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# Expected Credit Losses and Regulatory Capital:
# Effects and Implications of Adopting IFRS 9 for the Capital of European Banks

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Expected Credit Losses and Regulatory Capital:
Effects and Implications of Adopting IFRS 9 for the Capital of European Banks

Dissertation presented to the Accounting Postgraduate Program – PPGCont of the University of Brasília as a requirement for obtaining the title “Master in Accounting”.

Tutor: Prof. PhD. José Alves Dantas

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EFFECTS AND IMPLICATIONS OF ADOPTING IFRS 9 FOR THE CAPITAL OF EUROPEAN BANKS**

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# DEDICATION

*To my dear husband, Lucius, for his constant support.*

*To my wonderful parents,*

*Vincenzo and Hulda, for their unfailing love.*

*And to my sister and brother,*

*Chrystina and Vincenzo, for their genuine friendship.*

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*"If any of you lack wisdom, let him ask of God that giveth to all men liberally and upbraideth not; and it shall be given him"*
*(James Chapter 1 v 5  KJV)*

# RESUMO

O objetivo deste estudo foi verificar, em bancos europeus, o impacto causado pela adoção inicial do modelo de provisionamento com base um perdas de crédito esperadas, de acordo com a IFRS 9, sobre o capital regulamentar calculado no âmbito de Basileia III. Também visou buscar evidências que indiquem uma correção da subestimação ou do excesso de exigência de capital regulamentar no período pré-IFRS 9. Para verificar os efeitos da adoção do IFRS 9 sobre o capital regulamentar dos bancos, foram mensurados e testados empiricamente cinco diferentes *buffers* de capital, utilizando dados de 99 entidades significativas supervisionadas pelo Banco Central Europeu, representando 18 países da União Europeia, no período entre 2015 e 2019. Os resultados dos primeiros testes revelaram que houve uma redução estatisticamente significativa do nível dos *buffers* de capital dos bancos europeus, imediatamente após a adoção da IFRS 9. Essa redução foi mais intensa entre os bancos que adotam abordagem padronizada para cálculo do RWA de risco de crédito, em comparação com os que usam abordagem IRB. Considerando especificamente o *phase-in* de transição do IFRS 9, proposto pelo BCBS, a intensidade da redução dos *buffers* foi maior para os bancos que optaram pela aplicação dos arranjos de transição. Os testes utilizando modelos de regressão com dados em painel, confirmaram a premissa de subestimação dos requisitos de capital no período anterior à adoção da nova norma contábil de provisionamento por perdas esperadas, com evidências relevantes de que os bancos europeus estão implementando ações para restaurar os *buffers* de capital consumidos pela adoção inicial do IFRS 9. Estimativas adicionais realizadas controlando os bancos segundo a abordagem de risco de crédito de Basileia III, revelaram que os bancos que usam a abordagem padronizada sofreram um impacto negativo mais persistente nos *buffers* de capital do que aqueles que usam a abordagem IRB, após a entrada em vigor do IFRS 9. Na sequência, testes empíricos adicionais geraram evidências de que os *buffers* de capital dos bancos que aplicaram os arranjos de transição apresentam menor tendência de recomposição, ou mesmo redução, após a adoção do IFRS 9. Este estudo contribui para o avanço da literatura sobre o modelo de provisionamento de perdas de crédito esperadas em bancos e capital regulatório, aproveitando o ambiente de pesquisa único, criado pela adoção do IFRS 9. Após a análise dos resultados, há razões para acreditar que o sistema bancário europeu estaria sub capitalizado no período pré-IFRS 9, e o modelo de perdas esperadas contribuiu para a identificação e correção deste problema. Os órgãos reguladores e normatizadores podem utilizar os resultados desta pesquisa para realizar estudos de impacto, avaliar as condições de aplicação do modelo de perdas esperadas e as possíveis consequências para a solvência bancária. Pesquisas futuras podem explorar o impacto da adoção do IFRS 9 em determinados nichos bancários ou países específicos, identificando outras variáveis que podem influenciar o comportamento dos *buffers* de capital a partir de 2018, ou verificar a manutenção ou alteração das tendências encontradas neste estudo.

**Palavras-chave:** Perdas de Crédito Esperadas. IFRS 9. Capital Regulatório. Bancos.

# ABSTRACT

The purpose of this study was to determine the initial effects of adopting the provisioning model based on expected credit losses, in accordance with IFRS 9, on the regulatory capital of European banks, calculated within the terms of the Basel III framework. It also seeks to search for evidence that may indicate a correction of the underestimation or excess of regulatory capital requirement in the pre-IFRS 9 period. Five different capital buffers were measured and empirically tested to determine the effects of adopting IFRS 9 on the regulatory capital for the banks, by drawing on data from 99 significant entities supervised by the European Central Bank, representing 18 European Union countries, in the period 2015 - 2019. The first test results revealed that there was a statistically significant reduction in the level of capital buffers of European banks, when the IFRS 9 was first adopted. This reduction was more pronounced among banks that adopt a standardized approach to credit risk (RWA), than those that relied on an IRB approach. In light of the IFRS 9 transition phase-in, suggested by BCBS, the intensity of the buffer reduction was greater for banks that chose to apply the transitional arrangements. The tests using regression models with panel data, confirmed the premise that there was an underestimation of capital requirements in the period prior to the adoption of the new ECL accounting standard, together with significant evidence that European banks are taking measures to restore capital buffers absorbed by IFRS 9 when first adopted. Additional estimates carried out differentiating banks in accordance with the Basel III credit risk approach, revealed that banks that adopted a standardized approach suffered more persistent negative effects on capital buffers than those that relied on an IRB approach, after the IFRS 9 came into force. Following this, additional empirical tests provided evidence that the capital buffers of banks where transitional arrangements were applied, show less tendency for "restoration", or even reduction, after the adoption of IFRS 9. This study makes a research contribution to the literature related to provisioning model for expected credit losses in banks and regulatory capital, and taking advantage of the unique research environment, created by the adoption of IFRS 9. After analyzing the results, there are reasons to believe that the European banking system were under-capitalized in the pre-IFRS 9 period, and the ECL model had assist in detecting and correcting this problem. Regulatory bodies and standard setters will be able to draw on these research results to carry out "impact studies", to assess the conditions for applying the ECL model and its possible implications for bank solvency. Future research studies should explore the impact of adopting IFRS 9 in banking niches or particular countries, by identifying other variables that may have influenced the behavioral pattern of capital buffers from 2018 onwards, or confirm if the trends found in this study will be maintained or altered.

**Keywords:** Expected Credit Losses. IFRS 9. Regulatory Capital. Banks.

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| | |
|---|---|
| ASC | Accounting Standards Codification |
| BCBS | Basel Committee on Banking Supervision |
| BIS | Bank for International Settlements |
| CECL | Current Expected Credit Losses |
| CET1 | Common Equity Tier 1 |
| DW | Durbin-Watson |
| E&Y | Ernst & Young |
| EBA | European Banking Authority |
| EIR | Effective Interest Rate |
| EL | Expected Losses |
| ESRB | European Systemic Risk Board |
| EU | European Union |
| EEL | Excessive Expected Loss |
| FSB | Financial Stability Board |
| FSI | Financial Stability Institute |
| IRB | Internal Ratings-based |
| IAS | International Accounting Standards |
| IASB | International Accounting Standards Board |
| FASB | Financial Accounting Standards Board |
| IFRS | International Financial Reporting Standards |
| LGD | Loss Given Default |
| NPL | Non-performing Loan |
| OCR | Overall Capital Requirement |
| PD | Probability of Default |
| SEC | Securities and Exchange Commission |
| SREP | Supervisory Review and Evaluation Process |
| G-SIBs | Systemically Important Banks |
| ECL | Expected Credit Loss |
| USA | United States of America |

**SUMMARY**

# 1 INTRODUCTION

## 1.1 Contextualization

Among the significant factors required for establishing a sound and efficient financial system, timely recognition of credit losses and adequate provisioning for them play a key role. Following the 2008 financial crisis a debate began about the role of accounting in ensuring financial stability (Bischof, Laux, & Leuz, 2018; Seitz, 2019), and it was found that provisions based on incurred losses often prove to be insufficient to bear losses associated with credit risk, as well as being inadequate with regard to the moment of recognition (BCBS, 2017). Studies from the Financial Stability Board (FSB), conducted in 2009, showed that the increases of volume of provisions when the losses materialized led to a pro-cyclical effect, and thus aggravated the crisis (ESRB, 2017). A report from the Financial Stability Forum (FSF) on pro-cyclicality, also published in 2009, underlined the fact that a timely identification of credit losses is consistent with the needs of financial statements users and a policy of transparency about any changes in credit trends, to ensure the safety and soundness of the financial system. The FSF also recommended that the International Accounting Standards Board (IASB) and the Financial Accounting Standards Board (FASB) should revise the incurred loss model for recognizing and measuring credit losses (FSF, 2009).

Additionally, the G20[1] raised concerns about the accounting methods employed by banks to assess credit losses and the incurred loss model, and argued that this model delays the recognition of losses and, hence, prevents any corrective measures from being taken by financial institutions. A lack of proper risk assessment and the pro-cyclical nature of the impairment recognition, resulted in underestimated and delayed provisions (too little, too late), and this has led to severe criticism of the accounting method (Barth & Landsman, 2010; Curry, 2013; Seitz, 2019; Pucci & Skaerbaek, 2020). By requiring banks to wait for a loss event that had already been incurred before they could recognize the resulting loss, the accounting model prevented them from recognizing provisions that were suited to the emerging risks which could be reasonably anticipated. Thus, the recognition of large volumes of loan loss provisions amid a credit slowdown, generally at a time when profits and lending capacity were already experiencing stress, leads to pro-cyclicality.

In light of this, several studies have explored how provisioning practices based on the

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[1] Group created in 1999, formed by the 19 largest economies in the world, represented by the finance ministers and heads of central banks, and the European Union. The main goals of the G20 are to coordinate policies among its members that can foster sustainable growth and economic stability.

incurred loss model (backward-looking) can contribute to the pro-cyclicity of bank loans and business, while provisions based on the expected loss model (forward-looking) can cooperate to reduce pro-cyclicality (Bikker & Metzemakers, 2005; Agénor & Zilberman, 2015; Haan's Pool & Jacobs, 2015). The term "pro-cyclicality" refers to the interaction between the financial and 'real' sectors of the economy, which tend to strengthen each other, by broadening the business cycle fluctuations, which cause and/or aggravate financial instability (FSB, 2008; Cohen & Edwards Jr, 2017).

Furthermore, the recognition of losses during the financial crisis was viewed as inappropriate, since a significant volume of credit losses was recognized during the crisis, leading to the depletion of regulatory capital (Beatty & Liao, 2013), underlining the close relationship between banking accounting and prudential regulation. Equity, as determined by accounting rules, is the starting point for calculating the banks' regulatory capital. Thus, the recognition and provisioning for losses determines both the profits and equity of banks and can have a direct effect on regulatory capital as defined by the prudential framework. Several studies explore this interaction, which can lead to incentives for bank capital management through loan provisions (Bikker & Metzemakers, 2004; Bouvatier & Lepetit, 2008; Floro, 2010; Packer & Zhu, 2012; Curcio & Hasan, 2015; Dantas, Micheletto, Cardoso, & Freire, 2017), as well as showing that the credit provisioning model adopted by banks can have a significant effect on bank regulatory capital.

Minimum capital requirements for banks are essentially risk-sensitive and have a potential pro-cyclical effect on the economy (Turner, 2000; Borio et al., 2001; Segaviano & Lowe, 2002; Andersen, 2011; Torres-García, Ballesteros-Ruiz & Villca-Condori, 2019). In times of economic downturn, for example, it is likely that the bank asset quality may see a sharp deterioration, and increased exposure to risk and, thus, capital needs, exactly at the time when obtaining additional capital becomes more expensive or, in the case of weaker institutions, quite difficult. As a result, banks may be forced to reduce their loan portfolios, which will further weaken the economy in a credit crisis and accelerate the downturn, particularly in countries where corporate loans are provided mainly by banks (Bikker & Metzemarkers, 2005). Given this close relationship between provisions and capital, it can be argued that a solid provisioning policy must be part of any regulation of capital requirements (Cavallo & Majnoni, 2002; Céspedes, 2019).

As a result of the financial crisis, the incurred loss model was seen as responsible for the delay in loss recognition, and this encouraged a change in accounting standards to an expected credit loss model (Bischof et al., 2018). Thus, the effects of the crisis led to a questioning of the value of provisioning based on incurred losses and had a decisive influence on the edition of the International Financial Reporting Standard (IFRS) 9, in July 2014, and the Accounting Standards Codification (ASC) 326, in June 2016, by IASB and FASB, respectively. The IFRS 9 was incorporated into the European Union (EU) regulatory framework in November 2016 and became mandatory from January 1, 2018 onwards. The American standard came into effect on January 1, 2020 for banks that are required to regularly submit financial information to the Securities and Exchange Commission (SEC) and from January 1, 2021 for other institutions, with an early application allowed for all banks from 2019 onwards. With some differences, both reforms stated that banks must provision for expected credit losses from the time a loan is originated, rather than wait for specific events that could trigger imminent losses. The new rules are expected to change the behavior of banks during credit crises, by potentially reducing pro-cyclicality (Cohen & Edwards Jr, 2017), and, at the same time, affect the volume of regulatory capital held by financial institutions and the way banks manage that capital.

**1.2 Research Problem**

Loan loss provisions – considered to be the main accruals of financial institutions (Kanagaretnam, Krishnan and Lobo, 2009) – have a significant influence on the regulatory capital rates calculated within the Basel Accord framework, owing to the effects of accounting provisions on the capital (BCBS, 2017). Thus, it can be expected that the changes implemented in the accounting practices for provisioning, will be reflected in the regulatory rates of the financial institutions.

Concerns about the level of interference of the provisioning model in the regulatory capital requirements have led to discussions in Europe and the US between entities representing banks, audit firms and regulatory bodies. This has been particularly the case in recent years, as the implementation of the expected credit loss model (ECL) draws near. One of the main concerns raised in these forums is the negative impact on the regulatory capital of the banks, caused by a significant increase in credit loss provisions, especially at the time when the new model is adopted, based on the argument that a reduction in capital rates does not reflect an increase in the credit risk of the bank portfolio.

Owing to its prospective approach, the ECL model should result in an earlier and greater recognition of loan losses (Novotny-Farkas, 2015), and thus help to mitigate pro-cyclicality, and overcome the "too late" problem caused by the incurred loss model, in accordance with IAS 39 (Domikowsky, Bornemann, Duellmann, & Pfingsten, 2014). This means that if IFRS 9 works as expected, the loan loss provisions that reflect the expected credit losses, in accordance with the new standard, must exceed the levels of the reserves outlined by IAS 39.

Thus, if this expectation is confirmed, the negative impact on regulatory capital arising from an increase in loan loss provisions, and caused by a change in provisioning accounting practices, necessarily implies a reduction in capital rates, all else being equal. Since the Basel regulatory requirements have remained unchanged, it will be necessary to restore the capital consumed by the increasing of the loan loss alowance, if the institution wishes to maintain the solvency at the same levels they were before the adoption of IFRS 9. Hence, in light of the interaction between the Basel III framework and IFRS 9, it is plausible to expect that regulatory capital might be underestimated before the application of IFRS 9, and that the restoration of capital would result in the correction of this underestimation. On the other hand, if the regulatory solvency indicators do not return to pre-IFRS 9 levels, it could be argued that there would be an overestimation of capital needs before the new provisioning model was adopted.

In view of the above, an attempt is made to answer the following research questions: a) **Did the adoption of the impairment model based on expected losses significantly influence the regulatory capital of European banks? b) After the adoption of the new model, is there evidence of a correction of underestimated or excessive capital requirement in the pre-IFRS 9 period?**

### 1.3 Research Objectives

In light of the research questions, the general objective of this study is to determine the effects on the regulatory capital of the initial adoption of the provisioning model based on expected losses in European banks, in accordance with the requirements of the IFRS 9. Subsequently, involved searching for evidence of a correction of underestimated or excessive regulatory capital requirements in the pre-IFRS 9 period. The premise is based on the assumption that the evidence found of capital structure restoration after the implementation of the new model, indicates there has been an underestimation of regulatory capital. On the other hand, if the capital loss caused by the increase in credit provisions is not restored, resulting on the maintenance of the capital level below that observed during the term of the IAS 39, this would provide evidence of an overestimation of regulatory banking capital in the period pre-IFRS 9.

To achieve this general objective, the following specific goals need to be attained:

a) To measure the effect of the expected losses model on bank regulatory capital at the time when IFRS 9 was adopted, which makes it possible to assess the impact on regulatory capital caused solely by the implementation of the new loss provision model set up by the new accounting standard; and

b) To empirically test the behavior of capital buffers, in the context of the adoption of IFRS 9 for European banks. The buffers are defined as the capital surplus maintained by the bank in comparasion with Basel III minimum capital requirements. This entails searching for evidence of whether or not the capital has been restored to the pre-IFRS 9 level, which would suggest a probable underestimation of regulatory capital. If a restoration is not determined, the hypothesis confirmed would be that of an overestimation of regulatory capital during the effectiveness of the incurred credit loss model.

### 1.4 Justification and Relevance

In the years following the 2008 global financial crisis, the impairment model based on incurred losses was widely criticized, mainly because it resulted in provisions called "too little, too late". In an attempt to overcome this problem of inefficiency, IFRS 9 introduced a new accounting impairment structure based on the expected credit loss model. With regard to the provisioning models and their effects on the banking system, attention should be drawn to the following research pathways:

a) <u>The relationship between the banks' provisioning model and pro-cyclicality:</u> provisioning practices can contribute to the pro-cyclicality of bank loans and of the business cycle. Provisioning is important not only because the provisions serve as a cushion against loan losses, but also because they provide significant information on how banks assess credit risk. Pro-cyclicality in provisioning can thus mean that, during an expansion (boom) period of the economic cycle, credit risk is underestimated. This creates conditions for strong credit growth, followed by a period of crisis in which credit risk is overestimated, which leads to negative developments in the real economy. Some of the research studies that have sought to explore this relationship are Borio et al. (2001), Cavallo and Majnoni (2002), Laeven and Majnoni (2003), Bikker and Metzemakers (2005), Bouvatier and Lepetit (2008), Dungan (2009), Agénor and Zilberman (2015), Abad and Suarez (201), and Araújo and Lustosa (2017).

b) <u>Effects of provisioning for credit losses on bank regulatory capital:</u> owing to the need for discretion in estimating the provision for bank credit losses, the provisioning policy may pursue different objectives, including regulatory capital management. The existing literature suggests that the provision for loan losses is a tool that is widely used by financial institutions for the purposes of generating stable profits, as well as risk and capital management. These studies include those by Kim and Kross (1998), Beatty, Chamberlain and Magliolo (1995), Ahmed and Thomas (1998), Cebenoyan and Strahan (2001), Anandarajan and Lozano-Vivas (2003), Anandarajan, Hasan and McCarthy (2007), Bushman and Williams (2012), Andries, Gallemore and Jacobs (2017).

Previous research has sought to explore the dynamics between provisioning for credit losses and regulatory capital requirements – in some cases seeking for empirical evidence of capital management through provisions – against the background of the changes brought about by the Basel Accord and its requirements. The justification of the present study and its significance is that it seeks to assess the effects of changes in the accounting standard of provisioning on bank regulatory capital, as maintaining a suitable level of provisions plays an essential role in ensuring bank solvency and financial stability. Following the adoption of IFRS 9, which determines how the expected credit loss provision model will operate, a particular environment for research was created, which allowed the effects of the changes in accounting methods to be isolated and tested empirically. Likewise, the behavior assessment of capital in the period after the new standard adoption, makes it possible to understand the interactive dynamics between bank reserves when faced with expected losses (accounting provisions) and when bearing unexpected losses (capital).

The analysis of capital behavior to a great extent, enhances our funderstanding of factors related to the soundness, capital costs and credit supply expansion policies of banks. In this context, the adoption of IFRS 9 within the domain of the European markets offers an opportunity to expand knowledge of the influence of the expected credit losses model on capital, together with other factors arising from the behavioral trends of banks after the adoption of the accounting standard.

One of the driving-forces behind the changes in accounting standards with regard to a provision for credit losses was the need to ensure financial stability in times of crisis. This involved both the banking regulatory bodies and the policymakers responsible for accounting standards who sought to mitigate the risk of spreading a financial crisis to the real economy. Thus, examining the impact of adopting IFRS 9 in the European banking system, provides evidence of what may happen in other key markets, such as in the US and Brazil, with regard to the effects of the change in the loss recognition model on banking capital and financial soundness. In addition, the consequences of adopting one or other accounting models for credit loss provisions, should have a significant impact on the way banks assess and grant credit, as well as on regulatory capital management, which is inherently sensitive to credit risk.

In the case of the academic world, this study combines a list of research studies that link a provisioning model for expected credit losses for banks, regulatory capital, and financial institutions, with an empirical approach, at a time of change of provisions accounting standards in the international arena.

### 1.5 Research Structure

In addition to discussing the question of contextualization, the research problem, the objectives of this study, the basis of its justification and significance, as highlighted above, this study is divided into the following chapters:

- Chapter 2 establishes the theoretical framework, which lists the underlying features of the research, which include the following: addressing regulatory capital, discussing provisioning model based on incurred losses and expected losses, and estimation models for credit loss provisioning. The definition of the research hypothesis is underpinned by the theoretical framework and literature review.
- Chapter 3 highlights the methodological procedures that characterize the empirical testing design, including the definition of the models, variables, data sources and sample.
- Chapter 4 describes the results obtained, based on a description of the data analysis and examines results of the model for the econometric and estimation, used to test the research hypotheses.
- Chapter 5 summarizes the conclusions of the study, based on a panoramic view of the subjects treated, and the results obtained are compared with the theoretical premises and literature review.

## 2. THEORETICAL FRAMEWORK

The change in the accounting standards from the incurred loss approach to the expected credit loss model in banks, is one of the responses to the 2008 financial crisis and aimed at reducing 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. Moreover, in addition to reflecting more adequately (and in a timely manner) the credit risk to which the institution is exposed, this would also reduce unforeseen bank capital shocks during an economic recession, when the recognition of losses has an adverse effect on regulatory capital.

In the following sections, there will be an investigation of factors related to the incurred loss model and expected credit loss model, especially the driving-force behind the changes brought about by IFRS 9 and the expectations aroused by the effects of the new standard. Issues will also be addressed arising from the role of regulatory capital in banks, and the type of loss that this capital must bear, as well as its interaction with IFRS 9.

### 2.1 IFRS 9 Adoption and the expected Credit Loss Model

The accounting model based on provisioning for incurred credit losses only requires a recognition of an impairment that has already been incurred as of the balance sheet date, and not a prediction of probable future losses. According to this approach, losses can be detected through the occurrence of events that alter the credit quality and are also supported by observable evidence – such as the loss of a debtor's job, a decrease in the letter of guarantee value, the status of default, and so on – combined with expert judgment (Cohen & Edwards Jr, 2017). In turn, the expected credit loss model has a forward-looking approach, which emphasizes changes in the probability of future credit losses, even if the events responsible for triggering these losses have not yet occurred. Thus, the provisions view the expectation of losses within a more realistic timeframe, and are not restricted to those incurred on the date of the financial statements report (Dugan, 2009).

A key factor is the limited definition for identifying a significant increase in credit risk based on appropriate criteria and leading to a gradual recognition of credit losses over time, thus reducing the risk of pro-cyclicality at the beginning of the crisis. Suitable criteria for determining a significant increase in credit risk should on the one hand, avoid a delayed recognition of credit losses when they have already increased materially and, on the other hand, excessive credit restrictions in conditions that are still favorable (ERSB, 2019).

In light of this, the expected credit loss model that replaces the incurred loss model, should have a preventive effect, by leading to a much faster crystallization of loan losses and an improvement of credit quality control in the banking sector. However, the rapid materialization of losses in an expected credit loss model affects bank capital more quickly, and makes it essential for banks to be adequately capitalized (Hoogervost, 2014; Deloitte, 2016; Abad & Suarez, 2018; Rocamora, Garcia, Burke & Rubio, 2017).

According to Borio and Lowe (2001), if loan rates reflected credit risk properly and accurately, banks would have no reason to make additional provisions, and could seek to cover expected credit losses, when granting a loan. The higher Net Interest Margin on a riskier loan would reflect the increased risk of default. Hence, the interest rate of the loan would cover all the expected losses during the period of its duration (Novotny-Farkas, 2016). However, capital would still be needed to deal with unexpected losses. A recognition of provisions for credit loss would thus be appropriate if the credit risk of the loan increases at a later time than when it was initially granted. As part of the fair value accounting, the amount of the loan would be reduced to reflect the higher risk, through a higher discount rate for future cash flows coming from that loan – likewise, in this situation, the value of the loan could even increase if there is a fall in the risk attached to the asset.

It is worth reflecting on why the provisions should be based on expected credit losses, from the moment a loan is granted. According to Cohen and Edwards Jr. (2017), one answer is that the initial loan pricing may not reflect the risks caused by transitory market conditions, i.e., changes in the market or in macroeconomic conditions, which can modify the credit risk attached to the assets. If the past experience of the financial institution and a reliable model for risk prediction suggests that the credit risk is not fully reflected in initial loan pricing decisions, prudent risk management should seek to supplement this initial pricing with provisions for expected credit losses.

Arguments related to bank capital provide a second explanation: the regulatory obligation to maintain an adequate capital level, or to improve it when there is an imminent risk of a shortfall, is more important when making decisions about granting credit during tough economic times, than it is when the economy is sound, which creates a tendency to lend more liberally during the expansionary phase of the economic cycle (Dugan, 2009; Peek & Rosengren, 1995). Thus, the prospective provisioning for credit risk, which will be essentially higher at the boom periods of the economic cycle, when the volume of credit is greater, has the effect of anticipating an additional cost of capital, through loan loss provisions, and serves to reduce the incentive that was initially created.

Recognizing provisions based on the incurred loss model depends on determining a loss event that might incur a future loss and also can be measurable with a certain degree of accuracy. These are characteristics that define the model as backward-looking, in so far as only past or ex-post events, are reflected (Bouvatier & Lepetit, 2008). Banks only recognize losses attached to a credit risk when there is objective evidence that the impairment has already occurred on the reporting date. In this way, the incurred loss model can result in loss recognition at a time immediately prior to the default, which is usually very late (Hoogervost, 2014). Essentially, this means that loan losses are only taken into account when the probability of default (PD) is close to 100% (Novotny-Farkas, 2016).

On the other hand, the expected credit loss model (ECL) determines that banks must recognize loan loss provisions in terms of their credit loss expectations, which implies assessing information from past events and current conditions, as well as reasonable forecasts. In addition, the institutions should update the amount of recognized provision so that changes in the financial assets with a credit risk are reflected. Estimates are made of future losses based on a forward-looking approach, regardless of objective evidence at the time of provisioning (Araújo, Lustosa, & Paulo, 2017). It should be noted that the new standard eliminates the requirement for a trigger event, or a specific decisive event, for credit loss recognition. The new IASB and FASB standards for provisioning for expected credit losses have several common features, and both aim to provide stakeholders with financial statements that have more useful information on credit risk provisions. Both standards establish that the measurement of provision for loan losses should be based on reasonable and verifiable information, which must include historical and current data, and predicted information, since the use of forecasts is one of the main novel features.

However, there is an essential difference between the IASB and FASB models with regard to the timing of provision recognition. According to the current expected credit loss standard (CECL), and the FASB standard, lifetime expected credit losses should be held for all loans, at the time when they are originated, while IFRS 9, from IASB, prescribe a phased approach (Chae, Sarama, Vojtech, & Wang, 2017; Novotny-Farkas, 2016). The provision recognized for initial loan granting is expected to be higher under the CECL, since there is a requirement for lifetime ECL recognition. Under IFRS 9, the loan loss provision upon initial recognition will be lower because, generally, only a proportion of the lifetime expected credit loss is initially recognized. Nonetheless, this difference adds additional complexity to the IASB model, as it will be necessary to identify the exact moment when a significant increase in credit risk can be predicted, if it occurs, from the time of the initial loan recognition (PwC, 2017). Table 1 summarizes some of the most significant differences between FASB and IASB standards.

**Table 1 -** CECL x IFRS 9: Main differences

| CECL Model – FASB | IFRS 9 – IASB |
|---|---|
| Lifetime expected credit losses are recognized when the initial loan is first granted, as a provision for loan losses. | Following the initial recognition, only a proportion of lifetime ECL resulting from possible default events within 12 months after the reporting date are recorded ("Stage 1"). Lifetime expected credit losses are subsequently recorded only if there is a significant increase in the credit risk of the asset ("Stage 2"). Once there is objective evidence of impairment ("Stage 3"), the lifetime ECL continues to be recognized, although the interest revenue is calculated on the net carrying amount (that is, the amortized cost of the credit provision). |
| Changes in ECL estimation are generally recognized at each reporting period through earnings as a credit expense or a reversal of credit expense. | The loss provision estimation is adjusted at each reporting period, with recognized changes in profit or loss, as an impairment gain or loss. |
| No definition of default is given. | A definition of default should be applied that is consistent with the definition used for internal credit risk management purposes. However, there is a rebuttable presumption that default occurs when a financial asset has been overdue for 90 days, which can be rebutted when the institution has reasonable evidence that applying a different default criterion would be more appropriate. |
| There is no explicit requirement in the standard to take account of various prospective scenarios when measuring expected credit losses. However, the scenario used must be carefully selected so that it accurately represents the expected credit losses. | IASB believes that a single prospective economic scenario would not fully achieve the objectives of IFRS 9 when there is a non-linear relationship between possible prospective economic scenarios and their associated credit losses. In such circumstances, more than one forward-looking scenario should be used, that cover a wide range of possible outcomes. |

Source: adapted from PwC (2017)

More specifically, IFRS 9 requires banks to recognize ECL in three stages, when deterioration in credit quality occurs. In Stage 1, a recognition of a twelve months period of expected credit losses is required, while for Stages 2 and 3, there is a need to recognize lifetime expected credit losses. The provision in Stage 1 must be recognized as soon as a loan is granted, since it is calculated on the basis of the loan's probability of default (PD) in the next twelve months multiplied by how much the bank stands to lose on the loan if it actually suffers a default (i.e. a loss given default – LGD). Thus, the twelve-month ECL period is the proportion of the lifetime ECLs where there is a possibility of a loan defaulting in the next twelve months – it is worth noting that this does not refer to the expected cash deficits in the next twelve months, but the effect of the entire credit loss on a loan during its lifetime, weighted by the likelihood that

that loss will occur in the next 12 months (BIS, 2017). This means that the provision for losses in Stage 1 is a proxy for the initial expectations of credit losses (Barclays Capital, 2017).

If there is a significant deterioration in loan credit quality after its origination, but without any objective evidence of impairment, banks should recognize the expected loss for the lifetime of the loan, which corresponds to Stage 2. The amount of the provision in that stage must correspond to the probable default during the remaining lifetime of the loan multiplied by the LGD. Thus, the difference in expected loss between Stage 2 and Stage 1 is the difference in the PDs when the predicted timeframe is extended from twelve months to the overall lifetime of the loan. If the loan goes into default (usually when the borrower is more than 90 days in arrears), this loan is then classified as Stage 3 and becomes a non-performing loan (NPL). The amount of provisions to be recognized at this stage is calculated as the net amount of the provisions previously made for Stages 1 and 2 (Barclays Capital, 2017).

IFRS 9 assumes that a loan has a significant credit risk when it is in arrears for more than 30 days and should thus be classified in Stage 2 or 3 from that moment. The provisions for credit losses in Stage 3 are similar to those made in accordance with the model for incurred losses. Thus, the recognition of ECLs for the lifetime of the loan will be made earlier in the new expected loss model, when there is a significant increase in credit risk, (Stage 2), but before the real default, (Stage 3).

In an incurred loss model, a financial crisis or an economic downturn, increases credit risk and, hence, the provision for bank losses. A notable buildup of the loan loss allowance affects profits and banking capital, and aggravates the crisis, as well as, creating a pro-cyclical effect. Credit risk grows in times of strong economic expansion - since a boom period can lead to an excess of credit-granting and a less stringent assessment of risk, and then materializes during periods of economic downturn (Pool et al., 2015). As a means of avoiding these effects, and operating in accordance with the counter-cyclical approach, provisions must be positively correlated with the loan cycle, and banks must recognize properly the credit risk. This entails accumulating reserves during better times to be in a better position to face loan losses in worse times (Bikker & Metzemakers, 2005). This countercyclical behavior presupposes that banks are willing to undertake a prospective risk assessment that is compatible with the model for the expected credit loss provisioning.

Although there is a general awareness that the new ECL approach should assist in ensuring financial stability (ESRB, 2017), there are concerns about the ECL estimates. Depending on these estimates, the volume of the provisions for loan losses may end up increasing the pro-cyclical effect when compared with the incurred loss model. A change for the worse in aggregate credit market conditions, such as an economic contraction or the beginning of a crisis, might lead to a sudden increase in ECLs just when economic conditions are deteriorating. Additionally, the reaction of individual banks to the increase in expected credit losses, in view of their effect on profits and regulatory capital, may either cause or intensify a credit crisis and, again, have serious repercussions on the financial system (Abad & Suarez, 2018).

In a further exploration of loss estimates, Borio and Lowe (2001) believe that provisioning for expected losses with the aim of reducing pro-cyclicality is likely to have a relatively small effect. This view reflects the idea that banks tend to underestimate losses and credit risk at a time of economic upturn and, conversely, overestimate them during a recession. These inaccurate measurements lead to an incorrect, albeit unintentional, calculation of loan loss provisions, even though they are prospective.

Another factor that should be noted is that, in general, the early recognition of losses requires close scrutiny by risk managers, since more specific information about a credit loss will become available over time. The higher degree of subjectivity in calculating loan loss provisions may end up affecting accounting information comparability between banks. Thus, the application of consistent accounting policies and practices during the different periods becomes even more important (Sanchidrián & García, 2017).

The size and evolutionary pattern of the provisions, including changes in the loan stage, will depend on how long it takes for banks to incorporate relevant information and update the amount of the credit loss provision. This particularly applies to the change of classification from Stage 1 to 2, if the institution is not able, or willing, to detect a significant increase in credit risk in a timely manner. As a result, losses may continue to be recognized later, in a similar way to what was observed in the incurred loss model (Novotny-Farkas, 2016). Thus, it is reasonable to assume that there is a greater scope for judgment and management criteria under the expected credit loss model than in the incurred loss model. A proper application of the expected credit loss model by banks is essential to substantially mitigate pro-cyclicality.

As stated by Bholat, Lastra, Markose, Miglionico and Sen (2018), bad lending practices and a poor credit risk assessment are the factors that cause financial crises, not accounting per se or, more specifically, the provisioning model. A timely recognition of problematic loans and credit losses, together with a suitable degree of transparency on the part of the institutions, is even more important to prevent and mitigate crises, by providing a proper disclosure of the credit risk carried by banks.

After adopting the expected credit loss model, it is likely that banks will also reevaluate their credit granting policies and credit risk appetite. Long-term loans could potentially become riskier, and hence credit lines with longer terms could be reduced, for example, as a part of a strategic view of expected loan loss provisions. An alternative strategy is for banks to seek to cut back their lines of credit when the economy shows signs of contraction, since from then on, the probability of default (PD) could be increased. Thus, the expected credit loss model could have the unintended consequence of worsening a recession (Barclays Capital, 2017), or even lengthening its duration. On the other hand, the new standard may encourage banks to make innovations, by attempting to increase service revenues, and make more detailed assessments for granting credit.

## 2.2 The Effect of Expected Credit Loss on Regulatory Capital

According to the Basel Accord (BCBS, 2005), one of the roles of capital in banking is to provide a reserve for protection against peak losses that exceed expected levels, as illustrated by the peaks above the dashed line in Figure 1. Peak losses do not often occur, but when they do materialize, they can be potentially quite large. Losses above expected levels are usually called unexpected losses – those that banks know are probably going to occur, but whose exact timing and degree of gravity are unknown in advance. To some extent, interest rates, including risk premiums, 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 peak losses. The expected losses – predicted in terms of the average level of credit losses that the bank reasonably expects to experience – are shown in Figure 1 by the dashed line. Financial institutions regard expected losses as a cost component for doing business and manage them in a variety of ways, including through pricing for credit exposure and provisioning.

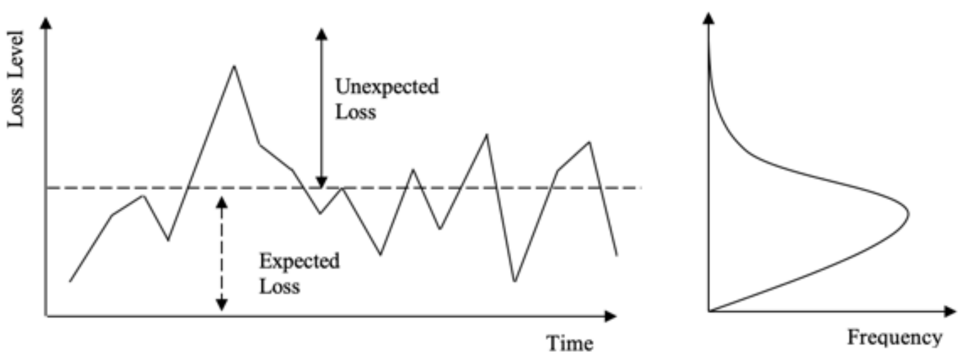


**Figure 1 -** Perspectives of expected loss and unexpected loss, including levels of loss and frequency
**Source: adapted from BCBS (2005)**

Thus, regulatory capital must face the problem of the occurrence of unexpected losses, that is: high losses, although low in frequency. In addition, provisions for credit losses should absorb expected losses - those that occur more frequently, in less significant amounts (Araújo et al., 2017). The effectiveness of regulatory capital as a cushion to absorb unexpected shocks is based on the existence of a first level of protection, created through 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 the credit portfolios of banks during periods of economic downturn, inevitably increases risk exposure and, hence, the level of required capital - just when capital is becoming more expensive or simply unavailable to weaker institutions (Cavallo & Majnoni, 2002). At the same time, capital positions deteriorate 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; Francis and Osborne, 2009).

In this context, the Basel III framework draws attention to two types of provision: specific provisions, attributed particularly to a specific operation or set of operations; and general provisions. The latter are constituted to face future losses which can freely absorb losses at the moment of their materialization, and are thus eligible for inclusion in the capital, at the additional tier 2, within certain pre-established limits. The qualification of general provisions to be a part of regulatory capital shows there is a close proximity between non-specific provisioning and capital, which makes it very difficult to define the exact boundary-line that separates these two types of loss-absorbing capacity of reserves. The migration to the expected loss model potentially increases this problem of diferentiation. In fact, the expected loss model, under IFRS 9, significantly reduces the conceptual differences between expected accounting and prudential losses.

Figure 2 illustrates the volume of provisions made according to the incurred loss model, at point A, by means of a loss distribution curve and the respective increase under the expected credit loss model, at point A’. The regulatory capital required remains unchanged.

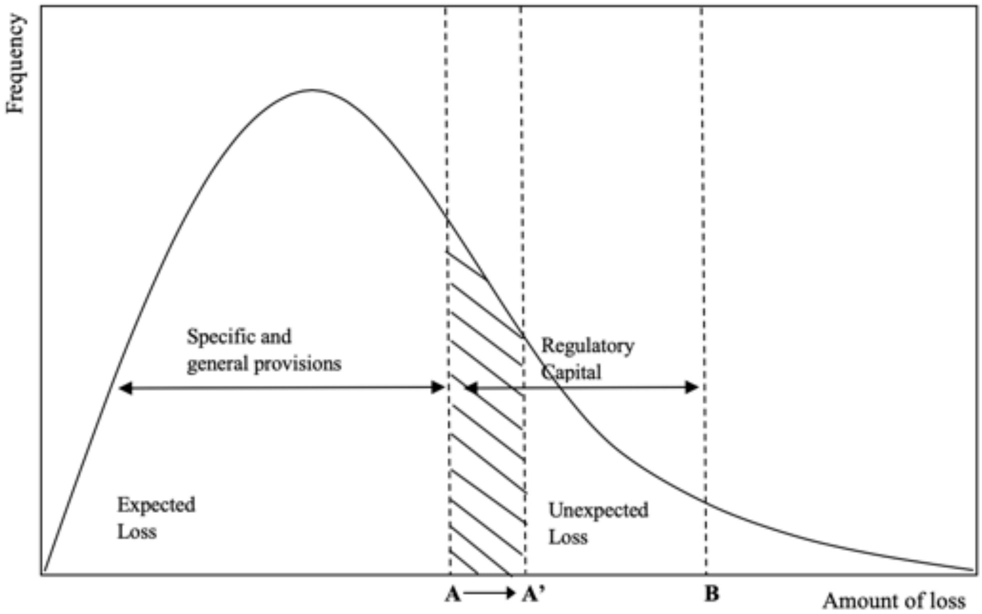


**Figure 2 -** Potential IFRS 9 effects on regulatory capital

The adverse effects on capital caused by provisions increase owed to the change in provisioning accounting practices, necessarily entail a reduction in capitalization rates, everything else being equal. On the other hand, following the Basel III schedule, the capital minimum regulatory requirements for banks remain, in their most significant part, unchanged, at the time of the IFRS 9 first adoption. In this context, if the bank wants to keep the solvency ratios the same, it will be necessary to restore the capital consumed by an increase in provision expense. Thus, the interaction between the Basel III framework and the expected credit losses provisioning model leads to the plausible hypothesis that the regulatory capital would be undersized before the adoption of the new model, and that the recomposition of the capital rates would enable this underestimation to be corrected.

Altought the capital ratio considers the amout of regulatory capital divided by the total amout of riks-weighted assets, which includes the exposure to credit, market and operational risks, the credit risk accounts for the bulk of most banks' risk-taking activities and regulatory capital requirements (BIS, 2017). Hence, the present work has choosen to focus on the impact of the adoption of IFRS 9 considering exclusive the banks credit risk.

According to the guidelines of the Basel framework, banks should have well-defined expected credit loss measurement models for purposes of calculating regulatory capital. These models can be used as an important starting point to measure ECL for accounting purposes, in other words, when calculating provisions. However, regulatory capital models cannot be used without adequate adjustments to measure the accounting ECL, because of its different objectives (Cohen & Edwards Jr, 2017).

The differences in the accounting and prudential perspectives of loan loss provisions result from the different objectives of each approach. Prudential regulation seeks to reduce the risk exposure of depositors and maintain financial stability, by reducing the operational sensitivity of banks to economic cycles. However, accounting seeks to provide useful information for various stakeholders of financial statements. More specifically, underestimated credit loss provisions, which generate overestimated regulatory capital, can increase the likelihood of bank insolvency, which may ultimately affect financial stability. At the same time, overestimated provisions do not give rise to prudential costs, and may even be regarded as of value from the standpoint of a banking regulator. Thus, with a view to maintaining regulatory capital, it is preferable for loan losses to be assessed on the basis of more conservative or pessimistic estimates (Novotny-Farkas, 2016). However, if one takes note of accounting factors, this perspective will not be the most appropriate. The information based on estimations must be that which most faithfully reflects the real situation of the loans, without any positive or negative bias.

As Benston and Wall (2005) point out, it is unlikely that the credit loss provisioning method, by itself, will play an important role in ensuring financial stability. Ultimately, the way in which a bank recognizes expected credit losses does not change the loans future cash flow. Provisioning for loan losses will only have an effect on financial stability to the extent that it effectively influences the decisions of institutions in terms of lending, financing and dividend policies. Essentially, these are the measures that reduce bank solvency risk and not the change in reported credit losses. However, the provisioning method employed by the banks serves theinterests of the stakeholders of accounting information, especially those external to the financial institution, and may increase awareness of risk exposure.

One of the main reasons for modifying the accounting provisioning standard is to provide greater economic stability, by correcting the inherent weaknesses of the replaced model (Cohen & Edwards Jr, 2017; ESRB, 2017; 2019). In this scenario, conducting an analysis of the new model implementation – and evaluating its effects on banking capital – can lead to a significant and continuous improvement of accounting standards.

### 2.3 Formulation of the Research Hypotheses

Provisions for credit losses and banking capital are cushions that are designed to preserve the continuous strengthening of the solvency of banks, with the aim of protecting financial institutions against both expected and unexpected losses. In light of their different purposes, provisions and capital must be set up on the basis of different premises. The optimal amount of regulatory capital is determined mainly on the basis of strategic and long-term arguments, that reflect, among other things, the trade-off between risk and assets returns, and the regulatory requirements, without taking into account specific macroeconomic conditions (Krüger, Rösch, & Scheule, 2018). Provisions for credit losses are more directly linked to the quality of the loan portfolio and, thus, are more susceptible to short-term fluctuations resulting from the macroeconomic environment and to changes in the solvency of individual counterparties (Bikker & Metzemakers, 2005).

For this reason, banks are expected to cover their expected losses continuously, through provisions, and only to use capital to absorb unexpected losses (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.

Since Basel I, established in 1988, the Basel Committee has recognized that there is a close relationship between capital and credit loss provisions, which is reflected in the regulatory treatment of accounting provisions (BIS, 2017) and highlights the difficulty of differentiating precisely between reserves for credit loss provisions and capital.

The migration to the expected credit loss 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 – with still uncertain implications for regulatory capital. The Basel Committee itself admits, in a document published regarding the prudential treatment of accounting provisions, that it has not reached a conclusion on how the interaction between the expected credit loss accounting model (ECL) and the prudential regime will take place (BIS, 2017). The main differences between the regulatory and accounting framework regarding the definition of expected losses, are shown in Table 2.

**Table 2 -** Relationship between expected credit loss provisions for Basel III and IFRS

| Expected Credit Losses under Basel III | IFRS 9 Accounting Provisions |
|---|---|
| **Prudence:** The calculation of the regulatory EL (expected losses) is more conservative. The loss estimation is measured in a scenario of economic slowdown. Regulators impose floors for PD and LGD. | **Neutrality:** The objective is to provide the market with an impartial view, weighted by the predicted loss probability. |
| **Losses in one year:** banks generally calculate regulatory EL within a year, except for assets that have suffered credit loss. | **Lifetime losses:** banks must calculate lifetime expected credit loss for assets classified in Stages two and three - those assets with significant credit deterioration and / or real credit losses. |
| **Through-the-cycle modeling:** many banks apply a through-the-cycle philosophy (or point-in-time plus additional capital), using long-term averages to calculate PD. These banks may keep an excessive expected loss (EEL) during the high economic cycle, and a deficit one during a slowdown. | **Point-in-time modeling:** banks generally produce unbiased, prospective and probability-weighted loss estimates in discrete scenarios that do not necessarily correspond to an economic cycle. |
| **Discount rate based on risk premium in stressed conditions:** banks generally use their capital costs or financing costs as a discount rate for calculating the regulatory EL. | **Discount rate based on effective interest rates:** banks are expected to discount future cash flows at the original effective interest rate (EIR). The discount rate may be lower or higher than that used to calculate the regulatory EL. |

Source: adapted from Deloitte (2016)

Another factor that should be considered is the difference between the definition of default under the Basel III framework and IFRS 9. The regulatory approach is based on two main indicators: a qualitative one, referring to the probability that the debtor will fail to honor his/her debt obligations; and a quantitative indicator that shows credit obligations are in arrears beyond 90 days (BCBS, 2019). The IASB, in turn, decided not to define a concept of default in the IFRS 9, since it thought that the determination of a preconceived concept could result in a definition for financial statement purposes that was inconsistent with that applied internally for credit risk management. However, IFRS 9 introduces a rebuttable presumption – in a situation where there is reasonable and verifiable evidence – that defaults occur when payment of a financial asset has been overdue for more than 90 days (Novotny-Farkas, 2016).

These guiding principles provide the basis for formulating a research hypothesis, as outlined in detail below, where they are divided as follows: initial impact at the time when the new accounting standard is adopted; and an evolutionary pattern of behavior of capital levels after the implementation of IFRS 9.

### 2.3.1 Impact on Capital Levels at the Initial Moment

The prospect view of credit quality, introduced by the new accounting standard, requires banks to recognize a provision for loan losses before a loss event occurs and even when the likelihood of loss is low. As a result, the provisions have a greater impact on retained earnings, an essential component for the formation of the CET1 ratio, also implying in an adverse effect on regulatory capital. In general, significant alterations are expected across the banking sector, with the prospect that the introduction of the IFRS 9 expected credit loss model will significantly increase the volume of the provisions (Deloitte, 2016; Moody's, 2016; BCBS, 2017; ESRB, 2017; Abad & Suarez, 2018; Rocamora, Garcia, Burke & Rubio, 2017; Krüger et al., 2018).

A quantitative IFRS 9 post-implementation study, assessing the effects of the change on provisions and the core capital ratio (Core Equity Tier 1 - CET1), was conducted by Ernst & Young in the first half of 2018 (E&Y, 2018). The analysis involved investigating a sample of 19 large banks – based in continental Europe, the United Kingdom and Canada - using publicly available information from the 2017 annual reports, IFRS 9 transition reports and first quarter 2018 financial results. The transition generally resulted in an increased of allowance for loan losses. The impact on CET1 was, in most cases, lower than previously estimated, and partly reflected more favorable economic conditions. Despite this, at the moment immediately after the adoption of the new standard (01.01.2018), 14 institutions experienced a reduction of capital adequacy ratio, 4 banks did not show a ratio increase or decrease, and a single bank showed an improvement in CET1 caused by an increase in deferred tax assets.

In light of this, it is reasonable to assume that the adoption of the expected credit loss model probably led to a regulatory capital reduction, at the time when the IFRS 9 was first implemented, with a consequent shortfall in regulatory ratios, all else being equal. On the basis of this context and a broader set of entities than those assessed by E&Y (2018), the following hypothesis can be formulated, and then tested empirically:

**$H_1$**: At the time of the initial adoption of IFRS 9, there was a significant reduction in the level of capital buffers for European banks.

The confirmation of this hypothesis is based on the assumption that the new standard based on expected credit losses in general, involve a greater volume of accounting provisions for losses related to credit risk, with a significant impact on bank capital buffers.

Another key factor to be considered, with consequences that remain uncertain, 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. However, IFRS 9 changes this situation for banks that adopt a standardized approach, by eliminating the possibility of adding a 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 faithful representation of the expected credit loss (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 function 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.

**Table 3 -** Regulatory treatment of accounting provisions in accordance with the Basel III framework

| | **Before IFRS 9** | **After IFRS 9** |
|---|---|---|
| **Standardized Approach** | Specific provisions: deducted from risk-weighted assets (RWA).<br>General provisions: added back to tier 2 capital, up to a limit of 1.25% of risk-weighted assets. | Provisions are only classified as specific and are deducted from risk-weighted assets.<br>The prerogative of adding back part of the accounting provisions to regulatory capital has been eliminated. |
| **IRB Approach** | Accounting provisions are compared with regulatory expected credit losses:<br>Accounting provisions < Regulatory Expected Loss → deficit is deducted from CET1<br>Accounting provisions > Regulatory Expected Loss → excess is added back to tier 2 capital up to a limit of 0.6% of risk-weighted assets | |

Source: Elaborated by the author

This means that in addition to bearing the impact on regulatory capital caused by the increase in accounting provisions, owed by the IFRS 9, common to all banks, 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 return a proportion of the accounting provisions to regulatory capital. Thus, it is reasonable to expect that the change to the expected credit loss model will reduce the capital of institutions that employ the standardized approach more significantly than in the case of institutions that adopt the IRB approach.

Estimates made before the new standard became effective suggested that the effects of IFRS 9 on Pillar 1 regulatory capital – i.e. the minimum regulatory capital requirements for banks – would be up to twice as high for banks that adopt the standardized approach, than financial institutions that rely on IRB models (Deloitte, 2016).

With regard to this, assuming the premise that capital reduction occurs at the time when IFRS 9 is adopted, as described in $\mathbf{H_1}$, 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:

$\mathbf{H_2}$: At the time when of IFRS 9 was adopted, the reduction of capital buffers of European banks were more intense among those that adopt the Basel III standardized approach for credit risk calculation.

Setting out from the assumption that the transition to a ECL model would, by definition, result in an increase in the loan loss allowance, with a consequent negative impact on bank capital ratios, BCBS (2017) designed a transitional model that allows a gradual absorption of the impact on regulatory capital, through a phase-in system. The application of the transitional arrangements seeks to mitigate the effects on the regulatory capital of the provisioning in accordance with the guidelines of the expected credit loss model, when the IFRS 9 was first adopted. This is especially important because there is a risk that the impact could be significantly greater than initially expected, and lead to a capital ratio shortfall of unexpected proportions (BCBS, 2017), and thus, damage the financial soundness of the banks.

The transition phase-in allows the negative effects on capital that are calculated at the time when the IFRS 9 is first adopted to be spread over annual 20% tranches, for 5 years – the maximum transition period. The phase-in application by the banks is optional and the transitional arrangement should only be applied to the new provisions, i.e. those resulting from the changes to the expected credit loss model.

In light of this, it is likely that the banks that decide to apply the IFRS 9 phase-in are precisely those that predicted there would be a greater negative impact on regulatory capital as a result of the new provisioning model implementation. This is a premise that supports the following research hypothesis:

**$H_3$**: At the time when the IFRS 9 is first adopted, the reduction of capital buffers of European banks was more intense among those which opted for the transitional arrangements for the impact of ECL accounting on regulatory capital.

### 2.3.2 Evolutionary Pattern of Behavior of Capital Levels, in the Post-IFRS 9 Period

After the IFRS 9 was adopted for the first time in January 2018, and once the reduction in regulatory capital has been confirmed, it is reasonable to assume that the financial institutions may decide to rebuild their capital resourses consumed by the increase in provisions – i.e. by ensuring the regulatory ratios return to similar levels to those found in the period before the new accounting standard was put into effect – or they can decide to keep their capital at the new level, i.e. lower than it was in the pre-IFRS 9 period. This understanding, shown in Figure 3, can be interpreted in two possible ways with regard to the situation prior to the adoption of the new accounting standard. These are either regulatory capital underestimation or overestimation, depending on how banks reacted to the effects of capital reduction, and whether or not they took mesuares to restore it to its previous level.

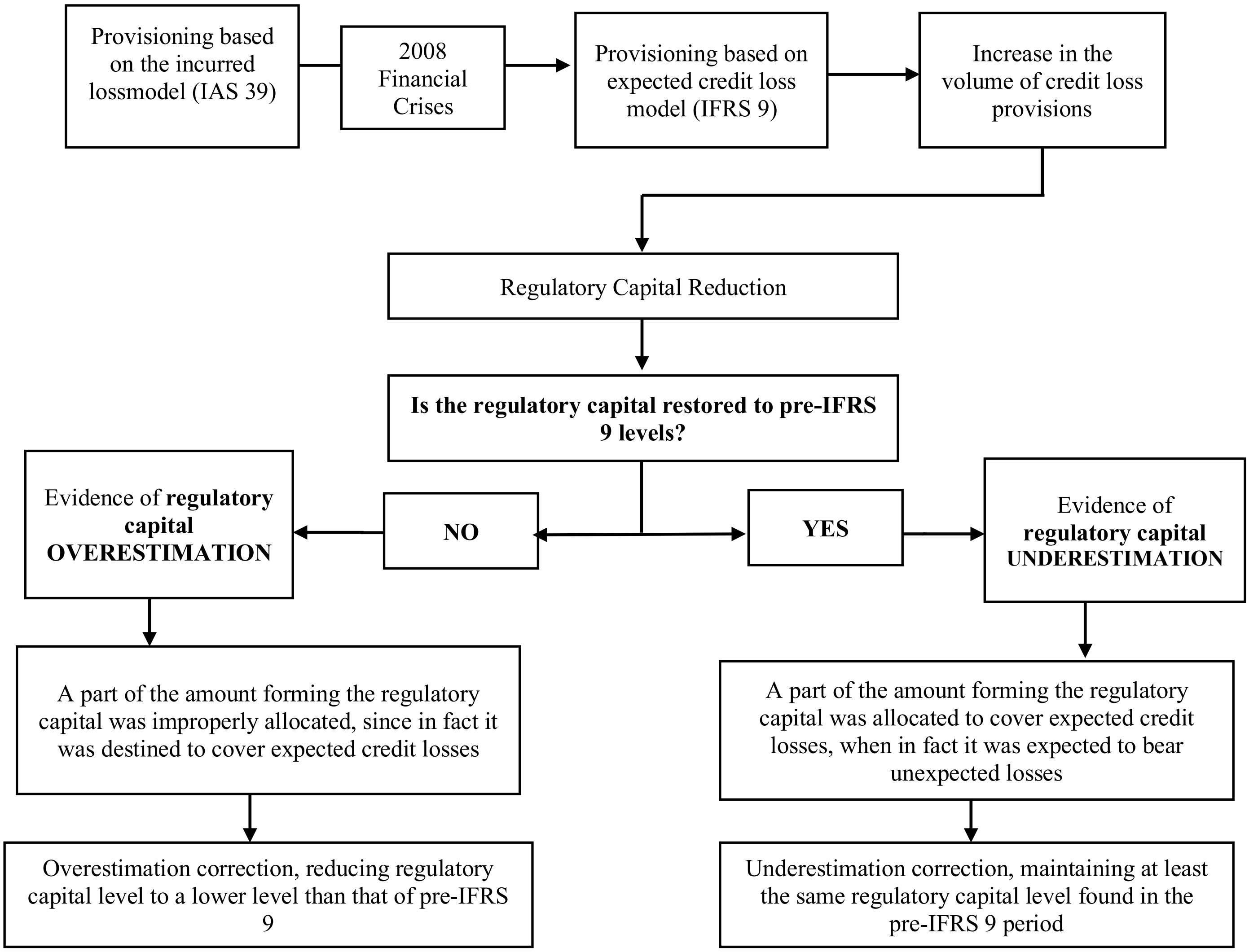


**Figure 3 -** Underestimation versus overestimation of regulatory capital

As illustrated in Figure 3, considering the premise that if banks promote the restoration of regulatory capital, seeking to keep capital ratios at a similar level to pre-IFRS 9 levels, it is assumed that this would be the amount necessary to bear unexpected losses. For this reason, it should be configured a regulatory capital underestimation before the new accounting standard was put into effect, since it would be inflated by the failure to recognize credit risk expected losses. Thus, to the extent that a proportion of the resources necessary to support unexpected losses was spent on the provisions set aside for expected losses, it would be necessary to restore the full amount.

Alternatively, if it is confirmed that banks do not seek to restore capital buffers, which would remain at the new level – reduced after the first time IFRS 9 was adopted – it can be assumed that the risk and capital management for banks reveals that this new capital level would be sufficient to bear unexpected losses, and suggests that capital in the pre-IFRS 9 period would be overestimated. In other words, a part of the amount that forms regulatory capital was actually maintained to support expected credit losses. The new model would thus have only corrected this distortion in its allocations, by increasing the provisions set aside for expected credit losses and reducing regulatory capital, in other words, the new total capital is only that necessary to support the unexpected losses. Thus, the new model for expected credit losses would be more suitable for a more consistent distinction between expected losses and unexpected losses, and in this way lead to reducing capital costs and their effective allocation.

In light of this, and with the support of the arguments put forward by Moody's (2016), Deloitte (2016), BCBS (2017), Sanchidrián and García (2017), Barclays (2017) and ESRB (2017) about the movements that may be caused by the adoption of the new accounting model adoption, the following research hypothesis can be formulated, and then tested empirically:

**$H_4$**: Since IFRS 9 came into force, European banks have been taking measures to rebuild capital buffers, being configured a regulatory capital underestimation in the period prior to the adoption of the new standard for the recognition of credit risk loss provisions.

When account is taken of the period after IFRS 9 was first adopted, it is reasonable to assume the identification of different patterns of behavior between the capital buffers of banks that adopt a standardized approach and the IRB approach when calculating credit risk, in accordance with the guidelines of the Basel framework.

After the IFRS 9 was first adopted, it is possible that banks relied 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 back a part of the accounting provisions to the regulatory capital, as of 01.01.2018. In contrast, the banks that employed internal modeling retained the option to add the surplus of accounting provisions with regard to the prudential metric to the regulatory capital, which would most likely benefit the capital buffer rates of these banks.

More practical matters, 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 PD and LGD, will certainly represent a greater challenge for them when estimating expected credit losses with the new accounting model. Thus, it is reasonable to assume that these banks will have greater difficulty in adapting to the new model and even assessing the capital impact and the likely need for a restoration of funds. This is because they must pass through a model calibration phase, which can lead to higher provision levels after the adoption of IFRS 9 and the consequent worsening of the buffers.

In contrast, banks that rely on the 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, while always taking note of the conceptual differences between the Basel model and IFRS 9. Adjustments made to the Basel IRB model for incorporating the IFRS 9 provisioning model, are certainly beneficial for banks that have already employed internal models for regulatory purposes and, thus, could use them as a starting point for implementing the new accounting model. According to a Moody's Analytics survey conducted with a sample of 28 banks of different sizes - with global operations (29%), in Europe (36%), in Asia (32%) and in North America (3%) - 63 % of the institutions planned to use existing IRB models to calculate provisions for credit loss in accordance with the guidelines of IFRS 9 (Moody's, 2015).

Against this background, since the banks that rely on a standardized approach have lost the prerogative of adding back a part of their accounting provisions to the regulatory capital, together with the technical complexities they face when seeking to implement IFRS 9, the following research hypothesis has been formulated:

**$H_5$**: 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 rely on an IRB approach.

By conducting a further analysis of the possible behavioral patterns of capital buffers in the post-IFRS 9 period, it is reasonable to assume that these capital buffers will follow different trends for banks that opted for the transition phase-in and banks that decided not to adopt these arrangements.

The institutions that adopted the phase-in will absorb the negative effects on regulatory capital, calculated at the time when IFRS 9 was first adopted, in five tranches of 20% spread over annual periods between 2018 and 2022. This means that at the beginning of each year these banks suffer a capital reduction related to a part of the phase-in. On the other hand, the banks that did not not opt for the transitional arrangements suffered the full impact of IFRS 9 in the initial period of adoption, on 01.01.2018, with no additional effects for capital in the coming years.

Even if in the post-IFRS 9 period, the banks opting for the phase-in decided to rebuild the capital at the same pace and with the same degree of intensity as the non-opting banks, the capital buffers of these institutions would behave in a different way from that found in the non-opting banks, since there is an annual compulsory capital reduction caused by the deduction of the phase-in tranche. This reduction automatically mitigates the effect of a possible restoration of the buffers, or modifies the effect of a likely capital stability, and may even result in an effective reduction of capital buffer rates.

Assuming that the banks that opted for the IFRS 9 phase-in are precisely those that are aware that the effects of the adoption of the new standard would be especially harmful to their capital levels, it is reasonable to assume that these bank buffers will suffer a significant decline each year, with the advance of the phase-in schedule. Possibly, the partial deductions of the capital impact determined on 01.01.2018, would be sufficient to set in motion a reduction of buffer rates, regardless of whether or not the banks made an effort to restore capital levels.

In light of the expectation that capital buffers of banks opting for phase-in will suffer significant annual deductions in the post-IFRS 9 period, the following research hypothesis has been formulated:

**$H_6$**: After IFRS 9 came into force, capital buffers of European banks that opted for phase-in arrangements should show less signs of restoration, or even reductions, in comparison with non-opting banks. This is in line with the gradual absorption of the impact determined at the time of the adoption of the new accounting provisioning standard.

## 3 METHODOLOGICAL PROCEDURES

This research is deductive and can be classified as empirical-analytical, as defined by Gamboa (1987), since the hypotheses will be supported or refuted on the basis of observation. The purpose of this is to describe and explain the interactions between the data, in order to confirm the effects on European banks of adopting the provisioning model based on expected credit loss in regulatory capital, as recommended by IFRS 9. A further aim is, to seek evidence of whether there has been a correction of underestimated or excessive regulatory capital requirements.

In this Section, the research hypotheses highlighted in Section 2.3, are tested as follows: a) by finding ways of measuring the capital metrics used for the study; b) specifying the tests conducted on the basis of the research hypotheses related to the impact of IFRS 9 when adopted for the first time and designing the model for assessing the evolutionary pattern of capital levels in the period after the standard was implemented; c) the composition of the study sample; d) the application of robustness tests in the model; and e) examining the limitations of the study, notably the possible anticipation of the reactions of banks to the effects of the new credit loss recognition model.

### 3.1 Regulatory Capital Metrics

The 2008 crisis demonstrated that credit losses and write-offs are essentially absorbed by the retained earnings of financial institutions. Thus, it is essential for banks' risk exposure to be supported by a high-quality capital base. As of October 2013, the reform package known as Basel III, developed by BCBS, sought to give the banking sector the capacity to absorb shocks resulting from financial and economic tensions, by making capital ratios more robust.

Basel III introduced higher minimum levels of Common Equity Tier 1 (CET1), Tier 1 capital and total capital ratios. CET1 became the predominant form of regulatory capital, made up of common shares and retained earnings. Adopting a macro-prudential perspective, designed to ensure financial stability and mitigate systemic risks, two additional capital buffer requirements applicable to all institutions were introduced: the conservation buffer and the countercyclical buffer, in addition to a third buffer which was only applicable to systemically important banks (G-SIBs), the so-called systemic risk buffer. In the case of the conservation buffer, a gradual implementation was scheduled, while the activation of the countercyclical buffer, limited to a 2.5% cap, depends on supervisory determinations and is related to credit growth conditions that may pose risks to the financial system. In turn, the systemic risk buffer can range from 1% to 3.5%, depending on the systemic importance attributed to the financial institution, as determined by the FSI methodology. In any case, all additional capital buffer requirements must be met by CET1.

The implementation of Basel III reforms designed to address capital requirements, took place through a phase-in system, between 2013 and 2019, as shown in Table 4.

**Table 4 -** Basel III phase-in and minimum capital requeriments

<table>
<tr><th></th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>Minimum Common Equity Capital Ratio</td><td>3.5%</td><td>4.0%</td><td colspan="4">4.5%</td><td>4.5%</td></tr>
<tr><td>Capital Conservation Buffer</td><td></td><td></td><td></td><td>0.625%</td><td>1.25%</td><td>1.875%</td><td>2.5%</td></tr>
<tr><td>Minimum common equity plus capital conservation buffer</td><td>3.5%</td><td>4.0%</td><td>4.5%</td><td>5.125%</td><td>5.75%</td><td>6.375%</td><td>7.0%</td></tr>
<tr><td>Minimum Tier 1 Capital</td><td>4.5%</td><td>5.5%</td><td colspan="4">6.0%</td><td>6.0%</td></tr>
<tr><td>Minimum Total Capital</td><td>8.0%</td><td colspan="5">8.0%</td><td>8.0%</td></tr>
<tr><td>Minimum total Capital plus conservation buffer</td><td></td><td colspan="2">8.0%</td><td>8.625%</td><td>9.25%</td><td>9.875%</td><td>10.5%</td></tr>
</table>

Source: adapted from BIS (2011)

As well as the minimum capital requirements – called Pillar 1 requirements – and additional capital buffers – conservation, countercyclical and systemic – 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 which significant European financial institutions overseen by the European Central Bank must be subject to. Depending on the SREP results, supervisors may ask banks to maintain additional capital reserves, which must also be met with CET1.

Figure 4 shows the capital requirements applicable to a financial institution, in accordance with the guidelines of the Basel III framework.

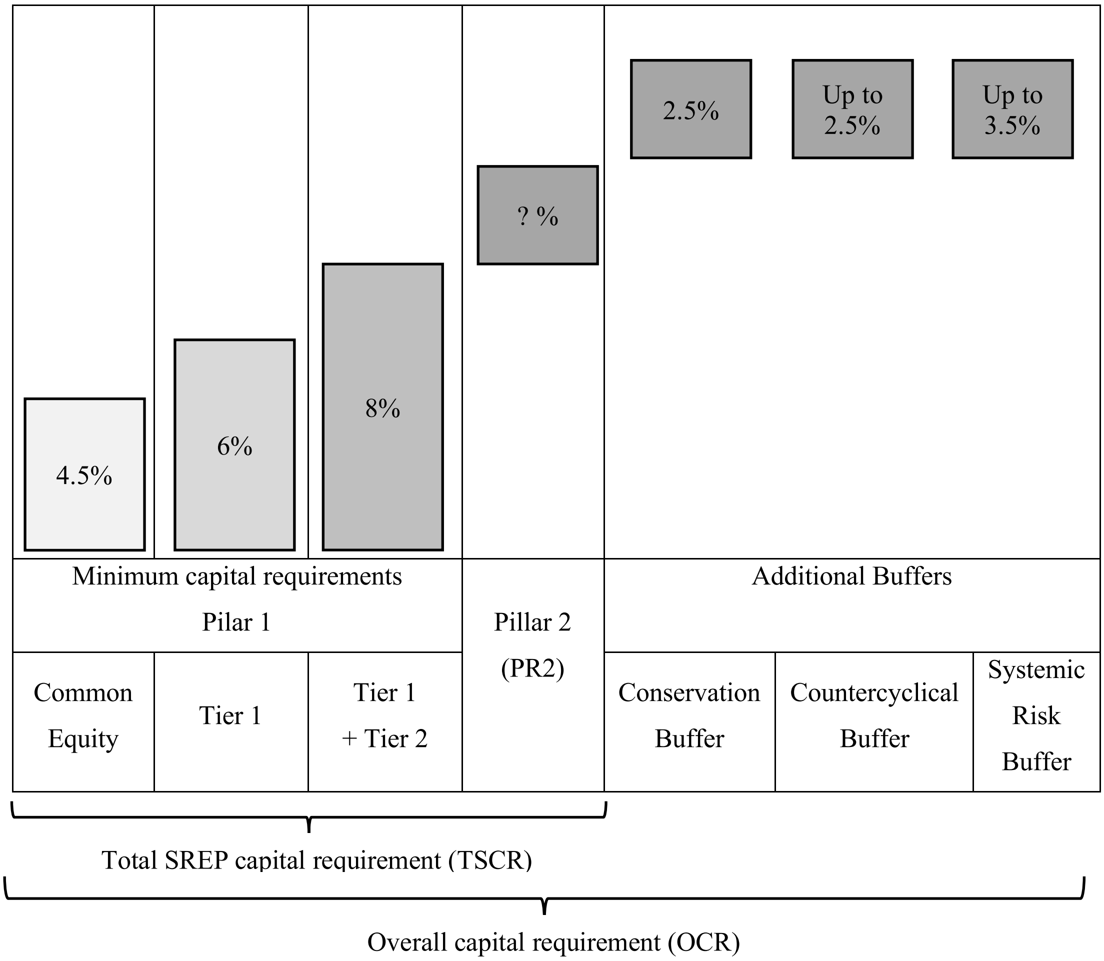


**Figure 4 -** Capital Requirements - Pillar 1, Pillar 2 and Total Requirement
Source: adapted from European Parliament (2018)

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 thus, different for each bank and may also vary over time, on account of changes in the Pillar 2 requirements and buffers. Another factor that affects the requirements over the period under analysis in this study, is the application of the Basel III phase-in schedule, as shown in Table 4. At the same time, it should be emphasized that most of this requirement must be met by CET1.

Before measuring the impact of adopting IFRS 9 for the first time on bank regulatory capital, it is worth examining each aspect of prudential requirements, as well as the OCR of each institution, individually. In this way, the measurement of the effects of the ECL model will be more accurate and more granular. As a result, the impact can be compared from a more general level, which takes account of the Pillar 1 requirements that are equally applicable to all banks, up to a highly personalized level. Moreover, they are more restricted, and include the specific features of financial institutions as a result of using SREP requirements and additional capital buffers with specific values, such as systemic and countercyclical. To achieve this goal, we intend to measure different types of capital buffers (as shown in Table 5), using the guiding principles set out in Table 4, Figure 4 and following Distinguin and Rugemintwari (2012) and Carvalho and Dantas (2021).

**Table 5 -** Capital buffers

| **Type of *Buffer*** | **Description** | **Formula** |
|---|---|---|
| Pillar 1 Buffer | Capital surplus linked to Pillar 1 requirements | $BPilar1_{i,t} = TCR_{i,t} - Pilar1R_{i,t}$<br>$BPilar1_{i,t}$: Pillar 1 buffer, represented by the surplus of total capital in relati Pillar 1 requirements, for an institution *i*, in period *t*.<br>$TCR_{i,t}$: Total Capital ratio, represented by the ratio between total regul capital and risk-weighted assets, for an institution *i*, in period *t*.<br>$Pilar1R$: Minimum Pillar 1 capital requirements, equivalent to 8%, in accor with the Basel framework. |
| SREP Buffer | Capital surplus linked to total SREP requirements | $BSREP_{i,t} = TCR_{i,t} - TSCR_{i,t}$<br>$BSREP_{i,t}$: SREP buffer, represented by the surplus of total capital in relatio SREP requirements, which includes Pillar 1 and Pillar 2 requireme for an institution *i*, in period *t*.<br>$TCR_{i,t}$: Total Capital ratio, represented by the ratio between total regula capital and risk-weighted assets, for an institution *i*, in period *t*.<br>$TSCR_{i,t}$: Total SREP requirements, which includes Pillar.1 minir requirements and Pillar 2 requirement, following the Basel framew for an institution *i*, in period *t*. |
| OCR Buffer | Capital surplus linked to total capital requirements applicable to the bank | $BOCR_{i,t} = TCR_{i,t} - OCR_{i,t}$<br>$BOCR_{i,t}$: Overall capital requirement buffer, represented by the surplus of to capital in relation to overall capital requirements, for an institution *i* period *t*.<br>$TCR_{i,t}$: Basel ratio (total capital ratio), represented by the ratio between to regulatory capital and risk-weighted assets, for an institution *i*, period *t*.<br>$OCR_{i,t}$: Overall capital requirements, which includes Pillar 1 minim requirements, Pillar 2 requirements and specific buffers, following Basel framework, for an institution *i*, in period *t*. |
| CET1 Buffer | Capital surplus linked to the specific Pillar 1 regulatory requirement to be met with Common Equity Tier 1 | $BCET1_{i,t} = CET_{1i,t} - CET1R_{i,t}$<br>$BCET1_{i,t}$: CET1 buffer, represented by the surplus of CET1 in relation to t minimum CET1 Pillar 1 requirement, for an institution *i*, in period<br>$CET1_{i,t}$: Common equity tier 1 ratio, represented by the ratio between CET and risk-weighted assets, for an institution *i*, in period *t*.<br>$CET1R$: Minimum CET1 Pillar 1 capital requirement, equivalent to 4.5 following the Basel framework. |

| | | |
|---|---|---|
| CET1 Restricted Buffer | Capital surplus linked to the total regulatory requirements that must be met entirely by Common Equity Tier 1 | $BrCET1_{i,t} = CET1_{i,t} - CETRt_{i,t}$<br>$BrCET1_{i,t}$: CET1 Restricted buffer, represented by the surplus of CET1 relation to all capital requirements to be met entirely by CET1, f an institution *i*, in period *t*.<br>$CET1_{i,t}$: CET1 ratio, represented by the ratio between CET1 and ris weighted assets, for an institution *i*, in period *t*.<br>$CET1Rt_{i,t}$: Total CET1 capital requirement, to be met entirely by CET1, whi includes the CET1 Pillar 1 minimum requirement, the Pillar requirement and specific additional capital, following Bas framework, for an institution *i*, in period *t*. |

### 3.2 Impacts at the time when IFRS 9 was First Adopted – Hypotheses H1, H2 and H3

Tests will be conducted to measure the effect of adopting the expected credit loss model for bank regulatory capital when IFRS 9 was first implemented – as well as to assess the impact on regulatory capital specifically caused by the implementation of the new loss provision model and following the accounting standard. These will also make a statistical comparison of the regulatory capital buffers of banks, on 12.31.2017, with this same capital measure, immediately after deducting the variation in credit loss provisions, brought about by adopting IFRS 9. Only the new provisions will be considered, that is, the increase in the loan loss allowance caused by the change in the accounting model.

Thus, the regulatory capital maintained on 12.31.2017, pre-IFRS 9, must be statistically different from the regulatory capital on 01.01.2018, measured according to Equation (3.1).

$$BCap_{i,18} = BCap_{i,17} - \Delta LLA_{i,18} \quad \textbf{(3.1)}$$

Where:

$BCap_{i,18}$: Capital buffer, represented by the excess of capital in relation to regulatory requirement, of institution *i*, on 01.01.2018, after the effects of the adoption of the expected credit loss model, in accordance with IFRS 9.

$BCap_{i,17}$: Capital buffer, represented by the excess of capital in relation to regulatory requirements, of institution *i*, on 31.12.2017, following Distinguin and Rugemintwari (2012) and Carvalho and Dantas (2021).

$\Delta LLA_{i,18}$ : Allowance for Loan loss balance variation, caused by the adoption of the expected credit loss model, in accordance with IFRS 9, from institution *i*, on 01.01.2018.

In carrying out the tests, the *BCap* variable will assume the alternating capital buffer measures summarized in Table 5 - *BPillar1, BSREP, BOCR, BCET1* and *BrCET1*.

According to Equation (3.1), regulatory capital on 01.01.2018 will be different from that reported by the bank on 12.31.2017 solely as a result of the impact of credit loss provisions recognized through IFRS 9, whether this effect is positive or negative. The possible mitigation of the effects of the increased provisions on the capital, as a result of the application of prudential transition arrangements (phase-in), allowed by BCBS and in line with the EBA guidelines, will be disregarded. The aim is to assess the effective impact of changes in provisions on capital for all institutions.

The empirical tests for the research hypotheses $\mathbf{H_1}$, $\mathbf{H_2}$ and $\mathbf{H_3}$ will be carried out through a descriptive statistical analysis and a t-test of comparison between the means of datsets, to determine if there was a statistically significant difference between the capital buffers *BPillar1, BSREP, BOCR, BCET1* and *BrCET1* of European banks on 12.31.2017 (pre-IFRS 9) and on 01.01.2018 (post-IFRS 9).

### 3.3 Evolutionary Pattern of Capital Buffers

The hypotheses $\mathbf{H_4}$, $\mathbf{H_5}$ and $\mathbf{H_6}$, will be tested empirically using the base model (3.2) and the derived models (3.3) and (3.4), and taking into account the objectives of this study. The tests seek to find evidence of: (i) regulatory capital underestimation of European banks before the adoption of IFRS 9; (ii) whether the use of the standardized approach by banks for calculating the credit risk RWA had contributed a more persistent negative impact on capital buffers, in the post-IFRS 9 period; and (iii) evidence that the bank's capital buffers that opted for the phase-in arrangements tended to decline, or not to recover, to the previous levels, in the post-IFRS 9 period.

Empirical tests for all the hypotheses will be conducted separately for each capital buffer examined, as in Table 5.

#### 3.3.1 Model for Testing Hypotheses $\mathbf{H_4}$

The base model (3.2) was recommended to carry out the empirical tests. This examines the relationship between the capital buffer calculated for the current and previous time, with the objective of providing evidence of buffer restoration to pre-IFRS 9 levels or the maintenance of its level at the new point reached after the expected credit loss provisioning model has come into effect.

$$\begin{aligned} BCap_{i,t} = \beta_0 + \beta_i + \beta_1 BCap_{i,t-1} + \beta_2 SIZE_{i,t} + \beta_3 ROE_{i,t} + \beta_4 RISK_{Cred_{i,t}} \\ + \beta_5 RISK_{Asset_{i,t}} + \varepsilon_{i,t} \end{aligned} \qquad \textbf{(3.2)}$$

where:

$BCap_{i,t}$ : Capital buffer, measured according to the recommendations of Table 5, of institution *i*,

| | |
|---|---|
| | in period *t*, following Distinguin and Rugemintwari (2012) and Carvalho and Dantas (2021). |
| $SIZE_{i,t}$ : | Size of institution *i*, in period *t*, defined as the natural logarithm of total assets. |
| $ROE_{i,t}$ : | Profitability level of institution *i*, in period *t*, measured by the return on shareholders' equity - calculated by the ratio between semi-annual net income and average shareholder equity. |
| $RISK_{Cred_{i,t}}$ : | Credit portfolio risk, of institution *i*, in period *t*, defined by the ratio between loan loss allowance (LLA) and the loan portfolio. |
| $RISK_{Asset_{i,t}}$: | Banks asset risk, of institution *i*, in period *t*, defined as the ratio of risk-weighted assets (RWA) to total assets. |
| $\varepsilon_{i,t}$ : | Error term, of institution *i*, in period *t*, with the normal distribution and constant variance premises. |

On the basis of hypotheses **H₄** formulated in Section 2.3, the model includes the independent variable of interest, represented by the coefficient $\beta_1$. Control variables were also incorporated to ensure the tests were robust and to assess the effects of other characteristics on the behavior of the capital buffers.

The trend and behavior of the variables in the period prior to the adoption of the expected credit loss provisioning model was assessed and, following this, the changes that had occurred after its implementation were also evaluated. For that purpose, the model (3.2) was estimated in two different periods – pre and post IFRS 9.

As shown in Figure 5, the first period includes the information referring to the period from June 30, 2015 to December 31, 2017, hence six semesters. The second period contains information for the period between 01.01.2018 and 12.31.2019, hence five semesters.

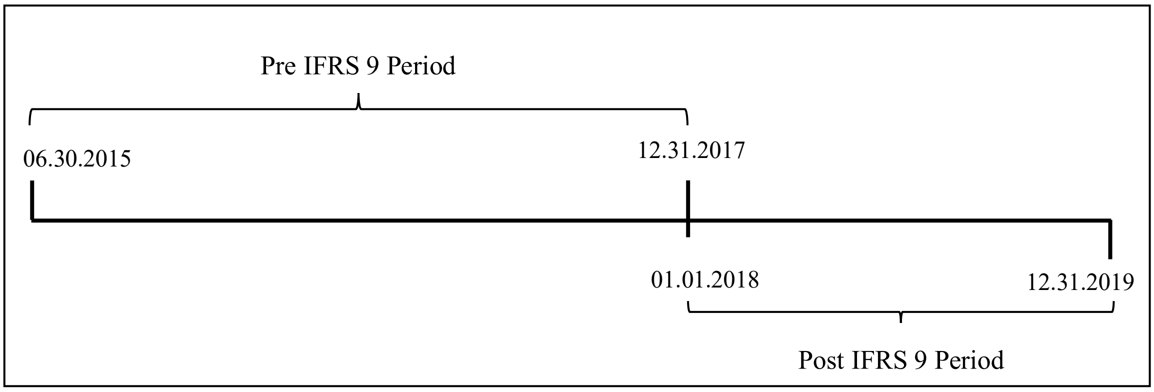


**Figure 5 -** IFRS 9 - pre and post adoption periods

The expected results of each independent variable of the model (3.2) with regard to the behavior of the dependent variable, that is representative of the different capital buffers, (including the theoretical factors covered in Chapter 2,) are summarized below.

a) <u>Coefficient $\beta_1$: Capital buffer from the previous period – $BCap_{i,t-1}$</u>

This variable test whether the capital buffer for the current period is influenced by the excess capital observed in the immediately preceding period. It is the classic characterization of a dynamic model, in which the value of the dependent variable is initially explained, by its lagged behavior.

The underlying premise is that banks encourage their regulatory capital management to maintain a certain degree of stability, causing investors, depositors and regulators to attribute a lower level of risk to the entity. 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 a level of stability – and a positive relationship with the dependent variable, in line with the findings of Barth et al. (2017) and Stolz and Wedow (2011).

By assessing this variable behavior in the post-IFRS 9 period, it will be possible to provide evidence of capital buffer restoration to pre-IFRS 9 levels or of the buffers being maintained at the same level as the new point reached after implementing the expected credit loss provisioning model. On the basis of this observation, conclusions can be drawn about the capital underestimation in the pre-IFRS 9 period, which is the concern of research hypotheses **$H_4$**.

In the post-IFRS 9 period, positive values for $\beta_1$, combined with the finding of $\beta_{1,post\ IFRS9} > \beta_{1,pre\ IFRS9}$, corroborate hypothesis **$H_4$**, which predicts the regulatory capital underestimation at the pre-IFRS 9 period. This finding is based on the premise that the detection of growth trends in capital buffers after IFRS 9, with greater intensity than that observed in the pre-IFRS 9 period, provides evidence that there is an effort made by banks to rebuild the capital buffer at the time when the IFRS 9 was adopted. In view of this, the regulatory capital underestimation would be configured before the new accounting standard was put into effect, since it would be inflated by the failure to recognize expected losses arising from the credit risk.

On the other hand, if after the adoption of IFRS 9 the values of coefficient $\beta_1$ are not higher than in the pre-IFRS 9 period ($\beta_{1,post\ IFRS9} \leq \beta_{1,pre\ IFRS9}$), this mean that hypothesis **$H_4$** is rejected, and suggests, very likely, that there was a regulatory capital overestimation in the period prior to the implementation of IFRS 9. In this case, the failure to identify the growth of capital buffers with an enough intensity to suggest the capital restoration, indicates that the new level reached after adopting IFRS 9 would be sufficient to cover unexpected losses, and thus, reveals that the amount of capital in the pre-IFRS 9 period had been overestimated.

b) <u>Coefficient $\beta_2$: Banking institution size – $SIZE_{i,t}$</u>

The size of banks can influence the capital buffer size in the following ways: (i) the too-big-to-fail hypothesis assumes that banks characterized in this way – too big to fail – would receive support from the regulator in insolvency situations, and hence, large banks could afford to have smaller buffers (Fonseca & González, 2010; Bouther & Francis, 2017); (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, while smaller banks need to offer higher returns to attract depositors, which increases their risk awarenes and, hence, the need to maintain a larger buffer (Afzal, 2015).

Following Carvalho and Dantas (2021), a negative relationship between the *SIZE* and *BCap* variables is expected without distinguishing the periods before and after the adoption of IFRS 9.

c) <u>Coefficient $\beta_3$: Profitability Level – $ROE_{i,t}$</u>

More profitable banks might be able to increase their capital base more easily, by means of retained earnings, while less profitable banks are likely to have more difficulty in retaining capital (Nier & Baumann, 2006; Carvalho & Dantas, 2021). In view of this, it is expected that there will be a positive relationship between the *ROE* and *BCap* variables, both in the pre and post IFRS 9 periods.

d) <u>Coefficient $\beta_4$: Credit Portfolio Risk– $RISKCred_{i,t}$</u>

Bank capital is related to the risk level assumed for different activities. According to Flannery and Rangan (2004), Ayuso et al. (2004), and Nier and Baumann (2006) ex-ante risk measures tend to be associated with larger capital buffers. Thus, the *RISKCred* 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 *RISKCred* and *BCap* being expected.

It is not expected that there will be a differentiation between the behavior of the *RISKCred* variable and the dependent variable in the pre- and post-IFRS 9 periods.

e) <u>Coefficient $\beta_5$: Assets Risk – $RISKAsset_{i,t}$</u>

Still following the views of Flannery and Rangan (2004), Ayuso et al. (2004), and Nier and Baumann (2006), it is clear that ex-post risk metrics arise from lower regulatory capital.

The *RISKAsset* variable, measured by the relationship between RWA and total assets, is an indicator of the risk level to which banks are exposed, and represents 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 *RISKAsset* and *BCap* is expected, regardless of whether the estimate is related to the pre or post period of IFRS 9.

In conclusion, the expected behavior for the independent variables of interest and control can be summarized in the way that is shown in Table 6.

**Table 6 -** Expected behavior and signs of model variables and coefficients

| Coefficient | Variable | Description | Expected Signal | |
|---|---|---|---|---|
| | | | Pre-IFRS 9 | Post-IFRS 9 |
| $\beta_1$ | $BCap_{i,t-1}$ | Capital *Buffer* of the previous period | + | **H**$_4$: + |
| $\beta_2$ | $SIZE$ | Size | - | - |
| $\beta_3$ | $ROE$ | Profitability | + | + |
| $\beta_4$ | $RISK_{Cred}$ | Credit Portfolio Risk | + | + |
| $\beta_5$ | $RISK_{Asset}$ | Bank's Asset Risk | - | - |

### 3.3.2 Model for testing hypothesis H$_5$

Model (3.3) was derived from the base model (3.2), which makes it possible to compare the capital buffer levels in the pre and post-IFRS 9 periods, to identify whether banks that adopt a standardized approach or IRB approach for calculating credit risk behave differently, in line with the arguments raised by the hypothesis **H$_5$** formulation.

$$BCap_{i,t} = \beta_0 + \beta_i + \beta_1 BCap_{i,t-1} + \beta_2 APROA_i + \beta_3\left(BCap_{i,t-1} * APROA_i\right) + \beta_4 SIZE_{i,t} + \beta_5 ROE_{i,t} + \beta_6 RISK_{Cred_{i,t}} + \beta_7 RISK_{Asset_{i,t}} + \varepsilon_{i,t} \quad \textbf{(3.3)}$$

where:

$APROA_i$ 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.

When testing hypothesis **H$_5$**, the variable of interest $APROA$ ($\beta_2$) and its interaction with the lagged dependent variable ($\beta_3$) were added to the model (3.2), while keeping the other variables from the original model. Like the base model (3.2), this model is also estimated for the pre and post IFRS 9 periods, so that the difference in behavior between banks that adopt a standardized approach and IRB can be assessed with regard to capital buffers in the previous period and after employing the expected credit loss model. The expected results for these new variables are outlined below, and include the theoretical factors covered in Chapter 2.

a) Coefficient $\beta_2$: Approach for measuring credit risk – $APROA_i$

This is the variable of interest for testing hypothesis **$H_5$**, which identifies banks that adopt a standardized approach for measuring credit risk. By assessing 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 an IRB approach, 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 chosen type of credit risk calculation 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. However, it remains feasible for banks that rely on internal modeling to add the accounting provisions that go beyond the the prudential metric to the regulatory capital.

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 $\beta_{2,pre\ IFRS9} \cong 0$ and $\beta_{2,post\ IFRS9} < 0$, corroborate hypothesis **$H_5$**, 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 rejection of hypothesis **$H_5$**, regardless of what values were obtained in the pre IFRS 9 period.

b) Coefficient $\beta_3$: Capital Buffer from the previous period, only for banks adopting a standardized approach for credit risk – ($BCap_{i,t-1}$ * $APROA_i$)

The purpose of this interaction variable is to determine the effects of the lagged measure on the capital buffer for the current period, but only 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 it was not believed that adopting a standardized approach for calculating credit risk has any definite influence on capital buffers.

During the period after the adoption of IFRS 9, the banks’ capital buffers that rely on a standardized approach are expected to behave differently from the IRB banks. As argued in Section 2.3, the first time IFRS 9 is adopted, it is expected to affect banks, with a greater volume of provisions for these banks than for the internal model banks. More practical issues, such as the operationalization of the provisioning accounting model for expected credit losse, can also likely to lead to slower rebuild of capital buffers for banks adopting a standardized approach, during the years following the implementation of IFRS 9.

In light of this, it is predicted that during post-IFRS 9 period, the relationship between the $\beta_3$ coefficient and the dependent variable will be positive. The underlying premise is that there is a less movement among capital buffers for banks with 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 with a standardized approach, when adopting IFRS 9.

The anticipated behavior of the independent variables related to hypothesis **$H_5$** is summarized in Table 7. The signs highlighted in Table 6 for the base model variables remain the same.

**Table 7 -** Expected behavior and signs for model variables and coefficients

| Coefficient | Variable | Description | Expected Signal | |
|---|---|---|---|---|
| | | | Pre-IFRS 9 | Post-IFRS 9 |
| $\beta_2$ | $APROA_i$ | Approach for measuring credit risk | +/- | H5: - |
| $\beta_3$ | $(BCap_{i,t-1} * APROA_i)$ | Capital buffer from the previous period, only for banks adopting a standardized approach for credit risk | +/- | + |

### 3.3.3 Model for testing hypothesis $H_6$

Moving forward on the analysis of the behavior of the capital buffers, model (3.4) is derived from the base model (3.2), and designed to analyze the effects of the decision to apply the IFRS 9 transition phase-in to the capital buffers, in line with the arguments raised in hypothesis $\mathbf{H_6}$.

$$BCap_{i,t} = \beta_0 + \beta_i + \beta_1 BCap_{i,t-1} + \beta_2 PHASE_i + \beta_3 \left(BCap_{i,t-1} * PHASE_i\right) + \beta_4 SIZE_{i,t} + \beta_5 ROE_{i,t} + \beta_6 RISK_{Cred_{i,t}} + \beta_7 RISK_{Asset_{i,t}} + \varepsilon_{i,t} \quad \textbf{(3.4)}$$

where:

$PHASE_i$ The variable dummy which characterizes the institutions that decide to apply the transition phase-in of the effects of regulatory capital, assumes 1 for the banks that adopt the phase-in and 0 for the banks that do not apply the phase-in.

To serve the purposes of hypothesis $\mathbf{H_6}$, with regard to the base model, the (3.4) model incorporates the *PHASE* variable and their interaction with lagged buffers as new features.

Unlike model (3.2), which is estimated for the pre and post IFRS 9 periods, this model is restricted to the period when the new expected credit losses model came into force. The predicted results for the independent variables, specifically related to the derived model (3.4), are outlined below.

a) Coefficient $\beta_2$: Transition phase-in adoption – $PHASE_i$

The purpose of the phase-in is to smooth the effects on capital caused by the accounting provisions recognized by the expected credit losses model; this allows the negative impact that is measured when IFRS 9 is adopted for the first time, to be divided into five annual tranches, between 2018 and 2022.

The banks that decide to apply the phase-in are more likely to have smaller capital buffers in the pre-IFRS 9 period and/or an expectation of a more significant increase in provisions for credit risk, than is the case with institutions that did not choose to apply the transitional arrangements. At the time of the adoption, this choice might allow larger buffers to be maintained, as a means of mitigating the effects of the initial implementation. At the same time, in the post-IFRS 9 period, the phase-in application can lead to: (i) downward trends during the post-IFRS 9 years, if there are no new capitalizations; (ii) neutrality, in the case of capital restoration to a level similar to that of the phase-in annual deductions; or (iii) an increase in buffers, if banks decide to assume capital levels higher than those found before the adoption of the new accounting standard.

For this reason, no specific signal is assigned to the relationship with the dependent variable, since the decision to apply transition arrangements should assist in mitigating the effects of IFRS 9 during the first years after the adoption of the new model. The evolutionary pattern of the buffers would also depend on the bank's behavior with regard to capital levels restoration.

b) Coefficient $\beta_3$: Capital buffer from the previous period – only for banks applying the phase-in – ($BCap_{i,t-1}$ * $PHASE_i$)

This interaction variable is the variable of interest for hypothesis **$H_6$**, and represents a way of assessing the effects of the lag measures of capital buffers in the present, but only for banks that decided to apply the phase-in. Moreover, this allows evidence to be provided about the behavior of the capital buffers and to compare the trends followed by these banks, with those that did not apply the phase-in.

It is expected that in the post-IFRS 9 period, the capital buffers of banks that apply the transition arrangements, will follow a neutral or downward trend, as these banks are annually subject to a compulsory capital deduction, referred to as the "phase-in tranche". This deduction automatically and significantly mitigates or even reverses the effects of a likely restoration of capital buffers.

Thus, the corroboration of hypothesis **$H_6$**., according to which capital buffers of banks applying the IFRS 9 effects phase-in follow a downward trend after adopting the new accounting model, are conditioned to the determination of negative or neutral values for $\beta_3$ combined with the $\beta_3 < \beta_1$ finding.

Positive values for coefficient β3, equal to, or greater than, the coefficient $\beta_1$, that is, $\beta_3 > \beta_1$, provide evidence that there was no tendency towards reduction or neutrality in the behavior of the capital buffers in banks applying the transitional arrangements, and this leads to the rejection of hypothesis **$H_6$**.

Table 8 summarizes the expected behavior of the independent variables in hypothesis **$H_6$**. The signs highlighted in Table 6 for the base model variables remain the same.

**Table 8 -** Expected behavior and signs for model variables and coefficient

| Coefficient | Variable | Description | Expected Signal | |
|---|---|---|---|---|
| | | | Pre-IFRS 9 | Post-IFRS 9 |
| $\beta_2$ | $PHASE_i$ | Transition phase-in adoption | | + / - |
| $\beta_3$ | ($BCap_{i,t-1}$ * $PHASE_i$) | Capital buffer from the previous period only for banks appling phase-in | | **$H_6$**: - / neutral |

### 3.4 Sample and Data Collection

Empirical tests were carried out using data from the main European banks supervised by the European Central Bank (ECB), owing to their economic and financial importance within the European Union. Additionally, this choice was motivated by the implementation approach of the IFRS 9, which was adopeted at the very same moment for all banks supervised by the ECB. Also, these banks are subject to a uniform prudential framework. Thus, it is possible to compare the effects of the adoption of the new accounting standard between banks, even between different jurisdictions.

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 two types of supervised entities, on a consolidated basis: the significant and the less significant. According to Article 6 of the standards, the significant character is assessed on the basis of 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, after a full assessment has been made of a credit institution, the competent national authority will judge that the entity is of value to the national economy and, thus, decide to classify it as significant for supervisory purposes.

The ECB may also, on its own initiative, consider an entity to be significant if it has banking subsidiaries established in more than one participating Member State and its cross-border assets or liabilities represent a considerable part of its total assets or liabilities, subject to conditions laid down in its regulations . Finally, entities for which public financial assistance was requested or received directly, cannot be considered to be less significant.

In January 2020, there were 117 significant entities that were initially considered for inclusion in the study sample, which are listed in Appendix I. Semiannual information was used, available on the banks' own website, in the period between 2015 and 2019. All the data were collected from the banks' financial reports. However, the necessary information was not always available, the main reasons being as follows: (i) the bank did not disclose the information; (ii) the information disclosed was not clear; or (iii) there was a lack of a standardized format for public disclosures over the years that would allow, in operational terms, a systematic and effective assessment of this information.

Thus, the final sample consists of 99 significant entities, supervised by the ECB, representing 18 countries in the European Union. Appendix I provides details of the information regarding the sample composition.

**3.5 Robustness Tests**

The following tests will be conducted to ensure the robustness of the empirical tests, notably with regard to the model (3.2) estimation: stationarity tests of the series (Im, Pesaran and Shin - IPS, ADF-Fisher and PPFisher), multicollinearity risk (Variance Inflation Factor - VIF), endogeneity (Hausman test), individual heterogeneity identification, autocorrelation risk (Durbin-Watson and Breusch-Godfrey) and heteroscedasticity of residuals (White test).

The Chow Test will be carried out to assess whether the existence of individual bank effects justifies the use of panel data, and then, if the use of pooled data is rejected, the Hausman test will be conducted to define which would be the most suitable model for the regression: fixed effects (EF) or random effects (EA).

**3.6 Limitations**

It should be noted that this work is subject to limitations. Given the fact that although IFRS 9 was finalized in 2014, it only came into force on January 1, 2018, it is possible that some banks have been planning to implement the standard, by intentionally increasing the capital buffer rates in the pre-IFRS 9 period and, hence, reducing the adverse effects of the regulatory capital when adopting the new standard. Despite this, in view of the wide range of impact studies and forecasts carried out by different bodies and forums (Moody's, 2016; Deloitte, 2016; BCBS 2017; Sanchidrián & García, 2017; Barclays, 2017; ESRB, 2017) and also the concerns raised by BCBS (BIS, 2017) regarding the effects of the ECL model on prudential requirements, it is expected that regulatory capital will suffer significant negative effects in the period immediately after the adoption of IFRS 9.

Another factor that can also be interpreted as a research limitation, is that the restoration of regulatory capital after IFRS 9 was adopted for the first time, may occur in a longer period than that one covered by this work. In any case, it is expected that a significant part of this movement, if any, will be assessed in the first two years of the implementation of the new rules, 2018 and 2019, the period covered by this research.

## 4 ANALYSIS OF RESULTS

In this Chapter, the results of the empirical tests are examined and discussed, by following the methodology described in Chapter 3 and the hypotheses formulated in Section 2.3. Two stages are required for this: i) a descriptive analysis of the capital buffer statistics and the impact on capital at the first time the new accounting standard is adopted; ii) an analysis of how the capital buffers evolved, from 2015 to 2019, together with an evaluation of their behavior after the implementation of IFRS 9.

Regarding the assessment made for the corroboration or refutation of the research hypotheses, the results of the analysis will include the following:

- The impact on the capital buffer levels at the time when IFRS 9 was first adopted, on 01.01.2018, comparing the effects onf three scenarios: for the total bank sample; for banks following different types of Basel III approach to calculate RWA credit risk; and for banks that opted or not for adopting the IFRS 9 phase-in arrangements; and
- An analysis of the evolution and behavior of the capital buffers, together with a comparison of the period from June 30, 2015 to December 31, 2017 (pre-IFRS 9), and from January 1, 2018 and December 31, 2019 (post-IFRS 9), in an attempt to discover restoration or maintenance movements in the capital levels after the adoption of IFRS 9.

### 4.1 Impact on Capital Buffers at the First Time IFRS 9 was Adopted

The data analysis starts with descriptive statistics regarding the European bank's capital buffers *BPillar1, BSREP, BOCR, BCET1* and *BrCET1* which are calculated for 12.31.2017 (pre-IFRS 9) and for 01.01.2018 (post-IFRS 9) and measured according to the specifications outlined in Table 5. The mean difference tests for all the variables between the two dates – which capture the effects of the expected credit loss model at the time when the IFRS 9 is first adopted – are used as a reference-point to empirically test the effects of the expected credit loss model on the sample banks (hypothesis $\mathbf{H_1}$), also according to the approach used for credit risk calculation, under the Basel framework (hypothesis $\mathbf{H_2}$) and, finally, according to the decision about whether or not to apply the IFRS 9 transition arrangements (phase -in) for the effects on the regulatory capital (hypothesis $\mathbf{H_3}$).

The variables were winsonized at 5% to assess whether the presence of outliers in the sample could modify the results. Through this procedure, the extreme values above or below the defined minimum and maximum percentile are replaced by the lower and higher values remaining in the distribution, calculated by the selected percentile. The results of the tests carried out with the winsorized sample, are displayed in Appendix II, and are 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 an original basis.

### 4.1.1 Descriptive Statistics

In this first stage of the tests, the statistics of the capital buffers are described in detail and take into account the variations in the dynamics of these metrics at the time IFRS 9 was first adopted, on the dates of 12.31.2017 and 01.01.2018.

**Table 9 -** Descriptive statistics of the Capital buffers descriptive statistics for the sample, on 12.31.2017 and 01.01.2018

| | | ***BCET1*** | ***BrCET1*** | ***BPillar1*** | ***BOCR*** | ***BSERP*** |
|---|---|---|---|---|---|---|
| 12.31.2017 (pre-IFRS9) | Mean | 0.1372 | 0.1073 | 0.1332 | 0.1033 | 0.1189 |
| | Median | 0.1078 | 0.0732 | 0.1001 | 0.0663 | 0.0841 |
| | Standard Deviation | 0.1146 | 0.1147 | 0.1240 | 0.1242 | 0.1247 |
| | Maximum | 0.8899 | 0.8324 | 0.8549 | 0.7974 | 0.8099 |
| | Minimum | 0.0465 | 0.0236 | 0.0460 | 0.0010 | 0.0135 |
| | Kurtosis | 24.3785 | 22.3128 | 19.4734 | 18.2106 | 17.7111 |
| 01.01.2018 (post-IFRS9) | Mean | 0.1296 | 0.0997 | 0.1265 | 0.0965 | 0.1121 |
| | Median | 0.1042 | 0.0723 | 0.0958 | 0.0639 | 0.0806 |
| | Standard Deviation | 0.1124 | 0.1128 | 0.1223 | 0.1228 | 0.1233 |
| | Maximum | 0.8898 | 0.8323 | 0.8548 | 0.7973 | 0.8098 |
| | Minimum | -0.0315 | -0.0815 | -0.0491 | -0.0991 | -0.0866 |
| | Kurtosis | 27.0522 | 24.4517 | 19.5535 | 18.0770 | 17.4801 |

Where: ***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 requirements; ***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 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 supervisory review (Supervisory Review and Evaluation Process), which considers the capital surplus in relation to the total SREP requirement.

The analysis of the behavior of the capital buffers can, to a large extent, make it easier to understand factors related to the soundness of the financial institutions, cost of capital and credit expansion capacity. The buffers calculated for the present study include features from general capital requirements, applicable to all banks (Pillar 1), to very specific and individualized requirements, based on the results of the supervisor’s direct assessments (SREP, systemic requirements) and macroeconomic conditions (additional countercyclical).

Descriptive statistics provide the first information about some of the financial institution's characteristics and group behavior. Of the *BCET1* and *BrCET1* from the 99 sample banks, between 12.31.2017 and 01.01.2018, 82 institutions showed a capital level reduction; 15 banks were positively impacted, and improved their capital margins; and 2 institutions did not change their capital level when implementing IFRS 9 (Bank of America Merrill Lynch International and Morgan Stanley Europe).

As shown in Figure 6, in the pre-IFRS 9 period, the margin related to core capital is, on average, the highest among all the buffers, 13.72%, suffering a 0.76 p.p. reduction at the time of the implementation of the new model. The core capital buffer (*BCET1*) is the most sensitive metric for loan loss provisions variations, since the likely increase in provisions is deducted directly from CET1. Precisely for this reason, most of the impact studies conducted before the adoption of IFRS 9 concentrated on the effects of the expected credit losses of the model implementation directly on the common equity tier 1 capital. The impact confirmed in *BCET1* is reflected in the other buffers, as other capital requirements are piled up, and there may be a mitigation of effects depending on the requirements specifically applicable to an institution and/or the amount of additional tier 1 capital and hybrid debt instruments (tier 2 capital) possessed by the bank.

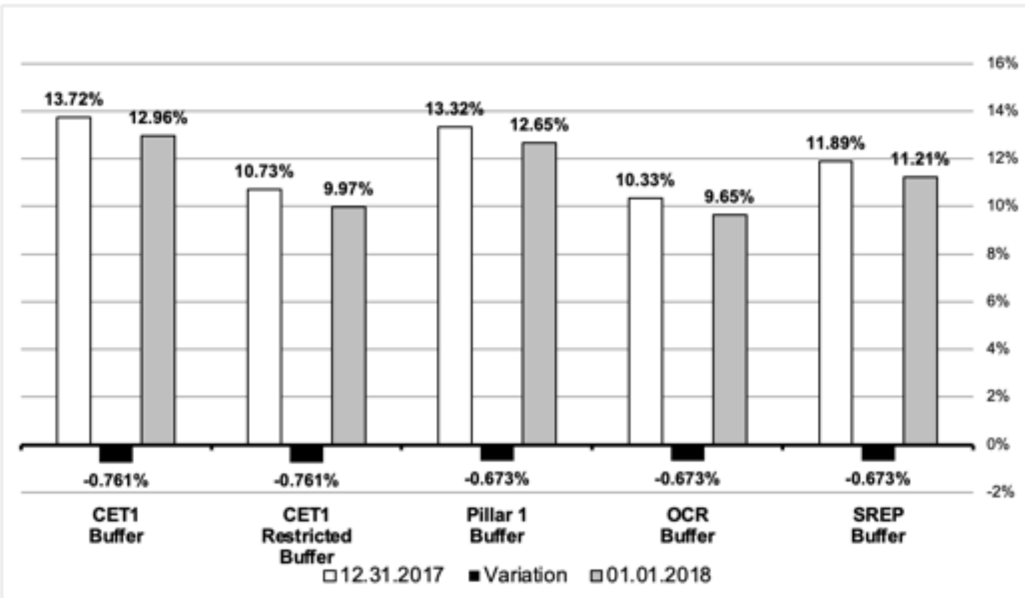


**Figure 6 -** Mean and nominal variation of capital buffers: 12.31.2017 x 01.01.2018

As for the most significant movements of BCET1, the following are worth mentioning:

- Bank of Cyprus suffered a BCET1 reduction from 8.15% to -3.15%, and thus, showed a negative[2] buffer on 01.01.2018. This decrease is mainly due to the 30.61% increase in total provisions for credit losses, with most of it being the result of rating part of the loans to customers in Stage 3, based on IFRS 9 parameters;

- Abanka, one of the largest financial institutions in Slovenia, showed an improvement of 2.63 pp in the CET1 buffer due to the 35.5% reduction in the volume of provisions for credit losses on 01.01.2018, most likely caused by the reclassification of a part of the customer portfolio at the time when IFRS 9 was first adopted;
- Nova Ljubljanska Banka bank, with a BCET1 improvement, ranging from 11.44% in December 2017 to 12.04% in January 2018, due to the 20% decrease in the total customers' loan loss allowance; this also reflects the retail portfolio reduction, resulting from the portfolio reclassifications made at the time IFRS 9 first adoption;
- RBC Investor Service Bank decreased 5.72 p.p. in the core capital buffer, as a result of recognizing provisions equivalent to 22.93% of the total customer portfolio on 01.01.2018. The RBC Investor Services Bank had no provisions recognized until the adoption of IFRS 9, at least since 2015. As of 01.01.2018, the bank recognized a loan loss allowance equivalent to 22.9% of its customer portfolio and 2.9% of its total portfolio, since these provisions almost entirely belong to the retail portfolio – in the case of RBC, 87.3% of loans are granted to other financial institutions; and
- MuniFin (Kuntarahoitus Oyj) was the institution that suffered the greatest impact in the entire group - before IFRS 9 came into force, it had a core capital buffer of 48.51%, which on 01.01.2018 was reduced to 27.89%. This bank also had no recognized provisions since, at least, December 2014, and as of January 2018 it recognized credit losses provisions that represent 2.01% of its total credit portfolio, spread across the three IFRS 9 stages.

The BCET1 median decreased by 0.36 p.p. between 12.31.2017 and 01.01.2018. It is worth mentioning that the core capital buffer median level is lower: 10.78% in the period prior to IFRS 9, dropping to 10.42% immediately after the implementation of the new accounting standard. This difference indicates that, if one disregards the extreme values, the core capital surplus, in general among the banks analyzed, is actually lower.

The restricted core capital buffer, BrCET1, takes account of all the prudential

[2] Negative capital buffers, in this study, do not necessarily mean that there was regulatory non-compliance by the bank. As explained in the methodology, in Section 3, the buffers were measured by deducting the amount referring to the provisions for loan loss variations between 12.31.2017 and 01.01.2018, of the core capital (CET1), with the objective of separately capturing the shifting effects of the accounting standard on the institutions' solvency. Thus, other factors involved in implementing IFRS 9 are not examined here, such as the origination of deferred tax assets, the incorporation of retained earnings, and capital subscription.

requirements that must be necessarily met with common equity tier 1 capital – and not just the minimum requirement of Pillar 1 (4.5%, like BCET1). Thus, the countercyclical, conservation, systemic risk and SREP additional capital requirements, applicable to each of the sample banks, are also included. Table 10 shows the number of banks that must meet some type of specific CET1 requirement, while remembering that all the institutions are equally subject to the 1.25% conservation surcharge in 2017, according to the Basel III schedule. The remaining additions are assigned on a case-by-case basis, at the discretion of the banking supervisor.

**Table 10 -** Sample composition by type of specific capital requirement

| Additional Requirement Type | Nº banks | Perc. |
|---|---|---|
| Conservation | 99 | 100.00% |
| Countercyclical | 26 | 26.26% |
| Systemic Risk | 44 | 44.44% |
| SREP | 67 | 67.68% |
| Total Banks in the Sample | 99 | |

The bank that has the highest specific CET1 requirement (12.95%), is AS SEB Banka, an institution based in Latvia, whose *BrCET1* ranged from 7.32% on 12.31.2017 to 7.62% on 01.01.2018, owing to the reduction of 11.45% of the loan loss allowance at the time of the IFRS 9 implementation. Thus, the AS SEB Banka total loan loss allowance in relation to the loan portfolio, went from 1.98% to 1.75% in the period. On the other hand, the lowest percentage in the sample of specific common equity tier 1 capital requirements is 5.75%, to which 22 institutions are subject, and comprise the minimum requirement of Pillar 1, 4.5%, plus the additional conservation of 1.25%, which all banks must meet.

The most significant *BrCET1* reductions are from MuniFin and Bank of Cyprus, already observed in *BCET1* and replicated entirely in the restricted buffer. It is worth noting that both banks must meet the Pillar 2 additional capital, established by the supervisors during the supervisory review procedure (SREP) for the 2017 financial year, those being 1.5% and 3.75%, respectively. The SREP requirement is determined by supervisors when, based on the financial institution's ad hoc analysis, since there is an understanding that the capital held by the bank would not be enough, in view of the risks arising from the business model, governance and management risks, capital risks and risks associated with liquidity and funding.

It is worth noting that the Bank of Cyprus, an institution with a significant increase in provisions on 01.01.2018, mainly resulting from the classification of assets in IFRS 9 Stage 3, received the third highest additional SREP percentage requirement, of all the sample banks in

December 2017, reaching a total CET requirement of 9.5%. The additional requirement imposed by the supervisors can be interpreted as an indication that a high credit risk, or not sufficiently covered, may have been detected through the personal assessment made by the supervisors. This argument gains strength in light of the reduction of the SERP requirement to 3% after the 2018[3] assessment, the same year in which there was an increase in credit provisions caused by the implementation of the expected credit loss model. In turn, Munifin must also comply with the 0.34% requirement for the additional countercyclical capital and the 0.5% additional systemic capital, since it is classified as "Other Systemically Important Institutions" (O-SII), reaching a CET1 total requirement of 8.09%.

Another institution worth mentioning is Piraeus Bank, which had a *BrCET1* reduction from 6.78% to 0.1% owing to a 69% increase in loan loss allowance – an increase mainly caused by assets being classified in Stage 3 on 01.01.2018. Piraeus, like Bank of Cyprus, is also expected to meet a SREP requirement of 3.75% in 2017 and has a total CET1 requirement of 9.5%.

As well as the *BCET1* median, the *BrCET1* median is also lower than the average, with a variation from 7.32% on 12.31.2017 to 7.15% on 01.01.2018, revealing that the typical restricted core capital buffer of the sample banks is lower when extreme values are disregarded. The reduction in the median of *BrCET1* after the adoption of IFRS 9 was 0.10 pp, less than the impact suffered by the *BCET1* median (-0.36 p.p.).

The *BPillar1* mean varied from 13.32% to 12.64%, at the time of the IFRS 9 first adoption, the main movements being the same as those already explained by the changes in *BCET1* and *BrCET1*. It should be noted that AS PNB Banka, from Latvia, showed a 0.06 pp reduction in *BCET1* and in *BrCET1*, but did not suffer any impact in *BPillar1*, *BOCR* and *BSREP*, which is essentially due to two factors: (i) an increase in provisions of only 1% at the IFRS 9 implementation, which thus had a small negative impact on CET1; and (ii) the existence of tier 2 capital instruments, in sufficient volume to neutralize the effect suffered by the CET1, when the other buffers are taken into account. The institution does not have any additional specific requirements.

The median of *BPillar1*, which was 10.01% on 12.31.2017, decreased by 0.44 p.p. with the new provision's standard implementation, thus reaching 9.58% on 01.01.2018. Note that

[3] The capital buffer measurement on 01.01.2018 had the same capital requirements in force on 12.31.2017, regardless of changes resulting from the advances of in the Basel III schedule, in the case of the additional conservation capital, or as the result of the SREP assessment for the year 2018. The objective is to isolate the effects of an increase in accounting provisions, resulting from the adoption of IFRS 9, on banking capital.

the median in *BPillar1* is lower than the *BCET1* median, but above the same metric calculated for *BrCET1*. This behavior can be explained by the alteration in the requirement level, inherent to the metric, and by the existence of additional tier 1 capital and hybrid debt instruments.

On December 31, 2017, the mean of the total capital requirement buffer (Overall Capital Requirement), BOCR, was 10.33%. After the adoption of IFRS 9, the metric decreased by 0.68 pp, reaching 9.65% on 01.01.2018. The BOCR median is at a lower level (6.63% in December 2017 and 6.39% in January 2018), in line with the other metrics, and with a reduction of 0.23pp. The *BOCR* reflects the worsening of capital ratios in a more comprehensive way, as it is the buffer that comprises all the requirements applicable to institutions, for each capital level, including the additional conservation, countercyclical and systemic requirements. This means that the BOCR represents the lowest capital margin for all institutions, thus, the metric that best reflects the credit expansion restrictions, and is the first indicator that could raise red flags for future problems related to banking soundness. The AS SEB Bank is the institution with the highest total capital requirement in December 2017, (16.45%). The lowest total requirement is 9.25%, with the capital requirement to be met by 22 of the sample banks in 2017.

As a result of the SREP assessment process, 67 institutions were required to meet an additional Pillar 2 capital requirement, at the time of IFRS 9 implementation, with percentages ranging from 0.7%, (Landesbank Hessen, to 6.2% (AS SEB Banka). It is worth mentioning that the SREP requirement must be fully met with core capital, the one with the best quality and whith is directly affected by an increase in the provisions for credit losses.

The *BSREP* mean on 12.31.2017 was 11.89%, but reduced to 11.21% on 01.01.2018, while the median, in the same period, ranged from 8.41% to 8.06% (-0.35 p.p.). While *BOCR* is more restrictive, since it includes all applicable capital requirements, the *BPillar1* is less restrictive, as it only discounts the minimum capital requirement (8% for all institutions) from the surplus capital. In turn, *BSREP* would be an intermediate metric. In addition to the Pillar 1 requirements, it also includes the predicted requirement resulting from the SREP assessment, to be met with CET1, but does not include the other additional capital requirements. Thus, this dynamic is reflected at the *BSREP* level: higher than *BOCR*, but lower than *BPillar1*. It is worth mentioning that this dynamic is evident in the sample because 67.68% of these banks are subject to a SREP requirement.

It is worth noting the difference between *BrCET1* and *BOCR*: a *BOCR* smaller than *BrCET1* may be an indication that most of the institutions' capital consists of core capital, which is being used to meet prudential requirements that could be met with inferior quality capital. In fact, since 2013 (following the implementation of Basel III, as shown in the schedule in Table

4), banks have been encouraged to improve their capital quality, as well as being obliged to meet several additional capital and Pillar 2 requirements.

The maximum value for all buffers, in the pre and post IFRS 9 period, can be found in Bank of America Merrill Lynch International. The impact of implementing the new accounting model for expected credit losses was practically null, -0.002%, which has been the same in each of the capital buffers. The Bank of America Merrill Lynch did not have provisions recognized on 12.31.2017, and on 01.01.2018 the provisions were only recognized for IFRS 9 Stage 1, since the bank does not have any loan portfolio assets classified in Stages 2 and 3. The SREP requirement for the bank in 2017 was 4.5%, and this was met without problems, since all the bank's capital consists of CET1.

In turn, the minimum value observed in the sample on 12.31.2017 was found in AS PNB Banka, an institution little affected by the first adoption of IFRS 9 with regard to an increase in the loan loss provisions. On 01.01.2018, the minimum buffers had negative percentages, calculated for the Bank of Cyprus, whose specific features have already been addressed.

#### 4.1.2 Effects on the Regulatory Capital, for the Complete Sample – Hypothesis $H_1$

The capital levels on 12.31.2017 and 01.01.2018 were compared for each one of the proposed buffers (*BCET1, BrCET1, BPillar1, BOCR* and *BSERP*), applying the t-test of comparison between means for paired samples, at a confidence interval of 5%. The purpose of this test is to determine whether, when two different periods are included within the same sample, the mean for the first period is statistically different from the mean for the second period. These periods are separated by the event of interest under study – in the case of this study, when the IFRS 9 was adopted for the first time, which leads to an expectation of the presence of a significant impact on the sample mean between those two periods.

**Table 11 -** Comparison of the capital buffers through mean difference tests, on 12.31.2017 and 01.01.2018 - complete sample

| | ***BCET1*** | ***BrCET1*** | ***BPillar1*** | ***BOCR*** | ***BSERP*** |
|---|---|---|---|---|---|
| 31.12.2017 Mean | 0.1372 | 0.1073 | 0.1332 | 0.1033 | 0.1189 |
| 01.01.2018 Mean | 0.1296 | 0.0997 | 0.1265 | 0.0965 | 0.1121 |
| Nominal Difference | -0.0076 | -0.0076 | -0.0067 | -0.0067 | -0.0067 |
| % Difference | -5.55% | -7.09% | -5.06% | -6.52% | -5.67% |
| T-Statistic | 2.9962 | 2.9962 | 3.5441 | 3.5441 | 3.5441 |
| p-value | (0.0017) | (0.0017) | (0.0003) | (0.0003) | (0.0003) |
| Significance | *** | *** | *** | *** | *** |

Where: ***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 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%)

According to the results shown in Table 11, after the comparison tests between means had been conducted, it was found that the means for the pre and post IFRS 9 periods, for the five proposed buffer metrics, are statistically different, with a significance level of 1%. Hence, the results obtained provide evidence that at the time of the first adoption of IFRS 9 there was a significant reduction in the capital buffer rates of European banks, leading to the confirmation of hypothesis $\mathbf{H_1}$. The findings also corroborate the various theoretical predictions (Moody's, 2016; Deloitte, 2016; BCBS, 2017; Sanchidrián and García, 2017; Barclays, 2017; ESRB, 2017) based on the premise that the increase in provisions to bear losses with credit, inherent in the expected credit loss model, would cause a significant capital reduction in financial institutions.

The statistical significance proof of the *BOCR* and *BrCET1* variables is especially interesting, as these buffers capture information regarding capital margins at a very individualized level, since they included specific requirements defined by the supervisory entity based on the institutions' idiosyncrasies. Thus, the results provide evidence that prospective provisioning, based on historical assumptions and expectations of future losses, represents a paradigm shift capable of impacting the capital structure and, hence, the institutions' solvency. The reduction in capital margins caused by the IFRS 9 adoption also restricts the ability of banks to grant credit, owing to the reduction in capital margins, and makes it desirable for capital planning to take into account the model assumptions of the the accounting provisioning.

### 4.1.3 Effects on the Regulatory Capital, in accordance with the Basel III Credit Risk Approach – Hypothesis $H_2$

The confirmation of the $\mathbf{H_1}$ hypothesis, as discussed in Section 4.1.2, configures the premise that the new standard based on expected credit losses, generally entail a greater volume of accounting provision for credit risk losses, with significant capital impacts on European banks.

Moving forward to the analysis of the effects of IFRS 9 when adopted for the first time, another key factor to be noted 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 is based on the assumption, discussed in Section 2.3.1, 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 IFRS 9 was implemented.

For this reason, the change to the expected credit losses model would reduce the capital of institutions that apply the standardized approach more significantly than those with IRB approach, an idea defended in hypothesis $\mathbf{H_2}$. Table 12 divides the banks in the sample according to the type of credit risk approach applied.

**Table 12 -** Sample composition by type of credit risk approach used to calculate regulatory capital

| Approach Type | Nº banks | Perc. |
|---|---|---|
| Standardized approach | 36 | 36.4% |
| Internal Rating Model approach | 63 | 63.6% |
| **Total** | **99** | **100.0%** |

The 99 banks that form the study sample are based in 18 different European Union country members. Table 13 shows the distribution of these entities, by country, according to the type of credit risk approach applied to calculate the credit risk RWA. It should be noted that the scenarios between countries are quite heterogeneous, and even when some countries are examined separately, there is a reasonable diversity. 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 13 -** Sample composition by country and type of credit risk approach adopted to calculate regulatory capital

| Country | Approach | | Total |
|---|---|---|---|
| | Standardized | IRB | |
| Germany | 1 | 12 | 13 |
| France | 2 | 8 | 10 |
| Italy | 3 | 8 | 11 |
| Spain | 6 | 6 | 12 |
| Belgium | 2 | 5 | 7 |
| Malta | 4 | 4 | 8 |
| Republic of Ireland | 2 | 3 | 5 |
| Austria | 2 | 3 | 5 |
| Estonia | 1 | 2 | 3 |
| Greece | 2 | 2 | 4 |
| Latvia | 1 | 2 | 3 |
| Lithuania | 1 | 0 | 1 |
| Luxembourg | 1 | 2 | 3 |
| Portugal | 1 | 2 | 3 |
| Cyprus | 3 | 0 | 3 |
| Slovenia | 3 | 0 | 3 |
| Slovakia | 0 | 2 | 2 |
| Finland | 1 | 2 | 3 |
| Total | 36 | 63 | 99 |

The difference of means test for paired samples, using t statistics was conducted to compare the capital buffers levels on 12.31.2017 and 01.01.2018 of banks applying the standardized approach and IRB approach for calculating credit risk, and also including each of the buffers. The results of these tests are shown in Table 14.

**Table 14 -** Mean difference t tests of the capital buffers, on 12.31.2017 and 01.01.2018, by type of credit risk approach according to Basel III

| | | ***BCET1*** | ***BrCET1*** | ***BPillar1*** | ***BOCR*** | ***BSERP*** |
|---|---|---|---|---|---|---|
| Standardized approach | 31.12.2017 Mean | 0.1677 | 0.1405 | 0.1568 | 0.1296 | 0.1435 |
| | 01.01.2018 Mean | 0.1538 | 0.1266 | 0.1452 | 0.1180 | 0.1318 |
| | Nominal Difference | -0.0139 | -0.0139 | -0.0116 | -0.0116 | -0.0117 |
| | Difference % | -8.31% | -9.92% | -7.40% | -8.96% | -8.09% |
| | T-Statistic | 2.0531 | 2.0531 | 2.3146 | 2.3146 | 2.3146 |
| | p-value | (0.0238) | (0.0238) | (0.0133) | (0.0133) | (0.0133) |
| | Significance | ** | ** | ** | ** | ** |
| Internal Rating Model (IRB) | 31.12.2017 Mean | 0.1198 | 0.0881 | 0.1197 | 0.0880 | 0.1048 |
| | 01.01.2018 Mean | 0.1158 | 0.0841 | 0.1158 | 0.0841 | 0.1009 |
| | Nominal Difference | -0.0040 | -0.0040 | -0.0039 | -0.0039 | -0.0039 |
| | Difference% | -3.33% | -4.53% | -3.30% | -4.48% | -3.77% |
| | T-Statistic | 5.2538 | 5.2538 | 5.5439 | 5. 5439 | 5. 5439 |
| | p-value | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | Significance | *** | *** | *** | *** | *** |

Where: ***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, for banks adopting a standardized approach and IRB banks, with a 5% and 1% significance level, respectively.

Among the 36 banks that adopt a standardized approach: 28 (77.8%) showed a worsening of capital levels, owing to buffer decreases; seven (19.4%) were positively impacted, and improved capital margins; and one (2.8%), Bank of America Merril Lynch, did not suffer any impact. In the case of banks adopting the internal rating model approach, it was noted that: 54 institutions (85.7%) suffered a capital level decline after the first adoption of IFRS 9; eight banks (12.7%) showed buffer enhancement; and one (1.6%) was not impacted, Morgan Stanley Europe.

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[4] 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 analyzed.

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

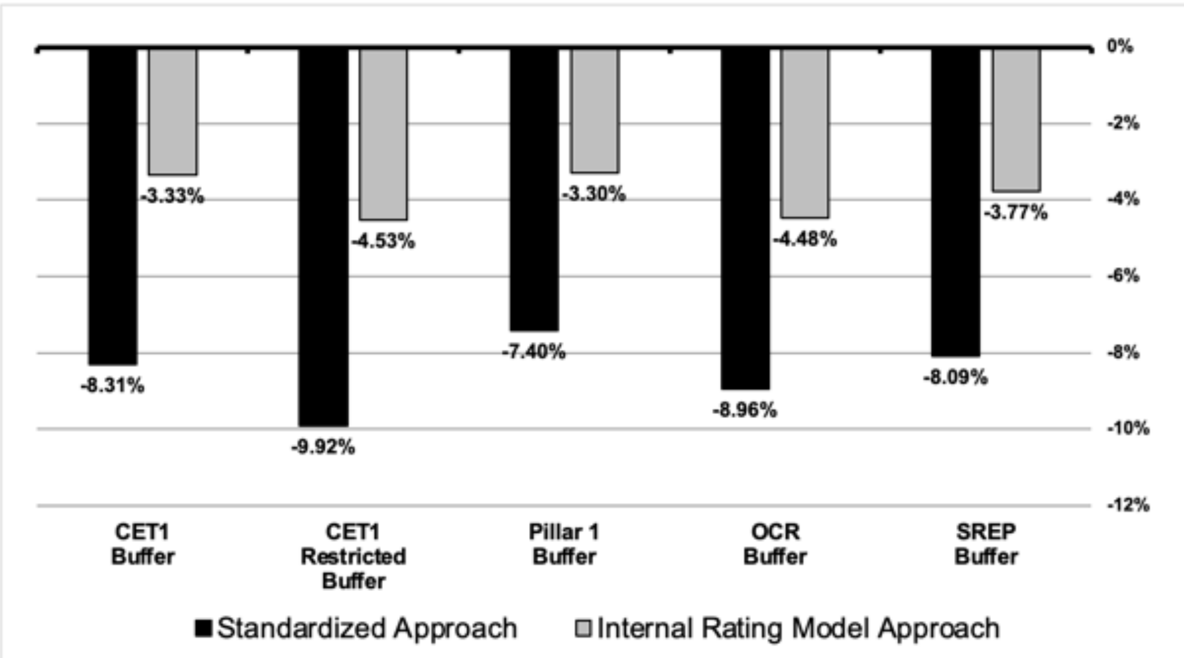


**Figure 7 -** Mean percentage variation of the capital buffers by categories of Basel III credit risk approach: 12.31.2017 x 01.01.2018

As shown in Figure 7, between 12.31.2017 and 01.01.2018, the reduction in all analyzed capital buffers (*BCET1, BrCET1, BPillar1, BOCR* and *BSREP*) was more significant for the banks that applied a standardized approach than for IRB banks. The nominal variations, shown

[4] Appendix III exhibits the total capital ratio mean and common equity tier 1 capital ratio mean for the following groups: (i) complete sample; (ii) banks that adopt the standardized approach; (iii) banks that adopt the IRB approach; (iv) banks that opted for applying the transition phase-in; and (v) banks that did not apply the transitional phase-in.

in Table 11, also confirm that the rate of buffer reduction was greater for banks that adopted a standardized approach. Thus, it was found 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 confirmed in IRB bank buffers, which leads to a confirmation of hypothesis $\mathbf{H_2}$.

In view of the fact that the only basic requirement for calculating *BCET1* is that of core capital, 4.5% applicable equally to all the banks in the sample, the higher impact seen in banks that adopt a standardized approach, can be explained by a greater increase in loan loss allowance (provisions average of 21.42% for banks adopting standardized approach versus 12.25% for IRB banks). In fact, the institutions with the most significant CET1 reductions after the adoption of IFRS 9, are banks that adopt standardized approach: MuniFin, Bank of Cyprus, Piraeus Bank and RBC Investor Services Bank, the main aspects of which were discussed in Section 4.1.1.

The nominal reduction confirmed in *BCET1* and *BrCET1* was the same, for banks that apply standardized approach and IRB approach. However, as already noted, the buffer levels are different, since they are lower for the IRB banks in both cases. The percentage variation was greater for banks that adopt standardized approach.

The dynamics of the *BPillar1* variation were influenced by: (i) an increase in loan loss allowance on 01.01.2018; and (ii) the amount of additional tier 1 capital and tier 2 capital, since it was noted that banks carrying more hybrid debt instruments as capital, suffered less impact on *BPillar1*. This is due to the fact that a part of the Pillar 1 requirement (3.5% of the total requirement of 8%) can be met by these instruments.

Banks that adopted a standardized approach had a greater increase in loan loss allowance, as already mentioned. Additionally, in December 2017, the capital of the banks that adopted a standardized approach, on average, consists of 2.09% of additional tier 1 capital and 5.22% of tier 2 capital, while in the case of banks adopting the IRB approach, on average, additional tier 1 capital is 6.25% and tier 2 is 15.22%. Thus, it is arguable that the reduction of the *BPillar1* mean for banks that adopt a standardized approach is greater than for IRB banks.

In the case of financial institutions that adopt a standardized approach, the average total requirement is 10.72% while for banks that use internal rating models, it is 11.28%. The banks with the highest OCR are AS SEB Banka (16.45%) and Swedbank AS Estonia, (15.05%), both of which adopt the IRB approach. The lowest total requirement to be observed is 9.25% and of the 22 institutions that must comply with it, only four adopt the IRB approach. The standard deviation of the mean total requirement for IRB banks is 1.54% and for institutions adopting the standardized approach, 1.35%, which shows a great dispersion among the requirements of

IRB banks.

Table 15 shows the details of specific common equity tier 1 capital requirements, segregated between banks that adopt a standardized approach and IRB banks, and shows the number of institutions subject to each type of requirement, as well as the average requirement for each of the additional capital requirements.

**Table 15 -** Sample composition by type of specific common equity tier 1 capital requirement

| Specific Requirement Type | Standardized approach | | | Internal Rating Model | | |
|---|---|---|---|---|---|---|
| | Nº banks | Perc. | Mean Req | Nº banks | Perc. | Mean Req |
| Conservation | 36 | 100.0% | 1.27% | 63 | 100.0% | 1.26% |
| Countercyclical | 3 | 8.3% | 0.23% | 23 | 36.5% | 0.12% |
| Systemic Risk | 6 | 16.7% | 0.58% | 38 | 60.3% | 2.39% |
| SREP | 20 | 55.6% | 2.41% | 47 | 74.6% | 2.00% |
| **Total** | **36** | **100.0%** | **7.22%** | **63** | **100.0%** | **7.78%** |

According to Table 15, the type of requirement that definitely differentiates the two groups is that of systemic risk. It is also worth noting that the number of banks employing a standardized approach that have an additional requirement for systemic risk, is much smaller than that of IRB banks. This difference is quite reasonable, since banks that opt for the IRB approach are usually more complex and larger, so it makes sense that they should have the greatest exposure to systemic risk and the requirement to keep more core capital to face it.

On the other hand, the SREP requirement of banks that adopt a standardized approach is greater than for IRB banks. A probable explanation is that banks that adopt a standardized approach for calculating credit risk are less able to calculate risk exposure efficiently. The adoption of the standardized approach is a strong indication that the bank calculates the risk exposure and, hence, the necessary capital to support it, based on simpler and more generic estimates, or even that those banks may not be effectively able to estimate relevant risks in their specific context. Thus, it makes sense for the SREP assessment to better evaluate these risks and impose an additional layer of requirement on those banks. In contrast, banks using internal rating models would be more sensitive to risks, since they are able to capture their exposures more efficiently, by taking note of their specific characteristics, information history and predictive models, which, ultimately, reduces the number of SREP requirements imposed by the supervisor.

The analysis of variations in capital buffers, between 12.31.2017 and 01.01.2018, reveals results in line with quantitative studies carried before IFRS 9 came into force, which had suggested that the impact of adopting the standard could be up to twice as large for banks that adopt a standardized approach (Delloite, 2016). Thus, it can be argued that the loss of the possibility of adding back general accounting provisions to capital for banks by means of the standardized approach, in fact led to a greater impact on capital buffers in these institutions.

Another key factor highlighted during the analyses is that the increase in loan loss allowance for banks relying on a standardized approach was greater, and hence had a more significant impact on the buffers. The adoption of a provisioning model based on expected credit losses makes it necessary to model EAD (Exposure at Default), PD (Probability of Default) and LGD (Loss Given Default), metrics that 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 of the banks that adopt a standardized approach would be applying these models for the very first time. Thus, it is reasonable to assume that the initial application has generated total credit loss provisions that are more sensitive to the banks' real needs and, as confirmed in most cases, is greater. In contrast, banks using an internal rating model are familiar with the assumptions for calculating expected credit losses, in addition to already having estimation models that are ready and calibrated, and 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 then in a smaller buffer impact.

The fact that the capital margins of IRB banks are also, in general, lower than the capital margins of banks that adopt standardized approach, gives evidence of a more efficient capital management and, probably, of the better understanding of the true amount of resources needed to meet credit losses, whether expected or unexpected. Thus, it is reasonable that fewer adjustments were made at the time of the IFRS 9 adoption, and this had a reduced impact on the capital buffers of IRB banks.

### 4.1.4 Effects on the Regulatory Capital, in accordance with the option for applying the IFRS 9 phase-in – Hypothesis $H_3$

From the perspective that the change to the ECL model would have a negative impact on banks' capital ratios – which was in fact confirmed by the $\mathbf{H_1}$ hypothesis – BCBS (2017) developed a transition model that allows the gradual absorption of these effects in the regulatory capital in order to avoid significant losses to the bank's soundness when implementing the new accounting standard. The transition phase-in allows the likely negative impact on the bank's capital, that was calculated at the time of the IFRS 9 implementation, to be spread over 5 years. The phase-in adoption by the banks is optional and the transitional arrangements should only be applied to the new provisions, resulting from the appliance of the expected credit losses model.

Thus, it can be assumed (as discussed in Section 2.3.1), that banks that have decided to apply the phase-in of the IFRS 9 implementation effects on the capital, are those that have estimated a greater negative impact on regulatory capital. According to the formulated hypothesis $\mathbf{H_3}$, it is expected that the reduction of capital buffers of European banks will be more intense among those that decide to apply the transition arrangements[5]. Table 16 separates the sample banks according to the decision to whether or not apply the phase-in.

**Table 16 -** Sample description, according to the option for applying the phase-in related to the expected credit loss model effects on regulatory capital

| | **Nº banks** | **Perc.** |
|---|---|---|
| Applying phase-in | 34 | 34,3% |
| Non applying phase-in | 65 | 65,7% |
| Total | 99 | 100.0% |

Most of the institutions in the study decided not to apply the IFRS 9 transition arrangements (65.7%). Table 17 shows the total sample composition regarding the phase-in choice.

[5] According to the methodology outlined in Section 3.2, the 01.01.2018 capital buffers will be different from those measured on 12.31.017 solely because of the impact of making provisions for credit losses constituted according to IFRS 9, whether this effect is positive or negative. The effects of the mitigation of the provisions' increase in the capital of banks that decided to apply the transition phase-in, was disregarded, since its objective was only to capture the effective impact of the variations in the provisions in the institutions' capital.

**Table 17 -** Sample distribution by country and according to the option for applying phase-in of the model effects on the expected credit losses for model effects on the regulatory capital

| Country | Approach | | Total |
|---|---|---|---|
| | Phase-in | No phase-in | |
| Germany | 0 | 13 | 13 |
| France | 1 | 9 | 10 |
| Italy | 9 | 2 | 11 |
| Spain | 9 | 3 | 12 |
| Belgium | 1 | 6 | 7 |
| Malta | 2 | 6 | 8 |
| Ireland | 3 | 2 | 5 |
| Austria | 0 | 5 | 5 |
| Estonia | 0 | 3 | 3 |
| Greece | 4 | 0 | 4 |
| Latvia | 1 | 2 | 3 |
| Luxembourg | 0 | 3 | 3 |
| Portugal | 2 | 1 | 3 |
| Lithuania | 0 | 1 | 1 |
| Cyprus | 2 | 1 | 3 |
| Slovenia | 0 | 3 | 3 |
| Slovakia | 0 | 2 | 2 |
| Finland | 0 | 3 | 3 |
| Total | 34 | 65 | 99 |

The t-statistical test for comparison between means for paired samples was conducted to compare the 12.31.2017 and 01.01.2018 capital buffers of the banks that chose to apply the IFRS 9 phase-in effects, and also compare the means of those that decided not to apply it between the two periods, for each one of the proposed metrics (*BCET1, BrCET1, BPillar1, BOCR* and *BSERP*). The results of these tests are shown in Table 18.

**Table 18 -** Mean difference t-tests of the capital buffers, on 12.31.2017 and 01.01.2018, according to the option for applying phase-in arrangements

| | | ***BCET1*** | ***BrCET1*** | ***BPillar1*** | ***BOCR*** | ***BSERP*** |
|---|---|---|---|---|---|---|
| Applying *phase-in* | 31.12.2017 Mean | 0.1000 | 0.0703 | 0.0843 | 0.0546 | 0.0682 |
| | 01.01.2018 Mean | 0.0878 | 0.0581 | 0.0722 | 0.0425 | 0.0561 |
| | Nominal Difference | -0.0122 | -0.0122 | -0.0121 | -0.0121 | -0.0121 |
| | Difference % | -12.24% | -17.40% | -14.41% | -22.23% | -17.81% |
| | T-Statistic | 3.2935 | 3.2935 | 3.3237 | 3.3237 | 3.3237 |
| | p-value | (0.0012) | (0.0012) | (0.0011) | (0.0011) | (0.0011) |
| | Significance | *** | *** | *** | *** | *** |
| Not applying *phase-in* | Average 31.12.2017 | 0.1567 | 0.1266 | 0.1588 | 0.1287 | 0.1454 |
| | Average 01.01.2018 | 0.1515 | 0.1212 | 0.1549 | 0.1248 | 0.1415 |
| | Nominal Difference | -0.0052 | -0.0052 | -0.0039 | -0.0039 | -0.0039 |
| | Diference % | -3.31% | -4.10% | -2.46% | -3.03% | -2.69% |
| | T-Statistic | 1.5606 | 1.5606 | 1.8497 | 1.8497 | 1.8497 |
| | p-value | (0.0618) | (0.0618) | (0.0313) | (0.0313) | (0.0313) |
| | Significance | * | * | ** | ** | ** |

Where: ***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 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 t-statistic tests of comparison between means reveal that the pre and post IFRS 9 periods means are statistically different, both for banks opting for and not opting for applying the phase-in and including all five proposed buffer metrics.

Among the 34 banks that opted for the phase-in, 33 (97.1%) showed a worsening capital level, caused by a decrease in buffers, and one (2.9%) was positively impacted, with an improvement in the core capital margin (the Unicaja Bank). On the other hand, among banks that did not apply the transition arrangements, it is observed that: 49 institutions (75.4%) suffered a deterioration of capital level after the IFRS 9 implementation; 14 banks (21.5%) showed an improvement in buffers; and two banks (3.1%) were not affected.

The means of all capital buffers under analysis (*BCET1, BrCET1, BPillar1, BOCR* and *BSREP*) for banks that did not opt for the phase-in, is at a higher level than the means of the banks that chose to apply it. The analysis of the mean common equity tier 1 capital and total capital ratios, in December 2017, reveals that banks not did not opt for the phase-in carried capital levels significantly higher than those of the banks that opted for the phase-in. These findings suggest that banks that chose not to adopt the transition arrangements were probably less concerned with the impact on their capital of the new standard implementation, as they had more comfortable solvency margins.

Thus, since the mean capital ratios of banks applying the transition arrangements are lower than those of non-opting institutions, it is natural that the level of difference is reflected in all the capital buffers. This preliminary analysis already provides supporting evidence for hypothesis **$H_3$**, as it shows that banks that in December 2017 already had lower capital ratios decided to mitigate the immediate IFRS 9 implementation effects.

As shown in Figure 8, between 12.31.2017 and 01.01.2018, the reduction in all the analyzed capital buffers (*BCET1, BrCET1, BPillar1, BOCR* and *BSREP*) was a more significant percentage for banks opting for the phase-in. The nominal variations, shown in Table 15, also confirm that the intensity of buffer reduction was greater for banks that decided to apply the transition arrangements. Thus, the findings reveal that when IFRS 9 was adopted for the first time, the reduction in capital buffers of European banks that adopted the phase-in was stronger than that of banks not applying this transition mechanism, which corroborates the predicted **$H_3$** hypothesis.

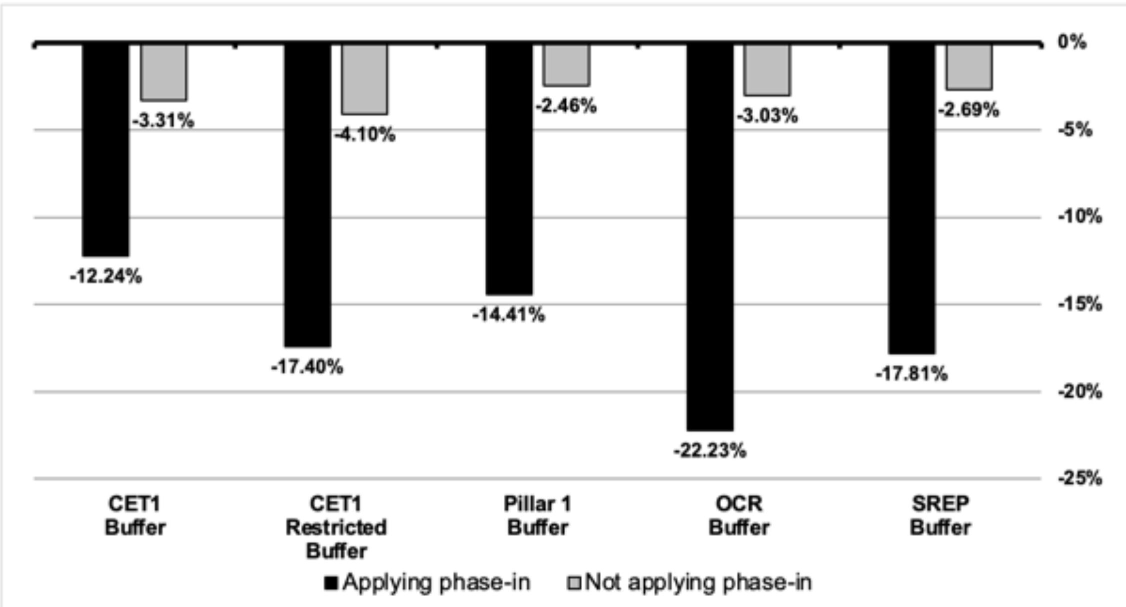


**Figure 8 -** Mean percentage variation of the capital buffers based on to the option for the transition arrangements (phase-in): 12.31.2017 x 01.01.2018

In the case of CET1, the most significant impact resulting from the adoption of IFRS 9 was found in banks opting for transition arrangements and this can be explained by the size of the reduction of capital metrics caused by the increase in provisions for expected credit losses. While the common equity tier 1 capital of the opting banks was reduced on average by 6.67% between 12.31.2017 and 01.01.2018, the average reduction in the core capital of non-opting banks was only 1.69%. In fact, the institutions with the most significant CET1 reductions after the IFRS 9 adoption are banks that opted for phase-in - Bank of Cyprus, Piraeus Bank, Banca Monte de Paschi di Siena, BPER Banca, National Bank of Grecee and Eurobank Ergasias. Additionally, Abanka and Norddeutsche Landesbank showed the most significant CET1 improvements of the entire sample, owing to the reduction in provisions by 35.5% and 17.54%, respectively. Both banks belong to the group that did not opt for the transition arrangements.

Regarding the increase in the loan loss allowance, caused by the adoption of IFRS 9, the banks that are applying the phase-in had an 11.3% increase, at the same time that the amount of provisions of non-opting banks increased 9.4%, a difference of only 1.9 pp. However, the impact on capital buffers was considerably greater for banks that adopted the transition arrangements. Thus, the amount of capital in the IFRS 9 pre-adoption was more important in determining the impact on the capital buffers. It can also be inferred that the choice of whether or not to adhere to the phase-in was more related to the analysis of capital margins than to the estimates of an increase in provisions after the new standard adoption.

The joint analysis of the CET1 level of reduction and the increase of provisions reveals that the capital of banks that do not opted for the phase-in is more robust than the capital of the opting banks, which therefore suffered a less significant reduction in buffers.

The size of the *BCET1* and *BrCET1*nominal reduction was -1.22 pp for both *BCET1* and *BrCET1* in banks applying phase-in and -0.52 pp for those same buffers in non-opting banks. However, as already noted, the buffers level are differents, since they are lower for the banks opting for the phase-in, when both metrics are taken into account.

Table 19 shows the details of the core capital specific requirements, segregated between banks by either applying the transition arrangements or not, and showing the number of institutions subject to each type of requirement, as well as the mean requirement for each of the additional requirements.

**Table 19 -** Sample description by type of common equity tier 1 capital specific requirement

| | Nº banks | Perc. | Mean Requirement |
|---|---|---|---|
| **Applying *phase-in*** | **34** | **100.0%** | **7.50%** |
| Conservation | 34 | 100.0% | 1.29% |
| Countercyclical | 6 | 17.6% | 0.07% |
| Systemic Risk | 6 | 17.6% | 0.50% |
| SREP | 25 | 73.5% | 2.19% |
| **Non applying *phase-in*** | **65** | **100.0%** | **7.62%** |
| Conservation | 65 | 100.0% | 1.25% |
| Countercyclical | 20 | 30.8% | 0.16% |
| Systemic Risk | 38 | 58.5% | 0.81% |
| SREP | 42 | 64.6% | 2.08% |

In general, the mean requirement levels between the two groups are similar, although the dispersion level of non-opting banks is higher (1.65%), compared with the banks that applied the transition arrangements (1.14 %). The average SREP requirement for opting banks is 0.11 pp, higher than for non-opting banks, which may indicate a greater risk perception on the part of the banking supervisor when assessing these institutions, in line with the lower capital margins held by these banks. In light of this, it is reasonable that these institutions also showing a greater concern with levels of soundness, decide to mitigate the effects of the IFRS 9 implementation.

Variation dynamics of *BPillar1* are also largely due to the banks' pre-IFRS 9 capital levels, since they are partly strengthened by the volume of addition tier 1 capital and level 2 capital in each group. The total capital of banks applying phase-in comprises, on average, 4.95% of additional tier 1 capital and 12.73% of level 2 capital. Non-opting banks, on average, had additional tier 1 capital of 6.32% and level 2 capital of 15.16%. Once again, there is evidence that the choice of whether or not to adhere to the transitional arrangements would be related to solvency levels before the adoption of the new accounting standard, as the banks with a lower volume of hybrid instruments are those that choose to apply the phase-in.

The total mean requirement of financial institutions that adopted the transition arrangements and banks that did not opt for phase-in is similar: 11.00% and 11.12%, respectively. Thus, individual capital requirements were not a decisive factor for differences in the impact of IFRS 9, between the two groups. This finding is quite reasonable, since the option of whether to apply the phase-in or not is a discretionary choice taken by the bank, and is most likely linked to the financial institution's own perception of the effects of the new standard on its level of soundness, than to capital requirements and additions designated by the supervisory entity.

As proved by the mean total capital requirement analysis, CET1 specific individual requirements were not the most important factor for the *BSREP* dynamics, when deciding on whether to happly the phase-in or not.

There is evidence in the comparison of mean variations of the capital buffers that at the moment of the first adoption of IFRS 9 the reduction in capital buffers was more intense among European banks that opted for the transition arrangements for absorbing the effects of the new provisioning model for credit risk, and so the findings lead to a confirmation of hypothesis $\mathbf{H_3}$. The option for applying the phase-in proves to be a consistent choice on the part of these institutions, insofar as: (i) the mean capital levels kept by the group of opting banks in December 2017 are lower than the mean capital levels maintained by non-opting banks; (ii) the application of the transitional arrangements allows the maintenance of higher capital margins and more comfortable soundness levels, which is especially important for institutions holding less capital margin; and (iii) most likely, the phase-in adoption avoids compromising the credit-granting capacity in an environment of uncertainty after the IFRS 9 implementation, while also benefiting capital maintenance.

## 4.2 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 models (3.2), (3.3) and (3.4) estimation in order to test hypotheses $\mathbf{H_4}$, $\mathbf{H_5}$ and $\mathbf{H_6}$.

### 4.2.1 Descriptive Statistics

In this stage of empirical estimation tests for the models (3.2), (3.3) and (3.4), the descriptive statistics of the base model are consolidated (3.2) together with non-dichotomous variables – the models (3.3) and (3.4) use the same variables, only adding dummies and interactive variables – including the half-yearly information from European banks for the entire sample period, from 2015 to 2019. The data are consolidated in Table 20.

**Table 20 -** Descriptive statistics for the Continuous variables of the base model (3.2)

| Variable | Mean | Median | Maximum | Minimum | St. Deviation |
|---|---|---|---|---|---|
| *BCET1* | 0.1245 | 0.0999 | 1.0830 | -0.0315 | 0.0981 |
| *BRCET1* | 0.0949 | 0.0724 | 1.9190 | -0.0815 | 0.0994 |
| *BPILLAR1* | 0.1206 | 0.0934 | 1.0480 | -0.0491 | 0.1104 |
| *BOCR* | 0.0910 | 0.0639 | 0.9840 | -0.0991 | 0.1110 |
| *BSREP* | 0.1070 | 0.0807 | 1.0037 | -0.0866 | 0.1114 |
| *SIZE* | 11.3764 | 11.2596 | 14.6795 | 6.3047 | 1.6224 |
| *ROE* | 0.0183 | 0.0304 | 0.3454 | -1.0632 | 0.0858 |
| *RISKCRED* | 0.0399 | 0.0207 | 0.3044 | 0.0000 | 0.0545 |
| *RISKASSET* | 0.4263 | 0.4003 | 0.9849 | 0.0359 | 0.1825 |

Where: ***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.; ***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.

The analysis of the descriptive statistics allows the formation of a more comprehensive understanding of the study banks, and covers the total analyzed period of ten semesters, between 2015 and 2019, in addition to the values on 01.01.2018, of the IFRS 9 impact, calculated in the first-time period of its adoption. These analyses can also provide the first impressions of the behavior of the variables during the analyzed period.

With regard to *BCET1, BRCET1, BPILLAR1, BOCR* and *BSREP* capital buffers, the central tendency measures (mean and median) show that in the period examined, European banks had a capitalization level above what is required, but with characteristics of strong dispersion, as shown by the standard deviation and the maximum and minimum points. It is noteworthy that there is evidence of negative values for all the buffers. The minimum values of the buffers in the sample belong to Bank of Cyprus, one of the most affected institutions in terms of capital, when IFRS 9 was first adopted. As discussed in Subsection 4.1.1, the Bank of Cyprus had the balance of its allowance for loan losses increased by 30.61% on 01.01.2018, so that the buffers measured immediately after the first adoption of IFRS 9 were all negative. More detailed analyses of buffer statistics for the pre- and post-IFRS 9 periods are given in Section 4.1.

As for the variable *SIZE*, which indicates the size of the banks, close values for mean and median are determined, which show the absence of extreme values in sufficient quantity to distort the metrics. The banks that belong to the sample are only those that are directly supervised by the ECB, due to their economic and financial importance within the European Union. These banks were classified as significant by the ECB, with size being the first of the criteria[6], as set out in Subsection 3.4. Thus, it is reasonable to conclude that information regarding the size of the banks has not been widely dispersed.

The largest bank in the sample was BNP Paribas, a French institution with total assets of approximately 2,372 billion euros in June 2019. Besides BPN Paribas, the largest banks in the sample (all with assets above 1,000 billion euros), are: Deutsche Bank, Santander, BPCE, Credit Agricole and Societe Generale. In contrast, the smallest bank in the sample is AS PNB Banka, a Latvia bank, with total assets of 0.547 billion in July 2019. AS PNB Banka is directly supervised by the ECB based on Article 6, item 5 (b), EU Regulation No. 1024/2013, which allows the supervisory authority to decide directly to exercise all relevant powers in relation to a credit institution, when deemed necessary to ensure a consistent application of high supervision standards. Four more banks in the sample are supervised by the ECB based on the same criteria: Morgan Stanley Europe, Sberbank Europe, Slovenska and Tatra Banka.

The banks median profitability (*ROE*) is 1.21 pp above the average, which suggests that, together with the standard deviation, there is reasonable variability for this ratio between banks and periods. In December 2018, Hellenic Bank registered a 34.54% *ROE*, percentage above the usual for the institution and which is explained by the recognition of its results with regard to the acquisition of a cooperative bank in September 2018. In July 2017, the Italian bank Monte dei Paschi de Siena suffered the worst result in the sample, owing to the effects of a planned transfer of certain doubtful credit exposures, as a part of the institution's Restructuring Plan. In general, 29 banks showed losses in at least one semester between 2015 and 2019, with an emphasis on Banco Carige, LSF Nani Investments and Dexia, institutions in Italy, Portugal and Belgium, respectively, which suffered losses in most of the semesters analyzed.

The analysis of the credit risk ratio (*RISKCredRED*) reveals a median lower than the average and suggests that the provisions for credit risk percentage with regard to the total portfolio is concentrated at a level of 1.91 pp below the average. The bank with highest credit risk was Hellenic Bank, with 30.44% on 01.01.2018, immediately after the adoption of IFRS 9. However, the bank already had high provisioning percentages since in previous semesters,

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[6] Table A-1, in Appendix I, shows all the sample banks as well as the justification for their classification as a significant entity by the ECB.

and the increase on the balance of the allowance of the loan losses because of the new ECL provisions was 2.94%. Some institutions did not recognize loan losses provisions for the portfolio, in certain periods under analysis: The Bank of New York Mellon (2015, 2016, 2017 and 2019), RCB Investor Services (2015, 2016 and 2017), Bank of America (2017) and Munifin (2017).

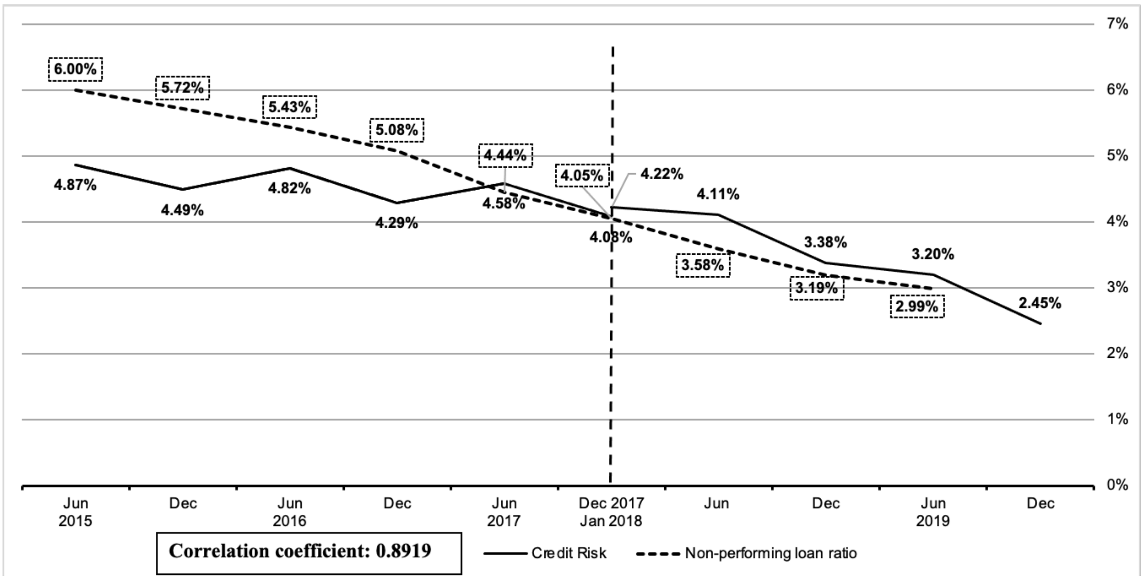


**Figure 9 -** Evolving pattern of the mean credit risk (RISKCred) for the complete sample in percentage terms and non-performing loan ratio on total loan portfolio for the European banking system aggregate, from 2015 to 2019

Figure 9 provides an overview of the variable credit risk evolution for the period from 2015 to 2019 and, also, the non-performing loan ratio for the European banking system. On 01.01.2018 there was an average increase of 0.14 pp in provisions, with the IFRS 9 being adopted for the first time. However, it is evident that the *RISKCred* variable trend is downward, which reflects a reduction in provisions, which is probably associated with a significant reduction in the default rate in the European banking system between 2015 and 2019. According to a report published by the European Bank Authority, in 2019, the non-performing loans of European banks have been reduced by 50% since 2015, despite the dispersion level between countries (EBA, 2019). The correlation coefficient between the two series is 0.8919, which shows a considerable high relation between the observed trends.

This tendency for a reduction in the NPL ratio between 2015 and 2019 is reflected, to a large extent, in the credit risk rate trend, as shown in Figure 9. It is worth stressing that, according to arguments outlined in Subsection 2.1, the change from a provisioning model based on incurred losses for a model based on expected losses, generates expectation of an increase in provisions, as well as a more timely credit risk materialization. However, other macroeconomic factors, such as the behavior of the bank NPL ratio, also affect the dynamics for credit losses provisioning within the banking system – which justifies the inclusion of this variable as a control in the model's estimates.

Despite the significant increase in the volume of provisions determined at the time of the IFRS 9 adoption, and confirmed by the $\mathbf{H_1}$ research hypothesis, it is possible that the gradual reduction in the volume of the mean provisions, when taking account of the total sample, may contribute to the growth in capital buffers. However, this factor alone would not be decisive for a likely capital restoration, since other factors such as the requirement level, profitability and asset risk assessment may also directly impact capital dynamics. A more detailed analysis of the behavior of the buffers and their relationship with credit risk is provided in Section 4.1

The analysis of the risk-asset ratio (*RISKAsset*) reveals a high dispersion, the largest among the series, which signals a considerable variation in the risk exposure of the banks throughout the semesters analyzed. On average, the ratio between risk-weighted assets and total assets has remained stable over the years, at approximately 42%. The Slovenian bank (Nova Ljubljanska) was the one with the highest ratio, 98.49% in December 2019, with a mean of RWA in relation to total assets reaching 94.23% between the first half of 2015 and the second semester of 2019. MunFin bank, on the other hand, has the lowest risk asset levels in the group, and maintains percentages below 5% for all ten semesters under analysis, reaching a minimum of 3.59% in December 2019. This bank has capital buffers that are quite high, a mean of 50% for BCET1 in the period, which is explained by its low exposure risk.

### 4.2.2 Robustness Tests

To ensure the empirical robustness, tests are applied to assess the stationary condition of the time series, identify the multicollinearity risk, analyse the endogeneity risk of the model, verify autocorrelation and heteroscedasticity in the residues, identify the individual heterogeneity that justifies the use of panel data and, if applicable, make the most appropriate choice for panel estimation with fixed or random effects.

The stationary tests Im, Pesaran and Shin (IPS)., ADF-Fisher and PPFisher were conducted on non-dichotomous variables to verify possible unit roots in the series. The results are consolidated in Table 21.

**Table 21 -** Results of the Im, Pesaran and Shin - I.P.S., ADF-Fisher and PP-Fisher tests on non-dichotomous variables in the model (3.2)

| Varable | IPS test | | ADF-Fisher test | | PPFisher test | |
|---|---|---|---|---|---|---|
| | Statistics | p-value | Statistics | p-value | Statistics | p-value |
| *BCET1* | -10.9654 | 0.0000 | 764.044 | 0.0000 | 790.243 | 0.0000 |
| *BRCET1* | -10.0339 | 0.0000 | 415.079 | 0.0000 | 363.585 | 0.0000 |
| *BPILLAR1* | -5.42425 | 0.0000 | 355.954 | 0.0000 | 376.364 | 0.0000 |
| *BOCR* | -10.5080 | 0.0000 | 432.861 | 0.0000 | 344.289 | 0.0000 |
| *BSREP* | -7.39508 | 0.0000 | 362.641 | 0.0000 | 359.732 | 0.0000 |
| $SIZE_{préIFRS9}$ | -0.13433 | 0.4466 | 171.630 | 0.0893 | 225.988 | 0.0000 |
| $SIZE_{pósIFRS9}$ | -29.4581 | 0.000 | 229.896 | 0.0000 | 203.443 | 0.0151 |
| *ROE* | -23.3072 | 0.0000 | 575.179 | 0.0000 | 641.607 | 0.0000 |
| $RISKCRED_{préIFRS9}$ | -12.4909 | 0.0000 | 268.563 | 0.0000 | 300.059 | 0.0000 |
| $RISKCRED_{pósIFRS9}$ | -9.51468 | 0.0000 | 269.936 | 0.0000 | 389.000 | 0.0000 |
| *RISKASSET* | -2.52779 | 0.0057 | 219.079 | 0.0007 | 263.830 | 0.0000 |

Where: ***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 Pilar 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.; ***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.

The variables *SIZE* and *RISKcred* were initially tested for the entire sample period, the results of which led to the non-rejection of the null hypothesis in the IPS and ADF-Fisher tests, and to the rejection of the null hypothesis in the PPFisher test in both cases. Any doubts were removed by conducting the unit root tests which involved segregating the sample variables between the pre and post IFRS 9 period, which is the reference-point for the estimates made. Thus, possible effects of temporal interaction on the variables were eliminated, and this led to the rejection, in all cases, of the null hypothesis that the series is stationary. Thus, the risk of spurious regression was eliminated, as the non-dichotomous explanatory variables do not have unitary roots.

To test the risk of multicollinearity, the variance inflation test (VIF) was carried out for the independent variables, using auxiliary regressions between each independent variable (j-th) and the other model regressors, the results of which are consolidated in Table 22.

**Table 22 -** Variance Inflation Factor Test for model (3.2) and for integration variables from the models (3.3) and (3.4)

| j-th variable | VIFj |
|---|---|
| $BCET1_{t-1}$ | 1.4604 |
| $BrCET1_{t-1}$ | 1.3633 |
| $BPillar1_{t-1}$ | 1.7613 |
| $BOCR_{t-1}$ | 1.6644 |
| $BSREP_{t-1}$ | 1.7842 |
| $PHASE$ | 1.7213 |
| $APROA$ | 2.2543 |
| $SIZE$ | 1.9690 |
| $ROE$ | 1.0526 |
| $RISKCRED$ | 2.3183 |
| $RISKASSET$ | 2.9281 |
| $(BCET1_{t-1} * APROA)$ | 2.7839 |
| $(BrCET1_{t-1} * APROA)$ | 2.0604 |
| $(BPillar1_{t-1} * APROA)$ | 2.1810 |
| $(BOCR_{t-1} * APROA)$ | 2.0396 |
| $(BSREP_{t-1} * APROA)$ | 2.4088 |
| $(BCET1_{t-1} * PHASE)$ | 2.9480 |
| $(BrCET1_{t-1} * PHASE)$ | 2.1611 |
| $(BPillar1_{t-1} * PHASE)$ | 2.3970 |
| $(BOCR_{t-1} * PHASE)$ | 1.7338 |
| $(BSREP_{t-1} * PHASE)$ | 1.9385 |

Where: ***BCET1t-1*** is the common equity tier 1 capital buffer for the previous period that considers the capital surplus in relation to the specific Common Equity Tier 1 Pillar 1 regulatory requirement; ***BrCET1t-1*** is the restricted common equity tier 1 capital buffer for the previous period, 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 Pilar 1 for the previous period, which considers the capital surplus in relation to the Pillar 1 requirements; ***BOCR t-1*** is the overall capital requirement buffer or the previous period, which considers the capital surplus in relation to the overall capital requirement applicable to financial institution; ***BSREP t-1*** is the capital buffer for the supervisor review (Supervisory Review and Evaluation Process) for the previous period, which considers the capital surplus in relation to the total SREP requirement.; ***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.

A VIF with a value starting at 10 indicates multicollinearity problems between the independent variables (Gujarati & Porter, 2011). Thus, as shown in Table 22, there is no evidence of the presence of multicollinearity in this study.

The Hausman test was applied in order to analyse the endogeneity risk. Each independent variable was tested separately, being testes agains each other, one at a time. Table 23 shows the results of the endogeneity test, considering each of the dependent variables of the study. The null hypotheses, according to which the independent variable is endogenous, was rejected in all cases.

**Table 23 –** Results of the Hausman test for endogeneity for the independent variables

| Variable | | ***BCET1*** | ***BRCET1*** | ***BPILLAR1*** | ***BOCR*** | ***BSREP*** |
|---|---|---|---|---|---|---|
| *APROA* | Statistics | 2.2320 | 1.3732 | 2.5353 | 1.7872 | 2.0012 |
| | p-Value | (0.0259) | (0.1702) | (0.0115) | (0.0744) | (0.0458) |
| *PHASE* | Statistics | 1.0692 | 0.8703 | 0.9599 | 0.7039 | 0.4560 |
| | p-Value | (0.2854) | (0.3845) | (0.3375) | (0.4817) | (0.6485) |
| *SIZE* | Statistics | 0.3026 | -1.4894 | -0.1180 | -0.9516 | -0.4717 |
| | p-Value | (0.7623) | (0.1369) | (0.9061) | (0.3417) | (0.6373) |
| *ROE* | Statistics | 2.1703 | 1.2660 | 2.4034 | 1.4776 | 2.0587 |
| | p-Value | (0.0301) | (0.2060) | (0.0165) | (0.1400) | (0.0399) |
| *RISKCRED* | Statistics | 1.3287 | 0.6553 | 1.2734 | 0.5608 | 0.4921 |
| | p-Value | (0.1844) | (0.5320) | (0.2033) | (0.5751) | (0.6228) |
| *RISKASSET* | Statistics | -3.0739 | -2.8690 | -3.1420 | -3.0081 | -2.8966 |
| | p-Value | (0.0022) | (0.0042) | (0.0018) | (0.0027) | (0.0039) |

Where: ***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 Pilar 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.; ***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.

To detect the possible presence of autocorrelation and heteroscedasticity between the regression residues (3.2), (3.3) and (3.4), the Durbin-Watson (DW) and the Breusch-Godfrey tests were applied, in line with Gujarati and Porter (2011). The results highlighted in Table 24 demonstrate that there is no evidence of autocorrelation in the residues. The results regarding the heteroscedasticity of the residues show that the null hypothesis, according to which the residues are homoscedastic, was accepted in all cases, except in the model (3.2) for the variable BOCR.

**Table 24 -** Results of Durbin-Watson tests for identification of autocorrelation in residues

| Test | Dependent Variable | *BCET1* | *BRCET1* | *BPILLAR1* | *BOCR* | *BSREP* |
|---|---|---|---|---|---|---|
| Durbin-Watson | Model (3.2) | 1.8473 | 2.1150 | 1.8478 | 2.0641 | 1.9667 |
| | Model (3.3) | 1.9810 | 2.1748 | 2.0327 | 2.1715 | 2.0967 |
| | Model (3.4) | 1.8175 | 2.0957 | 1.8250 | 2.0494 | 1.9472 |
| Breusch-Godfrey | Model (3.2) | 98.0515 | 93.0266 | 89.2087 | 167.5752 | 94.5846 |
| | Prob(F-satistic) | (0.1091) | (0.1903) | (0.2746) | (0.0000) | (0.1616) |
| | Model (3.3) | 66.7947 | 84.9087 | 65.8749 | 67.0103 | 89.8561 |
| | Prob(F-satistic) | (0.8882) | (0.3911) | (0.9031) | (0.8845) | (0.2590) |
| | Model (3.4) | 92.4533 | 99.8831 | 79.3651 | 63.6560 | 91.7841 |
| | Prob(F-satistic) | (0.2017) | (0.0873) | (0.5619) | (0.9335) | (0.2156) |

Where: ***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.

In order to mitigate the heteroscedasticity risk in the residues, in addition to relativizing all the variables used in the models, the estimations will be performed using the SUR (PCSE) sectional standard error method, which generates robust parameters even in the presence of heteroscedasticity and sectional autocorrelation in the residues.

The Chow Test was conducted to assess whether the presence of individual bank effects justifies the use of panel data, following Gujarati and Porter (2011), with the results shown in Table 25.

**Table 25 -** Chow Test statisitcs

| Dependent Variable | *BCET1* | *BRCET1* | *BPILLAR1* | *BOCR* | *BSREP* |
|---|---|---|---|---|---|
| Chow test | 57.0635 | 30.2956 | 47.0325 | 26.4265 | 30.2212 |
| Prob (F-statistic) | (0.0002) | (0.0002) | (0.0002) | (0.0002) | (0.0002) |

Where: ***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 Pilar 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.

The results in Table 25 lead to a rejection of the null hypothesis, according to which there would be equality in the intercepts and in the slopes for the sample individuals. Thus, the significance of using panel data is demonstrated, by the fact that they add greater informational value to the model. Panel data is best suited to examine the changing dynamics, by offering more informative data, greater variability, less collinearity between variables and more efficiency (Gujarati & Porter, 2011). There is thus, evidence, that the fixed effects model is more appropriate than the pooled model, since the rejection of the null hypothesis means that the pre and post IFRS 9 period regressions would be statistically equal.

Once the convenience of using the panel data with the Chow test had been determined, the Hausman test is then necessary to define which model would be the most appropriate for the estimations - fixed effects or random effects.

**Table 26 -** Hausman test statistics to define fixed effects or random effects

| Variable | ***BCET1*** | ***BRCET1*** | ***BPILLAR1*** | ***BOCR*** | ***BSREP*** |
|---|---|---|---|---|---|
| Hausman test | 3.3218 | 14.2898 | 15.8253 | 3.3799 | 5.1468 |
| (p-value) | (0.6505) | (0.0139) | (0.0074) | (0.6416) | (0.3982) |

Where: ***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.

According to the results shown in Table 26, the null hypothesis that the random effects model is consistent, is rejected for the *BrCET1* and *BPillar1* variables, and accepted for the other variables of interest - *BCET1, BOCR* and *BSREP*.

However, according to Gujarati and Porter (2011), the hypothesis underlying the random effects model is that the data form a part of a much larger population, which is not the case in the present study. The banks in the sample are all those that were classified by the ECB as a significant entity, and include the criteria established in Subsection 3.4, given their economic and financial importance within the European Union. Thus, when the individual units of the sample are not random extractions from a larger sample, the fixed effects model is suitable.

Thus, despite the results of the Hausman test for three of the variables of interest, it was decided to use the fixed effects model for all the estimations.

### 4.2.3 Restoration of Capital Buffers, in Post-IFRS 9 Period – Hypotheses $H_4$

The base model (3.2) was estimated to find evidence of capital buffer restoration to pre-

IFRS 9 levels or evidence of the maintanence of their level at the new level reached after the expected credit loss provision model came into force. It used panel data with fixed period effects and also applied the SUR method (PCSE), for each one of the selected buffers - *BCET1, BrCET1, BPillar1, BOCR* and *BSERP*.

According to the results shown in Table 27, the coefficients associated with the capital buffer variable from the previous period, showed statistically significant positive signs at 1%, in the periods before and after IFRS 9, for all the buffers tested.

**Table 27 -** Model estimates (3.2) results, for the periods before and after IFRS 9

**Model Tested**

$$BCap_{i,t} = \beta_0 + \beta_i + \beta_1 BCap_{i,t-1} + \beta_2 SIZE_{i,t} + \beta_3 ROE_{i,t} + \beta_4 RISK_{Cred_{i,t}} + \beta_5 RISK_{Asset_{i,t}} + \varepsilon_{i,t}$$

| Variable | *BCET1* | *BRCET1* | *BPILLAR1* | *BOCR* | *BSREP* |
|---|---|---|---|---|---|
| Painel A: pre-IFRS 9 period | | | | | |
| *C* | **0.0332*** (0.0003)** | **0.0460*** (0.0001)** | **0.0364*** (0.0004)** | **0.0423*** (0.0005)** | **0.0430*** (0.0004)** |
| *Bcap (-1)* | **0.8426*** (0.0000)** | **0.7536*** (0.0000)** | **0.8642*** (0.0000)** | **0.8057*** (0.0000)** | **0.8243*** (0.0000)** |
| *SIZE* | **-0.0010* (0.0735)** | **-0.0020*** (0.0072)** | -0.0010 (0.1200) | **-0.0016** (0.0406)** | **-0.0015* (0.0619)** |
| *ROE* | **0.0524*** (0.0000)** | **0.0548*** (0.0000)** | **0.0547*** (0.0000)** | **0.0547*** (0.0000)** | **0.0561*** (0.0000)** |
| *RISKCred* | **0.0533*** (0.0007)** | **0.0640*** (0.0016)** | **0.0402** (0.0321)** | **0.0423* (0.0572)** | 0.0353 (0.1117) |
| *RISKAsset* | **-0.0166*** 0.0058** | **-0.0230*** (0.0030)** | **-0.0250*** (0.0007)** | **-0.0308*** (0.0004)** | **-0.0298*** (0.0006)** |
| Nº Banks | 69 | 69 | 70 | 70 | 70 |
| Period | 2015-2017 | 2015-2017 | 2015-2017 | 2015-2017 | 2015-2017 |
| Observations | 358 | 358 | 360 | 360 | 360 |
| R-squared | 0.8052 | 0.7039 | 0.8339 | 0.7493 | 0.7630 |
| F-statistic | 142.3917 | 82.4736 | 175.1913 | 104.3050 | 112.3506 |
| P-value (F) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

| Painel B: post-IFRS 9 period | | | | | |
|---|---|---|---|---|---|
| *C* | 0.0048<br>(0.6154) | 0.0027<br>(0.7766) | 0.0054<br>(0.6305) | 0.0038<br>(0.7305) | 0.0046<br>(0.6897) |
| *BCap (-1)* | **1.0458*****<br>**(0.0000)** | **1.0265*****<br>**(0.0000)** | **1.0436*****<br>**(0.0000)** | **1.0236*****<br>**(0.0000)** | **1.0324*****<br>**(0.0000)** |
| *SIZE* | -0.00003<br>(0.5786) | -0.00002<br>(0.6949) | -0.0005<br>(0.5309) | -0.0004<br>(0.6274) | -0.0003<br>(0.7064) |
| *ROE* | -0.0023<br>(0.7356) | -0.0006<br>(0.9339) | -0.0013<br>(0.8721) | 0.0006<br>(0.9341) | 0.0006<br>(0.9441) |
| *RISKCred* | **0.0490****<br>**(0.0115)** | **0.0431****<br>**(0.0335)** | **0.0589****<br>**(0.0130)** | **0.0525****<br>**(0.0312)** | **0.0548****<br>**(0.0314)** |
| *RISKAsset* | **-0.0147****<br>**(0.0223)** | **-0.0140****<br>**(0.0332)** | -0.0114<br>(0.1616) | -0.0124<br>(0.1319) | -0.0119<br>(0.1646) |
| Nº Banks | 82 | 82 | 82 | 82 | 82 |
| Period | 2018-2019 | 2018-2019 | 2018-2019 | 2018-2019 | 2018-2019 |
| Observations | 348 | 348 | 348 | 348 | 348 |
| R-squared | 0.9321 | 0.9243 | 0.9401 | 0.9336 | 0.9361 |
| F-statistic | 515.4993 | 458.9311 | 588.9714 | 527.8082 | 550.4228 |
| P-value (F) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

Where: ***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.; ***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%)

The behavioral analysis of the lagged capital buffer variable coefficients shows values for $\beta_1$ post-IFRS 9 that are positive and higher than the values of $\beta_1$ pre-IFRS 9, also for all the metrics assessed (*BCET1, BrCET1, BPillar1, BOCR* and *BSERP*). Thus, it was found that $\beta_{1,post\ IFRS9} > \beta_{1,pre\ IFRS9}$, provide evidence that leads to the confirmation of hypothesis $\mathbf{H_4}$, by configuring the underestimation of the capital requirements premise in the period prior to the adoption of the new accounting standard for credit risk provisioning. The identification of capital buffer growth movements in the period after the adoption of IFRS 9, with greater intensity than that observed before IFRS 9, provides evidence that European banks are implementing actions to restore the capital buffers that were used up at the time of the IFRS 9 implementation.

The complementary interpretation of the evidence obtained by estimating the model (3.2) and the results obtained for hypothesis $\mathbf{H_1}$, which suggested a significant reduction in the capital buffer levels of European banks when IFRS 9 was adopted for the first time, strengthens and confirms hypothesis $\mathbf{H_4}$. After a significant immediate reduction in capital buffers on 01.01.2018, the buffer growth trend was more intense than the tendency seen in the period prior to the new standard adoption.

Thus, the underestimation of regulatory capital was configured before the new accounting standard came into effect, since this capital had, very likely, been inflated by the failure to properly recognize expected credit losses. The recognition of new accounting provisions led to a significant reduction in capital buffers and, subsequently, to the perception that the remaining buffers would not be sufficient to cover unexpected losses, so that it was necessary to rebuild bank capital in the post IFRS 9 period.

For the period prior to the IFRS 9 adoption, capital buffers from the previous period, *Bcap(-1)*, were expected to present positive coefficients, although not very significant, according to the premise about the stability of the level of capital buffers, in line with the findings of Barth et al. (2017) and Stolz and Wedow (2011). However, despite being positive, the lagged capital buffers of European banks between 2015 and 2017 went against expectations with regard to coefficient values, which were higher than 0.75 for all the tested metrics and suggest the existence of a buffer growth trend in the period prior to the adoption of the new accounting standard. This kind of behavior can be justified on the basis of essentially two lines of argument.

The first argument has to do with the gradual implementation of Basel III, according to the schedule in Table 4, which imposed a systematic increase in capital requirements between 2013 and 2019. Thus, each year the capital buffers were automatically reduced, as a result of the increase in capital requirement. During this period, after the impact of the initial increase on the prudential requirement at the beginning of each year, it is likely that banks have made efforts at capitalization, and thus generated a cycle of raising and lowering the capital buffer level as the Basel III schedule was moving forward. Figure 11 allows this movement to be clearly visualized and shows the significant growth trend of the buffers and the subsequent fall in the first semesters of the years 2016 and 2017. In 2015, it is possible to notice the part of the movement referring to the buffer's growth, until December of the same year. As of January 2018, the movement becomes less evident, with more flattened curves – but, even so, it can be noticed that there are more discrete cycles of buffer fall and recovery, especially for the *BOCR*, with the latest increase in prudential requirements associated with the Basel III schedule, in 2019.

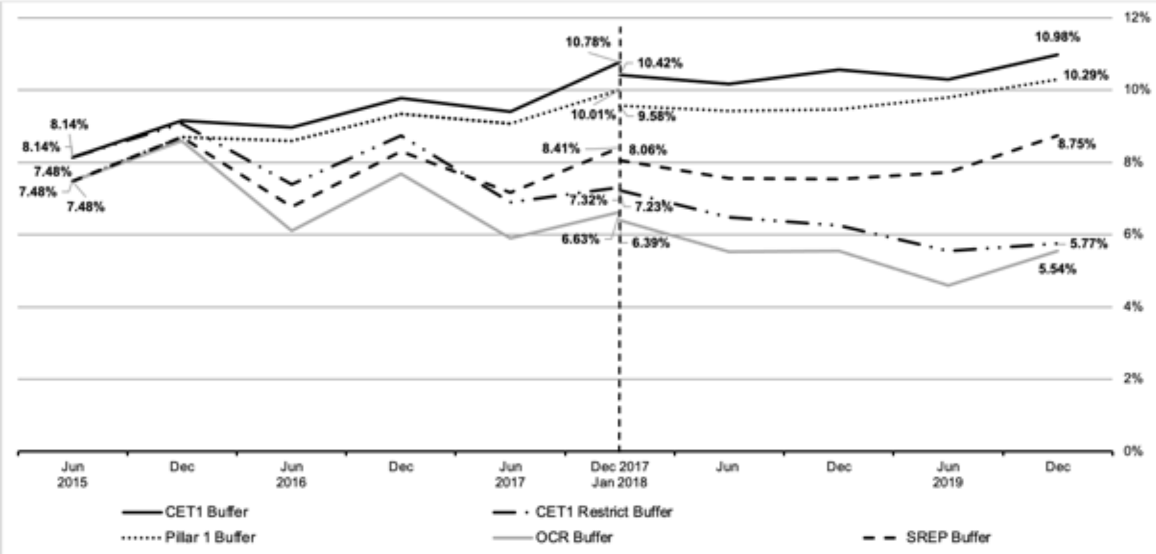


**Figure 10 -** Median evolution of Capital buffers between 2015 and 2019 - complete sample

Figure 10 also allows the change in the capital composition to be visualized, which provides evidence of the gradual increase in CET1 and the reduction in other types of capital. In June 2015, capital buffers were at similar levels, with the biggest difference between them being 0.66 p.p., and the Pillar 1; OCR and SREP buffers were very similar. Over the years, the distance between buffers increased significantly, with *BCET1* growing and *BOCR* falling. This reflects the likely increase in the better-quality capital and the reduction of debt instrument participation in bank capital composition, in addition to a growth of the average total requirement. In fact, one of the main goals of Basel III was to increase CET1participation in the banks' capital, a movement that is reflected in the *BCET1* behavior, with an 34% increase between 2015 and 2019. It should be noted that the core capital minimum requirement remained stable at 4.5% throughout the period. Certainly, the implementation of additional specific and general capital requirements (conservation, countercyclical, systemic and SREP), over the period, also contributed to the strengthening of the common equity tier 1 capital. In December 2017, the difference between the largest (*BCET1*) and the smallest buffer (*BOCR*) reached 4.15 pp.

The second argument that can plausibly explain the growth in buffers for the period between 2016 and 2017 is related to the very adoption of IFRS 9, as a response to expectations of buffer levels reduction, which would be caused by an increase in the loan loss allowance. Following the publication of IFRS 9 by the IASB, in June 2016, and its incorporation into the EU regulatory framework in November of the same year, it is possible that banks have been preparing to receive the new standard, by strengthening their capital base for absorption of the initial impact on 01.01.2018.

The joint analysis of *BCET1* and *BrCET1*, reveals that the restricted buffer growth trend is less strong, in the periods before and after IFRS 9, a behavior consistent with the level shown by these metrics annually. In light of this, the *BrCET1* mean is lower than that of *BCET1*, which is reasonable, since the restricted buffer includes the minimum and the additional capital requirements which must be met only with better quality capital (CET1). Thus, the stacking of the minimum requirement (4.5%) and additionals of conservation, countercyclical, systemic and SREP requirements are responsible for reducing the level displayed by *BrCET1* and, hence, smoothing the recovery efforts related to this buffer.

**Table 28 -** Sample description by type of specific principal capital requirement, per semester

| Period | Conservation | | Countercyclical | | Systemic | | SREP | |
|---|---|---|---|---|---|---|---|---|
| | **Nº banks** | **Mean Req** | **Nº banks** | **Mean Req** | **Nº banks** | **Mean Req** | **Nº banks** | **Mean Req** |
| Jun 2015 | 0 | - | 3 | 0.02% | 2 | 0.09% | 0 | - |
| Dec 2015 | 0 | - | 3 | 0.02% | 4 | 0.15% | 2 | 2.56% |
| Jun 2016 | 98 | 0.625% | 10 | 0.03% | 5 | 0.09% | 36 | 3.18% |
| Dec 2016 | 98 | 0.625% | 11 | 0.03% | 7 | 0.14% | 38 | 3.16% |
| Jun 2017 | 98[7] | 1.250% | 23 | 0.04% | 9 | 0.17% | 64 | 2.05% |
| Dec 2017 | 99 | 1.250% | 26 | 0.05% | 9 | 0.14% | 67 | 2.06% |
| Jun 2018 | 99 | 1.875% | 40 | 0.07% | 12 | 0.19% | 77 | 2.18% |
| Dec 2018 | 99 | 1.875% | 43 | 0.09% | 12 | 0.19% | 77 | 2.19% |
| Jun 2019 | 99 | 2.50% | 58 | 0.16% | 14 | 0.27% | 84 | 2.13% |
| Dec 2019 | 99 | 2.50% | 59 | 0.17% | 15 | 0.28% | 85 | 2.16% |

Table 28 outlines the specific common equity tier 1 capital requirements and shows the number of institutions subject to each type of regulatory requirement, as well as the average requirement for each additional capital requirement. The additional conservation requirement follows the Basel III schedule, as shown in Table 4. The mean percentages of countercyclical and systemic additional increases over the period, and the number of banks that must meet the systemic surcharge was more stable as of June 2017. The SREP requirement, in turn, had the highest average percentages in 2016, remaining at approximately 2% from 2017 on.

Figure 11 shows the evolution of total mean requirement, for the complete sample,

[7] Luminor bank started its operations in October 2017, so between June 2015 and June 2017 the sample is made up of 98 banks.

between 2015 and 2019. Despite the increase in the CET1 specific requirements over the years, mainly in the post-IFRS 9 period, the capital buffers directly impacted (*BrCET1, BSREP* and *BOCR*) showed a growth trend, which was even more intense after the adoption of the new accounting standard. This behavior is consistent with the argument of rebuilding buffers and regulatory capital underestimation in the pre-IFRS 9 period, and with the increase of CET1 proportion in banks' capital. Pillar 1's requirement remained stable over the period. Despite this, *BPillar1* suffered a 26% reduction between June 2015 and December 2019, which is probably related to the reduction in the participation of hybrid debt instruments in regulatory capital composition.

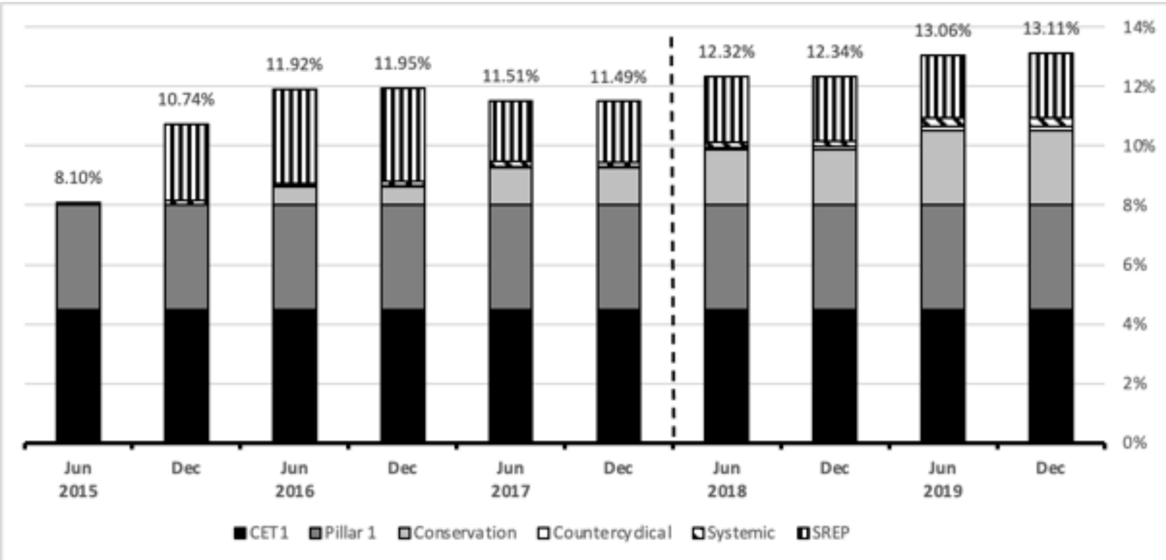


**Figure 11 -** Evolution of the estimated average requirements, between 2015 and 2019 - complete sample

The buffers that show less intense growth trends, with the lowest $\beta_1$ coefficients, both in the pre and post IFRS 9 period, are *BrCET1* and *BOCR*. This dynamic reflects the more restrictive capital requirements to which these buffers are subject.

With regard to the control variables, in the estimates related to the pre IFRS 9 period, it was found that, in general, the capital buffers of European banks are: negatively related to banks size (*SIZE*) and assets risk (*RISKAsset*); and positively associated with profitability levels (*ROE*) and credit risk (*RISKCred*) – which corroborates the predictions made about their association with the dependent variable, as shown in Table 6.

Larger banks would have greater experience and expertise related to asset diversification, which results in a lower risk perception and allows for the maintenance of smaller capital buffers. In addition, larger banks tend to receive regulatory financial support in insolvency situations, based on an assumption that they are too big to fail. The asset risk measure, *RISKAsset*, reflects the banks exposure level, and includes the institutions' RWA for this purpose. Given the direct influence of the asset risk weighting on the size of the buffers – more exposed banks need more capital, which reduces their buffers – the verification of a negative relationship is consistent with the established premise.

The influence of profitability on capital buffers is related to the fact that profitable banks find it easier to increase their capital base through profit retention. The verification of positive association of *RISKCred* variable with the buffers, is in line with the premise that the better the quality of the loans, the lower the provisions and the losses will be, and, hence, the greater the capital.

After the adoption of IFRS 9, no statistically relevant relationships were found with the dependent variable, in any of the analyzed buffers, for the variables *SIZE* and *ROE*. The lower ability of these control variables to explain the capital buffer behavior in the post-IFRS 9 period, can perhaps be attributed to the fact that movements in capitalization levels in this period may be more influenced by the prospect of rebuilding capital levels. In the case of the variables representing credit risk (*RISKCred*) and assets (*RISKAsset*), positive and negative associations were found, respectively, with capital buffers, in line with expectations, with the caveat that in the case of this second variable, the statistical significance can only be verified for estimates with *BCET1* and *BrCET1*. The relevance of credit risk to the capital buffer behavior is consistent with the premise that this risk is fundamental in determining the provisioning level. Thus, changes related to credit risk recognition policies and, hence, to the amount of provisions through the adoption of the ECL model, probably helped to maintain the importance of this variable for determining the different capital buffer levels.

### 4.2.4 Capital Buffer Restoration Intensity, in Post-IFRS 9 Period, According to the Credit Risk Approach – Hypothesis $H_5$

The indications that the regulatory capital buffers for European banks in the post-IFRS 9 period were restored, with regard to the complete sample, provided evidence of capital underestimation in the period prior to the adoption of the new accounting standard, and led to the confirmation of hypothesis $\mathbf{H_4}$, as explained in Subsection 4.2.3.

Continuing with the analysis of capital buffers for the period after the IFRS 9 implementation, and in line with the arguments put forward for hypothesis $\mathbf{H_5}$, it is possible that different types of behavioral patterns can be verified between the buffers of banks that adopt a standardized approach or an IRB approach for calculating credit risk under the Basel framework.

Thus, an estimate was made of the derived model (3.3), that took account of each of the selected buffers (*BCET1, BrCET1, BPillar1, BOCR* and *BSERP*), using panel data with fixed period effects, as well as the SUR method (PCSE). The purpose of the model (3.3) is to find evidence that banks with a standardized approach suffered a persistent negative impact on capital buffers in the post-IFRS 9 period. The test results are shown in Table 29.

**Table 29 -** Results of the model estimates (3.3), in the periods before and after IFRS 9

**Model Tested**

$$BCap_{i,t} = \beta_0 + \beta_i + \beta_1 BCap_{i,t-1} + \beta_2 APROA_i + \beta_3 (BCap_{i,t-1} * APROA_i) + \beta_4 SIZE_{i,t} + \beta_5 ROE_{i,t} + \beta_6 RISK_{Cred_{i,t}} + \beta_7 RISK_{Asset_{i,t}} + \varepsilon_{i,t}$$

| Variables | *BCET1* | *BRCET1* | *BPILLAR1* | *BOCR* | *BSREP* |
|---|---|---|---|---|---|
| Painel A: pre-IFRS 9 period | | | | | |
| *C* | **0.0265**** <br> **(0.0176)** | **0.0528***** <br> **(0.0001)** | **0.0329***** <br> **(0.0039)** | **0.0483***** <br> **(0.0004)** | **0.0490***** <br> **(0.0003)** |
| *Bcap (-1)* | **0.8715***** <br> **(0.0000)** | **0.7550***** <br> **(0.0000)** | **0.8915***** <br> **(0.0000)** | **0.8021***** <br> **(0.0000)** | **0.8408***** <br> **(0.0000)** |
| *APROA* | **0.0141**** <br> **(0.0304)** | 0.0001 <br> (0.9841) | **0.0177***** <br> **(0.0022)** | 0.0057 <br> (0.2591) | 0.0075 <br> (0.1665) |
| *(Bcap (-1) * APROA)* | **-0.1769**** <br> **(0.0103)** | -0.0671 <br> (0.3436) | **-0.2847***** <br> **(0.0003)** | **-0.1984**** <br> **(0.0167)** | **-0.2143**** <br> **(0.0102)** |
| *SIZE* | -0.0008 <br> (0.2243) | **-0.0026***** <br> **(0.0029)** | -0.0010 <br> (0.1571) | **-0.0023**** <br> **(0.0114)** | **-0.0021**** <br> **(0.0162)** |
| *ROE* | **0.0550***** <br> **(0.0000)** | **0.0565***** <br> **(0.0000)** | **0.0554***** <br> **(0.0000)** | **0.0572***** <br> **(0.0000)** | **0.0582***** <br> **(0.0000)** |
| *RISKCred* | **0.0593***** <br> **(0.0000)** | **0.0696***** <br> **(0.0007)** | **0.0559***** <br> **(0.0033)** | **0.0567**** <br> **(0.0129)** | 0.0502** <br> (0.0275) |
| *RISKAsset* | **-0.0129**** <br> **(0.0394)** | **-0.0204**** <br> **(0.0100)** | **-0.0234***** <br> **(0.0011)** | **-0.0287***** <br> **(0.0009)** | **-0.0276***** <br> **(0.0014)** |
| Nº Banks | 69 | 69 | 70 | 70 | 70 |
| Period | 2015-2017 | 2015-2017 | 2015-2017 | 2015-2017 | 2015-2017 |
| Observations | 358 | 358 | 360 | 360 | 360 |
| R-squared | 0.8087 | 0.7070 | 0.8394 | 0.7544 | 0.7682 |
| F-statistic | 121.5229 | 69.3693 | 151.1927 | 88.8184 | 95.8310 |
| P-value(F) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

| Painel B: Post-IFRS 9 period | | | | | |
|---|---|---|---|---|---|
| *C* | 0.0292*** (0.0009) | **0.0155* (0.0897)** | **0.0286*** (0.0031)** | **0.0169* (0.0898)** | **0.0197* (0.0519)** |
| *Bcap (-1)* | **0.9005*** (0.0000)** | **0.9053*** (0.0000)** | **0.8643*** (0.0000)** | **0.8584*** (0.0000)** | **0.8648*** (0.0000)** |
| *APROA* | **-0.0216*** (0.0000)** | **-0.0082*** (0.0041)** | **-0.0195*** (0.0000)** | **-0.0071** (0.0120)** | **-0.0127*** (0.0001)** |
| *(Bcap (-1) * APROA)* | **0.2567*** (0.0000)** | **0.2224*** (0.0000)** | **0.2690*** (0.0000)** | **0.2514*** (0.0000)** | **0.2596*** (0.0000)** |
| *SIZE* | -0.0009 (0.1136) | -0.0005 (0.4382) | -0.0005 (0.4079) | -0.0003 (0.6790) | -0.0000 (0.9382) |
| *ROE* | 0.0026 (0.6548) | 0.0032 (0.5874) | 0.0063 (0.3370) | 0.0074 (0.2713) | 0.0084 (0.2205) |
| *RISKCred* | **0.0384** (0.0180)** | **0.0379** (0.0385)** | **0.0350* (0.0677)** | 0.0334 (0.1101) | 0.0330 (0.1212) |
| *RISKAsset* | **-0.0235** (0.0000)** | **-0.0227*** (0.0002)** | **-0.0219*** (0.0008)** | **-0.0229*** (0.0011)** | **-0.0222*** (0.0018)** |
| Nº Banks | 82 | 82 | 82 | 82 | 82 |
| Period | 2017-2018 | 2017-2018 | 2017-2018 | 2017-2018 | 2017-2018 |
| Observations | 348 | 348 | 348 | 348 | 348 |
| R-squared | 0.9473 | 0.9371 | 0.9558 | 0.9484 | 0.9519 |
| F-statistic | 548.9324 | 454.8666 | 660.3619 | 561.1198 | 604.2040 |
| P-value(F) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

Where: ***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 Pilar 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.; ***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%)

The results of the model (3.3) estimations initially support the findings of the model (3.2) and confirm hypothesis $\mathbf{H_4}$ which predicts that there are signs of the restoration of capital buffers in the post-IFRS 9 period, in four of the five types of buffers. The findings with regard to the control variables (*SIZE, ROE, RISKCred* and *RISKAsset)*, were also confirmed.

With regard to the variables of interest for the testing hypothesis $\mathbf{H_5}$, the findings highlighted in Table 29 reveal that for the period before IFRS 9 came into force, the coefficient $\beta_2$ values are positive and statistically relevant in only two (*BCET1* and *BPillar1*) of the five estimates – no relevant relationships were found for the other buffers. Thus, the predictions related to the *APROA* variable in the period prior to the adoption of IFRS 9 were confirmed, based on the assumption that there should be no direct influence between the choice of credit risk approach and the capital buffers, before the implementation of the new accounting standard for accounting provisioning.

From the adoption of IFRS 9 on, the results found 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*), at a significance level of 1%. Thus, there is strong evidence that the change in the provisioning accounting 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 $\beta_{2,pre\ IFRS9} \cong 0$ and $\beta_{2,post\ IFRS9}<0$, led to the confirmation of hypothesis $\mathbf{H_5}$, according to which 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 the implementation of IFRS 9. It is very likely that since the adoption of IFRS 9, capital margins of standardized approach banks suffered from the loss of the prerogative of being able to add a part of the accounting provisions to the capital, which used to make it possible to strengthen regulatory capital by using a part of the general credit loss accounting provisions. In contrast, banks using an internal rating model kept the option of being able to add to the regulatory capital the excess of accounting provisions in relation to the prudential metric – which certainly benefits the IRB banks' capital buffer levels.

Another key factor to be taken into account when seeking to understand this relationship, is the possible influence of capital requirement levels in the buffers, since banks either adopt a standardized or IRB approach. Figure 12 sheds light on this issue and shows that 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.

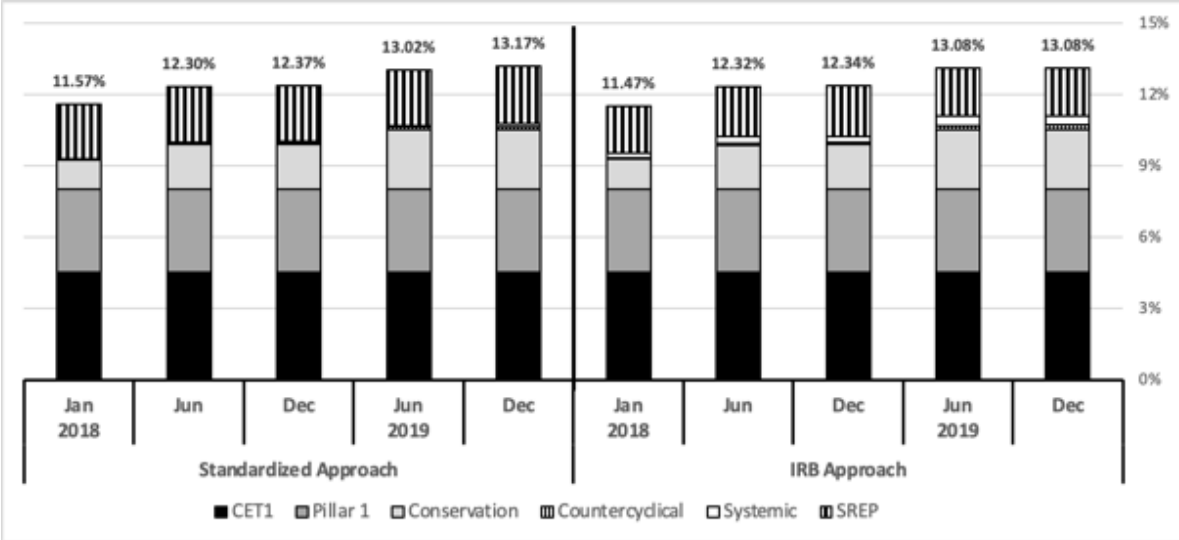


**Figure 12 -** Evolution of the estimated average requirement, during the post-IFRS 9 period, for banks adopting both a standardized and IRB approach

The interaction variable ($Bcap_{i,t-1}$ * $APROA_i$) for behavior 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, which was relevant at 5% and 1%, with the dependent variable for buffers *BCET1*, *BPillar1, BOCR* and *BSREP*; this contradicted the expectation that the values would be irrelevant or of low significance. In light of this, 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.

With regard to the adoption of new accounting standard, the lagged capital buffers of banks that adopted a standardized approach started to show a positive relationship with the buffers from the present period, at a significance level of 1%. 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 in the pre-IFRS 9 period.

However, the different behavior observed between the lagged buffers of banks that adopt a standardized approach and IRB banks, after the adoption of IFRS 9, shows that the recovery intensity of buffers from banks relying on a standardized approach was lower than that of IRB banks, since $\beta_{3,post\ IFRS9} < \beta_{1,post\ IFRS9}$.

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 of the the capital buffers to recover. 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 idea of the risks to which the bank is exposed and the capital necessary to support them, which can lead to a faster buffer recovery after the adoption of IFRS 9. 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 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.

As shown in Figure 13, the mean credit risk behavior for banks that rely on a standardized approach and IRB approach, reveals different levels and different volatilities, despite the reductive trend for both groups.

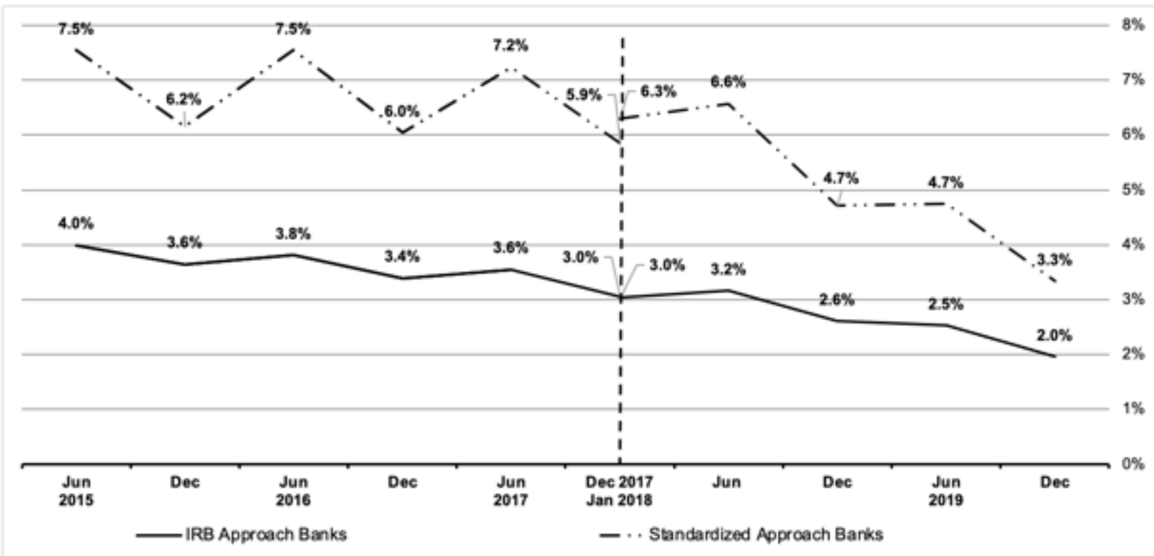


**Figure 13 -** Mean credit risk (RISKCred) percentage evolution of banks that rely on a standardized approach and IRB approach, from 2015 to 2019

The more stable trend in the mean credit risk of banks that employ an internal rating model approach, the lower risk level with regard to banks that adopted a standardized approach, and the absence of variation when adopting IFRS 9, may indicate that IRB banks are more efficient in measuring risks. It is possible that this efficiency is related to the development of the own risk measurement models, which include parameters and assumptions established according to the bank's specific features. On the other hand, banks that rely on a standardized approach probably use more generic credit risk measurement methods, which may eventually expose these banks to greater risk fluctuations, in addition to maintaining higher exposure levels, which may compromise the capital buffers "restoration intensity", compared with what occurs in IRB banks.

The reduced level of defaults in the European banking system, according to the EBA report (2019), particularly in the post-IFRS 9 period, led to a shortfall in the mean credit risk levels. It is possible that capital buffers of banks that adopt a standardized approach may have benefited from this reduction. However, the recovery intensity of these bank buffers proved to be less than that of the IRB banks, despite the greater influence of credit risk reduction for banks that followed a standardized approach. Thus, it is reasonable to state that the credit risk reduction, per se, would not be sufficient to determine the dynamics of capital buffer restoration of banks that rely on a standardized approach and IRB approach.

Finally, the confirmation of hypothesis $\mathbf{H_2}$ showed that at the time of the IFRS 9 adoption, the capital buffers of banks with a standardized approach suffered a more significant effect. 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.

### 4.2.5 Capital Buffer Restoration Intensity, in the Post-IFRS 9 Period, According to the Phase-in Option – Hypothesis $\mathbf{H_6}$

The use of a transition model for the effects of the IFRS 9 on regulatory capital was permitted by BCBS to allow the gradual absorption of the negative impact on banking capital, measured at the time of the adoption of the ECL provisioning model. The phase-in system is optional, which means that the European banks that have chosen to apply it are those subject to the most significant capital buffer reductions, as is shown in the confirmation for hypothesis $\mathbf{H_3}$, in Subsection 4.1.4.

In view of this first finding with regard to the IFRS 9 initial impact on capital buffers, it is reasonable to assume that in the post-IFRS 9 period, the evolution of capital buffers reveals different trends for banks that decide to apply the phase-in and banks that do not, in line with the arguments explored when formulating hypothesis $\mathbf{H_6}$.

Thus, the derived model (3.4) seeks to analyze the effects of the option for applying the transition phase-in for IFRS 9 capital impacts on capital buffers, since this analysis is restricted to the post-IFRS 9 period. The model estimation results, which uses panel data with fixed period effects and SUR method (PCSE), are consolidated in Table 30.

**Table 30 -** Model estimates (3.4) results, for the post-IFRS 9 period

**Tested Model**

$$BCap_{i,t} = \beta_0 + \beta_i + \beta_1 BCap_{i,t-1} + \beta_2 PHASE_i + \beta_3 (BCap_{i,t-1} * PHASE_i) + \beta_4 SIZE_{i,t} + \beta_5 ROE_{i,t} + \beta_6 RISK_{Cred_{i,t}} + \beta_7 RISK_{Asset_{i,t}} + \varepsilon_{i,t}$$

| Variables | *BCET1* | *BRCET1* | *BPILLAR1* | *BOCR* | *BSREP* |
|---|---|---|---|---|---|
| *C* | 0.0006<br>(0.9484) | -0.0002<br>(0.9835) | -0.0013<br>(0.9087) | -0.0015<br>(0.8894) | -0.0011<br>(0.9267) |
| *Bcap (-1)* | **1.0633***<br>(0.0000)** | **1.0436***<br>(0.0000)** | **1.0625***<br>(0.0000)** | **1.0413***<br>(0.0000)** | **1.0503***<br>(0.0000)** |
| *PHASE* | **0.0159***<br>(0.0030)** | **0.0121***<br>(0.0011)** | **0.0224***<br>(0.0003)** | **0.0149***<br>(0.0002)** | **0.0193***<br>(0.0003)** |
| *(Bcap (-1) * PHASE)* | **-0.1290**<br>(0.0142)** | **-0.1576***<br>(0.0036)** | **-0.2087***<br>(0.0025)** | **-0.2357***<br>(0.0007)** | **-0.2320***<br>(0.0013)** |
| *SIZE* | -0.0002<br>(0.6959) | -0.0002<br>(0.7628) | -0.0002<br>(0.7656) | -0.0002<br>(0.8350) | 0.0001<br>(0.8996) |
| *ROE* | -0.0026<br>(0.7010) | -0.0009<br>(0.8974) | -0.0006<br>(0.9381) | 0.0015<br>(0.8517) | 0.0012<br>(0.8831) |
| *RISKCred* | **0.0376*<br>(0.723)** | 0.0279<br>(0.200 | 0.0338<br>(0.1800) | 0.0197<br>(0.4531) | 0.0206<br>(0.4571) |
| *RISKAsset* | **-0.0147**<br>(0.0242)** | **-0.0135**<br>(0.0416)** | -0.0103<br>(0.2064) | -0.0105<br>(0.1998) | -0.0096<br>(0.2644) |
| Nº Banks | 82 | 82 | 82 | 82 | 82 |
| Period | 2017-2018 | 2017-2018 | 2017-2018 | 2017-2018 | 2017-2018 |
| Observations | 348 | 348 | 348 | 348 | 348 |
| R-squared | 0.9338 | 0.9264 | 0.9424 | 0.9361 | 0.9385 |
| F-statistic | 430.9574 | 384.5278 | 499.755 | 447.7274 | 465.9752 |
| P-value(F) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

Where: ***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.; ***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%)

Initially, tests with model (3.4) confirm the results found with models (3.2) and (3.3) for the lagged *BCap (-1)* variable and show that the capital buffer in the present period is positively associated with the same variable in the previous period. Regarding the control variables *SIZE*, *ROE, RISKCred* and *RISKAsset*, there were also no results substantially different from those found in the previous models, for the post-IFRS periods 9.

Regarding the variables that were incorporated to test the $\mathbf{H_6}$ hypothesis, the results of the model estimation (3.4) demonstrate a positive association between the *PHASE* variable and capital buffers (*BCET1, BrCET1, BPillar1, BOCR* and *BSREP*). This suggests that the banks applying phase-in registered higher capital buffers, which is compatible with the very essence of the transition model, and responsible for diluting the effects of IFRS 9 on regulatory capital over time.

With regard to the specific variable of interest for the analysis of the behavior of capital buffers in the previous period, specifically for banks that opted for the phase-in ($Bcap_{i,t-1}$ * $PHASE_i$), in the post-IFRS 9 period, the results reveal a negative association with the dependent variable, taking into account each of the selected buffers (*BCET1, BrCET1, BPillar1, BOCR* and *BSREP*). Thus, the findings of negative values for $\beta_3$, combined with $\beta_3 < \beta_1$, corroborates hypothesis $\mathbf{H_6}$, according to which, after IFRS 9 came into force, the capital buffers of European banks that opted for applying the phase-in transition arrangements have a lower restoration level, or even a reduction tendency, than banks not applying the phase-in. This is in line with the argument of gradual absorption of the capital impact, measured at the time when the new accounting provisioning standard was adopted for the first time.

This is consistent with the premise that in the period between 2018 and 2022, banks that have opted for the transition arrangements must deduct annually from the capital, a 20% tranche, related to the negative impact determined at the first time that the IFRS 9 was adopted.

The behavior of the provisioning amount with regard to the credit portfolio (*RISKCred*), after the adoption of IFRS 9, could strengthen a likely tendency for a reduction of capital buffers, if there is a persistence of high levels credit loss provisioning or even growth trends. Thus, it is necessary to determine whether the behavior of the buffers of banks that are opting for a phase-in, has suffered this type of influence.

In this context, Figure 14 shows that after the initial impact of adopting the new provisioning model, the mean provision volume with regard to loan portfolios for banks not opting for the transition arrangements, showed a more stable behavior. The *RISKCred* after the adoption of IFRS 9 for banks opting for a phase-in, in turn, showed a significant downward trend, which largely reflects the reduction in the European banks NPL ratio (-50%), between 2014 and 2019. Even so, the verified evidence points to a less intense restoration, or even reduction, of the capital buffers in the post-IFRS 9 period for banks applying the phase-in, when compared with banks that did not adhere to the transition arrangements.

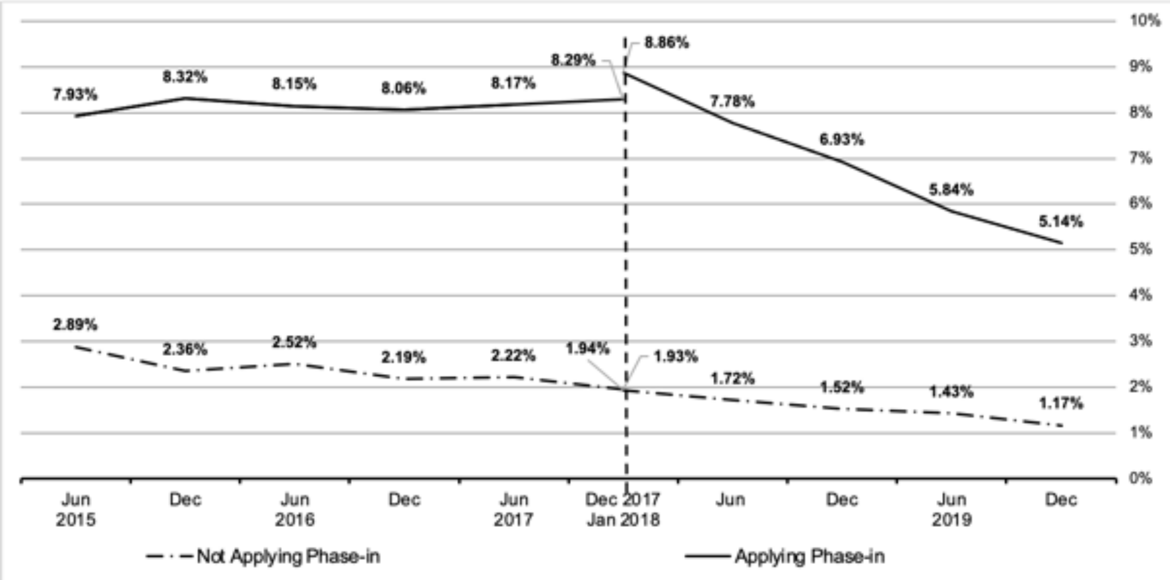


**Figure 14 -** Mean credit risk (RISKCred) percentage evolution of banks either applying the phase-in or not, from 2015 to 2019

Thus, the analysis of the capital buffer dynamics for each group, together with the credit risk evolution and the finding of no statistical relevance for the *RISKCred* variable indicate that there is no evidence that the behavior of the provisions, in the post-IFRS 9 period, has had a decisive influence on the evolution of capital buffers. This strengthens the argument that the lower intensity of the restoration, or even a possible reduction, of capital buffers of banks applying phase-in, is very likely to be more closely related to the deductions of the annual tranches from the transition arrangements.

**4.3 Final Considerations**

The management of multiple risks and necessities, which sometimes seem to be opposed, is inherent to banking activities. Maintaining adequate solvency levels to support unexpected losses is essential for the continuity of the bank's activities and for the mitigation of systemic risk. Therefore, capital must be properly dimensioned. On the other hand, the recognition of expected losses arising from credit risk – essential for the efficient management of that kind of risk – reduces profitability and directly consumes banking capital. Properly balancing capital requirements and credit risk, therefore, is a constant challenge in the banking industry.

By following the dynamics of the evolutionary patterns of the European banks' capital between 2015 and 2019, it was possible to perceive the change in the composition of regulatory capital. An increase in the representativeness of the core capital over the analyzed period is noticed. Therefore, the analysis of the results generates indications that the Basel III reforms were able to strengthen capital, increasing its quantity and quality. Even so, the adoption of IFRS 9 in January 2018, was able to significantly impact banks'capital.

Certainly, IFRS 9 brings more challenges to credit risk management and, also, for capital measurement. The significant increment in the balance of accounting loan losses provisions at the time of the IFRS 9 adoption, as evidenced in this study, indicates that the objectives of the new accounting standard regarding the size oef provisions for ECL were very likely achieved. However, the aims related to the improvement in the timing of the provisions, should still be established over the next few years, and under different or even stressful circumstances.

As of 01.01.2018, banks must continuously assess the nature, probability of loss and risks involved in lending, as well as those related to credit granting decisions, adjusting their policies and procedures to the requirements of IFRS 9. At the same time, bank capital must be prepared to immediately absorb the negative impacts of new credit loss recognitions. The efforts made in order to recompose the capital in the post-IFRS 9 period, indicate that banks are aware of this necessity. The perception of the bank's risk by external users of accounting information can be directly affected if the bank is not alert to unexpected fluctuations in loan losses provisions and capital. Sound risk management policies, adapted to the bank's real demands, and also capable of reflecting market conditions in a timely manner, will be even more important in the post IFRS 9 scenario.

The reduction on banks capital margins, as a consequence of IFRS 9 implementation, also compromises their capacity of granting credit, making it desirable for capital planning to take into account the accounting provisioning model assumptions. Having sufficient capital to expand their operations and take advantage of market opportunities, without compromising the level of solvency, is a matter of the utmost importance for banks. The trend of capital growth at a higher pace than the one observed in the pre-IFRS 9 period, which strongly suggests banks efforts to rebuild capital, point out to an active capital management. Possibly, the strengthening of the capital base has been prioritized by these institutions. Future analyzes, also considering dividend distribution policies, can better explore this aspect.

The IFRS 9 significantly expands the role of judgment in assessing credit risk, in a process that is inherently discretionary by nature. Therefore, the bank's own experience and caution will be paramount. In this sense, some aspects that can materially influence the timing and size of loan losses provisions are highlighted: (i) decisions related to triggers used to migrate loans from Stage 1 to Stage 2; (ii) which kind of prospective information will be considered reasonable and sufficient, and how long is the time horizon to be considered for the estimation of the provisioning model parameters; (iii) loss estimation for Stage 3 loans and collateral valuation.

The challenges of implementing the new accounting standard also have prudential implications. IFRS 9 requires a degree of management judgment comparable to the discretion allowed by the most advanced Basel III approaches to capital measurement, which is o novelty for many banks. Unjustified divergences between provisioning and capital management practices can undermine the comparability and reliability of regulatory capital measures.

Most likely, the ECL provisioning model should bring capital and credit risk management closer by eliminating conceptual differences that existed before the new standard. The benefits of this alignment should be noticed over the next few years. However, bank supervisors must be aware of any unwanted impacts of this narrowing, such as assuming excessive risk from a prudential point of view, even though it may be in accordance with the bank's policies.

Another challenge that is relevant, also related to the increased discretion, is comparability between banks and between different jurisdictions, since similar circumstances can give rise to different amounts of provisioning depending on the choices made by the banks. The results obtained revealed that IFRS 9 have had different impacts between banks, despite the negative effects on capital verified in the comprehensive analysis. In this sense, bank supervisors and users of accounting information should be more conscientious, searching to understand the criteria used in the measurements of the provisions, and assess their relevance in each case. The role of Pillar 2 supervisory processes, such as SREP, may go through changes of scope to meet new supervisory needs. Observing the behavior of Pillar 2 requirements and systemic risk over the next few years, can bring relevant information in this context.

As credit risk will materialize more quickly, which could make capital more volatile, generally impacting risk perception and capitation costs, it will be relevant to assess the possible impacts on banks' cost of capital and funding. Banks that use a standardized approach for calculating the credit risk RWA can potentially benefit from the adoption of less generic provisioning models and mare accurate capital management. A proper and more reliable assessment of the risks to which these banks are exposed, can reduce capital costs, even allowing the maintenance of reduced capital margins, more adequate to the institution's credit profile.

Finally, considering aspects related to systemic risk, the prospective assessment of credit risk and its impact on capital should contribute to mitigate the risks of bank loan procyclicality. Once again, the results obtained seem to point to the mantainance of higher levels of loan losses provisions and capital which should be, possibly, more adequate than those verified before the adoption of IFRS 9. With quality accounting information, the users of accounting information will probabley be able to make better decisions, better allocating their resources and contributing to the strengthening of the banking system.

Overall, the IFRS 9 ECL model should represent a compromise between providing relevant information and meeting prudential needs related to improving financial stability and capital levels. Whether the introduction of the expected credit loss model will produce the desired benefits will ultimately depend on proper and consist application of the rules. This, in turn, will require the joint effort of bank management, supervisory bodies and users of accounting information.

## 5 CONCLUSIONS

The purpose of this work was to determine the impact caused by the initial adoption of the ECL provisioning model in European banks, in accordance with IFRS 9, in the regulatory capital calculated under the Basel III framework. It also involved searching for evidence to suggest there was a correction of underestimated or excessive regulatory capital requirement in the pre-IFRS 9 period.

To measure the effects of adopting the ECL provisioning model on banks' regulatory capital – by seeking to capture the impact on five different types of capital buffers specifically dueto the implementation of the new provision model – mean difference t-tests were conducted, which statistically compared the banks' capital buffers on 12.31.2017 and 01.01.2018, immediately after deducting the variation in the balance of the loan loss allowance, caused solely by the adoption of IFRS 9. Only the new provisions were included for conducting the tests, which means only taking account of the increased value of the provisions caused by the change in the accounting model.

The tests results revealed that: (i) there was a statistically significant reduction in the capital buffer level of European banks, which confirms the expectations of hypothesis $\mathbf{H_1}$, based on the premise that the increase in provisions to cover credit losses, inherent to the ECL model, would, very likely, cause a significant reduction in the capital of banks; (ii) this reduction of capital buffers was more pronounced among banks that adopt a standardized approach to credit risk, compared with IRB banks, and corroborates hypothesis $\mathbf{H_2}$ – according to this, there is an expectation that banks that adopt a standardized approach are subject to the possibility of additional capital reduction, caused by the loss of the prerogative of adding a part of the accounting provisions to the regulatory capital; and (iii) the intensity of the buffer reduction was greater for banks that decided to apply IFRS 9 transitional phase-in, design by BCBS, consistent with the expectations that the application of transitional arrangements allowed the maintenance of higher capital margins and also more comfortable levels of soundness, which is especially important for banks with less capital, and corroborates hypothesis $\mathbf{H_3}$.

After carrying out the initial impact tests related to the adoption of ECL model for the first time, other tests were conducted, using regression models with panel data, to identify whether: (i) there is evidence of regulatory capital underestimation or overestimation on European banks before the adoption of IFRS 9 ; (ii) there is a difference in behavior between banks that adopt a standardized approach or an IRB approach for calculating credit risk RWA, with regard to the persistent negative impact on capital buffers, in the post-IFRS 9 period; and (iii) there is a difference between banks opting and not opting for applying the phase-in regarding the behavior of capital buffers in the post-IFRS 9 period.

The evidence obtained by the estimations led, initially, to the confirmation of hypothesis **$H_4$**, configuring the premise of an underestimation of capital requirements in the period prior to the adoption of the new ECL accounting standard. The identification of capital buffer growth movements in the period after the adoption of IFRS 9, with greater intensity than that observed before IFRS 9, provides evidence to support the hypotheses that European banks are taking measures to restore the capital buffers used up during the adoption of IFRS 9 for the first time.

Additional estimations that were carried out segregating banks in accordance with the Basel III approach to calculate credit risk RWA, led to the confirmation of hypothesis **$H_5$**, according to which banks that relied on a standardized approach suffered a more persistent negative impact on capital buffers than those that adopt the IRB approach, after IFRS 9 came into force. The analysis of the factors that led to these findings showed that the loss of the prerogative of adding a part of the accounting provisions to regulatory capital, factors related to operational difficulties in adapting to the new provisioning model and capital management, had a negative influence on the recovery of the capital bank margins.

In the sequence, empirical tests with specific control between banks that either opted or not for the phase-in arrangements, had corroborated hypothesis **$H_6$**, revealing that capital buffers of banks that opted for the transition arrangements showed less tendency for restoration, or even reduction, after the IFRS 9 came into force. This is in line with the gradual absorption of the impact produced at the time when the new accounting provisioning standard was adopted.

With regard to the control variables, the tests revealed that, in the pre-IFRS 9 period, and in line with expectations, capital buffers are: positively related to the banks' profitability (*ROE*) and credit risk (*RISKCred*); and negatively associated with the size (*SIZE*) of the entities and theirasset risk assessment (*RISKAsset*). In contrast, after the adoption of IFRS 9, no statistically relevant relations were found with the variables representing size and profitability, while asset risk and credit risk were negative and positive, respectively, associated with the level of capital buffers in some of the estimations (not all).

The research limitations are related to the fact that following the IFRS 9 publication in 2016, with effects only starting from January 2018, it is possible that some banks have been preparing to receive the standard, by intentionally increasing capital buffers in the pre-IFRS 9 period and thus reducing the negative impact of adopting the standard on regulatory capital. In any case, the tests were able to detect a significant impact of the ECL model on capital buffers in all the planned scenarios. With regard to the sample and data collection, it was possible to gather information for 99 banks, from a total of 117 significant entities directly supervised by the ECB. The exclusion of 18 banks from the final sample is justified by their non-disclosure of information, or by the disclosure of inaccurate information, and/or by the lack of a standardized disclosure format that could allow data compilation. Even so, the empirical tests took account of 85% of the institutions that constitute the domain inspected by the ECB, in January 2020.

This study has made a research contribution to the literature on the provisioning model for expected credit losses in banks and regulatory capital, also taking advantage of a particular research environment, created by the adoption of IFRS 9, which allowed the initial impacts and subsequent effects of the new provisioning model on capital buffers, to be isolated and empirically tested. The assessment of the capital buffers behavior in the pre and post IFRS 9 periods, made it possible to better understand how the ECL provisioning model and bank capital interacted, while shedding light on factors related to the maintenance of reserves to support expected and unexpected losses. One of the main problems brought to light by the 2008 crisis, was the insufficiency of reserves to support losses that – at the very least should have been – expected, culminating in the excessive expenditure of resources that were destined to support unexpected losses.

Thus, discussions about the impacts of the accounting provisioning standard on the soundness of the financial system raised questions such as those addressed in this study: can the adoption of the ECL model severely compromise capital buffer levels? Would reserves for unexpected losses, that is, bank capital, be underestimated before the adoption of the ECL provision model? Or, in fact, is it just a classification matter, and would the adoption of IFRS 9 allow reserves for expected losses, which had been improperly allocated as a part of the capital, to be correctly classified from then on? After the adoption of IFRS 9, would capital buffers from banks with different characteristics have the same capacity and same reaction rhythm?

The empirical findings provide answers to these questions, within the context of the adoption of the ECL model in the European banking system. The evidence suggests that, in fact, most likely there was a structural break when IFRS 9 was adopted, despite the different levels of impact determined in the specific analyses of each group of banks, according to certain specific features. After analyzing the results, there are reasons to support the believe that the European banking system would be under-capitalized in the pre-IFRS 9 period, and the expected credit loss model contributed, at some level, to the identification and correction of this problem, as the banks made efforts to rebuild the capital base used up by the increase in accounting provisions. The European bank buffers in the post-IFRS 9 period, showed different kinds of behavior, which could be explained by the idiosyncrasies of these institutions.

In this sense, the process of responding to the implementation of IFRS 9 is still ongoing. Only three years have passed since the adoption of the new model, the phase-in scheduled for transitioning effects will be completed by 2022, and future financial crises are yet to test the resilience of the ECL model, and the adequacy of the capital buffer levels. However, the findings of this study, while clarifying key factors, encourage new research questions, which may explore, for example, the impact of adopting IFRS 9 in banking niches or specific countries, identify other variables that may influence the behavior of the capital buffers from 2018 onwards, or determine the maintenance of the patterns of behavior or the alteration of trends found in this study.

Finally, examining the impact and implications of adopting IFRS 9 in the European banking system provides evidence of what may happen in other key markets, such as those of the United States and Brazil, with regard to the effects of changing the model for recognizing credit losses in capital banking and bank soundness. Contributions also extend to regulatory bodies and standard setters, which can use these research results to carry out impact studies, or to assess the conditions for applying the ECL model and its possible consequences for bank solvency.

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## Appendix I

**Table A 1 -** List of significant entities directly supervised by the European Central Bank in January 2020

| | Type of Institution | Name | Justification for Significance | Country |
|---|---|---|---|---|
| 1 | Credit Institution | AXA Bank Belgium AS | Size (total assets EUR 30-50 bn) | Belgium |
| 2 | Credit Institution | Banque Degroof Petercam SA | Significant cross-border assets | Belgium |
| 3 | Credit Institution | Belfius Banque SA | Size (total assets EUR 100-150 bn) | Belgium |
| 4 | Financial Holding | Dexia SA | Size (total assets EUR 150-300 bn) | Belgium |
| 5 | Mixed Financial Holding | Investeringsmaatschappij Argenta NV | Size (total assets EUR 30-50 bn) | Belgium |
| 6 | Mixed Financial Holding | KBC Group NV | Size (total assets EUR 150-300 bn) | Belgium |
| 7 | Credit Institution | The Bank of New York Mellon SA | Size (total assets EUR 30-50 bn) | Belgium |
| 8 | Credit Institution | Aareal Bank AG | Size (total assets EUR 30-50 bn) | Germany |
| 9 | Credit Institution | Bayerische Landesbank | Size (total assets EUR 150-300 bn) | Germany |
| 10 | Credit Institution | COMMERZBANK Aktiengesellschaft | Size (total assets EUR 300-500 bn) | Germany |
| 11 | Credit Institution | DekaBank Deutsche Girozentrale | Size (total assets EUR 100-150 bn) | Germany |
| 12 | Credit Institution | Deutsche Apotheker- und Ärztebank eG | Size (total assets EUR 30-50 bn) | Germany |
| 13 | Credit Institution | Deutsche Bank AG | Size (total assets above EUR 1,000 bn) | Germany |
| 14 | Credit Institution | Deutsche Pfandbriefbank AG | Size (total assets EUR 50-75 bn) | Germany |
| 15 | Credit Institution | DZ BANK AG Deutsche Zentral-Genossenschaftsbank | Size (total assets EUR 300-500 bn) | Germany |
| 16 | Financial Holding | Erwerbsgesellschaft der S-Finanzgruppe mbH & Co. KG | Size (total assets EUR 50-75 bn) | Germany |
| 17 | Credit Institution | Goldman Sachs Bank Europe SE | Article 6(5)(b) of Regulation (EU) No 1024/2013 | Germany |
| 18 | Financial Holding | HASPA Finanzholding | Size (total assets EUR 30-50 bn) | Germany |
| 19 | Credit Institution | Hamburg Commercial Bank AG | Size (total assets EUR 50-75 bn) | Germany |

| | | | | |
|---|---|---|---|---|
| 20 | Credit Institution | J.P. Morgan AG | Article 6(5)(b) of Regulation (EU) No 1024/2013 | Germany |
| 21 | Credit Institution | Landesbank Baden-Württemberg | Size (total assets EUR 150-300 bn) | Germany |
| 22 | Credit Institution | Landesbank Hessen-Thüringen Girozentrale | Size (total assets EUR 150-300 bn) | Germany |
| 23 | Credit Institution | Münchener Hypothekenbank eG | Size (total assets EUR 30-50 bn) | Germany |
| 24 | Financial Holding | Morgan Stanley Europe Holding SE | Article 6(5)(b) of Regulation (EU) No 1024/2013 | Germany |
| 25 | Credit Institution | Norddeutsche Landesbank -Girozentrale- | Size (total assets EUR 150-300 bn) | Germany |
| 26 | Financial Holding | State Street Europe Holdings Germany S.à.r.l. & Co. KG | Size (total assets EUR 30-50 bn) | Germany |
| 27 | Credit Institution | UBS Europe SE | Size (total assets EUR 30-50 bn) | Germany |
| 28 | Credit Institution | Volkswagen Bank GmbH | Size (total assets EUR 75-100 bn) | Germany |
| 29 | Credit Institution | AS SEB Pank | Total assets above 20% of GDP | Estonia |
| 30 | Financial Holding | Luminor Holding AS | Total assets above 20% of GDP | Estonia |
| 31 | Credit Institution | Swedbank AS | Total assets above 20% of GDP | Estonia |
| 32 | Financial Holding | AIB Group plc | Size (total assets EUR 75-100 bn) | Ireland |
| 33 | Credit Institution | Bank of America Merrill Lynch International Designated Activity Company | Size (total assets EUR 30-50 bn) | Ireland |
| 34 | Financial Holding | Bank of Ireland Group plc | Size (total assets EUR 100-150 bn) | Ireland |
| 35 | Credit Institution | Barclays Bank Ireland PLC | Size (total assets EUR 30-50 bn) | Ireland |
| 36 | Financial Holding | Citibank Holdings Ireland Limited | Size (total assets EUR 30-50 bn) | Ireland |
| 37 | Credit Institution | Ulster Bank Ireland Designated Activity Company | Size (total assets EUR 30-50 bn) | Ireland |
| 38 | Credit Institution | Alpha Bank AE | Size (total assets EUR 50-75 bn) | Greece |
| 39 | Credit Institution | Eurobank Ergasias S.A. | Size (total assets EUR 50-75 bn) | Greece |
| 40 | Credit Institution | National Bank of Greece S.A. | Size (total assets EUR 50-75 bn) | Greece |
| 41 | Credit Institution | Piraeus Bank S.A. | Size (total assets EUR 50-75 bn) | Greece |

| | | | | |
|---|---|---|---|---|
| 42 | Financial Holding | ABANCA Holding Financiero S.A | Size (total assets EUR 50-75 bn) | Spain |
| 43 | Credit Institution | Banco Bilbao Vizcaya Argentaria, S.A | Size (total assets EUR 500-1,000 bn) | Spain |
| 44 | Credit Institution | Banco de Crédito Social Cooperativo, S.A. | Size (total assets EUR 30-50 bn) | Spain |
| 45 | Credit Institution | Banco de Sabadell, S.A. | Size (total assets EUR 150-300 bn) | Spain |
| 46 | Credit Institution | Banco Santander, S.A | Size (total assets above EUR 1,000 bn | Spain |
| 47 | Credit Institution | Bankinter, S.A. | Size (total assets EUR 75-100 bn) | Spain |
| 48 | Financial Holding | BFA Tenedora De Acciones S.A.U. | Size (total assets EUR 150-300 bn) | Spain |
| 49 | Credit Institution | CaixaBank, S.A. | Size (total assets EUR 300-500 bn) | Spain |
| 50 | Credit Institution | Ibercaja Banco, S.A. | Size (total assets EUR 30-50 bn) | Spain |
| 51 | Credit Institution | Kutxabank, S.A. | Size (total assets EUR 50-75 bn) | Spain |
| 52 | Credit Institution | Liberbank, S.A. | Size (total assets EUR 30-50 bn) | Spain |
| 53 | Credit Institution | Unicaja Banco, S.A. | Size (total assets EUR 50-75 bn | Spain |
| 54 | Credit Institution | BNP Paribas S.A. | Size (total assets above EUR 1,000 bn) | France |
| 55 | Credit Institution | BPCE S.A. | Size (total assets above EUR 1,000 bn) | France |
| 56 | Financial Holding | Bpifrance S.A. (Banque Publique d'Investissement) | Size (total assets EUR 75-100 bn) | France |
| 57 | Credit Institution | C.R.H. - Caisse de Refinancement de l'Habitat | Size (total assets EUR 30-50 bn) | France |
| 58 | Credit Institution | Confédération Nationale du Crédit Mutuel | Size (total assets EUR 500-1,000 bn) | France |
| 59 | Credit Institution | Crédit Agricole S.A | Size (total assets above EUR 1,000 b n) | France |
| 60 | Credit Institution | HSBC France | Size (total assets EUR 150-300 bn | France |
| 61 | Credit Institution | La Banque Postale | Size (total assets EUR 150-300 bn) | France |
| 62 | Credit Institution | RCI Banque SA | Size (total assets EUR 50-75 bn) | France |
| 63 | Credit Institution | SFIL S.A. | Size (total assets EUR 50-75 bn) | France |
| 64 | Credit Institution | Société Générale S.A. | Size (total assets above EUR 1,000 bn | France |
| 65 | Credit Institution | Banca Carige S.p.A. - Cassa di Risparmio di Genova e Imperia | Size (total assets below EUR 30 bn) | Italy |

| | | | | |
|---|---|---|---|---|
| 66 | Credit Institution | BANCA MONTE DEI PASCHI DI SIENA S.p.A. | Size (total assets EUR 100-150 bn) | Italy |
| 67 | Credit Institution | Banca Popolare di Sondrio, Società Cooperativa per Azioni | Size (total assets EUR 30-50 bn) | Italy |
| 68 | Credit Institution | Banco BPM S.p.A. | Size (total assets EUR 150-300 bn) | Italy |
| 69 | Credit Institution | BPER Banca S.p.A. | Size (total assets EUR 50-75 bn) | Italy |
| 70 | Credit Institution | Cassa Centrale Banca - Credito Cooperativo Italiano S.p.A. | Size (total assets EUR 50-75 bn) | Italy |
| 71 | Financial Holding | Credito Emiliano Holding S.p.A | Size (total assets EUR 30-50 bn) | Italy |
| 72 | Credit Institution | Iccrea Banca S.p.A. - Istituto Centrale del Credito Cooperativo | Size (total assets EUR 150-300 bn) | Italy |
| 73 | Credit Institution | Intesa Sanpaolo S.p.A. | Size (total assets EUR 500-1,000 bn) | Italy |
| 74 | Credit Institution | Mediobanca - Banca di Credito Finanziario S.p.A | Size (total assets EUR 75-100 bn) | Italy |
| 75 | Credit Institution | UniCredit S.p.A. | Size (total assets EUR 500-1,000 bn) | Italy |
| 76 | Credit Institution | Unione di Banche Italiane Società per Azioni | Size (total assets EUR 100-150 bn) | Italy |
| 77 | Financial Holding | Bank of Cyprus Holdings Public Limited Company | Total assets above 20% of GDP | Cyprus |
| 78 | Credit Institution | Hellenic Bank Public Company Limited | Total assets above 20% of GDP | Cyprus |
| 79 | Credit Institution | RCB Bank LT | Total assets above 20% of GDP | Cyprus |
| 80 | Credit Institution | AS "SEB banka" | Among the three largest credit institutions in the Member State | Latvia |
| 81 | Credit Institution | "Swedbank" AS | Among the three largest credit institutions in the Member State | Latvia |
| 82 | Credit Institution | AS "PNB Banka | Article 6(5)(b) of Regulation (EU) No 1024/2013 | Latvia |
| 83 | Credit Institution | AB SEB bancas | Among the three largest credit institutions in the Member State | Lithuania |
| 84 | Credit Institution | "Swedbank", AB | Total assets above 20% of GDP | Lithuania |
| 85 | Credit Institution | Akcinė bendrovė Šiaulių bankas | Among the three largest credit institutions in the Member State | Lithuania |
| 86 | Credit Institution | Banque et Caisse d'Epargne de l'Etat, Luxembourg | Size (total assets EUR 30-50 bn) | Luxemburg |

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|---|---|---|---|---|
| 87 | Credit Institution | Banque Internationale à Luxembourg S.A | Total assets above 20% of GDP | Luxemburg |
| 88 | Credit Institution | | Total assets above 20% of GDP | Luxemburg |
| 89 | Financial Holding | | Total assets above 20% of GDP | Luxemburg |
| 90 | Credit Institution | | Total assets above 20% of GDP | Luxemburg |
| 91 | Credit Institution | | Total assets above 20% of GDP | Malta |
| 92 | Credit Institution | | Total assets above 20% of GDP | Malta |
| 93 | Financial Holding | | Among the three largest credit institutions in the Member State | Malta |
| 94 | Credit Institution | | Size (total assets EUR 300-500 bn) | Malta |
| 95 | Credit Institution | | Size (total assets EUR 100-150 bn) | Malta |
| 96 | Credit Institution | | Size (total assets EUR 500-1,000 bn) | Malta |
| 97 | Credit Institution | | Size (total assets EUR 50-75 bn) | Malta |
| 98 | Mixed Financial Holding | | Size (total assets EUR 500-1,000 bn) | Malta |
| 99 | Credit Institution | | | Malta |
| 100 | Financial Holding | BAWAG Group AG | Size (total assets EUR 30-50 bn) | Austria |
| 101 | Credit Institution | Erste Group Bank AG | Size (total assets EUR 150-300 bn) | Austria |
| 102 | Credit Institution | Raiffeisen Bank International AG | Size (total assets EUR 100-150 b | Austria |
| 103 | Financial Holding | Raiffeisenbankengruppe OÖ Verbund eGen | Size (total assets EUR 30-50 bn) | Austria |
| 104 | Credit Institution | Sberbank Europe AG | Article 6(5)(b) of Regulation (EU) No 1024/2013 | Austria |
| 105 | Credit Institution | Volksbank Wien AG | Importance for the economy of the | Austria |
| 106 | Credit Institution | Banco Comercial Português, SA | Size (total assets EUR 75-100 bn) | Portugal |
| 107 | Credit Institution | Caixa Geral de Depósitos, SA | Size (total assets EUR 75-100 bn) | Portugal |
| 108 | Financial Holding | LSF Nani Investments S.à.r.l. | Size (total assets EUR 30-50 bn) | Portugal |

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|---|---|---|---|---|
| 109 | Credit Institution | Abanka d.d. | Among the three largest credit institutions in the Member State | Slovenia |
| 110 | Financial Holding | Biser Topco S.à.r.l. | Among the three largest credit institutions in the Member State | Slovenia |
| 111 | Credit Institution | Nova Ljubljanska Banka d.d. Ljubljana | Total assets above 20% of GDP | Slovenia |
| 112 | Credit Institution | Slovenská sporiteľňa, a.s. | Among the three largest credit institutions (‡) in the Member State | Slovakia |
| 113 | Credit Institution | Tatra banka, a.s. | Among the three largest credit institutions (‡) in the Member State | Slovakia |
| 114 | Credit Institution | Všeobecná úverová banka, a.s. | Among the three largest credit institutions (‡) in the Member State | Slovakia |
| 115 | Credit Institution | Kuntarahoitus Oyj | Size (total assets EUR 30-50 bn) | Finland |
| 116 | Credit Institution | Nordea Bank Abp | Size (total assets EUR 500-1,000 bn) | Finland |
| 117 | Credit Institution | OP Osuuskunta | Size (total assets EUR 100-150 bn) | Finland |

**Source:** adapted from European Central Bank (2019)

**Table A 2 -** List of entities excluded from the sample

| **Type of Institution** | **Name** | **Justification for Exclusion** |
|---|---|---|
| Credit Institution | Deutsche Apotheker- und Ärztebank eG | Disclosed statements prepared in German Commercial Code (HGB) |
| Financial Holding | Erwerbsgesellschaft der S-Finanzgruppe mbH & Co. KG | Credit portfolio information not available |
| Credit Institution | Goldman Sachs Bank Europe SE | Disclosed statements prepared in German Commercial Code (HGB<br>Regulatory capital information not available |
| Financial Holding | HASPA Finanzholding | Disclosed statements prepared in German Commercial Code (HGB |
| Credit Institution | J.P. Morgan AG | Disclosed statements prepared in German Commercial Code (HGB |
| Financial Holding | State Street Europe Holdings Germany S.à.r.l. & Co. KG | Credit portfolio information not available |
| Credit Institution | UBS Europe SE | Regulatory capital and credit portfolio information not available |
| Credit Institution | Barclays Bank Ireland PLC | inaccurate and / or poorly disclosed capital information |
| Credit Institution | C.R.H. - Caisse de Refinancement de l'Habitat | t is a refinancing institution for real estate loans, formed by other French institutions: Credit Agricole; Credit Mutuel; Societe Generale; BNP Paribas; BPCE.<br>It has a different nature from the other institutions analyzed. |
| Credit Institution | Cassa Centrale Banca - Credito Cooperativo Italiano S.p.A. | Institution created in January 2019, by the Italian Cooperative Credit Reform. Therefore, excluded due to the lack of data. |
| Credit Institution | AB SEB bankas | Regulatory capital and credit portfolio information not available |
| Credit Institution | "Swedbank", AB | Regulatory capital and credit portfolio information not available |
| Credit Institution | J.P. Morgan Bank Luxembourg S.A. | Credit portfolio information not available |
| Financial Holding | Precision Capital S.A. | Credit portfolio information not available |
| Credit Institution | Nederlandse Waterschapsbank N.V. | IFRS 9 will apply only from January 2020 |
| Financial Holding | Raiffeisenbankengruppe OÖ Verbund eGen | Credit portfolio information not available |
| Credit Institution | Všeobecná úverová banka, a.s. | Regulatory capital and credit portfolio information not available |

**Appendix II**

Descriptive statistics of the variables BCET1, BrCET1, BPillar1, BOCR and BSREP, and t-test results obtained from comparison between means, with the sample winsorized at 5%.

**Table B 1 -** Descriptive statistics of capital buffers of the bank sample, winsorized at 5%, on 12.31.2017 and 01.01.2018

| | | *BCET1* | *BrCET1* | *BPillar1* | *BOCR* | *BSERP* |
|---|---|---|---|---|---|---|
| 12.31.2017 | Mean | 0.1237 | 0.0939 | 0.1189 | 0.0882 | 0.1044 |
| | Median | 0.1078 | 0.0732 | 0.1001 | 0.0643 | 0.0841 |
| | Standard Deviation | 0.0536 | 0.0576 | 0.0607 | 0.0617 | 0.0625 |
| | Maximum | 0.2670 | 0.2489 | 0.2767 | 0.2457 | 0.2582 |
| | Minimum | 0.0717 | 0.0359 | 0.0593 | 0.0225 | 0.0396 |
| 01.01.2018 | Mean | 0.1191 | 0.0894 | 0.1145 | 0.0843 | 0.1004 |
| | Median | 0.1042 | 0.0723 | 0.0958 | 0.0638 | 0.0797 |
| | Standard Deviation | 0.0550 | 0.0584 | 0.0628 | 0.0630 | 0.0640 |
| | Maximum | 0.2648 | 0.2441 | 0.2761 | 0.2436 | 0.2561 |
| | Minimum | 0.0633 | 0.0268 | 0.0465 | 0.0165 | 0.0290 |
| Mean Difference T Test | Nominal Difference | -0.0046 | -0.0045 | -0.0044 | -0.0039 | 0.0040 |
| | Difference % | -3.72% | -4.79% | -3.70% | 4.42% | 3.83% |
| | t statistics | 4.6005 | 4.8711 | 4.8748 | 4.7682 | 4.9497 |
| | p-value | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | Significance | *** | *** | *** | *** | *** |

**Table B 2 -** Mean difference t tests of the capital buffers, winsorized at 5%, on 12.31.2017 and 01.01.2018, by type of credit risk approach according to Basel III

| | | ***BCET1*** | ***BrCET 1*** | ***BPillar1*** | ***BOCR*** | ***BSERP*** |
|---|---|---|---|---|---|---|
| Standardized approach | 31.12.2017 Mean | 0.1333 | 0.1070 | 0.1179 | 0.0909 | 0.1050 |
| | 01.01.2018 Mean | 0.1277 | 0.1022 | 0.1129 | 0.0871 | 0.1007 |
| | Nominal Difference | -0.0056 | -0.0048 | -0.0050 | -0.0038 | -0.0043 |
| | Difference % | -4.20% | -4.49% | -4.24% | -4.18% | -4.10% |
| | T-Statistic | 2.2927 | 2.2144 | 2.3178 | 1.9347 | 2.1629 |
| | p-value | (0.0140) | (0.0167) | (0.0132) | (0.0306) | (0.0187) |
| | Significance | ** | ** | ** | ** | ** |
| Internal Rating Model (IRB) | 31.12.2017 Mean | 0.1182 | 0.0864 | 0.1194 | 0.0867 | 0.1041 |
| | 01.01.2018 Mean | 0.1141 | 0.0821 | 0.1154 | 0.0827 | 0.1002 |
| | Nominal Difference | -0.0041 | -0.0043 | -0.004 | -0.004 | -0.0030 |
| | Difference % | -3.47% | -4.98% | -3.35% | -4.61% | -3.75% |
| | T-Statistic | 5.3831 | 5.6965 | 5.7152 | 6.0383 | 6.0548 |
| | p-value | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | Significance | *** | *** | *** | *** | *** |

Where: ***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 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%)

**Table B 3 -** Mean difference t tests of the capital buffers, winsorized at 5%, on 12.31.2017 and 01.01.2018, according to the option for applying phase-in arrangements

| | | ***BCET1*** | ***BrCET1*** | ***BPillar1*** | ***BOCR*** | ***BSERP*** |
|---|---|---|---|---|---|---|
| Applying *phase-in* | 31.12.2017 Mean | 0.1009 | 0.0702 | 0.0852 | 0.0550 | 0.0694 |
| | 01.01.2018 Mean | 0.0917 | 0.0617 | 0.0764 | 0.0478 | 0.0617 |
| | Nominal Difference | -0.0092 | -0.0085 | -0.0088 | -0.0072 | -0.0077 |
| | Difference % | -9.12% | -12.11% | -10.33% | 13.09% | -11.10% |
| | T-Statistic | 5.0494 | 5.586 | 6.1149 | 6.4934 | 7.0175 |
| | p-value | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| | Significance | *** | *** | *** | *** | *** |
| Non applying *phase-in* | 31.12.2017 Mean | 0.1356 | 0.1063 | 0.1365 | 0.1056 | 0.1228 |
| | 01.01.2018 Mean | 0.1334 | 0.1039 | 0.1344 | 0.1034 | 0.1206 |
| | Nominal Difference | -0.0022 | -0.0024 | -0.0021 | -0.0022 | -0.0022 |
| | Difference % | -1.62% | -2.26% | -1.54% | -2.08% | -1.79% |
| | T-Statistic | 2.0259 | 2.2356 | 2.0006 | 2.0828 | 2.0896 |
| | p-value | (0.0235) | (0.0144) | (0.0248) | (0.0203) | (0.0203) |
| | Significance | ** | ** | ** | ** | ** |

Where: ***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 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%)

**Appendix III**

The table bellow exhibit the total capital ratio (TCR) mean and common equity tier 1 capital (CET1) ratio mean, by semester and also including data from 01.01.2018, for the following groups: (i) complete sample; (ii) banks that adopt the standardized approach; (iii) banks that adopt the IRB approach; (iv) banks that opted for applying the transition phase-in; and (v) banks that do not applied the transitiona phase-in.

**Table C 1 -** Capital ratio mean, and common equity tier 1 ratio mean for the complete sample

| Period | Complete Sample | | Standardized Approach | | IRB Approach | | Applying *phase-in* | | Not applying *phase-in* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean TCR | Mean CET1 | Mean TCR | Mean CET1 | Mean TCR | Mean CET1 | Mean TCR | Mean CET1 | Mean TCR | Mean CET1 |
| Jun 2015 | 16.16% | 9.15% | 17.80% | 16.35% | 15.92% | 12.77% | 13.97% | 12.22% | 18.84% | 16.05% |
| Dec 2015 | 20.13% | 12.70% | 22.52% | 19.97% | 17.21% | 13.58% | 15.33% | 13.57% | 22.85% | 19.26% |
| Jun 2016 | 18.44% | 10.92% | 20.35% | 17.71% | 17.05% | 13.36% | 15.06% | 13.26% | 20.70% | 16.86% |
| Dec 2016 | 20.63% | 12.97% | 22.64% | 20.33% | 18.17% | 14.22% | 15.59% | 13.77% | 23.31% | 19.43% |
| Jun 2017 | 19.05% | 11.34% | 20.22% | 17.85% | 17.51% | 14.10% | 15.06% | 13.10% | 21.71% | 17.68% |
| Dec 2017 | 21.32% | 13.72% | 23.68% | 21.27% | 18.11% | 14.94% | 16.43% | 14.50% | 23.88% | 20.17% |
| Jan 2018 | 20.65% | 12.96% | 22.52% | 19.88% | 18.14% | 14.64% | 15.22% | 13.28% | 23.49% | 19.65% |
| Jun 2018 | 10.94% | 13.24% | 23.31% | 21.00% | 17.72% | 14.56% | 15.83% | 13.74% | 23.80% | 19.98% |
| Dec 2018 | 20.48% | 12.84% | 22.40% | 19.80% | 17.54% | 14.94% | 16.43% | 14.23% | 22.59% | 18.96% |
| Jun 2019 | 19.89% | 12.19% | 21.76% | 19.14% | 17.86% | 14.55% | 16.48% | 14.23% | 21.76% | 18.05% |
| Dec 2019 | 21.34% | 13.46% | 24.21% | 21.23% | 18.08% | 14.60% | 17.72% | 15.25% | 23.17% | 19.33% |