Regarding the distinction vulnerable/non-vulnerable the results show that ROA is slightly less sensitive to GDP growth for banks in vulnerable countries, though this difference is not

[15] We consider subsidiaries and branches of foreign banks in each Member State as headquartered in that Member State, on a sub-consolidated accounting basis, as long as they fulfil the prescribed size significance criteria.

[16] Floating rate countries are the ones where banks grant credit predominantly at rates with a fixation period of up to one year and include Austria, Denmark, Finland, Greece, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden and the United Kingdom. Fixed rate countries comprise Belgium, France, Germany and Netherlands.

statistically significant. The effect of money market rates on ROA is positive only in the case of non-vulnerable countries. The same applies to the term premium. As expected, we obtain a stronger negative relationship between country risk premium and banks´ ROA in vulnerable countries, mainly due to the recognition of impairments in a period with strong deterioration of customers' creditworthiness, and a decrease in other operating income (possibly through the recognition of losses on sovereign debt securities). In addition, the results display a significant relationship between ROA and credit growth in the vulnerable economies, providing evidence that bank profitability has some relationship to credit growth, in contrast to banks in non-vulnerable countries.

Concerning the split floating/fixed rate countries, Table 4 (columns 3 and 4) outlines that the term premium has a statistically significant and positive effect on ROA, but only in fixed rate countries. On the other hand, the effect of money market rates on banks´ profitability is quite similar in both types of countries.

It is our view that differences in coefficient signs with respect to the literature do not necessarily imply contradictory results, as it may be the case that each sample contains distinct regions, time periods and, especially, banks, which possess genuinely diverse underlying behaviours, as per the conceptual framework presented in the previous section. In summary, the evidence provided in table 4 confirms the existence of coefficient heterogeneity between groups of banks, as postulated in Section 3. This is especially important for our purposes, given that we aim both at understanding the dynamics of European bank profitability and constructing a tool that can forecast its future path. In practice, the common coefficients model ends up being superior in out-of-sample forecasting.

With respect to time-invariant unobserved heterogeneity, estimated fixed effect parameters point to the existence of cross-country differences. Banks in some countries recorded, on average, higher profitability than what was expected given the macro fundamentals of their economies. We find no evidence of systematic differences along group line (stressed vs. non-stressed, and fixed vs. floating).

6. Forecasting

We use the specification in Table 3, which assumes that the common coefficients model of equation (1.4) is the true model and that coefficient heterogeneity is negligible, as a starting point to forecast the future path of the ROA of the European banking system. We test the

model's forecasting performance by estimating it with a training sample and then producing out-of-sample forecasts which can be compared with actual values.

We first estimate the model using the whole sample and remove those variables which are statistically insignificant and the procedure is repeated until the model contains only regressors with statistically significant coefficients. The goal is to reduce forecast uncertainty by removing redundant information from model estimation. The final specification is then used for the out-of-sample performance exercise and it is dubbed the baseline. The benchmark for comparison is a simple AR(1) model of bank ROA.

The 2001-2010 period is used as the estimation sample to obtain the h-step-ahead forecast $y^h_{2010+h|t}$. The estimation sample is then incremented by one period to obtain the next h-step-ahead forecast $y^h_{2010+h|2010}$. This experiment is carried out for a total of three horizons, i.e., one to three periods ahead. The final simulated out of sample forecast is made in 2015-h for y^h_{2015}.

This exercise is limited when compared to usual time-series forecasts: (i) as mentioned above, model selection is based upon the entire sample, which is due to the limited number of time periods with which to conduct model selection in smaller samples; (ii) we use observed values of regressors, as opposed to real-time forecasts (there is no macroeconomic scenario uncertainty) in contrast to what will be done in the forecasting of profitability for the 2016-2018 period.

Table 6 shows the performance of the baseline model with respect to a benchmark AR (1) model at every horizon, as measured by the Root Mean Squared Error (RMSE). It also showcases the performance of the baseline model against models estimated using only observations from floating and fixed rate countries.

Table 6: Forecast performance in predicting ROA

Forecast horizon	h = 1		h = 2		h = 3	
	RMSE	std. error	RMSE	std. error	RMSE	std. error
Forecast model						
All obs.						
AR (1)	1.26	0.90	1.30	0.85	1.29	0.82
Baseline	1.07	0.85	1.06	0.74	1.22	0.88
Floating						
Baseline	1.26	0.88	1.45	1.03	1.31	0.96
Restricted	1.47	1.05	1.40	1.04	1.55	0.99
Fixed						
Baseline	0.29	0.18	0.39	0.17	0.34	0.17
Restricted	0.48	0.22	0.63	0.22	0.42	0.23

Note: bootstrap standard errors reported.

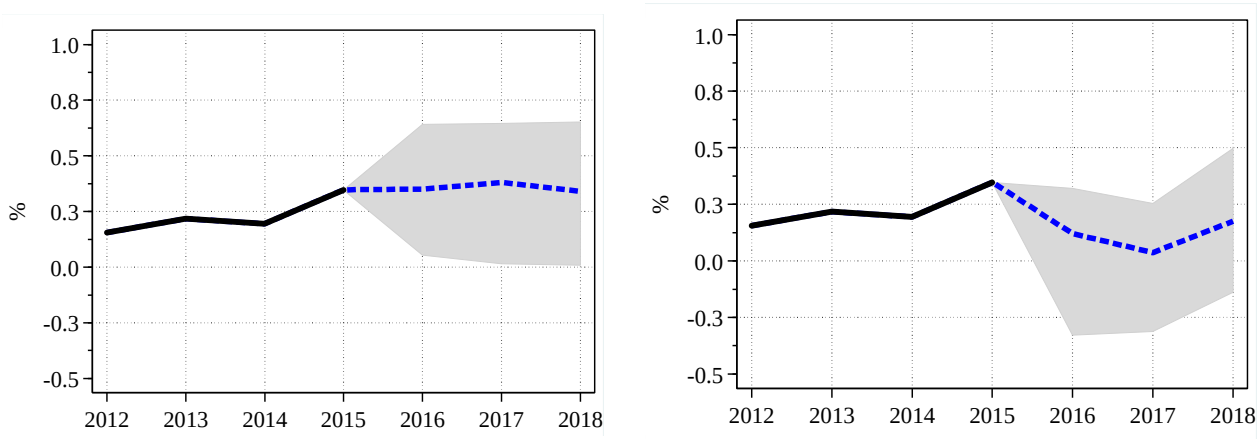
Results show that the Baseline outperforms the AR(1) specification at all horizons, given the lower values of the RMSE. Overall, however, both the AR(1) and the baseline specification seem to perform poorly in predicting ROA out of sample. It is our view that this reflects the nature of accounting data, which is heavily dependent on each bank's practices and the idiosyncrasies of different jurisdictions. Given the limited number of periods available, the difficulty of estimating the effect of so-called common variables (i.e., the macroeconomic factors) on profitability is hardly surprising.

In what concerns the performance of the baseline model versus models estimated over restricted samples, we find that the baseline, which assumes common coefficients between countries, outperforms restricted models at every horizon (with the exception of the floating model when forecasting two periods ahead). This indicates that restricting the sample does not increase the accuracy of model estimation, but eliminates information which reduces model forecasting performance.

Given its superior forecasting performance, the baseline model is used to forecast euro area aggregate bank ROA for the 2016-2018 period under alternative macroeconomic scenarios. The scenarios were created by the ESRB for the purpose of EBA's 2016 EU-wide stress test with reference to December 2015 and include both a baseline and an adverse scenario for real GDP growth, short-term interest rates and bond yields at the country-level for 2016 to 2018. Figure 6 contains the results of this exercise for both scenarios.[17]

[17] For a detailed description of the scenarios used in the 2016 EU-wide stress test please refer to the ESRB document: "Adverse macro-financial scenario for the EBA 2016 EU-wide bank stress testing exercise" at

Figure 4 – Forecasts of euro area aggregate bank ROA under alternative macroeconomic scenarios



(a) Baseline (b) Adverse

Notes: solid line is the median of euro area banks observed ROA. Dashed blue line is the median of bank-level ROA projections. The shaded area is the 20-80 interquartile range for bank-level forecasts.

Under the baseline scenario assumptions, the baseline model forecasts that ROA in the euro area will average 0.36% over the 2016-2018 period, with substantial idiosyncratic variation reflected in the large confidence intervals. Under this scenario, short-term interest rates will remain close to the zero lower bound for the next three years, peripheral country spreads stay near their current levels and real output growth averages 1.9%. The decrease in median bank profitability in 2018 is mainly driven by the slightly lower GDP growth. Nevertheless, even in the baseline scenario, the outlook for European bank profitability seems quite heterogeneous with roughly 20% of the banks still struggling with negative profitability in 2018, while the 20% top performers manage to achieve a ROA above 0.7%.

In the adverse scenario, we forecast that average ROA in the euro area will average 0.10% over the 2016-2018 period. Both interest rates and spreads will rise, coupled with an average real output drop of 0.8% (-2.8 p.p. compared to the baseline). Spread hikes and prolonged recessions in most countries are the main contributors to the forecast. In the adverse scenario, average profitability will be negative over the 2016-2018 period for roughly 40% the European banks.

7. Concluding Remarks

We find that macro factors explain a large fraction of the evolution of individual bank ROA in the EU. In particular, adverse economic conditions and interest rate shifts explain the large drops in average bank ROA. We find a positive effect of GDP growth on bank profitability, stemming mainly from its impact

https://www.eba.europa.eu/documents/10180/1383302/2016+EU-wide+stress+test-Adverse+macro-financial+scenario.pdf

on impairments. Both the short-term rate and the term premium contributes positively to ROA, although these estimates embed some uncertainty. In addition, increases in country risk premium are associated with lower profitability. According to our results, the cumulated fall in bank profitability since 2007 is mostly explained by the joint dynamic of short-term and long-term interest rates, given that GDP growth has rebounded in the last couple of years.

The distinction between vulnerable and non-vulnerable countries highlights substantial differences in the contributions of the macro variables, with the exception of GDP. On the other hand, the splitting between fixed and floating countries shows that the term premium has a statistically significant and positive effect on ROA only in the former.

Under the ESRB's baseline scenario, we project that a 20% of banks in our sample will have negative profitability over the 2016-2018 period, indicating that internal capital generation may not be enough to ensure adequate capitalization of a portion of the banking system. Under the adverse scenario, we find that as many as 40% of the banks in our sample will, on average, be in the red during the reference period. A more complete exercise could be carried out by using forecast uncertainty as well as additional scenarios with distinct interest rate paths. We leave this for future work.

As explained on section 4 and throughout the text, data constraints (small N and T) led us to focus on a limited number of regressors for which we estimated common coefficients for pre-set groups of banks. This strategy allows us to approximate what we believe to be the true model of the impact of macroeconomic factors on bank profitability, of which the most salient feature is the heterogeneity of exposures to different types of non-diversifiable risk. A promising avenue of future research is to use the so-called data fields of harmonized and market data to estimate the factor loadings across European banks, in order to measure exposure heterogeneity and the role of idiosyncratic risk of banks across Europe, which is especially important in the context of the setting up of a Banking Union.

Further work could also be done with respect to the sovereign-bank nexus, which stems both from bank sovereign bond holdings as well as the possibility of bank bailouts using public funds, creating contingent liabilities for the government. This mapping is crucial for the identification of the impact of the sovereign spread on bank balance-sheets and profitability, and is not well identified in our estimates given the low variability of the sovereign spreads and the special circumstances of its occurrence.[18]

[18] This is reflected in the compression of European sovereign spreads vis-à-vis the German bund, which remained close to zero until 2010, even during periods of increased uncertainty in international financial markets.

Appendix

Table 1 – Sample Means

Member State (period means)	GDP growth	Inflation rate	Money market rate	Long-term interest rate	Total credit-to-GDP	Interest income (1)	Interest expenses (2)	Net interest income (1) - (2)	Non-interest income (3)	Operational costs (4)	Impairments /provisions (5)	ROA (1) + (2) + (3) - (4) - (5)
2000-2007												
Austria	2,39	1,91	3,25	4,14	132,61	4,35	2,74	1,61	1,27	1,87	0,28	0,62
Belgium	2,33	2,08	3,25	4,14	154,11	4,77	3,70	1,07	0,82	1,19	0,05	0,53
Denmark	1,88	1,91	3,46	4,14	195,08	4,42	3,37	1,05	0,42	0,82	0,03	0,48
Finland	3,49	1,60	3,25	4,14	129,18	4,15	1,97	2,18	1,34	2,05	0,02	1,14
France	2,13	1,93	3,25	4,14	140,14	4,11	3,58	0,53	1,20	1,17	0,12	0,40
Germany	1,61	1,69	3,25	4,14	126,03	3,82	3,10	0,72	1,05	1,33	0,21	0,21
Greece	4,05	3,33	3,25	4,14	75,41	6,18	3,28	2,90	1,41	2,51	0,47	1,01
Ireland	5,94	3,51	3,25	4,14	163,11	4,05	2,78	1,27	0,98	1,33	0,04	0,69
Italy	1,49	2,38	3,25	4,14	93,80	4,14	2,78	1,36	1,39	1,77	0,22	0,57
Luxembourg	3,54	2,94	3,25	4,14		6,50	5,50	0,99	1,45	1,41	0,07	0,78
Netherlands	2,26	2,45	3,25	4,14	222,16	4,88	3,49	1,39	0,84	1,58	0,12	0,43
Portugal	1,54	3,01	3,25	4,14	173,09	5,47	3,39	2,09	1,30	2,05	0,42	0,86
Spain	3,79	3,24	3,25	4,14	155,25	4,35	2,43	1,91	0,98	1,51	0,26	0,94
Sweden	3,25	1,65	3,29	4,14	166,16	4,21	2,93	1,28	0,81	1,12	0,03	0,72
UK	2,86	1,59	4,84	4,14	163,88	4,27	2,73	1,54	1,23	1,55	0,26	0,70
EU-15	2,84	2,35	3,37	4,14	159,06	4,64	3,19	1,46	1,10	1,55	0,17	0,67
2008-2015												
Austria	0,65	1,99	1,13	2,10	145,79	4,12	1,98	2,14	1,08	1,71	0,73	0,31
Belgium	0,73	1,89	1,13	2,10	200,74	5,75	4,62	1,12	0,32	0,79	0,29	0,04
Denmark	-0,13	1,63	1,43	2,10	249,00	2,90	1,88	1,02	0,30	0,73	0,30	0,18
Finland	-0,59	2,11	1,13	2,10	170,85	3,18	2,00	1,18	1,27	1,40	0,24	0,49
France	0,51	1,40	1,13	2,10	171,73	2,29	1,52	0,74	0,63	0,92	0,20	0,17
Germany	0,91	1,40	1,13	2,10	111,86	2,52	1,71	0,81	0,61	0,99	0,16	0,02
Greece	-3,65	1,36	1,13	2,10	126,46	5,08	2,57	2,50	0,55	1,67	3,37	-1,51
Ireland	3,48	0,46	1,13	2,10	298,75	2,92	1,86	1,06	0,26	0,72	1,23	-0,75
Italy	-1,04	1,70	1,13	2,10	123,31	2,61	1,30	1,31	0,95	1,39	0,49	0,11
Luxembourg	1,81	2,00	1,13	2,10	410,23	3,52	2,30	1,23	0,61	1,05	0,15	0,34
Netherlands	0,39	1,56	1,13	2,10	240,38	4,35	3,02	1,33	0,42	1,00	0,33	0,13
Portugal	-0,68	1,29	1,13	2,10	213,10	4,26	2,82	1,44	1,09	1,53	0,93	0,05
Spain	-0,40	1,50	1,13	2,10	201,65	3,07	1,61	1,44	0,76	1,07	0,91	0,18
Sweden	1,29	1,34	1,59	2,10	229,43	2,40	1,49	0,91	0,61	0,74	0,11	0,49
UK	0,88	2,56	1,34	2,10	176,56	2,15	1,11	1,04	0,76	1,08	0,50	0,02
EU-15	0,28	1,61	1,20	2,10	204,66	3,41	2,12	1,29	0,68	1,12	0,66	0,02

Notes: All variables are expressed in percentages. Bank variables are expressed as percentages of average total assets.

Table 2 – Variables - Description and Sources

Variables	Description	Source
Bank-specific		
ROA	Ratio of net income to the average of assets	Bankscope/SNL
NII	Ratio of net interest margin to the average of assets	Bankscope/SNL
Interest income	Ratio of interest income over the average of assets	Bankscope/SNL
Interest expenses	Ratio of interest expenses over the average of assets	Bankscope/SNL
Non-interest income	Ratio of non-interest income over the average of assets	Bankscope/SNL
Leverage	Ratio of Common Equity Tier 1 over the average of assets	Bankscope/SNL
Operational Costs	Ratio of operational costs over the average of assets	Bankscope/SNL
Impairments	Ratio of impairments´ flow over the average of assets	Bankscope/SNL
Retail ratio	Ratio of loans over the average assets	Bankscope/SNL
Bank Size	Logarithm of total assets	Bankscope/SNL
Macroeconomic Variables		
GDP growth	Annual real GDP growth	Eurostat
Money market rate	3-month Euribor (quarterly average)	Eurostat
Long-term interest rate	Germany 10 year sovereign bond YTM	Eurostat
Sovereign rate	Country´s 10-year sovereign bond YTM	Eurostat
Credit Growth	Annual change of the ratio Credit to private sector as a percentage of GDP	Eurostat
Stock Index	Local Stock Market Index	OECD
Yield curve slope	Yield on German 10-year sovereign bond minus 3-month Euribor (quarterly average)	Eurostat
PT- DE spread	Yield on Portuguese 10-year sovereign bond minus yield on German 10-year sovereign bond (quarterly average)	Eurostat

Table 3 - Expected effects of each variable on banks profitability

Variables	Expected Sign	Rationale
Bank-Specific		
Leverage	+	The literature finds evidence that banks with higher capital tend to be associated with higher profitability Demirguc and Huizinga (1999), Goddard, et al. (2004), Mevis and Cheng (2015) and Kok, et al. (2015). These results are attributed to the possibility that higher capitalized banks have usually room for more risk taking (which according to the theory generates more profitability) than undercapitalized banks.
Size	+/?	According to some studies, scale economies exist in banking and larger banks are able to profit from diversification, thus increasing their performance (Bolt , et al. (2012) and Borio, et al. (2015)). However another study conducted by Kok, et al. (2015) concludes that larger and more complex institutions show, in a systematic way, lower levels of profitability.
Macroeconomic variables		
GDP growth	+/0	The literature broadly agrees on the procyclicality of banks performance i.e an increase of GDP growth has a positive effect on banks performance (Albertazzi and Gambacorta (2009), Beckman (2007), Kok, et al. (2015) and Mevis and Cheng (2015). It is worth mentioning that this procyclicality is magnified in downswing periods Bolt , et al. (2012). Still, Borio, et al. (2015) find no statistically significant effect in ROA and in its major components.
Short-term interest rate	+	According to multiple papers, higher levels of interest rates lead to an increase in banks performance, i.e. the positive effect on the net interest margin dominates the negative effects from impairments´ increasing (Borio, et al. (2015) and Demirguc and Huizinga (1999), even though some differences of these effects across countries (Albertazzi and Gambacorta (2009)).
Credit Growth	-/?	Given the study carried out by Kok, et al. (2015) we could expect a positive relationship between this ratio and banks profitability. Nevertheless, considering that this ratio means that economy´s indebtedness, we can also expect a negative impact on banks profitability through an increase of impairments.

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