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The procyclicality of banking: evidence from the euro area

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Abstract: Loan loss provisions in the euro area are negatively related to GDP growth, i.e., they are procyclical. Loan loss provisions tend to be more procyclical at larger and better capitalized banks. The procyclicality of loan loss provisions can explain about two-thirds of the variation of bank capitalization over the business cycle. We estimate that provisioning procyclicality in the euro area is about twice as large as in other advanced economies. This difference reflects a larger procyclicality of provisioning in euro area countries already prior to euro adoption, and the divergent growth experiences of euro area countries following the global financial crisis.

JEL classification: G20

Keywords: Banks, financial regulation, accounting, bank capital, loan loss provisioning, financial stability

Executive Summary

Banks set aside loan loss provisions in anticipation of future loan losses. Loan loss provisions reduce bank profits and capital. As banks are subject to minimum capital requirements, additional loan loss provisions can constrain a bank's capacity to make new loans. Several studies have shown that loan loss provisions are lower at times of high economic growth, and vice versa. This makes loan loss provisions procyclical.

A high procyclicality of banks' loan loss provisioning is undesirable from a financial stability perspective, as it implies that bank capitalizations are more negatively affected at the trough of the business cycle, which is exactly when capital market conditions for banks are at their weakest. In addition, the procyclicality of loan loss provisions can be a driver of cyclical loan supply, as lower bank equity during economic downturns can lead to a credit crunch.

In this paper, we examine the procyclicality of loan loss provision for banks internationally. A main finding is that provisioning procyclicality— the impact of GDP growth on provisioning— in the euro area is about twice as big as in other countries. The higher provisioning procyclicality in the euro area is partly caused by an already higher loan loss procyclicality of euro area banks before their respective countries of location adopted the euro. In addition, the higher provisioning procyclicality in the euro area reflects the more negative growth experience of euro area countries during the global financial crisis, as the relation between GDP growth and provisioning is stronger during economic downturns.

In addition, there is considerable heterogeneity in provisioning procyclicality among euro area banks. In particular, provisioning is more procyclical at bigger banks, which could reflect that bigger banks are willing to take on more business-cycle related risks to their capitalization due to their too-big-to-fail status. Similarly, banks that are directly supervised

by the European Central Bank (ECB), which tend to be larger, display more procyclical provisioning patterns. Furthermore, provisioning is more procyclical at better capitalized banks, which could reflect that better capitalized banks can better sustain the risks to capital inherent in provisioning procyclicality. Consistent with this, provisioning is more procyclical in countries with more stringent capital regulations.

Loan loss provisioning is the main driver of the cyclicality of bank capitalization in the euro area, as the sensitivity of provisioning to GDP growth in the euro area can explain about two-thirds of the variation of bank capitalization over the business cycle. In addition, we show that banks with more procyclical provisioning also display more procyclical lending over the business cycle.

In early 2018, the European Union moved from the incurred loss model of provisioning to an expected loss model, with the implementation of International Financial Reporting Standard (IFRS) 9 on Financial Instruments. The expected credit loss model of IFRS 9 requires banks to set credit impairment allowances for all loans rather than just for loans where loss is probable or has already occurred. The broader application of the expected loss model to all loans should lead to an increase in the average level of allowances. The introduction of IFRS 9 thus could mitigate the negative relationship between provisioning and economic growth, with a potentially positive effect on financial stability.

However, some have argued that the impact of IFRS 9 on the procyclicality of loan loss provisioning is ambiguous. Provisioning for a next economic downturn under the expected credit loss model may be rather abrupt, if an initial turning point in the business cycle is taken to forebode a serious business cycle downturn, triggering large loan loss provisioning in anticipation of future loan impairment. The introduction of the expected credit loss model

thus could lead to a concentration of loan loss allowances at the time of an initial economic downturn, with possible negative ramifications for financial stability.

Our evidence on loan loss provisioning has important implications for the supervision of euro area banks going forward. First, the relatively large provisioning cyclicality in the euro area stresses the need to make efforts to reduce this procyclicality, given that this is likely to remain a problem after the introduction of IFRS 9. Second, the considerable heterogeneity in provisioning among euro area banks could reflect that banks apply the accounting rules regarding provisioning unevenly, which should be a concern for bank supervisors. This heterogeneity is also likely to persist under IFRS 9, and hence supervisors will need to apply efforts to make the application of loan loss provisioning rules across euro area banks more uniform. More generally, our findings call for increased attention to potential undesirable consequences of provisioning rules for the procyclicality of lending.

1. Introduction

Banks set aside loan loss provisions for future loan losses. Such provisions make up a large part of bank expenses, reducing bank profitability and potentially regulatory capital. By implication, loan loss provisions can influence credit cycles, especially when bank capital is a constraint on the bank's lending capacity. When studying the procyclicality of banking, loan loss provisions are therefore a natural starting point.

A high procyclicality of banks' loan loss provisioning is undesirable from a financial stability perspective, as it implies that bank capitalizations are more negatively affected at the trough of the business cycle which is exactly when capital market conditions for banks are at their weakest. Furthermore, the procyclicality of loan loss provisions can be a driver of a cyclical bank loan supply arising from changes in bank capital, which is also unwarranted. Provisioning procyclicality is particularly problematic in a monetary union where a single monetary policy is ill equipped to absorb shocks transmitted through financial linkages and divergent domestic economic and financial cycles, and the burden of adjustment falls primarily on fiscal and (macro)prudential policies.

This paper provides new empirical evidence on the cyclicality of banks' provisioning for loan losses in the euro area – the largest monetary union in the world – in comparison to non-euro area countries. In the euro area, loan loss provisions are a very sizeable component of bank earnings, amounting to 41% of earnings before provisions on average.

There is a long-standing debate between bank regulators and accounting standard setters over the calculation of loan loss provisions by banks. Accounting standard setters have long employed a relatively straightforward incurred loss model which requires banks to record loss provisions for expected loan losses based solely on information that a loss is probable at the balance sheet date. Bank regulators, however, are focused on the safety and soundness of banks.

Some in the regulatory and academic communities have argued that banks should use countercyclical provisions so that banks record larger provisions during upswings of the economy and lower provisions during downturns to cushion the negative impact of recessions on bank capital. Laeven and Majnoni (2003), for instance, argue that loan loss reserves should meet a minimum requirement on average over the business cycle. To achieve this, banks would smooth loan loss provisions so that provisions compensate for the difference between realized credit losses and average credit losses by taking positive values during cyclical expansions and possibly negative values during downturns. As a result loan loss reserves would increase in good times and decrease in bad times. Along these lines, Spain has introduced dynamic provisioning rules in 2000 that require banks to build up a dynamic provision fund through retained earnings in good times to cover loan losses in bad times. Jimenez et al. (2017) find that the Spanish dynamic provisioning rules smooth credit cycles, and support firm performance in bad times.

On January 1, 2018, the European Union (EU) moved from the incurred loss model of provisioning to a more comprehensive expected loss model, with the implementation of International Financial Reporting Standard (IFRS) 9 on Financial Instruments. The expected credit loss model of IFRS 9 requires banks to set credit impairment allowances for all loans rather than just for loans where loss is probable or has occurred. This accounting rule change should increase the average level of allowances, and make them also timelier and potentially less procyclical.[1]

Our empirical analysis shows that loan loss provisions in the euro area are negatively related to Gross Domestic Product (GDP) growth, i.e., they are procyclical. The sensitivity of provisioning to GDP growth in the euro area can explain about two-thirds of the variation of bank capitalization over the business cycle. The fluctuation of loan loss provisioning over the

[1] In an initial assessment, the European Banking Authority (2018) reports that the immediate impact of IFRS 9 was a reduction in the Common Equity Tier 1 ratio by 47 basis points on average for a sample of 38 European banks.

business cycle thus is the main driver of changes in bank capitalization and lending capacity over the cycle. Consistent with this, we find that loan growth is positively related to bank capitalization and negatively to loan loss reserves. In addition, we show that banks with more procyclical provisioning also display more procyclical credit provision.

Among euro area banks, we find considerable heterogeneity in provisioning procyclicality. In particular, provisioning is more procyclical at bigger banks, which could reflect that bigger banks are willing to take on more business-cycle related risk to their capitalization due to their too-big-to-fail status. Similarly, banks that are directly supervised by the European Central Bank (ECB), which tend to be larger, display more procyclical provisioning patterns. Furthermore, provisioning is more procyclical at better capitalized banks, which could reflect that better capitalized banks can better sustain the risks to capital inherent in provisioning procyclicality or alternatively that they have less of a need to delay provisioning during business cycle downturns. Consistent with this, provisioning is more procyclical in countries with more stringent capital regulations. In addition, provisioning is more procyclical in countries with less competitive banking markets, as a lack of competition may enhance opportunities for bank managers to engage in accounting discretion regarding loan loss provisioning.

We estimate that provisioning procyclicality in the euro area is about twice as big as in other countries. Higher provisioning procyclicality in the euro area is found to reflect an already higher procyclicality of euro area banks before their respective countries adopted the euro. In addition, the higher euro area provisioning procyclicality reflects the divergent GDP growth experiences of euro area countries during the global financial crisis and its aftermath.

We find that the procyclicality of loan loss provisioning is negatively related to a country's rate of real exchange rate appreciation, which could reflect that real exchange rate appreciations tend to be expansionary in the euro area. This suggest that the procyclicality of

loan loss provisioning in the euro area could be higher, because the introduction of the euro limits the potential for real exchange rate adjustments following a negative GDP shock.

Our results have important implications for the supervision of euro area banks going forward. First, our finding of a relatively large provisioning cyclicality in the euro area stresses the need to make efforts to reduce this procyclicality, given that this is likely to remain a problem after the introduction of IFRS 9. Second, our findings of considerable provisioning heterogeneity among euro area banks suggest that banks have used material discretion in applying the incurred loss model of loan loss provisioning. This heterogeneity is unlikely to vanish on account of IFRS 9, and hence supervisors will need to apply considerable efforts to effect a more uniform application of loan loss provisioning rules across euro area banks.

Several studies have previously examined the determinants of loan loss provisioning for international samples of banks. Using data for 45 countries during the period 1988–1999, Laeven and Majnoni (2003) find that loan loss provisions are positively related to bank profitability consistent with bank income smoothing, but negatively to GDP growth. Similar results are obtained by Bikker and Metzemakers (2005) for a set of 29 OECD countries during the period 1991–2001. Olszak, Pipien, Kowalska, and Roszkowska (2017) examine provisioning procyclicality of banks in the European Union during 1996–2011. These authors find that large, publicly traded, and commercial banks display more procyclical provisioning, while more restrictive bank capital standards are associated with weaker procyclicality. However, none of these studies considers the impact of the euro and the implications of loan provisioning for the cyclicality of bank capital and lending.

Bouvatier and Lepetit (2012) provide a theoretical model where procyclical provisioning, which depends only on current loan performance, amplifies loan procyclicality. Loan procycliality arises as banks underestimate the costs of new loans during economic

upswings due to currently low provisioning levels, leading to loan interest rates that are too low and credit that is too high, and vice versa. Loan mispricing over the business cycle arises, as banks base their lending decisions on accounting profits, as affected by the procyclical provisioning, rather than on true economic profits. In this setting, the introduction of forward-looking provisioning based on expected credit losses brings accounting profits in line with true economic profits, and hence eliminates the mispricing of loans over the business cycle and also loan procyclicality. This theoretical analysis suggests that the introduction of provisioning rules based on expected credit losses, as in the case of IFRS 9, is welfare improving.

In the remainder of the paper, section 2 offers some institutional and regulatory background on loan loss provisions, including the change from the incurred loss model to the expected loss model, and how this affects provisioning procyclicality and discretion. Section 3 outlines the empirical approach. Section 4 discusses the data. Section 5 presents the empirical results. Section 6 concludes.

2. Institutional and regulatory background of loan loss provisioning

A loan loss provision is an expense set aside as an allowance for bad loans. Loan loss provisions enter the bank's income statement as a non-interest expense item thereby reducing profits, and they cumulate over time into loan loss reserves on the bank's balance sheet after subtracting loan write offs. The loan loss reserves account is a "contra-asset" account, accounting for the difference between the gross loans and the net loans recorded on the asset side of the bank's balance sheet (see Figure 1).

Loan loss reserves are in principle supposed to cover expected loan losses, while bank capital should cover unexpected loan losses (Figure 2). Expected losses are losses that occur on average and can be measured by the mean value of the frequency distribution of loan

losses, while unexpected losses are losses that are large but infrequent and that are located far in the tail of the frequency distribution of loan losses. Basel capital regulations allow (general) loss provisions to be included in Tier 2 capital up to a limit of 1.25% of credit risk-weighted assets. Loan loss provisions therefore subtract from regulatory capital (i.e., the sum of Tier 1 and Tier 2 capital) to the extent that loan loss reserves exceed this limit.

2.1 Accounting rules for loan loss provisioning

Loan loss provisioning has to follow a set of accounting rules. For internationally active banks, these accounting rules are typically based on International Financial Reporting Standard (IFRS) guidelines promulgated by the International Accounting Standards Board (IASB). Of relevance for provisioning is the new set of accounting principles under IFRS 9, which specifies how an entity should classify and measure financial assets, financial liabilities, and some contracts to buy or sell non-financial items.

Under IFRS 9, banks have to set credit impairment allowances for all loans and other fixed income assets using an expected loss model.[2] The credit impairment provisions of IFRS 9 replace International Accounting Standard (IAS) 39 which required banks to set loan loss provisions for their loan portfolio using an incurred loss model. Under the incurred loss model, banks only had to take loan loss provisions after a loan became impaired.[3]

Loans are more likely to become impaired during economic downturns, and hence the application of IAS 39 implied that loan loss provisions were concentrated during economic downturns. Loan loss provisions that are not based on expected losses reduce not only bank income but also reduce bank capital when actual losses exceed expected losses. Therefore,

[2] This section draws on the discussion of the introduction of IFRS 9 and its implications for provisioning proyclicality and discretion in Huizinga (2017, pp. 7-9).
[3] Often a distinction is made between "general" and "specific" loan loss provisions, with "general" provisions referring to "ex-ante" provisions related to future uncertain events and "specific" provisions referring to "ex-post" provisions related to certain events (such as past due payments or other default-like events) for which a specific documentation can be produced. The introduction of IFRS 9 strengthens the role of 'ex ante' provisions.

the incurred loss model of IAS 39 caused banks' capitalization rates to decline especially during economic downturns. In other words, accounting standards rendered loan loss provisioning procyclical. This can pose a threat to financial stability, as banks find it difficult to raise additional capital at times of negative economic growth and low profitability.[4] In the analysis, we will capture this procyclical behavior of loan loss provisioning through the inclusion of an economic growth variable.

The new accounting rules under IFRS 9 require banks to take material provisions also during economic expansions, in the absence of significant credit impairment, to reflect the probability of a business cycle turn, which could induce greater credit losses later. More provisioning in anticipation of the next economic downturn implies that banks have higher loan loss reserves once a downturn occurs, and that they need to take fewer provisions during economic declines. In the extreme, and absent any other frictions, if loan loss provisions accurately reflect expected losses and bank capital absorbs unexpected losses, then under IFRS 9 loan loss provisioning should no longer affect bank capital. The introduction of IFRS 9 thus could mitigate the negative relationship between provisioning and economic growth, with a potentially positive effect on financial stability (see European Systemic Risk Board, 2017).

2.2 A simple conceptual framework of loan loss provisioning

To illustrate the rationale for loan loss provisioning rules and their implications for the variability of lending, we next develop a simple conceptual framework. We consider a bank with assets only in the form of loans, L, financed in part by capital, K, and for the remainder by debt. The bank incurs an actual economic credit loss, E, each period, which is

[4] Using US data, Berger and Bouwman (2013) find that capital helps small banks to increase their probability of survival at all times, while capital enhances the performance of medium and large banks primarily during banking crises. Also using US data Bushman and Williams (2015) find that delayed expected loan loss recognition is associated with greater downside tail risk of banks and codependence of downside tail risk among banks.

taken to be independently and identically distributed. Let P be the bank's loan loss provisioning. Loan loss provisions add to loan loss reserves, R, and they subtract from current income and, other things equal, from capital, K.

As a benchmark, we can counterfactually think about a world in which a bank failure entails no externalities to bank customers and the overall economy. In this setting, there are no external costs of failure that set banks apart from other firms. Hence, there is no reason to introduce banking sector specific regulation, and banks should be free to choose their capitalization rate given by K/L, trading off, among other things, the advantage of debt finance offered by the deductibility of interest from corporate taxation against the disadvantage of higher prospective bankruptcy costs. In this case, there also is no reason to regulate the loan loss provisioning of banks, as they will choose the appropriate level of economic capitalization regardless of any accounting provisioning for future loan losses.

Now consider the more realistic case where a bank failure entails substantial negative externalities to the economy, say through a reduction in credit provision. This could make a bank too big (or generally too important) to fail, and cause public authorities to offer explicit or implicit bank debt liability guarantees, for instance in the form of deposit insurance. This introduces the incentive for the bank's owners to enhance the valuation of public guarantees by taking on more risk and by lowering their rate of capitalization. To counter the latter, the authorities can introduce a minimum capital requirement given by $K \geq \gamma L$, where γ is the minimum capital requirement rate. As loan loss provisions subtract from capital, banks have an incentive to reduce their loan loss provisioning, P, below the level of economic credit loss, E, or even to zero. This introduces the need to regulate loan loss provisioning as well.

If the incurred loss model of loan loss provisioning is prescribed, the bank will set provisions, P, equal to the incurred economic credit loss, E, each period. Setting P equal to E implies that loan loss provisions are procyclical with respect to GDP, as credit losses tend to

occur when GDP declines. In this setting, a large value of E, and thus P, implies a large reduction in capital, K, and also in loans, L, if the capital requirement is binding, unless the bank is able to immediately raise enough new equity to stabilize its capital. In practice, however, a bank can experience increasing marginal costs of funding in a given period, which prevents the bank from raising enough capital immediately to make up for a large credit loss. Rather, the bank could take some time to replenish its capital following a large realization of E, which implies that loans, L, and hence new lending, will be relatively low for one or several periods. This implies that lending can decline with GDP.

Alternatively, we can consider that the bank is required to apply an expected loss model of loan loss provisioning along the lines of IFRS 9 so that provisions, P, each period are set equal to the expected value of the credit loss, E, which eliminates provisioning procyclicality. The expected loss model of provisioning generally results in a build-up of loan loss reserves, R, over time. In this scenario, a larger than average credit loss, E, can be accommodated by a reduction of loan loss reserves, R, rather than by a reduction of capital, K. With more stable capital, K, also lending can be more stable over time, eliminating the dependence of lending on (prior) GDP shocks. In this simple framework, an accounting reform that replaces the incurred loss model by the expected loss model thus can smooth lending over time.

2.3 The expected credit loss model of loan loss provisioning in practice

While our simple conceptual framework suggests that the introduction of expected loss accounting under IFRS 9 will make loan loss provisioning less procyclical, some have argued that the impact of IFRS 9 on the procyclicality of loan loss provisioning is ambiguous. Provisioning for a next economic downturn under the expected credit loss model may be rather abrupt if an initial turning point in the business cycle is taken to forebode a serious

business cycle downturn, triggering large loan loss provisioning in anticipation of future loan impairment. The introduction of the expected credit loss model thus eliminates the concentration of loan loss provisioning at the trough of the economic cycle at the expense of concentrating them at the time of an initial downturn, with possible negative ramifications for financial stability. Indeed, simulations by Abad and Suarez (2017) show that IFRS 9 will concentrate the impact of credit losses on profit and losses and on the Common Equity Tier 1 (CET1) ratio at the beginning phases of the economic cycle, yielding that banks will face a higher yearly probability of having to be recapitalized. Moreover, the application of IFRS 9 will depend on banks' internal risk models. To the extent that these models depend on historical data, the application of IFRS 9 could lead banks to provision less than would have been the case under IAS 39 if losses occur following a long period of exceptionally low defaults, as was the case during the 2007-08 global financial crisis.[5] More generally, even when provisions are set aside based on expected losses at a future date, as in the case of IFRS 9, provisioning will remain procyclical because recessions are by definition outcomes that are worse than anticipated.[6] The empirical analysis in this paper pre-dates IFRS 9, which entered into force on 1 January 2018. We expect to find that provisioning in the euro area is procyclical. We leave it a question for future research whether IFRS 9 will increase or decrease the procyclicality of provisioning.

2.4 Discretion over loan loss provisioning

Beyond the accounting rules that render provisioning procyclical, provisioning for credit impairment may also reflect bank discretion on the implementation of formal rules. In terms of the earlier conceptual framework, banks can have discretion over loan loss

[5] Consistent with this, Gaffney and McCann (2018) find that the application of IFRS 9 accounting reforms to the calculation of credit risk of mortgage loans in Ireland, which went through a major boom-bust cycle in housing, if anything, is making provisioning for such loans more procyclical.

[6] A similar argument has been made by Kashyap and Stein (2004) for capital requirements.

provisioning, if the economic credit loss, E, is not perfectly verifiable by the bank's outside auditors. Accounting discretion over loan loss provisioning then can introduce a wedge between a bank's reported loan loss provisioning, profitability and capitalization and true economic values. In practice, banks can have varying motives in setting discretionary loan loss provisions, which could have repercussions for provisioning procyclicality and hence financial stability. The literature identifies the following three main motives:[7]

- *An income smoothing motive*: Bank managers may aim to take provisions when profits are relatively high in order to smooth reported income after provisions. Conversely, banks can smooth their earnings by drawing from loan loss reserves if actual losses exceed expected losses. This type of bias could reduce provisioning procyclicality, as bank profitability and GDP growth tend to be positively related (Laeven and Majnoni, 2003).[8] In the analysis, we will capture this income-smoothing motive through the inclusion of a bank earnings variable.
- *A risk-taking motive*: Banks with higher loan growth often find it difficult to maintain the same credit standards, in part because loan officers may have perverse incentives to expand credit as their compensation often depends on the volume of loans granted rather than the quality of the average loan. Indeed, there is ample evidence that credit standards deteriorate during economic expansions (Asea and Blomberg, 1998; and Dell'Ariccia et al. 2002). In the analysis, we will capture this risk-taking motive through the inclusion of a loan growth variable.
- *A capital management motive*: Banks can time loan loss provisions to ensure that they meet minimum regulatory capital requirements. This implies that banks reduce provisioning levels when regulatory capital levels are relatively low. Capital

[7] See Beatty and Liao (2014) and Ozili and Outa (2017) for surveys.
[8] Laeven and Majnoni (2003) find evidence that loan loss provisioning is positively related to the ratio of a bank's earnings before-tax and before loan loss provisioning for an international set of banks during 1988–1999.

management of this kind reduces provisioning procyclicality, as bank capitalization rates are more likely to be stressed during economic downturns (Ahmed et al. 1999).[9] However, risk-based capital requirements per se are procyclical because the deterioration of the quality of bank loan portfolios during economic downturns inevitably increases banks' risk exposure—and therefore the level of risk-weighted capital requirements—exactly when capital becomes more expensive (Laeven and Majnoni 2003; Repullo and Suarez 2013; Aiyar, Calomiris, and Wieladek 2015). In the analysis, we will capture this capital-management motive through the inclusion of an interaction between bank capital and economic growth.

The implementation of IFRS 9 affects the incentives as well as the opportunities for banks to apply discretion in setting credit impairment allowances.[10] By potentially reducing provisioning procyclicality, the new accounting rules should also mitigate the desire of banks to manipulate provisioning levels as motivated by the income smoothing and capital management motives. However, in practice banks need to use complex statistical models that take into account various probability-weighted scenarios as based on forward-looking macroeconomic information to calculate expected credit losses under IFRS 9. This introduces considerable additional accounting discretion over credit impairment provisions.[11] On net, it is thus not clear how IFRS will affect the role of accounting discretion in setting loan loss provisions and their implied procyclicality.

[9] Ahmed et al. (1999) provide evidence in favor of this hypothesis for the case of US banks during 1986–1995. Consistent with a capital management motive, Huizinga and Laeven (2012) find that during the crisis in 2008 US banks with large exposures to mortgage-backed securities that had declined in value displayed relatively low loan loss provisions.

[10] Following the Basel Committee on Banking Supervision (2015), the European Banking Authority (2017) and the ECB (2017) provide guidance on how banks should account for expected credit losses and nonperforming loans, no doubt with the aim of limiting the scope for bank discretion.

[11] The Global Public Policy Committee (2017, p. 12) representing the major accounting firms indicates that 'it is expected that for most banks, the estimates of expected credit losses (ECL) will present a risk of material misstatement that is not low'.

3. Empirical approach

In this paper we examine the sensitivity of loan loss provisions to the business cycle as potentially affected by the introduction of the euro. Our main hypothesis is that provisioning is procyclical, i.e., comoves with economic growth. The basic estimating equation is as follows:

$$\text{Provisions/assets}_{ict} = \alpha + \beta_1 \text{EBP/assets}_{ict} + \beta_2 \text{Loan growth}_{ict} + \beta_3 \text{GDP growth}_{ict} + u_i + v_t + \varepsilon_{it} \quad (1)$$

In equation 1, the dependent variable is $\text{Provisions/assets}_{ict,}$ which is loan loss provisions over lagged total assets for bank i located in country c at time t, while u_i and v_t are bank and year fixed effects.[12] As a first explanatory variable, EBP/assets_{ict} is a bank's profits before tax and loan loss provisions over lagged total assets. A positive relation between loan loss provisioning and current profitability, as evidenced by a higher $\beta_{1,}$ suggests that bank managers use their discretion with respect to loan loss provisioning to smooth bank income over time, either because they wish to portray a picture of stable bank income or they think it is prudent to provision more when bank profits are higher. A positive β_1 is consistent with an income smoothing motive.

As a second explanatory variable, Loan growth_{ict} is the growth rate of net loans, i.e. gross loans net of loan loss reserves. This variable captures the risk-taking motive. In practice, many banks are able to expand their loan portfolios only by extending riskier loans. A positive relation between Loan growth and the Provisioning/assets variable, i.e. $\beta_2 > 0$, would be consistent with this. Alternatively, a bank that imprudently expands its loan

[12] Equation (1) does not include country fixed effects because these are already subsumed by the bank fixed effects.

portfolio could similarly take imprudently low loan loss provisions, which could explain that we find $\beta_2 < 0$.

The explanatory variable of main interest is GDP growth_{ict}, which is the growth rate of real per capita GDP of country c where bank i is located. A lower rate of GDP growth is expected to lead to higher loan loss provisioning consistent with $\beta_3 < 0$, as loans are more likely to become impaired during economic downturns. We will consider loan loss provisioning to be more procyclical if Provisioning/assets is more negatively related to GDP growth, i.e., if β_3 is more negative.

We consider a variety of additional causes of heterogeneity in loan loss provisioning and its procyclicality. To this end, we estimate regressions of the following form:

$$\text{Provisions/assets}_{ict} = \alpha + \beta_1 \text{EBP/assets}_{ict} + \beta_2 \text{Loan growth}_{ict} + \beta_3 \text{GDP growth}_{ict} + \beta_4 X_{ict} + \beta_5 X_{ict} \times \text{GDP growth}_{ict} + u_i + v_t + \varepsilon_{it} \quad (2)$$

in which X_{ict} is a potential determinant of provisioning procyclicality for bank i located in country c at time t. The factor X_{ict} enhances provisioning procyclicality if $\beta_5 < 0$, and vice versa. Among potential drivers of provisioning procyclicality, we consider differences in bank characteristics and country traits. In terms of bank characteristics, we consider differences in bank size, bank equity, and nonperforming loan ratios.

The interaction with bank equity captures a capital management motive. Banks could reduce provisioning levels when regulatory capital levels are relatively low, especially during economic downturns when it is more difficult to raise additional capital. We include bank size because larger banks may be more diversified and better able to withstand shocks. Larger banks may also benefit from too-big-to-fail subsidies, reducing their default risk. We also account for differences in (changes in) nonperforming loan ratios because some banks may

systematically have higher shares of impaired loans due to their location or business model, and this may impact future loan losses and provisioning behavior.

In terms of country characteristics, we consider GDP growth experiences during and following the crisis, real exchange rate adjustment, the stringency of capital regulation, and bank competition. The inclusion of the GDP growth rates during and following the crisis accounts for the possibility that the procyclicality of provisioning is disproportionately affected by the crisis shock (i.e., procyclicality is asymmetric over the cycle). Real exchange rate adjustment could attenuate the relation between loan loss provisioning and GDP growth. If so, more limited real exchange rate adjustment in the euro in response to GDP shocks could explain a higher estimated procyclicality of loan loss provisioning. Country level variation in the stringency of capital regulation captures variation in the enforcement of bank capital rules. A stringent application of such rules could limit bank's discretion to use provisioning to smooth earnings. Similarly, recent research suggests that bank competition reduces bank opacity (see, for instance, Jiang et al., 2016), suggesting that bank competition could reduce provisioning procyclicality to the extent that it reflects accounting discretion.

4. The data

The accounting data in this study are obtained from Bankscope. We use the most recent version of Bankscope, which contains data for 8 years, as well as earlier annual editions to put together a comprehensive panel data set for the period 1996–2015. We consider banks located in the 32 countries that are listed in Table 1. These countries are the 28 EU member states plus Canada, Norway, Switzerland and the United States. For the 19 current euro area countries, the table also provides the date of euro adoption. As reflected in the table, a group of 11 countries initially acquired the euro on January 1, 1999. The other 8 current euro countries adopted the euro at various later dates, with the most recent euro

adoption by Lithuania on January 1, 2015. Using these euro adoption dates, we construct a euro sample of banks located in euro countries after euro introduction. Similarly, we define an EU sample of banks located in EU countries.

Table 2 provides summary statistics for the main variables in the analysis for the full and euro samples in Panels A and B, respectively. All bank level variables based on accounting data are winsorized at the 1st and 99th percentiles to mitigate the effect of outliers. The mean Provisions/assets variable is 0.33% in the full sample compared to 0.44% in the euro sample. Banks in the full sample are more profitable as indicated by an average EBP/assets of 1.29% compared to 1.08% for euro area banks. In our sample, loan loss provisioning amount to about 26.2% of EBP compared to 41.3% for euro area banks. Indeed, loan loss provisions are the largest accounting item driving net income in our sample. Banks in the full sample also achieve a higher average loan growth of 10.0% in comparison to 8.16% for the euro sample. Finally, average GDP growth of 1.27% in the overall sample of banks is higher than the average of 1.04% for euro area banks.

Figure 3 shows aggregate provisioning levels over time, together with real per capita GDP growth aggregated over countries in our sample. The chart clearly shows that bank provisioning is procyclical, being higher during economic downturns. Downturns are highlighted in grey using NBER recession dates for the United States.

5. Empirical results

Subsection 5.1 presents estimates of equation (1) for the overall, the euro and the EU samples and of equation (2) while taking into account country characteristics that affect provisioning procyclicality in the euro area. Subsection 5.2 considers how bank characteristics influence provisioning procyclicality. Finally, subsection 5.3 broadens the

analysis by jointly considering the procyclicality of provisioning, bank capitalization, and loan growth.

5.1 Evidence on provisioning procyclicality and country characteristics

Table 3 shows the results of estimating equation (1) for the full sample, the EU sample, and the euro area sample to be able to compare loan loss procyclicality across the three sets of countries. The regressions includes bank and year fixed effects, and errors are clustered at the bank level. In regression 1 based on the full sample, the EBP/assets variable obtains a positive and significant estimated coefficient of 0.073. This result is evidence in support of the hypothesis that bank managers set loan loss provisions to smooth bank income over time. Loan growth is estimated with a negative and significant coefficient of -0.0009 which could reflect that bank managers experiencing high loan growth rates underestimate the need to take commensurate loan loss provisions. The estimated coefficient for the GDP growth rate variable is negative and significant at -0.061 pointing at provisioning procyclicality. This effect is economically strong. The regression estimates imply that a one standard deviation increase in GDP growth is associated with a decrease in Provisions/assets of 0.0012 or 18% of its standard deviation in the full sample.

Regression 2 includes EU and Euro dummies that obtain a negative and significant coefficient of -0.0015, and a positive and significant coefficient of 0.0007, respectively. Thus, euro area membership is associated with higher loan loss provisioning rates compared to non-euro EU countries.

In regression 3, we consider the relation between euro membership and provisioning procyclicality. In particular, this regression includes the Euro dummy and interactions of this dummy with EBP/assets, Loan growth, and GDP growth starting from regression 1. The Euro dummy is estimated with an insignificant coefficient, but the three interaction terms obtain

coefficients that have the same signs as the uninteracted variables and are significant. Hence, loan loss provisioning appears to be more positively related to bank profitability in the euro area consistent with stronger income smoothing, and at the same time it is more procyclical with GDP. In particular, the estimated coefficients of -0.055 and -0.050 for the GDP growth and Euro × GDP growth variables suggest that provisioning procyclicality is about twice as high in the euro area compared to non-euro countries.

Regression 4 estimates equation (1) for the EU sample of banks. The GDP growth variable is estimated with a negative and significant coefficient of -0.096, which is more negative than the corresponding estimate of -0.061 in regression 1 for the full sample. Provisioning procyclicality thus is estimated to be higher in the EU than elsewhere.

Regression 5 includes the Euro dummy in regression 4, which is estimated to be insignificant. Regression 6 in addition includes interactions of the Euro dummy with EBP/assets, Loan growth, and GDP growth to see whether provisioning procyclicality is different in euro countries compared to EU member states that have not adopted the euro. The three interaction terms receive estimated coefficients with the same signs as the uninteracted variables that are significant in the cases of Euro × EBP/assets and Euro × GDP growth. Relative to non-euro EU countries, there thus appears to be stronger income smoothing through loan loss provisions in the euro area and a higher provisioning procyclicality with respect to GDP.

In regressions 7 and 8, we split the overall sample into euro and non-euro samples. This yields significant estimated coefficients for the GDP growth variable of -0.107 and -0.061 in the two regressions, as additional evidence of a higher provisioning procyclicality in the euro area compared to other countries. The economic effect in regression 7 for the euro sample is indeed much larger than in the full sample. The regression estimates in this

regression imply that a one standard deviation increase in GDP growth is associated with a decrease in provisioning of 0.0026 or 40% of its standard deviation in the euro area.

The higher provisioning procyclicality in the euro area could simply reflect that banks in countries that adopted the euro already experienced higher procyclicality before euro adoption. To examine this, regressions 1 and 2 in Table 4 are based on pre-1999 samples of banks located in countries that subsequently did and did not adopt the euro, respectively. The significantly estimated coefficients for the GDP growth variable of -0.082 and -0.063 in these two regressions suggest that prior to euro introduction provisioning already was more procyclical in countries that subsequently adopted the euro. The coefficient of -0.082 in regression 1 is less negative than the corresponding coefficient of -0.107 in regression 7 in Table 3 for the euro sample, which could mean that euro adoption has increased provisioning procyclicality further.

Next, we consider whether a greater provisioning procyclicality in euro countries compared to non-euro countries can be attributed to differences in growth experiences since 2007 when the recent global economic and financial crisis started. To this end, we include a Crisis dummy (signaling the years 2007–2015) and its interactions with EBP/assets, Loan growth, and GDP growth in regression 3 of Table 3 for the full sample, with the results presented in column 3 of Table 4. In this regression, the Euro × GDP growth and Crisis × GDP growth variables receive negative and significant coefficients of -0.030 and -0.060, respectively. This is evidence that there already was a greater provisioning procyclicality in the euro area prior to 2007, which became more pronounced from 2007 onwards. The results also indicate that the provisioning procyclicality in all countries can in large part be contributed to the post-2007 period. After controlling for the differential effects of the euro and the post-2007 period, the coefficient on GDP growth obtains a coefficient of -0.029 which is much reduced from the coefficient of -0.061 in the unconditional regression 1 in

Table 3. Regression 4 shows that this result on the post-2007 period holds when contrasting euro area countries with non-euro EU countries.

To further distinguish between the effects from the euro and the post-2007 experience, we include an interaction term between the Euro and Crisis dummies and its interactions with EBP/assets, Loan growth, and GDP growth in regressions 5 and 6 of Table 3 for the full and EU samples. In regression 5, the Euro × Crisis × GDP growth variable obtains a negative and significant coefficient of -0.107. This is evidence that the greater provisioning procyclicality in the euro area is mainly driven by the post-2007 period, perhaps reflecting differences in growth experiences of the euro area countries during the crisis compared to other countries. This result is maintained when limiting the sample to EU countries in regression 6. These findings may reflect a greater growth dispersion of euro area countries in the post-2007 period, with a standard deviation of GDP growth rates of 0.031 as compared to 0.018 for non-euro area countries.

Overall, Table 4 provides evidence that the greater provisioning procyclicality in the euro area reflects a selection of banks or countries with greater pre-euro adoption procyclicality into the euro area as well as different post-adoption growth experiences following the global economic and financial crisis.

Table 5 provides additional evidence on how macroeconomic developments related to GDP growth and real exchange rate adjustment affect provisioning procyclicality in the euro area. Regression 1 adds an interaction of GDP growth with a Negative growth dummy to the baseline regression specification in column 7 of Table 3 for the euro sample. In this regression, GDP growth and its interaction with the Negative growth dummy receive negative and significant coefficients of -0.047 and -0.204, respectively. This is evidence that provisioning in the euro area is far more procyclical at times of negative economic growth. Since these negative growth experiences are concentrated in the post-2007 period this result

reinforces the findings in Table 4 that greater provisioning procyclicality in the euro area partly reflects different growth experiences following the start of the global economic and financial crisis. More generally these results indicate that provisioning is highest during economic downturns.

Regression 2 alternatively includes an interaction of GDP growth with a GIIPS dummy variable that signals a bank located in Greece, Ireland, Italy, Portugal or Spain. These five countries were greatly affected by the crisis, as reflected by relatively large negative growth rates. Hence, the GIIPS dummy represents a crisis shock. The negative and significant interaction GIIPS × GDP growth shows that provisioning is more procyclical in the crisis-hit GIIPS countries.

Provisioning procyclicality may also be affected by real exchange rate adjustments. Such effects are of particular interest for the euro area which as a currency union provides for limited exchange rate adjustment. The effect of real exchange rate adjustments on provisioning depends on the expansionary effect of exchange rate movements. If exchange rate movements are expansionary, then they may stabilize output and enhance financial stability, reducing the procyclicality of loan loss provisioning. The expansionary effect of real appreciations is theoretically ambiguous. On the one hand, they make exports less competitive, lowering export demand (Johnson, 1976). On the other hand, they lower import prices, improving the terms of trade, and increasing consumption (Krugman and Taylor, 1978). For the euro area, recent evidence by Lane and Stracca (2018) suggests that the terms of trade gains outweigh the losses in competitiveness of the export sector, such that on average real appreciations are expansionary. The impact on the banking sector depends in part on whether banks cater more to the tradable or nontradable sectors. If the main clients of banks are exporters, then the loss in competitiveness could be destabilizing for banks.

To examine how provisioning procyclicality is affected by real exchange rate adjustment, regression 3 includes an interaction of GDP growth with ΔREER, which is the log annual change in the real effective exchange rate of the country from the Bank for International Settlements, using the full sample. An increase in ΔREER represents an appreciation of the real exchange rate. This interaction obtains a positive coefficient that is significant, which suggests that real exchange rate appreciations reduce the procyclicality of loan loss provisioning: a lower GDP growth rate increases provisioning less if at the same time the real exchange rate appreciates. This result is consistent with appreciations being expansionary, stabilizing output and enhancing financial stability, thereby reducing the procyclicality of loan loss provisioning. In addition we find that the ΔREER variable obtains a negative and significant coefficient, suggesting that a real exchange rate appreciation reduces loan loss provisioning, possibly because of its stabilizing effects on the economy.

The euro area can be interpreted as a fixed exchange rate system that prevents nominal and, to some extent, real exchange rate adjustment in response to GDP shocks. A diminished role for real exchange rate adjustment to steady nonfinancial and financial firms in the face of GDP shocks is consistent with a greater estimated provisioning procyclicality in the euro area. Lower real exchange rate flexibility in the euro area can be a reason why euro adoption per se has occasioned greater provisioning procyclicality at euro area banks.

Following monetary union, another significant institutional change in the euro area has been the introduction of a banking union, resulting in common supervision and a convergence of supervisory practices. A strict enforcement of regulatory capital standards may influence provisioning procyclicality by constraining banks' discretion on loan loss provisioning. Regression 4 includes interactions with the Capital stringency variable, which is an index of the stringency of bank capital regulations that ranges from 0 to 10 (from Barth, Caprio, and Levine, 2013). The interaction Capital stringency × GDP growth receives a

negative and significant coefficient, indicating that provisioning is more procyclical in countries with more stringent capital regulation. This suggests that stringent capital regulation reduces incentives to use discretionary provisioning for capital management purposes.

Similarly, bank competition may shape provisioning procyclicality by reducing banks' incentives to manipulate their financial accounts and to engage in earnings management. We expect that enhanced competition, by reducing bank opacity, reduces provisioning procyclicality. Regression 5 includes interactions with a proxy of bank competition: the Lerner index. The Lerner index is a measure of market power in the banking market, defined as the difference between output prices and marginal costs, relative to output prices. Prices are calculated as total bank revenue over assets, whereas marginal costs are obtained from an estimated translog cost function with respect to output. Higher values of the Lerner index indicate less bank competition. We obtain data on the Lerner index at the country level from the World Bank's Global Development Finance database. Data for the year 2015 is missing for the Lerner index. As expected, we find that the interaction Lerner index × GDP growth obtains a negative and significant coefficient. This suggests that a more contestable banking market, as measured by a lower Lerner index, reduces provisioning procyclicality.

5.2 Evidence on provisioning procyclicality and bank characteristics

Heterogeneity in provisioning procyclicality potentially reflects variation in bank characteristics such as size and bank capitalization. To examine the role of bank size, we construct the Size dummy signaling that a bank's total assets are above the sample median. Regression 1 of Table 6 includes the Size variable and its interactions with EBP/assets, Loan growth, and GDP growth in regression 7 of Table 3 for the euro sample. The GDP growth variable and its interaction with Size receive negative and significant coefficient of -0.095

and -0.006, respectively, indicating that bigger banks display more provisioning procyclicality. This could reflect that bigger banks can afford to implement more procyclical and riskier provisioning strategies on account of their too-big-to-fail status or alternatively that bigger banks have loan portfolios for which expected losses objectively are more negatively correlated with GDP growth.

The greater provisioning procyclicality of bigger banks could be driven by differences in bank business models rather than bank size. We therefore include the bank's loans-to-assets ratio to account for the extent to which banks are engaged in lending rather than other banking activities, such as investment banking or asset management. The results are presented in column 2 of Table 6. As expected, we find that banks that specialize in lending (i.e., have higher loans-to-assets ratios) tend to have more procyclical provisioning. Moreover, controlling for this difference in bank business models does not materially alter the effect of bank size on provisioning procyclicality.

Regression 3 includes the SSM variable that signals that a bank is directly supervised by the ECB as part of the Single Supervisory Mechanism (SSM), and interactions of this variable with EBP/assets, Loan growth, and GDP growth. GDP growth and SSM × GDP growth are estimated with negative and significant coefficients of -0.100 and -0.026, respectively, providing evidence that procyclicality at banks that are directly supervised by the ECB is greater than at other euro area banks.

Next, we consider the role of bank capitalization in explaining differences in provisioning procyclicality among euro area banks. Regression 4 includes the Equity variable, constructed as the lagged ratio of equity to total assets, and its interactions with EBP/assets, Loan growth, and GDP growth. The estimated coefficient for the Equity × GDP growth variable is negative and significant at -0.110. Thus, provisioning procyclicality at less well capitalized banks is lower, consistent with a capital smoothing hypothesis: less well

capitalized banks avoid taking higher loan loss provisions when GDP growth declines to limit the negative implications for capitalization.

By taking loan loss provisions, a bank sets aside funds in preparation for expected future loan losses. Expected loan losses may well be higher at banks that are already experiencing high loan losses, as indicated by currently high nonperforming loans. To account for the role of nonperforming loans, regression 1 of Table 7 includes the NPL ratio, which is the ratio of nonperforming loans to lagged gross loans. This variable receives a positive and significant coefficient of 0.065, indicating that provisioning is higher at banks that already have high nonperforming loan ratios. In this regression, the estimated coefficient for the GDP growth variable is negative and significant at -0.049, which is less negative than the corresponding estimated coefficient of -0.107 in regression 7 of Table 3, possibly reflecting that NPL ratios tend to higher at times of negative GDP growth.

Regression 2 instead includes the Change in NPL ratio variable, constructed as the change in nonperforming loans divided by lagged total assets, as an additional control variable, while regression 3 includes the NPL ratio as well as the Change in NPL ratio as additional variables. In these two regressions, the additional control variables receive positive and significant coefficients, while the GDP growth variable receives significant coefficients of -0.058 and -0.060, which in both instances are less negative than the estimate of -0.107 in regression 7 of Table 3. Overall, Table 7 provides evidence of a lower estimated provisioning procyclicality in the euro area once we control for the nonperforming loans ratio and the change in the nonperforming loans ratio.

5.3 Implications for the cyclicality of bank capitalization and loan growth

Higher loan loss provisions translate into lower earnings and *ceteris paribus* lower equity. This suggests that the cyclicalities of loan loss provisions and bank equity with

respect to GDP are directly related. In particular, we would expect that greater increases in loan loss provisions as GDP declines translate into greater reductions in bank equity. To compare these two cyclicalities, regressions 1 and 2 of Table 8 provide estimates of the cyclicalities of Provisions/assets variable and the Change in equity/assets variable, constructed as the change in bank equity divided by lagged total assets. These two regressions include the Equity ratio as a control variable. In the Provisions/assets regression 1, GDP growth receives a negative and significant negative coefficient of -0.100, while in the Change in equity/assets regression 2 the GDP growth rate receives a positive and significant coefficient of 0.154. If we assume a one-to-one relationship between provisions and changes in equity, these coefficient estimates suggest that about two-thirds of the cyclicality of the change in equity can be attributed to the cyclicality of provisioning.

Another way of comparing the magnitudes of the effects is to compute the economic effects of a change in GDP growth in the two regressions. Based on the estimates of regression 1, a one standard deviation increase in GDP growth translates into a decrease in the provisioning ratio of 0.15 times its standard deviation; similarly, based on regression 2, a one standard deviation increase in GDP growth corresponds to an increase in the change in bank equity of 0.19 times its standard deviation. These are significant effects and produce similar results as a direct comparison of regression estimates.

The link between the cyclicality of loan loss provisions and bank equity could in part be driven by changes in dividend policy as reductions in earnings reduce the banks' capacity to pay out dividends. To assess the cyclicality of dividends, in regression 3 the dependent variable is the Dividends/net income variable, which is constructed as the ratio of dividends paid to net income. This regression has fewer observations than regressions 1 and 2 as not all banks pay dividends. In this regression, GDP growth is estimated with a negative coefficient of -0.192 that is insignificant. This result suggests that dividend payouts remain broadly

stable over the business cycle, consistent with dividend signaling theories, contributing to the procyclicality of equity.

Next we consider the procyclicality of loan growth. Loan loss provisions can influence loan growth both directly and indirectly. The direct effect arises when current provisioning levels are an indicator of future credit quality. The indirect effect arises when provisioning affects the procyclicality of bank capital, and bank lending channels are present. In regression 4, the dependent variable is the Loan growth variable. The estimated coefficient for GDP growth in this regression is positive and significant at 1.408, showing that loan growth is procyclical with GDP growth. The coefficient on Equity is also positive and significant, consistent with existing evidence that a shortage of bank capital can lead to a credit crunch (Bernanke and Lown, 1991). The economic effect is substantial. Based on the coefficient estimates in regression 4, a one standard deviation increase in GDP growth translates into an increase in loan growth of 0.15 times its standard deviation.

Next we consider the link between the build-up of loan loss provisions and loan growth. Loan loss provisions cumulate over time into loan loss reserves on the bank's balance sheet as a "contra-asset" account. Loan loss reserves increase with loan loss provisions and decrease with loan charge-offs. Regression 5 includes the LLR/assets variable, which is lagged loan loss reserves over lagged assets, as an additional control variable. The negative and significant coefficient for this variable shows that banks with high loan loss reserves experience lower loan growth. This could reflect that past provisions are a harbinger of additional provisioning in the future, which can already constrain current loan growth. The economic effect is substantial. Based on the coefficient estimates in regression 5, a one standard deviation increase in the ratio of loan loss reserves to assets translates into a decrease in loan growth of 0.23 times its standard deviation. The effect of GDP growth is not materially affected when controlling for loan loss reserves.

Thus far the results in Table 8 indicate that provisioning procyclicality implies reductions in equity and additions to loan loss reserves at times of negative growth. These relations and the positive and negative coefficients for the Equity and LLR/assets variables in the Loan growth regression in column 5 together suggest that provisioning procyclicality can constrain loan growth during recessions.

Finally, we gauge the implications of the procyclicality of loan loss provisioning for the procyclicality of lending in a more direct way. To do so, we proceed in two steps. In the first step, we estimate regression 1 in Table 8 for each bank, without fixed effects, over the pre-crisis period 1996-2006. We then compute loan loss provisioning procyclicality for each bank as the coefficient on GDP growth in these regressions. We exclude from this computation banks with less than 5 observations over this period. As a second step, we extend regression model 4 in Table 8 by including an interaction between this provisioning procyclicality coefficient and the GDP growth variable, and estimate this model over the post-crisis period 2007-2015. The reason for estimating the two stages over different sample periods is to mitigate concerns of reverse causality given that provisioning and lending decisions are jointly determined. However, even in the two-step procedure, there remains possible endogeneity, as macroeconomic variables that drive both provisioning and lending decisions tend to be persistent over time. All the same, the two-step procedure potentially informs on the correlation between provisioning and lending procyclicalities.

The results of the second-step regression are presented in column 7 of Table 8. To ease comparison, column 6 reports results when estimating regression model 4 over the post-crisis period. We lose observations because we estimate over a shorter sample and exclude banks with less than 5 (annual) observations. We find that more provisioning procyclicality (i.e., the negative relation between provisioning and GDP growth) is associated with more lending procyclicality, as indicated by a negative coefficient of -0.765 on the interaction

between the estimated provisioning procyclicality coefficient, called LLP procyclicality, and GDP growth. The economic relevance of this association is substantial given the sample standard deviation of LLP procyclicality of 0.142. In particular, a one standard deviation increase in provisioning procyclicality, i.e., a reduction in LLP procyclicality of -0.142, is associated with an increase in the procyclicality of loan growth of 0.109. This is a large increase compared to the unconditionally estimated average procyclicality of lending of 0.921, as reported in regression 6. Thus, our results suggest that provisioning procyclicality correlates strongly with lower credit growth during recessions, with possibly detrimental implications for the economy.

6. Conclusions

We have analyzed the cyclical behavior of banks' provisioning for loan losses in the euro area in comparison to that of non-euro countries. We find that loan loss provisions in the euro area are procyclical in the sense that they are negatively related to GDP growth. The sensitivity of provisioning to GDP growth in the euro area can explain about two-thirds of the variation of bank capitalization over the business cycle. This has significant implications for bank lending, as we find that loan growth is positively related to bank capitalization and negatively to loan loss reserves.

Among euro area banks, we find considerable heterogeneity in provisioning procyclicality. We find that loan loss provisioning is more procyclical at banks that are larger, better capitalized and located in countries with more stringent capital regulations and less competitive banking markets.

We estimate that provisioning procyclicality in the euro area is about twice as large as in other advanced economies. This difference can in part be explained by a larger procyclicality of provisioning in euro area countries already prior to adopting the euro, and

the divergent growth experiences of euro area countries following the global financial crisis. The greater provisioning procyclicality in the euro area could also reflects an effect of the euro per se, as the euro limits potential real exchange rate adjustment that could stabilize commercial borrowers in the face of GDP shocks.

Our results have important implications for the supervision of euro area banks going forward. First, our finding of a relatively large provisioning cyclicality in the euro area stresses the need to make efforts to reduce this procyclicality, given that this is likely to remain a problem after the introduction of IFRS 9. Second, our finding of considerable heterogeneity in provisioning among euro area banks suggests that banks have used material discretion in applying the incurred loss model of loan loss provisioning. This heterogeneity is unlikely to vanish on account of IFRS 9, and hence supervisors will need to apply considerable efforts to effect a more uniform application of loan loss provisioning rules across euro area banks. More generally, our results call for increased attention to potential undesirable consequences of provisioning rules for the procyclicality of lending.

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Figure 1. Provisioning and loan loss reserves in banks' income statement and balance sheet

Income statement

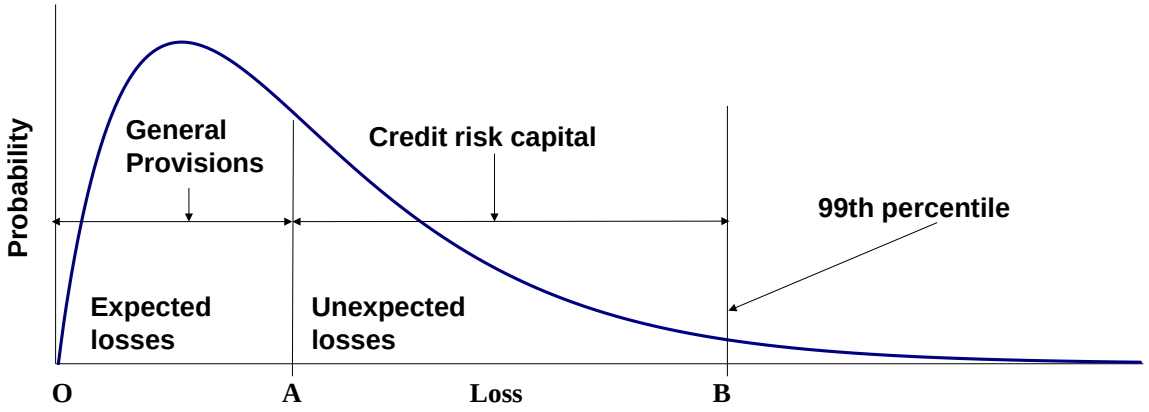
Net interest income
Plus: Noninterest income
Less: Salaries and benefits
Less: Provision for loan losses
Less: Other noninterest expense
Equals: Income before taxes
Less: Income taxes
Equals: Net income

Balance sheet

Assets	Liabilities and Equity
Cash	Deposits
Securities	Other liabilities
Total loans	Sum: Total liabilities
Less: Reserves for loan losses	Equity
Equals: Net loans	
Other assets	
Sum: Total assets	Sum: Total liabilities and equity

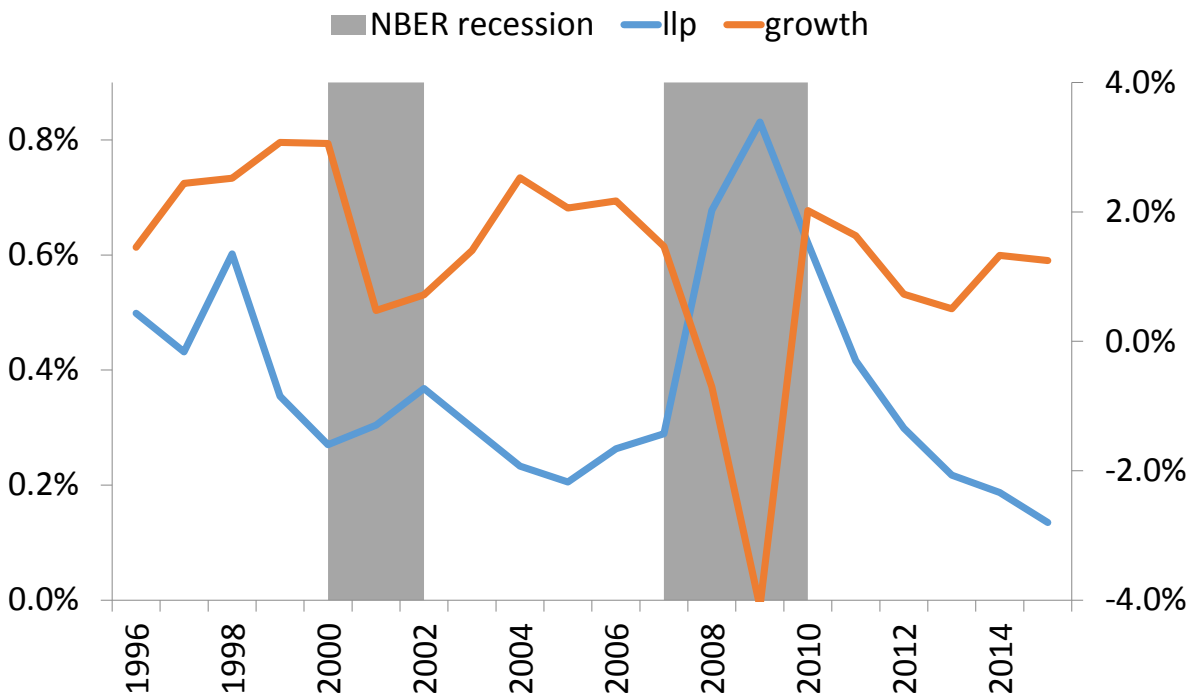
Source: Balla, Rose, and Romero (2012).

Figure 2. Loan losses, provisions and regulatory capital



Source: Laeven and Majnoni (2003).

Figure 3. Loan loss provisions and economic growth



Notes: Llp denotes the ratio of loan loss provisioning to lagged total assets; growth denotes real per capita GDP growth; NBER recession denotes recession years according to the NBER. Llp and growth are aggregated values across banks in the full sample of countries used for the analysis in this paper.

Table 1. Countries included in the analysis and their EU membership and euro adoption dates

Canada, Norway, Switzerland, and the United States are included non-EU countries

Country	EU member since	Euro since
Austria	1 January 1995	1 January 1999
Belgium	1 January 1958	1 January 1999
Bulgaria	1 January 2007	-
Canada	-	-
Croatia	1 July 2013	-
Cyprus	1 May 2004	1 January 2008
Czech Republic	1 May 2004	-
Denmark	1 January 1973	-
Estonia	1 May 2004	1 January 2011
Finland	1 January 1995	1 January 1999
France	1 January 1958	1 January 1999
Germany	1 January 1958	1 January 1999
Greece	1 January 1981	1 January 2001
Hungary	1 May 2004	-
Ireland	1 January 1973	1 January 1999
Italy	1 January 1958	1 January 1999
Latvia	1 May 2004	1 January 2014
Lithuania	1 May 2004	1 January 2015
Luxembourg	1 January 1958	1 January 1999
Malta	1 May 2004	1 January 2008
Netherlands	1 January 1958	1 January 1999
Norway	-	-
Poland	1 May 2004	-
Portugal	1 January 1986	1 January 1999
Romania	1 January 2007	-
Slovakia	1 May 2004	1 January 2009
Slovenia	1 May 2004	1 January 2007
Spain	1 January 1986	1 January 1999
Sweden	1 January 1995	-
Switzerland	-	-
United Kingdom	1 January 1973	-
United States	-	-

Table 2. Summary statistics

Provisions/assets is loan loss provisions over lagged total assets. EBP/assets is profits before tax and loan loss provisions over lagged total assets. Loan growth is the growth rate of net loans. GDP growth is the growth rate of real per capita GDP. Panel A provides summary statistics for the full sample of banks in countries listed in Table 1 during 1996-2015. Panel B provides summary statistics for the euro area sample of banks in euro countries after their euro adoption dates.

Panel A. Full sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Provisions/assets	173,814	0.003386	0.006512	-0.00474	0.039998
EBP/assets	173,814	0.012908	0.012914	-0.02597	0.075488
Loan growth	171,710	0.100456	0.247748	-0.32985	1.571429
GDP growth	186,891	0.012737	0.0193	-0.1456	0.130815

Panel B. Euro area sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Provisions/assets	43,022	0.004482	0.006438	-0.00474	0.039998
EBP/assets	43,022	0.010849	0.010971	-0.02597	0.075488
Loan growth	42,488	0.081602	0.231439	-0.32985	1.571429
GDP growth	44,517	0.010405	0.024321	-0.08998	0.096202

Table 3. Provisioning procyclicality in the full sample, and in the EU and euro samples

The dependent variable is Provisions/assets, which is the ratio of loan loss provisioning to lagged total assets. EBP/assets is profits before tax and loan loss provisions over lagged total assets. Loan growth is the growth rate of net loans. GDP growth is the growth rate of real per capita GDP. EU is a dummy variable signaling EU membership. Euro is a dummy variable signaling that a country has adopted the euro. Regressions 1-3 are based on the full sample. Regressions 4-6 are based on the EU sample. Regressions 7 and 8 are based on euro and non-euro samples. A constant and bank and year fixed effects are included but not reported. Regressions 3 and 6 include year fixed effects interacted with the euro dummy. Standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%.

VARIABLES	(1) All	(2) All	(3) All	(4) EU	(5) EU	(6) EU	(7) Euro	(8) Not euro
EBP/assets	0.0734***	0.0730***	0.0340***	0.219***	0.219***	0.160***	0.262***	0.0272***
	(0.00401)	(0.00400)	(0.00431)	(0.00859)	(0.00859)	(0.0126)	(0.0103)	(0.00439)
Loan growth	-0.000944***	-0.000961***	-0.000973***	-0.00204***	-0.00204***	-0.00179***	-0.00202***	-0.000939***
	(0.000115)	(0.000115)	(0.000135)	(0.000206)	(0.000206)	(0.000359)	(0.000246)	(0.000136)
GDP growth	-0.0610***	-0.0620***	-0.0553***	-0.0969***	-0.0970***	-0.0433***	-0.107***	-0.0616***
	(0.00193)	(0.00194)	(0.00458)	(0.00367)	(0.00367)	(0.00824)	(0.00421)	(0.00485)
EU		-0.00156**						
		(0.000705)						
Euro		0.000740***	-0.000801		0.000245	-0.00158		
		(0.000159)	(0.00173)		(0.000324)	(0.00206)		
Euro × EBP/assets			0.199***			0.0845***		
			(0.0101)			(0.0137)		
Euro × Loan growth			-0.000886***			-7.23e-05		
			(0.000272)			(0.000424)		
Euro × GDP growth			-0.0503***			-0.0631***		
			(0.00593)			(0.00864)		
Observations	171,710	171,710	171,710	55,478	55,478	55,478	42,488	129,222
R-squared	0.097	0.097	0.150	0.179	0.179	0.205	0.233	0.133
Number of banks	16,701	16,701	16,701	5,489	5,489	5,489	4,514	14,981

Table 4. The adoption of the euro and provisioning procyclicality in the euro area

The dependent variable is Provisions/assets, which is the ratio of loan loss provisioning to lagged total assets. EBP/assets is profits before tax and loan loss provisions over lagged total assets. Loan growth is growth rate of net loans. GDP growth is the growth rate of real per capita GDP. Euro is a dummy variable signaling that a country has adopted the euro. Crisis is a dummy variable that takes a value of one in the crisis and post-crisis period 2007-2015. Regressions 1 and 2 are based on samples before 1999 with banks in countries that did and did not later adopt the euro. Regression 3 is based on the full sample. Regression 4 is based on the EU sample. A constant and bank and year fixed effects are included but not reported. Regressions 3 and 4 include year fixed effects interacted with the euro dummy. Standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Year < 1999 & Country adopts euro later	Year < 1999 & Country does not adopt euro later	All	EU	All	EU
EBP/assets	0.208***	0.191***	0.0537***	0.154***	0.0612***	0.157***
	(0.0322)	(0.0261)	(0.00476)	(0.0130)	(0.00481)	(0.0129)
Loan growth	-0.000422	0.00110*	-0.000588***	-0.00137***	-0.000600***	-0.00127***
	(0.000501)	(0.000642)	(0.000141)	(0.000356)	(0.000145)	(0.000339)
GDP growth	-0.0820***	-0.0636***	-0.0297***	0.0148	-0.0462***	-0.0126
	(0.0203)	(0.0230)	(0.00609)	(0.00974)	(0.00634)	(0.00981)
Euro			-0.00122	-0.00223	0.000625*	0.00381***
			(0.00182)	(0.00220)	(0.000328)	(0.000558)
Euro × EBP/assets			0.202***	0.0729***	0.152***	0.0673***
			(0.0101)	(0.0139)	(0.0113)	(0.0140)
Euro × Loan growth			-0.000917***	0.000447	-0.000246	0.000420
			(0.000273)	(0.000440)	(0.000298)	(0.000424)
Euro × GDP growth			-0.0308***	-0.0445***	0.0387***	0.00847
			(0.00590)	(0.00888)	(0.00850)	(0.00970)
Crisis			-9.75e-05	0.00180	-0.000458	0.00115
			(0.000596)	(0.00126)	(0.000588)	(0.00129)
Crisis × EBP/assets			-0.0491***	0.0321***	-0.0686***	0.0109
			(0.00581)	(0.0121)	(0.00640)	(0.0227)
Crisis × Loan growth			-0.00109***	-0.00222***	-0.000991***	-0.00253**
			(0.000253)	(0.000453)	(0.000293)	(0.00114)

Crisis × GDP growth			-0.0605***	-0.0948***	-0.0165*	-0.0345**
			(0.00698)	(0.00852)	(0.00858)	(0.0146)
Euro × Crisis					-0.00233	-0.00548**
					(0.00197)	(0.00231)
Euro × Crisis × EBP/assets					0.106***	0.0245
					(0.0147)	(0.0254)
Euro × Crisis × Loan growth					-0.00136**	0.000194
					(0.000577)	(0.00125)
Euro × Crisis × GDP growth					-0.107***	-0.0936***
					(0.0112)	(0.0155)
Observations	8,256	4,195	171,710	55,478	171,710	55,478
R-squared	0.126	0.157	0.154	0.214	0.157	0.216
Number of banks	3,267	1,570	16,701	5,489	16,701	5,489

Table 5. Country heterogeneity and provisioning procyclicality: negative growth, real exchange rates, capital regulation, and bank competition

The dependent variable is Provisions/assets, which is the ratio of loan loss provisioning to lagged total assets. EBP/assets is profits before tax and loan loss provisions over lagged total assets. Loan growth is the growth rate of net loans. GDP growth is the growth rate of real per capita GDP. Negative growth is a dummy variable that signals a negative growth rate of real per capita GDP. GIIPS is a dummy indicating that the bank is located in Greece, Ireland, Italy, Portugal or Spain. ΔREER is the log annual change in the real effective exchange rate. A positive value of ΔREER indicates an appreciation of the real exchange rate. Capital stringency is the index of stringency of bank capital regulations from Barth, Caprio and Levine (2013), which ranges from 0 to 10 and is increasing in stringency. Values are available only for 1999, 2003, 2007, and 2011. For years between 1999 and 2003, the 1999 values are used, etc. Lerner index is the Lerner index of the banking market in the country from the Global Financial Development database of the World Bank. The Lerner index is a measure of market power that is decreasing in the degree of competition. Data on the Lerner index is missing for the year 2015. A constant and bank and year fixed effects are included but not reported. Regressions 1-2 are based on the euro sample, and regressions 3-5 are based on the full sample. Standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%.

VARIABLES	(1) Negative growth	(2) Crisis shock	(3) Real exchange rate change	(4) Capital stringency	(5) Bank market power
EBP/assets	0.255***	0.344***	0.0742***	0.129***	0.265***
	(0.0100)	(0.0138)	(0.00401)	(0.0307)	(0.00980)
Loan growth	-0.00168***	-7.55e-05	-0.00106***	-0.00599***	0.000979***
	(0.000242)	(0.000260)	(0.000122)	(0.000991)	(0.000376)
GDP growth	-0.0469***	-0.0582***	-0.0643***	-0.0163*	-0.0160***
	(0.00402)	(0.00364)	(0.00198)	(0.00937)	(0.00193)
Negative growth × GDP growth	-0.204***				
	(0.00948)				
GIIPS × EBP/assets		-0.219***			
		(0.0196)			
GIIPS × Loan growth		-0.00479***			
		(0.000477)			
GIIPS × GDP growth		-0.0771***			
		(0.00286)			
ΔREER			-0.00549***		
			(0.000760)		
ΔREER × EBP/Assets			0.124***		
			(0.0429)		

ΔREER × Loan growth			0.00793***		
			(0.00215)		
ΔREER × GDP growth			0.555***		
			(0.0256)		
Capital stringency				-0.000844***	
				(7.80e-05)	
Capital stringency × EBP/assets				-0.00507	
				(0.00431)	
Capital stringency × Loan growth				0.000667***	
				(0.000141)	
Capital stringency × GDP growth				-0.00477***	
				(0.00128)	
Lerner index					0.00978***
					(0.000649)
Lerner index × EBP/assets					-0.829***
					(0.0372)
Lerner index × Loan growth					-0.00859***
					(0.00167)
Lerner index × GDP growth					-0.265***
					(0.00967)
Observations	42,488	42,488	171,710	87,906	171,307
R-squared	0.263	0.300	0.104	0.130	0.127
Number of banks	4,514	4,514	16,701	12,051	16,657

Table 6. Bank heterogeneity and provisioning procyclicality in the euro area: bank size and capitalization

The dependent variable is Provisions/assets, which is the ratio of loan loss provisioning to lagged total assets. EBP/assets is profits before tax and loan loss provisions over lagged total assets. Loan growth is the growth rate of net loans. GDP growth is the growth rate of real per capita GDP. Loans/assets is the ratio of lagged net loans to lagged total assets. SSM is a dummy variable that signals that a bank is directly supervised by the ECB as part of the Single Supervisory Mechanism (SSM). Equity is lagged equity over lagged total assets of the bank. Regressions are based on the euro area sample. A constant and bank and year fixed effects are included but not reported. Standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%.

VARIABLES	(1) Size	(2) Loans/assets	(3) SSM	(4) Capital
EBP/assets	0.260***	0.128***	0.272***	0.365***
	(0.0115)	(0.0212)	(0.0107)	(0.0128)
Loan growth	-0.00142***	0.000267	-0.00190***	-0.00251***
	(0.000240)	(0.000368)	(0.000253)	(0.000309)
GDP growth	-0.0954***	-0.0392***	-0.100***	-0.0903***
	(0.00411)	(0.00563)	(0.00417)	(0.00526)
Bank size	0.00181***	0.00163***		
	(0.000205)	(0.000190)		
Bank size × EBP/assets	-0.00545	-0.0107**		
	(0.00563)	(0.00532)		
Bank size × Loan growth	-0.000262***	-0.000312***		
	(9.97e-05)	(9.83e-05)		
Bank size × GDP growth	-0.00639***	-0.00640***		
	(0.000720)	(0.000669)		
Loans/assets		0.00417***		
		(0.000729)		
Loans/assets × EBP/assets		0.244***		
		(0.0374)		
Loans/assets × Loan growth		-0.00339***		
		(0.000924)		
Loans/assets × GDP growth		-0.0821***		
		(0.00835)		

SSM × EBP/assets		-0.280***	
		(0.0443)	
SSM × Loan growth		0.000180	
		(0.000922)	
SSM × GDP growth		-0.0260***	
		(0.00844)	
Equity			-0.00655**
			(0.00285)
Equity × EBP/assets			-0.635***
			(0.0588)
Equity × Loan growth			0.00477**
			(0.00200)
Equity × GDP growth			-0.110**
			(0.0432)
Observations	42,488	42,488	42,488
R-squared	0.243	0.240	0.261
Number of banks	4,514	4,514	4,514

Table 7. Nonperforming loans and provisioning procyclicality in the euro area

The dependent variable is Provisions/assets, which is the ratio of loan loss provisioning to lagged total assets. EBP/assets is profits before tax and loan loss provisions over lagged total assets. Loan growth is the growth rate of net loans. GDP growth is the growth rate of real per capita GDP. NPL ratio is nonperforming loans over lagged gross loans. Change in NPL ratio is difference of nonperforming loans over lagged total assets. Equity is lagged equity over lagged total assets. Regressions are based on the euro area sample. A constant and bank and year fixed effects are included but not reported. Standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%.

	(1)	(2)	(3)
VARIABLES	NPL ratio	Change in NPL ratio	NPL ratio and Change in NPL ratio
EBP/assets	0.159***	0.135***	0.137***
	(0.0139)	(0.0175)	(0.0159)
Loan growth	-0.00246***	-0.00381***	-0.00316***
	(0.000496)	(0.000651)	(0.000567)
GDP growth	-0.0494***	-0.0581***	-0.0609***
	(0.00873)	(0.00887)	(0.00908)
NPL ratio	0.0655***		0.0590***
	(0.00268)		(0.00293)
Change in NPL ratio		0.0687***	0.0311***
		(0.00441)	(0.00425)
Observations	13,637	10,809	10,809
R-squared	0.390	0.345	0.418
Number of banks	2,725	2,401	2,401

Table 8. A comparison of provisioning procyclicality, bank capitalization, dividend payouts and lending behavior in the euro area

The dependent variable in column 1 is Provisions/assets, which is the ratio of loan loss provisioning to lagged total assets. The dependent variable in column 2 is Change in equity/assets, which is the change in equity over lagged total assets. The dependent variable in columns 3 is Dividends/net income, which is the ratio of dividends paid to net income. The dependent variable in columns 4 to 7 is Loan growth, which is the growth rate of net loans. EBP/assets is profits before tax and loan loss provisions over lagged total assets. GDP growth is growth rate of real per capita GDP. Equity is lagged equity over lagged total assets. LLR/assets is lagged loan loss reserves (LLR) over lagged total assets. LLP procyclicality is the coefficient on GDP growth of the regression model in column 1 estimated at the bank level over the period 1996 to 2006 and without fixed effects. Regressions are based on the euro area sample. The sample period is 1996 to 2015, except in columns 6 and 7 where the sample period is limited to 2007 to 2015. A constant and bank and year fixed effects are included but not reported. Standard errors are clustered at the bank level. *, **, and *** denote significance at 10%, 5%, and 1%.

VARIABLES	(1) Provisions/assets	(2) Change in equity/assets	(3) Dividends/net income	(4) Loan growth	(5) Loan growth	(6) Loan growth (2007-2015)	(7) Loan growth (2007-2015)
EBP/assets	0.261***	0.364***	-1.294**	3.275***	3.271***	1.349***	1.320***
	(0.0105)	(0.0287)	(0.513)	(0.343)	(0.337)	(0.454)	(0.507)
Loan growth	-0.00170***	0.0376***	0.0470**				
	(0.000242)	(0.00134)	(0.0211)				
Equity	-0.0169***	-0.0656***	0.661**	1.116***	1.098***	1.221***	1.414***
	(0.00319)	(0.0105)	(0.298)	(0.134)	(0.137)	(0.272)	(0.251)
GDP growth	-0.100***	0.154***	-0.192	1.408***	1.333***	0.921***	0.740***
	(0.00429)	(0.0101)	(0.371)	(0.136)	(0.135)	(0.179)	(0.184)
LLR/assets					-1.772***		
					(0.188)		
LLP procyclicality × GDP growth							-0.765***
							(0.275)
Observations	42,488	42,488	13,753	42,488	42,468	21,027	15,314
R-squared	0.239	0.449	0.015	0.310	0.314	0.251	0.315
Number of banks	4,514	4,514	2,124	4,514	4,510	3,310	2,173

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