Effects of the ECL Model on Regulatory Capital in European Banks: IRB and Standardized Approaches

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ABSTRACT

The paper’s purpose was to assess whether the effects on the regulatory capital of the ECL model in European banks differs among those that adopted IRB or standardized approaches to credit risk management. The empirical tests revealed that there was a significant reduction in the level of capital buffers of European banks when the IFRS 9 was first adopted, and that this reduction was more pronounced among banks using a standardized approach to credit risk than for those that relied on an IRB approach. Further testing confirmed the premise that there was an underestimation of capital requirements in the period prior to the adoption of the ECL. The study fills a gap in literature, by evaluating the difference in the impact of adopting the ECL model on the banking system, as a function of the credit risk management approach for capital purposes. The assessment of what happened in the European banking system can be used as a guidance to other jurisdictions still in transition to the ECL model.

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Introduction

The objective of this study was to assess whether the effects on the regulatory capital of the impairment model based on expected credit losses (ECL), in European banks, in accordance with the International Financial Reporting Standard [IFRS] 9, differs among those that adopted internal ratings-based (IRB) approach for capital purposes, and those using the standardized approach [SA]. Although changes in accounting practices tend to affect all banks, on this study we theorize that entities adopting the IRB may apply the concept of expected losses for credit risk management purposes, pathing the way to facilitate the adoption of the IFRS 9 requirements.

The development of IFRS 9, in particular the ECL model for credit risk losses, occurred as a response to questions about the role of the provisioning model based on incurred losses during the 2008 global financial crisis, with repercussions on financial stability (Bischof, Laux, & Leuz, 2018). The debate involved discussions on how the provisions from the incurred credit loss (ICL) model could be insufficient to bear losses in financial institutions. Another negative question raised in the debate relates to the “too little, too late” phenomenon – losses recognized in an insufficient amount and with delay (Barth & Landsman, 2010; BCBS, 2017; Pucci & Skaerbaek, 2020). Finally, other pertinent question relates to the recognition of losses after their materialization, which is often followed by a pro-cyclical effect, intensifying the consequences of financial crises, such as the one seen in 2008 (ESRB, 2017).

Several studies have explored the dichotomy between the two models of provision for credit losses from the perspective of accounting effects – moment of losses recognition and level of provisions – and their economic consequences – in particular the pro-cyclicality
The change in the accounting standards from the incurred loss approach to the expected credit loss model in banks is one of the regulatory responses to the 2008 financial crisis and seeks to reduce the pro-cyclicality of the financial system, especially in times of economic downturn. In the context of banking financial institutions, the shift to a prospective provisioning model for the loan portfolio should lead to an early recognition of credit losses. In addition to reflecting more adequately (and in a timely manner) the credit risk to which the institution is exposed, this change in regulation is expected to reduce unforeseen bank capital shocks during an economic recession, when the recognition of losses has an adverse effect on regulatory capital.
The effect of Expected Credit Loss (ECL) on regulatory capital

One of the roles of capital in banking is to provide a cushion against unforeseen losses that exceed expected levels (BCBS, 2005). To some extent, interest rates, including risk premia, calculated on risk-weighted credit exposures may absorb some of the components of unexpected losses, but not their entirety. Thus, capital is needed to cover the risks of such losses. The effectiveness of regulatory capital as proper reserve to absorb unexpected shocks is based on the existence of a first level of protection, formed by expected loss provisions.

However, the minimum regulatory capital requirement, based on risk exposure, tends to have a pro-cyclical effect on the economy. The deterioration of the quality of credit portfolios of banks during periods of economic downturn inevitably increases risk exposure and, hence, the level of required capital – just when capital becomes more expensive or simply unavailable to weaker institutions (Cavallo & Majnoni, 2002). At the same time, capital positions worsen as loan losses increase, which can induce banks to reduce loan granting and increase their profit margins, thereby broadening the pro-cyclical effect (Andersen, 2011).

With the adoption of the ECL model, under IFRS 9, these effects are expected to be mitigated, with the early recognition of credit risk losses. Another likely benefit of the ECL model for accounting purposes is a greater alignment with the prudential regulation regarding credit risk, considering that under Basel III framework (BCBS, 2011) the concept of expected losses was already adopted.

The effects of adopting the ECL model and its relationship to regulatory capital are illustrated in Figure 1. The volume of provisions made according to the incurred loss model is established at point A, by means of a loss distribution curve, and the respective increase under the expected credit loss model is shown at point A’. The regulatory capital required remains unchanged.

![Figure 1: Potential IFRS 9 effects on regulatory capital](image)

The adverse effects on capital caused by provisions increase, owed to the change in accounting practices, imply a reduction in capitalization rates, and affects all banks, everything else being equal. Nonetheless, this study investigates whether such effects are different among those banks that adopted internal ratings-based (IRB) approach for capital purposes, compared to those using the standardized approach (SA). The assumption is that entities adopting the IRB approach already apply the concept of expected losses for credit risk management, which would facilitate the adoption of IFRS 9 requirements.

Banks are expected to cover their expected losses continuously, through provisions, and only to use capital to absorb unexpected losses (Bikker & Metzemakers, 2005; BCBS, 2005). Thus, the Basel Pillar I minimum capital requirements were designed to cover unexpected losses, precisely because the expected losses would be already recognized by the credit loss provision.

The migration to ECL model poses new challenges – since both the accounting provision model according to IFRS 9 and the Basel III regulatory capital are based on the concept of expected loss, although they originate from different premises. These guiding principles provide the basis for formulating the research hypotheses, that were divided as follows: initial impact at the time when the IFRS 9 was first adopted; and an evolutionary pattern of capital levels behavior after the implementation of the new accounting standard.

One of the key factors to be considered is the impact of the regulatory treatment of accounting provisions for credit risk in the capital, after the new accounting model has come into effect. Until the IFRS 9 was implemented, there were two alternatives, under the Basel framework:

- A standardized approach (SA): accounting provisions for credit risk losses are fully deducted from common equity tier 1 [CET1]. However, those provisions which are classified as general – i.e. available to cover non-specific losses from the credit portfolio – can be included back in Tier 2 capital, subject to a limit of 1.25% of risk-weighted assets.
- The Internal ratings-based (IRB) approach: banks must compare the total amount of accounting provisions with the total value of expected credit losses, calculated in accordance with the guidelines of the IRB approach, in two possible situations: (i) if the amount of the accounting provision is less than the regulatory expected credit loss, the deficit should be deducted...
from the core capital [CET1]; and (ii) if the accounting provision is larger than the regulatory expected credit loss, the excess should be returned to tier 2 capital, up to a certain limit (0.6% of risk-weighted assets).

Thus, in both approaches for regulatory capital calculation – SA and IRB – a proportion of credit risk provisions could be recognized or deducted from the total capital. Nevertheless, IFRS 9 changes this situation only for banks that adopt a standardized approach, by eliminating the possibility of adding back part of the accounting provisions to the regulatory capital.

According to EBA (2017), IFRS 9 provisions can be attributed to certain assets, whether individual or grouped, in a way that can allow all credit loss accounting provisions to be now classified as “specific”. The change to an expected credit loss model should lead to a more accurate representation of the ECL, which is also neutral and free from bias. Thus, provisions under the new accounting model correspond to the amount considered necessary to support expected credit losses, and do not serve as a cushion to cover other losses that were not estimated at the time of the credit recognition, a role once attributed to provisions that were classified as general.

In addition to bearing the impact on regulatory capital caused by the increase in accounting provisions entities that adopt the Basel standardized approach are also subject to the risk of further capital reduction, since they no longer have the prerogative to add back a proportion of the accounting provisions to regulatory capital. Thus, we argue that the change to the expected credit loss model will reduce the capital of institutions that adopt the standardized approach more significantly than in the case of institutions that adopt the IRB approach.

Assuming the premise that capital reduction occurs at the time when IFRS 9 is adopted, the following research hypothesis can be formulated to determine how the negative impact on bank capital differs in degrees of intensity, depending on what kind of credit risk approach is adopted for calculating regulatory capital:

**H1:** At the time when IFRS 9 was adopted, the reduction of capital buffers of European banks was more intense among those that adopt the Basel III standardized approach for credit risk calculation.

When focusing on the period after IFRS 9 first time adoption, it is reasonable to assume that there might be different patterns of behavior between the capital buffers of banks that adopt the standardized approach and of banks using the IRB approach when calculating credit risk.

After the IFRS 9 was first adopted, it is possible that, on one hand, banks relying on a standardized approach for calculating the credit risk RWA would undergo a more persistent negative impact on capital buffers, owing to the elimination of the prerogative of adding part of the accounting provisions back to the regulatory capital, as of 01.01.2018. On the other hand, banks using the IRB approach still have the option to add the surplus of accounting provisions, with regard to the prudential metric, back to the regulatory capital. This option would most likely benefit the capital buffer rates of these banks.

Other practical issues, such as the operationalization of the provisioning accounting model for expected credit losses, can also lead to a systematic deterioration of the capital buffers of those banks that rely on a standardized approach. In the case of these institutions, the lack of their own traditional empirical database and the need for human and technological resources to design models for calculating the probability of default (PD) and loss given default (LGD), will certainly represent a greater challenge for them.

In contrast, banks using IRB approach for calculating regulatory capital can benefit from their previous experience in building a model for estimating expected credit losses, as well as from their own established databases, when recognizing conceptual differences between the Basel model and IFRS 9.

Taking into account that the banks adopting the standardized approach have lost the prerogative of adding back a part of their accounting provisions to the regulatory capital, and the technical complexities they face when seeking to implement IFRS 9, the following research hypothesis has been formulated:

**H2:** After IFRS 9 came into force, the European banks that adopted a standardized approach for calculating Basel III credit risk suffered a more persistent negative impact on capital buffers than those that relied on an IRB approach.

In addition, a more persistent adverse effect on regulatory capital, due to the ECL model implementation, is expected for entities using the standardized approach for calculating the credit risk RWA, leading to the following research hypothesis:

**H3:** Since IFRS 9 came into force, European banks that adopted a standardized approach for calculating Basel III credit risk have been taking measures more intensively to rebuild capital buffers than those that relied on an IRB approach.
Method

Regulatory capital metrics

One of the major consequences of the global financial crisis, was the implementation of higher minimum levels of Common Equity Tier 1 (CET1), Tier 1 capital and total capital ratios, by the Basel III reforms (BCBS, 2011). CET1 became the predominant form of regulatory capital, comprised by common shares and retained earnings. Under a macro-prudential perspective, three additional capital buffer requirements were introduced: the conservation buffer, the countercyclical buffer, and the systemic risk buffer. In the case of the conservation buffer, a phased implementation was scheduled, while the activation of the countercyclical buffer depends on supervisory determinations, being related to credit growth conditions that may pose risks to the financial system. Finally, the systemic risk buffer is applicable only to global systemically important banks (G-SIBs) depending on the systemic relevance attributed to the institution by supervisors. All additional capital buffer must be met by CET1.

The Basel framework also recommends the application of Pillar 2 (P2R) requirements, which are determined at the discretion of the Supervisory Review and Evaluation Process (SREP), an annual procedure to which some of the European banks overseen by the ECB must be subject to. Depending on the SREP results, supervisors may ask banks to hold additional capital reserves, which must also be met with CET1.

The combination of Pillar 1, Pillar 2 and additional buffers results in the total capital requirement of a specific institution – overall capital requirement (OCR) – which is, therefore, different for each bank and may also change over time.

Before measuring the impact of the first-time adoption of IFRS 9 on bank regulatory capital, it is worth examining each aspect of the prudential requirements, as well as the OCR of each institution, individually. By observing those specific aspects, the measurement of the effects of the ECL model can be more accurate and granular. As a result, the impact on the capital can be compared from a more general to a highly personalized level. To achieve this goal, we intend to measure different types of capital buffers, as shown in Equation (1), following Carvalho and Dantas (2021).

\[ BCap_{i,t} = Cap_{i,t} - CapR_{i,t} \]  

(1)

where: \( BCap_{i,t} \) is the Capital Buffer, represented by the surplus of Capital (\( Cap_{i,t} \)) in relation to minimum capital requirements (\( CapR_{i,t} \)), for a bank \( i \), in period \( t \).

The \( BCap \) measure is calculated, alternately, in five different ways, aiming to identify: (i) the capital surplus linked to Pillar 1 requirements (\( BPillar1 \)); (ii) the capital surplus linked to total SREP requirements (\( BSREP \)); (iii) the capital surplus linked to total capital requirements applicable to the bank (\( BOCR \)); (iv) the capital surplus linked to the specific Pillar 1 regulatory requirement to be met with Common Equity Tier 1 (\( BrCET1 \)); and (v) the capital surplus linked to the total regulatory requirements that must be met entirely by Common Equity Tier 1 (\( BrCET1 \)). The use of different measures of capital buffers allows a type of sensitivity analysis, increasing the robustness of the findings.

Impacts at the time when IFRS 9 was first adopted – Hypothesis H1

We conduct statistical tests to compare the regulatory capital buffers of banks, on 31.12.2017, with this same capital measure, on 01.01.2018. Only the new provisions are considered, i.e., the increase in the loan loss allowance caused by the change in the accounting model.

Thus, the regulatory capital maintained on 31.12.2017, pre-IFRS 9, must be statistically different from the regulatory capital on 01.01.2018, measured according to Equation (2).

\[ BCap_{i,18} = BCap_{i,17} - \Delta LLA_{i,18} \]  

(2)

where: \( BCap_{i,18} \) is the capital buffer, represented by the excess of capital in relation to regulatory requirement, of bank \( i \), on 01.01.2018, after the effects of the adoption of the expected credit loss model, in accordance with IFRS 9; \( BCap_{i,17} \) is the capital buffer, represented by the excess of capital in relation to regulatory requirements, of bank \( i \), on 31.12.2017, following Distinguin and Rugemintwari (2012) and Carvalho and Dantas (2021); and \( \Delta LLA_{i,18} \) is the Loan Loss Allowance variation, caused by the adoption of the ECL model, in accordance with the IFRS 9, by bank \( i \), on 01.01.2018.

Aiming at conduct robustness checks, the \( BCap \) variable will assume the alternating capital buffer measures summarized in the section - \( BPillar1, BSREP, BOCR, BCET1 \) and \( BrCET1 \).

According to Equation (2), regulatory capital on 01.01.2018 is different from that reported by the bank on 31.12.2017 solely because of the impact of LLP recognized through IFRS 9, whether this effect is positive or negative. The potential mitigation of the effects of the increased provisions on the capital, due to the application of prudential transition arrangements (phase-in), allowed by BCBS and in line with the EBA guidelines, is disregarded, as our aim is to assess only the effective impact of changes in provisions on capital for all institutions.

The empirical tests for the research hypotheses H1 are carried out through a descriptive statistical analysis and a t-test of comparison between the means of variables, to determine whether there was a statistically significant difference between the capital buffers of
European banks on 31.12.2017 (pre-IFRS 9) and on 01.01.2018 (post-IFRS 9). We consider two sample groups: banks that adopted the standardized approach or the IRB approach.

**Evolutionary pattern of capital buffers – Hypotheses H2 and H3**

Model (3) was implemented to carry out the empirical analysis to test hypothesis H2 and H3, focusing on identifying whether banks that adopt a standardized approach or IRB approach for calculating credit risk behave differently.

\[ BCap_{it} = \beta_0 + \beta_1 + \beta_2 BCap_{it-1} + \beta_3 (BCap_{it-2} \times APROA_{t}) + \beta_4 \text{SIZE}_{i,t} \]

\[ + \beta_5 \text{ROE}_{i,t} + \beta_6 \text{RISK}_{\text{Cred}}_{i,t} + \beta_7 \text{RISK}_{\text{Asset}}_{i,t} + \epsilon_{i,t} \]

which: \( BCap \) is the Capital buffers, measured according to Equation (1), of institution \( i \), in period \( t \); \( APROA \) is a dummy variable that characterizes the institutional approach for measuring credit risk, assuming 1 for banks that adopt the standardized approach and 0 for institutions with the IRB approach; \( \text{SIZE} \) indicates the size of institution \( i \), in period \( t \), defined as the natural logarithm of total assets; \( \text{ROE} \) indicates the profitability level of institution \( i \), in period \( t \), as measured by the return on equity; \( \text{RISK}_{\text{Cred}} \) indicates the risk of the credit portfolio of institution \( i \), in period \( t \), defined as the ratio between loan losses allowance (LLA) and the loan portfolio; \( \text{RISK}_{\text{Asset}} \) indicates the risk of the bank’s assets, of institution \( i \), in period \( t \), defined as the ratio between risk-weighted assets (RWA) to total assets.

The coefficient \( \beta_1 \) test whether the capital buffer for the current period is influenced by the surplus capital observed in the immediately preceding period (\( BCap_{it-1} \)). The underlying premise is that banks manage their regulatory capital to maintain a certain degree of stability, reducing risk perception for depositors, investors and regulators. Thus, it is expected that in the pre-IFRS 9 period, the tests will not reveal very significant coefficients – given the premise that the capital buffer has some level of stability. It is also expected a positive relationship with the dependent variable, in line with the findings of Barth, Gomez-Biscarrí, Kasznik, and López-Espinosa (2017) and Stolz and Wedow (2011).

The variable of interest for testing hypothesis H2 is the credit risk approach \( APROA \), which identifies banks that adopt a standardized approach for measuring prudential credit risk. By assessing the coefficient of this variable, it will be possible to provide evidence about the behavior of the capital buffers of these banks and compare them with those that adopt the IRB approach, both in the pre and post IFRS 9 periods. During the pre-IFRS 9 period, it can be assumed that there will be “non-relevant” or low significance values (whether positive or negative), for the \( \beta_2 \) coefficient, since it is not expected that there will be a significant direct influence of the choice of credit risk approach on the capital buffers, before IFRS 9 comes into force. From the moment that IFRS 9 is adopted, it is likely that banks adopting a standardized approach for credit risk RWA will have a more negative impact on the capital buffers than those using IRB, since they have lost the prerogative to add a part of their accounting provisions to their capital, as of 01.01.2018.

The values of low significance (positive or negative), in the pre-IFRS 9 period, combined with negative values for \( \beta_2 \) in the post-IFRS 9 period, meaning that \( \beta_{2,\text{pre} \text{-IFRS}} \geq 0 \) and \( \beta_{2,\text{post} \text{-IFRS}} < 0 \), would corroborate hypothesis H2, which predicts a persistent negative impact on the capital buffers of European banks that have adopted the standardized approach, after IFRS 9 came into force. In contrast, positive or neutral values for \( \beta_2 \) in the period after IFRS 9 lead to the evidence against hypothesis H2, regardless of what values were obtained in the pre IFRS 9 period.

In order to test hypothesis H3, the interaction variable (\( BCap_{i,t-1} \times APROA \)) is introduced to determine the effects of the lagged measure on the capital buffer for the current period, for banks adopting a credit risk standardized approach, rather than those that rely on the IRB approach. Prior to the adoption of IFRS 9, “non-relevant” or low significance values (whether positive or negative), were expected for the \( \beta_3 \) coefficient, since as theorized, by adopting a standardized approach for calculating credit risk may not have an explicit influence on capital buffers. It is predicted that during post-IFRS 9 period, the relationship between the \( \beta_3 \) coefficient and the dependent variable will be positive and greater than pre-IFRS 9 period. The underlying premise of hypothesis H3 is that there is a stronger movement to rebuilding capital buffers for banks using a standardized approach than for IRB banks, for the following reasons: (i) the greatest operational difficulties in making an adjustment to the new model; and (ii) the greatest initial impact on capital buffers suffered by banks using the standardized approach, when adopting IFRS 9.

The size of banks (\( \text{SIZE} \)) can influence the capital buffer in the following ways: (i) the too-big-to-fail hypothesis assumes that large banks receive support from the regulator in insolvency situations, and hence, could afford to have smaller buffers (Fonseca & González, 2010); (ii) the experience, greater expertise and asset diversification capacity of larger banks would be responsible for reducing the risk awareness, which makes it possible to maintain smaller capital buffers (Afzal, 2015). Then, a negative relationship between the \( \text{SIZE} \) and \( BCap \) variables is expected.

More profitable banks (\( \text{ROE} \)) might be able to increase their capital base more easily, using retained earnings, while less profitable banks are likely to have more difficulty in strengthening their capital base (Nier & Baumann, 2006; Carvalho & Dantas, 2021). In this sense, it is expected that there will be a positive relationship between the \( \text{ROE} \) and \( BCap \) variables.

According to Flannery and Rangan (2008), Ayuso, Pérez, and Saurina (2004), and Nier and Baumann (2006), ex-ante risk measures tend to be associated with larger capital buffers. Thus, the \( \text{RISK}_{\text{Cred}} \) variable, which represents the credit portfolio risk, seeks to assess the ex-ante effect. The better the quality of the loans, the lower the provisions and losses and, hence, the greater the capital, with a positive relationship between \( \text{RISK}_{\text{Cred}} \) and \( BCap \) being expected.
Still following Flannery and Rangan (2008), Ayuso et al. (2004), and Nier and Baumann (2006), it is possible to assume that ex-post risk metrics arise from lower regulatory capital. The \( RISK_{Asset} \) variable is an indicator of the risk level to which banks are exposed, representing the bank’s total risk and the ex-post effect. Thus, the higher this proportion, the smaller would be the regulatory capital, since the assumption of greater risks would most likely generate greater capital expenditure, so that a negative relationship between \( RISK_{Asset} \) and \( BCap \) is expected.

**Sample and Data Collection**

We carry out empirical tests using data from the main European banks supervised by the ECB, owing to their economic and financial importance within the European Union. Additionally, this choice was motivated by the implementation of the IFRS 9, which was adopted at the very same moment for all banks supervised by the ECB. Complementary, these banks are subject to uniform prudential framework.

Regulation (EU) No. 1024, of October 15, 2013, known as the Single Supervisory Mechanism (SSM), which gives the ECB specific powers regarding prudential supervision policies of credit institutions, establishes that the significant character is assessed based on the following criteria: (i) dimension; (ii) importance for the European Union economy or for a participating Member State; (iii) the importance of its international activities. An entity will be regarded as significant if one of the following conditions is met: the total value of its assets exceeds 30 billion euros; or the ratio between total assets and the GDP of a participating Member State exceeds 20%, unless the total value of its assets is less than EUR 5 billion. However, it is still the possible that, even if a credit institution has not meet any of the criteria, the competent national authority will judge that the entity relevant to the national economy, after the full assessment, and, thus, decide to classify it as significant for supervisory purposes.

In January 2020, there were 117 significant entities that were initially considered for inclusion in the study sample. Semi-annual information was used, available on the banks’ own website, in the period between 2015 and 2019. All data were collected from the banks’ financial reports. However, the necessary information was not always available. Thus, the final sample consists of 99 significant entities, supervised by the ECB, representing 18 countries in the European Union.

**Results and Analysis**

In this section, we examine and discuss our empirical results focusing on main two pillars: i) the impact on capital when the new accounting standard was initially adopted; ii) how the capital buffers evolved, from 2015 to 2019, together with an evaluation of their behaviour after the implementation of IFRS 9.

**Impact on capital buffers at the first time IFRS 9 was adopted**

The first empirical test relates with the calculation of the European bank’s capital buffers \( BPillar1 \), \( BSREP \), \( BOCR \), \( BCET1 \) and \( BrCET1 \) for 31.12.2017 (pre-IFRS 9) and for 01.01.2018 (post-IFRS 9). The variables were winsonized at 5% to assess whether the presence of outliers in the sample could modify the results. The results of the tests carried out with the winsorized sample were consistent with those found in the original database – without the treatment of outliers. Thus, from now on the analysis of the results is concentrated on tests with the original basis.

Moving forward to the analysis of the effects of IFRS 9 when initially implemented, one key factor to be considered is the impact of the regulatory treatment of accounting provisions on the capital, in accordance with the Basel III approach for credit risk. In this context, banks can choose to apply a standardized approach or an internal rating model (IRB). This choice based on the assumption that entities using a standardized model may have further reduction of their capital level, owing to the loss of the prerogative of adding a part of the accounting provisions to the regulatory capital, when the IFRS 9 was implemented.

For this reason, the change to ECL model would reduce the capital of institutions that apply the standardized approach more significantly than those with IRB approach, as suggested in hypothesis H1. In the sample of 99 banks (Table 1) from 18 European Union countries, 36.4% apply the standardized approach and 63.6%, the IRB approach. The characteristics of the countries are quite heterogeneous, and even when some countries are examined separately, there is a relevant disparity. In general, Germany, France, Italy and Spain concentrate 46.5% of the institutions participating in the study, and they are also the countries with the highest concentration of IRB banks, while the other institutions are spread among the 14 other countries.
Table 1: Sample composition by country and type of credit risk approach adopted to calculate regulatory capital

<table>
<thead>
<tr>
<th>Country</th>
<th>Approach</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standardized</td>
<td>IRB</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>France</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Italy</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Spain</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Belgium</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Malta</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Republic of Ireland</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Austria</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Estonia</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Greece</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Latvia</td>
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<td>2</td>
</tr>
<tr>
<td>Lithuania</td>
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<td>0</td>
</tr>
<tr>
<td>Luxembourg</td>
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<td>2</td>
</tr>
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<td>Portugal</td>
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<td>2</td>
</tr>
<tr>
<td>Cyprus</td>
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<td>0</td>
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<tr>
<td>Slovenia</td>
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<td>0</td>
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<tr>
<td>Slovakia</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Finland</td>
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<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>36</td>
<td>63</td>
</tr>
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</table>

Table 2: Mean difference t tests of the capital buffers, on 31.12.2017 and 01.01.2018, by type of credit risk approach according to Basel III

<table>
<thead>
<tr>
<th>Approach</th>
<th>BCET1 31.12.2017 Mean</th>
<th>BCET1 01.01.2018 Mean</th>
<th>BrCET1 Difference %</th>
<th>BPillar1 Difference %</th>
<th>BOCR Difference %</th>
<th>BSREP Difference %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized</td>
<td>0.1677</td>
<td>0.1405</td>
<td>-8.31%</td>
<td>-9.92%</td>
<td>-7.40%</td>
<td>-8.96%</td>
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<tr>
<td></td>
<td>0.1538</td>
<td>0.1266</td>
<td>-0.0139</td>
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<td>-0.0116</td>
<td>-0.0117</td>
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<td></td>
<td>20.531</td>
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<td>-0.0040</td>
<td>-0.0040</td>
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<td>-0.0039</td>
</tr>
<tr>
<td>Significance</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Internal Rating Model (IRB)</td>
<td>0.1198</td>
<td>0.0881</td>
<td>-3.33%</td>
<td>-4.53%</td>
<td>-3.30%</td>
<td>-4.48%</td>
</tr>
<tr>
<td></td>
<td>0.1158</td>
<td>0.0841</td>
<td>-0.0040</td>
<td>-0.0040</td>
<td>-0.0039</td>
<td>-0.0039</td>
</tr>
<tr>
<td></td>
<td>52.538</td>
<td>52.538</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>Significance</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

Which: BCET1 is the Common Equity Tier 1 capital buffer that considers the capital surplus in relation to the specific Common Equity Tier 1 Pillar 1 regulatory requirement; BrCET1 is the restricted Common Equity Tier 1 capital buffer, which considers the capital surplus in relation to all regulatory requirements that must be met entirely with Common Equity Tier 1; BPillar1 is the Pillar 1 capital buffer, which considers the capital surplus in relation to the Pillar 1 requirements; BOCR is the overall capital requirement buffer, which considers the capital surplus in relation to the overall capital requirement applicable to the financial institution; BSREP is the capital buffer for the supervisor review (Supervisory Review and Evaluation Process), which considers the capital surplus in relation to the total SREP requirement.

Statistical significance level: *** (1%), ** (5%) and * (10%)

The results of the mean comparison tests show that, for the five buffers metrics proposed, the pre and post IFRS 9 periods means are statistically different, when comparing banks adopting a standardized approach and banks following the IRB approach. The mean of all capital buffers under analysis (BCET1, BrCET1, BPillar1, BOCR and BSREP) for banks adopting a standardized approach is at a higher level than the mean of the IRB banks. This difference can be explained by the fact that, in December 2017, the mean of the
core capital ratio and the total capital ratio of banks adopting a standardized approach are higher than the mean ratios of the IRB banks approach: core capital ratio of 21.27% and total capital ratio of 23.68% versus core capital ratio of 16.48% and total capital ratio of 19.97%, respectively. Thus, the capital level difference is reflected in all the buffers analysed.

Banks that operate with a higher capital margin have a greater credit expansion capacity and, thus, can explore more easily growth opportunities at times of economic expansion, since they have immediately available capital. However, these banks incur a higher capital cost, as they keep idle a larger volume of the most expensive type of capital (equity). Thus, there is evidence that IRB banks may be managing their capital more efficiently, by keeping their margins lower.

![Figure 2](image)

**Figure 2:** Mean percentage variation of the capital buffers by categories of Basel III credit risk approach: 31.12.2017 x 01.01.2018

As shown in Figure 2 and Table 1, between 31.12.2017 and 01.01.2018, the reduction in all five capital buffers (BCET1, BrCET1, BPillar1, BOCR and BSREP) was more pronounced for banks that applied a standardized approach than for IRB banks. The nominal variations also confirm that the rate of buffer reduction was greater for banks under a standardized approach. The results suggest that when the IFRS 9 was adopted for the first time, there was a greater reduction of capital buffers in European banks that applied a standardized approach for credit risk than was observed in IRB bank buffers, which leads to evidence supporting hypothesis H1.

The analysis of variations in capital buffers, between 31.12.2017 and 01.01.2018, reveals results in line with quantitative studies carried before IFRS 9 came into force (EBA, 2017). It can be argued that the loss of the possibility of adding back general accounting provisions to capital for banks using the standardized approach in fact led to a greater impact on capital buffers for these institutions.

The adoption of an ECL model makes it necessary to model credit components, e.g., Exposure at Default (EAD), Probability of Default (PD) and Loss Given Default (LGD). These metrics require specific premises to be formulated by the bank in view of the particular features of their credit portfolio, and historical data, among other parameters. At the time when IFRS 9 was first adopted, most banks that adopt a standardized approach would be applying these components’ models for the very first time. Thus, it is reasonable to conjecture that the initial application has generated a total credit loss provision more sensitive to the banks’ real needs and also, in most cases, greater. In contrast, banks using an internal rating model are familiar with the assumptions for calculating expected credit losses, may have applied calibrated models to estimative the credit components, which can be adapted for accounting provisioning purposes. This may have led to a less significant variation in the volume of provisions of IRB banks, reflected in a smaller buffer impact.

**The evolution of capital buffers in the IFRS 9 post-adoption period**

The empirical tests to assess the evolution of capital buffers after adopting the expected credit loss model comprises a descriptive statistical analysis of the variables, the performance of tests for ensuring model robustness and, finally, the model (3.3) estimation to test hypothesis H2.

**Descriptive Statistics**

The descriptive statistics of the model (3) variables are consolidated in Table 3, including the half-yearly information from European banks for the entire sample period, from 2015 to 2019.
Table 3: Results of the model estimates (3), in the periods before and after IFRS 9

\[ BCap_{it} = \beta_0 + \beta_1 + \beta_1 BCap_{it-1} + \beta_2 APROA_i + \beta_3 (BCap_{it-1} \times APROA_i) + \beta_4 SIZE_{it} + \beta_5 ROE_{it} + \beta_6 RISK_{cred} + \beta_7 RISK_{assetit} + \epsilon_{it} \]

<table>
<thead>
<tr>
<th>Variables</th>
<th>BCET1</th>
<th>BrCET1</th>
<th>BPillar1</th>
<th>BOCR</th>
<th>BSREP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painel A: pre-IFRS 9 period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.0256**</td>
<td>0.0528***</td>
<td>0.0319***</td>
<td>0.0488***</td>
<td>0.0497***</td>
</tr>
<tr>
<td></td>
<td>(0.0328)</td>
<td>(0.0004)</td>
<td>(0.0094)</td>
<td>(0.0011)</td>
<td>(0.0009)</td>
</tr>
<tr>
<td>Bcap (-1)</td>
<td>0.8633***</td>
<td>0.7460***</td>
<td>0.8828***</td>
<td>0.8063***</td>
<td>0.8254***</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>APROA</td>
<td>0.0122*</td>
<td>-0.0022</td>
<td>0.0202***</td>
<td>0.0051</td>
<td>0.0070</td>
</tr>
<tr>
<td></td>
<td>(0.0461)</td>
<td>(0.7162)</td>
<td>(0.0023)</td>
<td>(0.3494)</td>
<td>(0.2383)</td>
</tr>
<tr>
<td>(Bcap (-1) * APROA)</td>
<td>-0.1523**</td>
<td>-0.0394</td>
<td>-0.3081***</td>
<td>-0.1860**</td>
<td>-0.2034**</td>
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<td></td>
<td>(0.3613)</td>
<td>(0.0072)</td>
<td>(0.2752)</td>
<td>(0.0226)</td>
<td>(0.0313)</td>
</tr>
<tr>
<td>SIZE</td>
<td>0.0495***</td>
<td>0.0517***</td>
<td>0.0510***</td>
<td>0.0520***</td>
<td>0.0536***</td>
</tr>
<tr>
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<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>ROE</td>
<td>0.0670***</td>
<td>0.0767***</td>
<td>0.0671***</td>
<td>0.0654***</td>
<td>0.0592***</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0004)</td>
<td>(0.0009)</td>
<td>(0.0074)</td>
<td>(0.0156)</td>
</tr>
<tr>
<td>RISKAsset</td>
<td>-0.0130*</td>
<td>-0.0211***</td>
<td>-0.0257***</td>
<td>-0.0318***</td>
<td>-0.0300***</td>
</tr>
<tr>
<td></td>
<td>(0.0556)</td>
<td>(0.0163)</td>
<td>(0.0012)</td>
<td>(0.0010)</td>
<td>(0.0002)</td>
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</table>

Painel B: Post-IFRS 9 period

<table>
<thead>
<tr>
<th>Variables</th>
<th>BCET1</th>
<th>BrCET1</th>
<th>BPillar1</th>
<th>BOCR</th>
<th>BSREP</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.0292***</td>
<td>0.0155*</td>
<td>0.0286***</td>
<td>0.0169*</td>
<td>0.0197*</td>
</tr>
<tr>
<td></td>
<td>(0.0009)</td>
<td>(0.0097)</td>
<td>(0.0031)</td>
<td>(0.0098)</td>
<td>(0.0519)</td>
</tr>
<tr>
<td>Bcap (-1)</td>
<td>0.9005***</td>
<td>0.9053***</td>
<td>0.8643***</td>
<td>0.8584***</td>
<td>0.8648***</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>APROA</td>
<td>-0.0216***</td>
<td>-0.0082***</td>
<td>-0.0195***</td>
<td>-0.0071***</td>
<td>-0.0127***</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.0041)</td>
<td>(0.0000)</td>
<td>(0.0120)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>(Bcap (-1) * APROA)</td>
<td>0.2567***</td>
<td>0.2224***</td>
<td>0.2690***</td>
<td>0.2514***</td>
<td>0.2596***</td>
</tr>
<tr>
<td></td>
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<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
</tr>
<tr>
<td>SIZE</td>
<td>-0.0009</td>
<td>-0.0005</td>
<td>-0.0005</td>
<td>-0.0003</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>(0.1136)</td>
<td>(0.4382)</td>
<td>(0.4079)</td>
<td>(0.6790)</td>
<td>(0.9382)</td>
</tr>
<tr>
<td>ROE</td>
<td>0.0026</td>
<td>0.0032</td>
<td>0.0065</td>
<td>0.0074</td>
<td>0.0084</td>
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<tr>
<td></td>
<td>(0.6548)</td>
<td>(0.5874)</td>
<td>(0.3370)</td>
<td>(0.2713)</td>
<td>(0.2205)</td>
</tr>
<tr>
<td>RISKcred</td>
<td>0.0384***</td>
<td>0.0379**</td>
<td>0.0350*</td>
<td>0.0334</td>
<td>0.0330</td>
</tr>
<tr>
<td></td>
<td>(0.0180)</td>
<td>(0.0385)</td>
<td>(0.0677)</td>
<td>(0.1101)</td>
<td>(0.1212)</td>
</tr>
<tr>
<td>RISKAsset</td>
<td>-0.0235**</td>
<td>-0.0227***</td>
<td>-0.0219***</td>
<td>-0.0229***</td>
<td>-0.0222***</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
<td>(0.0002)</td>
<td>(0.0008)</td>
<td>(0.0011)</td>
<td>(0.0018)</td>
</tr>
</tbody>
</table>

Which: BCET1 is the common equity tier 1 capital buffer that considers the capital surplus in relation to the specific Common Equity Tier 1 Pillar 1 regulatory requirement; BrCET1 is the restricted common equity tier 1 capital buffer, which considers the capital surplus in relation to all regulatory requirements that must be met exclusively with Common Equity Tier 1; BPillar1 is the capital buffer of Pillar 1, which considers the capital surplus in relation to the Pillar 1 requirements; BOCR is the overall capital requirement buffer, which considers the capital surplus in relation to the overall capital requirement applicable to financial institution; BSREP is the capital buffer for the supervisor review (Supervisory Review and Evaluation Process), which considers the capital surplus in relation to the total SREP requirement; APROA, is a dummy variable that characterizes the institutional approach for measuring credit risk, assuming 1 for banks that adopt the standardized approach and 0 for institutions with the IRB approach; SIZE indicates the size of institution i, in period t, defined as the natural logarithm of total assets; ROE indicates the profitability level of institution i, in period t, as measured by the return on shareholders’ equity; RISKcred indicates the risk of the credit portfolio of institution i, in period t, defined as the ratio between loan losses allowance (LLA) and the loan portfolio; RISKAsset indicates the risk of the bank's assets, of institution i, in period t, defined as the ratio between risk-weighted assets (RWA) and total assets.

P-value in parentheses. Statistical significance level: *** (1%), ** (5%) and * (10%).
Regarding the variables of interest for the testing hypothesis H2, the findings suggest that for the period before the IFRS 9 adoption, the values of the coefficient $\beta_2$ are positive and statistically relevant for two of the five regulatory capital buffers (BCET1 and BPillar1). Thus, the hypotheses related to the APROA variable in the period prior to the adoption of IFRS 9 were confirmed. In other words, there should be no direct influence between the choice of credit risk approach and the capital buffers, before the implementation of the ECL model. Departing from the adoption of IFRS 9, the results show a negative relationship between banks that adopt a standardized approach (APROA) and each of the analyzed capital buffers (BCET1, BrCET1, BPillar1, BOCR and BSERP). Thus, there is evidence that the change in LLP standard has influenced the relationship between the approach to credit risk calculation and capital buffers.

The joint analysis of the values found for coefficient $\beta_2$ in the pre-IFRS 9 period, with negative $\beta_2$ values in the post-IFRS 9 period, being $\beta_{2,pre\ IFRS\ 9} \geq 0$ and $\beta_{2,post\ IFRS\ 9} < 0$, led to the confirmation of hypothesis H2. In this context, European banks that adopt a standardized approach for calculating the Basel III credit risk suffered a more persistent negative impact on capital buffers than those that adopt an IRB approach, after IFRS 9. It is possible that since the adoption of the IFRS 9, capital margins of banks using the standardized approach suffered from the loss of the prerogative of being able to add a part of the LLP to the capital, which used to make it possible to strengthen regulatory capital by using a part of the general LLP. In contrast, banks using an IRB model kept the option of adding to the regulatory capital the excess of accounting provisions in relation to the prudential metric – benefiting the IRB banks’ capital buffer levels.

Another key factor to be considered when seeking to understand this relationship is the possible influence of capital requirement levels in the buffers. In the post-IFRS 9 period, there was no significant difference between capital requirements, according to the type of approach used to calculate credit risk RWA. In light of this, the possibility that the persistent impact on buffers in the period after the adoption of IFRS 9 may have been decisively influenced by a greater or lesser requirement can be disregarded.

The interaction variable ($Bcap_{-1} \times APROA$) provides evidence of the effects of the capital buffer lagged measure on the current period buffer, but only for banks relying on the standardized approach for credit risk. In the pre IFRS 9 period, this variable showed a negative association with the dependent variable for buffers BCET1, BPillar1, BOCR and BSERP, showing that entities adopting the standardized approach registered lower levels of maintenance or increase in capital buffers, in comparison to those that used the IRB approach. The tests reveal that in the pre-IFRS 9 period, the banks that adopted a standardized approach had registered a less intense “restoration” tendency, or even reduction trend, of capital buffers, compared with those adopting IRB approach. This result may suggest that banks with an IRB approach were already anticipating the impacts of IFRS 9, while those with a standardized approach, perhaps because they still did not master all the mechanisms of the expected losses model, did not do it or did it to a lesser intense.

With regard to the ECL adoption, the lagged capital buffers of banks that adopted a standardized approach begin to show a positive relationship with the buffers from the present period. This change in behavior indicates that, since IFRS 9 came into force, banks relying on a standardized approach for calculating credit risk began to make efforts to restore capital margins more intensely than those adopted IRB approach. These empirical findings corroborate the expectations of hypothesis H3, in the sense that banks that adopted the standardized approach for calculating Basel III credit risk have been taking more intensive measures to rebuild capital buffers than those that rely on an IRB approach.

The greater operational difficulties involved in adapting to new accounting models and capital management, faced by banks that adopt a standardized approach, may eventually lead to a reduction in the ability to anticipate the effects on the capital buffers of adopting the ECL model. Banks that rely on an IRB approach to calculate regulatory capital credit risk can benefit from previous experience in building the model for estimating ECL, and from more efficient capital management. The option for internal modeling allows banks to have a more precise perspective of the risks to which the bank is exposed and the capital needed to support them, which can lead to a faster buffer recovery. In contrast, banks that rely on a standardized approach, must go through an adaptation period to the expected credit loss provisioning model, which probably involves: (i) the formation of their own historical database for measuring credit risk; (ii) the development of models for calculating PD and LGD; and (iii) the calibration of the provisioning model to the real needs determined after the adoption of the IFRS 9. Thus, the recovery of capital margins of banks that adopt a standardized approach may be impaired, compared with what occurs in IRB banks.

Finally, the confirmation of hypotheses H1, H2 and H3 showed that banks using a standardized approach suffered a more significant effect at the time of the IFRS 9 adoption, and their capital buffers also suffered a more significant and persistent negative impact, despite more intensive measures to recover capital buffers in the post-IFRS 9 period. Thus, it is possible that the movement of these banks towards a buffer restoration was more influenced by this initial disadvantage, than the IRB banks that were proportionally less affected and may have anticipated actions to rebuild regulatory capital.

Regarding the control variables, estimates in the pre- and post-IFRS 9 periods revealed that capital buffers are, in general, associated: (i) negatively with bank size (SIZE), confirming Fonseca and González (2010), and Afzal (2015); (ii) positively with the profitability level (ROE), according Nier and Baumann (2006), and Carvalho and Dantas (2021); (iii) positively with credit portfolio risk (RISKCred), in line with the fundamentals presented by Ayuso, Pérez, and Saurina (2004), Flannery and Rangan (2008), and Nier and Baumann (2006); and (iv) negatively with asset risk (RISKAsset), consistent with the arguments of Ayuso et al. (2004), Flannery and Rangan (2008), and Nier and Baumann (2006).


Discussion and Conclusion

Our study investigated whether the effects on the regulatory capital of the ECL model in European banks were different among those that adopted the IRB or standardized approaches for regulatory capital purposes. In line with the hypotheses, the results revealed that banks using a standardized approach suffered a more relevant and pronounced negative impact from the adoption of the ECL model, despite more intensive actions to recover capital buffers in the post-IFRS 9 period. The empirical evidence suggests that entities adopting the IRB approach, may have been already applying concepts related to expected losses for credit risk management purposes, which, very likely, facilitated the adoption of IFRS 9 requirements.

Extending the findings of empirical tests outside the Euro banking system area should be done accounting for eventual differences and specific guidelines regarding regulatory capital. It should also be noted that after the publication of the IFRS 9 in 2016, which came to force only from January 2018, it is possible that some banks have been preparing to receive the standard, adopting capital management actions in the pre-IFRS 9 period, not captured by the method used in the empirical tests. Thus, it is possible, for example, that banks adopting the IRB approach have anticipated actions for capital recompositing because of the ECL model, before it came into force. In any case, the tests were able to detect an impact of the ECL model on capital buffers in all planned scenarios, which guarantees robustness to the findings.

The study fills a gap in the literature, by evaluating the difference in the impact of adopting the ECL model on the banking system, as a function of the credit risk management approach for capital purposes. The study therefore helps regulators to assess the effectiveness of the adopted policies. The empirical results contribute to reinforce the questioning of the ICL model, revealing that the European banking system presented signs of credit risk under-provisioning, with reflections on the adequacy of capital levels. More specifically, this issue was more pronounced among entities adopting the standardized approach to credit risk management. Finally, despite possible differences between jurisdictions, the assessment of what happened in the European banking system can be used as a guidance to other jurisdictions still in transition to the ECL model.

Author Contributions: Conceptualization, M.R.B., J.A.D.; Methodology, M.R.B., J.A.D.; Data Collection, M.R.B.; Formal Analysis, M.R.B., J.A.D.; Writing—Original Draft Preparation, M.R.B., J.A.D.; Writing—Review And Editing, M.R.B., J.A.D., V.L., H.K. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to that the research does not deal with vulnerable groups or sensitive issues.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy.

Conflicts of Interest: The authors declare no conflict of interest.

References


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