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Title: Relation between solvency and profitability of Spanish banking institutions

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RELATION BETWEEN SOLVENCY AND PROFITABILITY OF SPANISH BANKING INSTITUTIONS

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Abstract

In this work, a descriptive analysis is exposed, both at a theoretical and practical level, regarding the relationship that exists between Solvency and Profitability of Spanish deposit institutions, especially banks. The analysis is structured in two clearly differentiated parts. On the one hand, in the first part of the theoretical content, a review is made of the different regulations on banking prudential matters and the different causes that make the profitability of the banking sector do not recover to the levels prior to the 2008 financial crisis. On the other hand, in the second part of practical content, a multivariate statistical model known as the "Structural Equation Model" is implemented in order to see the relationship between solvency regulation and the profitability of entities. As a result, we can observe as a regression how all the new banking regulation, whose objective is to guarantee solvency, has contributed to improving profitability in recent years, but has not been able to return it to levels prior to 2008.

Keywords: Solvency, Banking Regulation, Credit institutions, Profitability, Structural Equations.

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Notation

ATA	Average Total Assets
BCBS	Basel Committee on Banking Supervision
BdE	Banco de España
BU	Banking Union
CCB	Countercyclical Capital Buffer
CNMV	Comisión Nacional del Mercado de Valores
DGSFP	Dirección General de Seguros y Fondos de Pensiones
EBA	European Banking Authority
EUCO	European Council
EC	European Commission
ECB	European Central Bank
ECBS	European Committee of Banking Supervisors
EFSS	European Financial Supervision System
EIOPA	European Insurance and Retirement Pension Authority
EP	European Parliament
ESCB	European System of Central Banks
ESMA	European Securities and Markets Authority
ESRB	European Systemic Risk Board
EU	European Union
FROB	Fondo de Reestructuración Ordenada Bancaria
GDP	Gross Domestic Product
LCR	Liquidity Coverage Ratio
MoU	Memorandum of Understanding
NCAs	National Competent Authorities
NSFR	Net Stable Financing Ratio
RoA	Return on Assets
RoE	Return on Equity
SAREB	Sociedad de Gestión de Activos procedentes de la Reestructuración bancaria
SEM	Structural Equation Models
SRM	Single Resolution Mechanism
SSM	Single Supervisory Mechanism
WHO	World Health Organization

1. Introduction.

1.1. Presentation of the topic.

In August 2007, the bankruptcy of several smaller American investment banks was a prelude to the global economic crisis, called by many experts as the "crisis of developed countries", which began in 2008 after the fall of the *Lehman Brothers*[1] bank, highlighting the existing failures in economic regulation that caused a credit-mortgage and confidence crisis in the different international financial markets.

The capital levels of the banking system were not sufficient or of the necessary quality, and there was excessive leverage in many countries. Additionally, the liquidity problems suffered by credit institutions made it impossible to refinance them in the short term. Consequently, the deleveraging process carried out to face this lack of liquidity, together with the great dependency that existed between the different entities, led to a situation of instability in the financial system and, therefore, in a situation of instability of the economy in general.

The response that was carried out to face this problem consisted of a strengthening of the rules and regulations of banking supervision as well as the establishment of guidelines for the correct management of the different risks to which the entities were exposed. The *Basel Committee on Banking Supervision* (BCBS)[2] designed the Basel III[3] agreement as a set of very broad regulations and reforms aimed at solving the financial crisis and improving economic and financial relations in the different countries.

Therefore, it is necessary an analysis that allows to relate the different solvency obligations imposed on the banking sector by the *European Central Bank* and the new regulatory laws of these entities with the evolution of their profitability to be able to study if this increase that It has been produced in the protection of solvency has affected profitability and, therefore, the future of their business.

1.2. Objectives.

There is no doubt that the role played by financial institutions and, especially, banks is essential for the economy of any country. These entities grant credits so that both families and companies can finance their economic activity. In view of this, the present work proposes to present and analyze information related to the stability of the Spanish banking sector as well as information related to its profitability from 2007 to 2019.

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[1] American investment bank founded in 1850 and dissolved in 2008 as a result of high exposure to risks related to subprime mortgages. His bankruptcy is blamed for the start of the 2008 financial crisis.

[2] Entity that guides on financial regulation. It issues recommendations, such as the different Basel agreements, that it is not mandatory to abide by them.

[3] Agreement whose main objective is to improve the situation of the banking sector by strengthening its regulation, supervision and risk management. These guidelines were published in late 2010.

There is a clear limitation as it is not intended nor can it be thoroughly reviewed all the existing regulations, nor is it the task of this work to carry out an exhaustive patrimonial analysis since to validate the hypothesis that we set out in the methodology of this work.

The present work focuses on three main general objectives. The first of these is to review, broadly speaking, the current banking regulations divided in turn into two specific objectives that seek to study the evolution of this regulation throughout the study period and review the evolution of the Basel Agreements. The second general objective is to expose in a concise and illustrative way the performance that the Spanish banking system has been taking in the face of the past profitability crisis. Finally, and as a more important objective, the relationship between the different capital requirements that have been imposed and profitability is analyzed, to try to draw conclusions on whether all these measures have benefited or have harmed the banking business. This relationship will become apparent after the application of a statistical model widely used in Economic Science, called "*Structural Equations*"[4] (SEM).

These objectives are intended to be achieved by studying the rules and the different regulations on banking supervision. The approach of the *International Bank of Payments*[5] (IBP) and the *European Central Bank* will be used in accordance with the regulations established by the *European Committee of Banking Supervisors*[6] (ECBS).

1.3. State of the question.

The speed and scope of the economic and financial crisis of 2008, the key role that the banking system played and has in the intermediation process in the economy and the character of banks' systemic interest entities made it necessary to take measures to strengthen the resistance of the financial sector, especially the banking sector, to avoid further contagion to the real economy.

The *Basel Committee*, which is in charge of international supervision regulation, was in charge of reinforcing the banking sector by establishing a series of reforms aimed at improving the liquidity and solvency statements of financial institutions. All of these reforms focused on strengthening entities' global capital as well as establishing previously agreed international liquidity standards.

Focusing on Spain, the situation was a little different from the rest of the European economies. At the beginning of this crisis Spain was in an advantageous situation since its economy was not flooded with toxic assets[7], a very efficient financing model for families and small companies was used, there was a very strict solvency regulation and

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[4] Multivariate technique used in Statistics to test and estimate relationships from data and qualitative assumptions between variables.

[5] International financial entity whose objective is to promote international cooperation between central banks to guarantee monetary and financial stability.

[6] Entity that links the Commission and the NCAs, and ensures that the Community measures are applied uniformly.

[7] Risky assets with a very bad or subprime rating.

an immense network of commercial bank offices that allowed raising large amounts of funds. As the years after the outbreak of the crisis progressed, the Spanish banking sector began to be affected as a consequence of the large imbalances in the real estate market, increasing the number of defaults and reducing the demand for financing.

The Spanish authorities acted establishing measures focused on guaranteeing bank liquidity and aimed at solving the different imbalances and structural problems suffered by the banking sector. We can summarize the most important ones as:

- October 2008: The coverage of the deposit guarantee was increased and the *Fondo de Adquisición de Activos Financieros*[8] was created, which was intended to increase the liquidity of financial institutions.

- The Spanish State granted guarantees to the new bank issues. For this, a series of characteristics had to be fulfilled and where the maturity of the issue had to be a maximum of five years.

- June 2009: The *Fondo de Reestructuración Ordenada Bancaria*[9] (FROB) was created to facilitate the integration of viable financial entities. Thus, solvency was improved.

- Year 2012: The high amount of capital necessary to guarantee bank solvency made Spain request help from the *European Union*. In July 2012, the *Memorandum of Understanding*[10] (MoU) was signed where a roadmap was created for the banking sector to be restructured.

- The *Sociedad de Gestión de Activos procedentes de la Reestructuración Bancaria*[11] (SAREB) was created. This partnership helped entities reduce toxic portfolio assets.

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[8] According to López Domínguez, Ignacio in Expansión Daily Economic Dictionary: "Fund created in order to support the supply of credit to the productive activity of companies and individuals. It is administered, managed and directed by the Ministry of Economy and Finance, it has an initial contribution of 30,000 million euros, expandable up to 50,000 million euros".

[9] Organization created in 2008 that is responsible for the resolution of credit institutions and investment services companies. Its main purpose is to restructure the financial system and try to strengthen its own resources after a merger of entities. Created by the *RD-Ley 9/2009, de 26 de junio, sobre reestructuración bancaria y reforzamiento de los recursos propios de las entidades de crédito.*

[10] Document signed by at least two entities, declaring the will to act with a shared objective, without legally binding any of the participants.

[11] Asset management company established through financial institutions nationalized in Spain and by entities that are in the process of resolution or restructuring. The participation of this company is divided into 45% of public capital and 55% of private capital.

1.4. Data.

The data to be used in this work, especially for the fourth chapter where the statistical model is used, have been obtained mainly from statistical sources and financial stability reports provided by the *European Central Bank* and the *Banco de España*. The data used correspond to those ratios that are of interest such as profitability, solvency, leverage or indebtedness. Data extracted corresponding to the period 2007-2019, that is a 13-year period.

This type of data serves as the basis for the construction of the database to be used in the proposed statistical model.

1.5. Methodology.

The methodology pursued consists of a mixed type of research. The first part of this work consists of a qualitative investigation where a series of bibliography is reviewed with the aim of contextualizing the subject matter as well as trying to shed light on relevant theoretical aspects.

The bibliography on which this work has been supported is very wide and varied. There are a large number of resources on the web as well as countless works and articles related to the subject in which we deal here. We highlight a series of authors with whom without their contribution this work would not have been possible:

- *Guajardo* (2002), argues that the indicators related to profitability try to evaluate the amount of profit obtained with respect to the investment made, being able to take into account both the capital for accounting purposes and the company's assets as a whole. Therefore, profitability analysis is essential for the survival and sustainability of a company.

- *Mc Callum* (2009), the ability of a bank to create value is mainly based on three aspects: the entity's profit, the raising of funds in the form of a deposit and capitalization.

- *Valverde and Fernández* (2007), *Demirgüç-Kunt and Huizinga* (1999), *Brock and Suárez* (2000), *Demirgüç-kunt and Levine* (2003) and *Goddard et al.* (2004), banks with higher capital levels are more profitable and efficient than those with a lower capital level since there is a relationship between profitability and the financial structure.

- *Kosmidou* (2008), the greater own capital in relation to assets, less dependence on external financing and consequently higher profitability.

- *Terraza* (2015), analyzes 1270 European banking entities in the period 2005-2013, detecting that liquidity risk depends on the size of the entity and that a higher capitalization increases profitability.

In the second part, the research carried out is specifically quantitative, where the analysis of the databases provided by the *European Central Bank* and the *Banco de España* of the different Spanish Credit institutions serve as the basis for the elaboration of the statistical model used. This model is intended to validate the hypothesis in which we assume that the banking regulation imposed in terms of solvency has benefited banks by increasing their profitability and guaranteeing their future business.

1.6. Structure of work.

The elaboration of this work has been developed in a series of chapters detailed below as follow.

In the second chapter, the different banking regulations that are currently in force are exposed, as well as the evolution that the regulations have had from 2007 to 2019 and the different Basel agreements that have been adopted. In the third chapter, the profitability crisis experienced by banks since the beginning of the 2008 financial crisis and the different actions that entities have carried out to face the profitability decline are highlighted. In the fourth and last chapter, a practical application is made using the statistical model "*Structural equations*" (SEM) using as data those set forth in the previous section **1.4** to try to analyze and see numerically the relationship that has had the different regulations on solvency with the profitability of banks.

2. The new European banking regulation.

2.1. Bank supervision.

Banking supervision is the essential activity in order to control that a responsible operation is carried out to carry entities in the market, dictating the appropriate capital and reserve levels so that future risky situations can be faced. The *Basel Committee on Banking Supervision* indicates a set of recommendations and principles for correct supervisory and regulatory activity in the banking sector.

These principles were last revised in October 2011 to try to adjust to market developments and new changes. The main adaptation was the proposal to weigh the relative importance of each bank, in relation to its risk and importance to the system.

The current supervisory system is understood through what is called, on the one hand, microprudential supervision and, on the other hand, macroprudential supervision. These are key concepts within the banking supervisory activity.

2.1.1. Macroprudential supervision.

Focused on European banks, macroprudential supervision is carried out by a number of institutions in the *European Union* and its main objective is to reduce systematic risk as much as possible.

One of the institutions dedicated to this type of supervision is the so-called *European Financial Supervision System*[12] (EFSS), created as a group of independent institutions based on the *Larosiére Report*[13] for 2009. A notable feature of this institution is that it achieves a very effective supervision acting in a decentralized way thanks to the collaboration of all the members of the same achievement, thus a constant and reliable flow of information. Among these members we can highlight the *European Systemic Risk Board*[14] (ESRB) whose main objective is to contribute to the financial stability of the *European Union*, trying to minimize the systematic risk of banking entities. To do this, its supervision is based on a macroeconomic analysis of the different market factors.

Another institution that carries out macroprudential supervision is the so-called *European System of Central Banks*[15] (ESCB) and supports the ESRB. This is made up of the *European Central Bank* and all the Central Banks of the different countries that make up the *European Union*.

Finally, there is another institution called the *European Banking Authority* (EBA) that aims to control that good supervision and operation of the European financial sector is carried out. To do this, it implements supervision techniques and improves existing techniques to try to achieve harmonization of the internal market. The EBA is key in the protection and security of the different investors since it establishes balanced conditions in the competition.

2.1.2. Microprudential supervision.

Individualizing the supervision according to the geographical area, national or european, and the sectorial area of the entities (banks, insurance and securities markets) we have what is known as microprudential supervision.

The national supervisors are in charge of controlling all the financial entities existing in each country, with the central task of ensuring compliance with the minimum mandatory requirements to carry out their activity. These requirements are the level of reserves, identification and quantification of its risks, level of capital, level of solvency,

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[12] Framework for financial supervision in EU since 2011.

[13] Published on February 25, 2009, it arises as a consequence of a commission from the European Commission to a high-level group of experts for which they should analyze the regulatory and supervisory framework existing in the European Union, establishing specific recommendations for its improvement.

[14] It contributes to prevent or mitigate systemic risk to promote stability in the EU.

[15] It is the union of ECB and the national central banks of all members of the EU.

among others. However, EBA also has competences in the field of microprudential supervision, checking that national supervisors respect and apply European Community regulations.

2.2. Spanish and European organizations with functions in banking supervision.

2.2.1. *Banco de España* (BdE).

The *Banco de España* exercises the functions of a central bank in our country. It is an entity with its own legal personality under public law and independent from the executive branch, member of the *Eurosystem*[16] and the *European System of Central Banks* (ESCB). It has functions as central bank and as a member of the ESCB.

Functions as central bank:

- It supervises that the regulations regarding financial and credit entities are complied with.
- Monitors solvency.
- Through its actions, it seeks the stability of the financial system and its proper functioning.
- It safeguards and manages the reserves of foreign exchange, precious metals and other assets not assigned to the *European Central Bank*.
- It prepares and publishes information on its functions and shares this information with the ECB.
- It acts as a financial agent in the acquisition of Public Debt and advises the Government of the nation.

Functions as a member of the ESCB:

- It collaborates in the design and execution of the monetary policy of the euro zone in order to achieve price stability.
- It carries out currency exchange operations, promotes a good payment system and issues legal tender currency and banknotes.

[16] Entity composed of the ECB and the countries belonging to the EU whose common currency is the Euro.

2.2.2. *Comisión Nacional del Mercado de Valores* (CNMV).

The inspection and supervision of the securities markets in Spain and of the activity of those who intervene in them is carried out by the *Comisión Nacional del Mercado de Valores*. This entity was created in 1988 after the publication of the *Ley 24/1998, de 28 de julio, del Mercado de Valores*. This Law completely reformed the Spanish financial system.

The objective of this organization is to make the stock markets in Spain transparent and that price formation occurs correctly. In addition, another of its objectives is to protect all investors by having a large amount of information within their official public records.

Its activity is carried out above all on the different companies that issue securities to be sold publicly, on secondary securities markets and on investment services entities and collective investment institutions, exercising prudential supervision, thus guaranteeing security in operations and solvency.

2.2.3. *Dirección General de Seguros y Fondos de Pensiones* (DGSFP).

This is a regulatory and executive entity that reports directly to the *Secretaria de Economía y Apoyo a la empresa*[17], attached to the *Ministerio de Asuntos Económicos y Transformación Digital*[18], in accordance with the *Real Decreto 139/2020, de 28 de enero, por el que se establece la estructura orgánica básica de los departamentos ministeriales*.

This entity supervises and controls the Spanish pension fund and insurance sector, guaranteeing its proper functioning, protecting clients and participants in pension plans.

2.2.4. *European Central Bank* (ECB).

The *European Central Bank* is, together with the different central banks of each member state, a body responsible for the prudential supervision of European credit institutions. This is part of the *Eurosystem* and its main objective is to keep prices stable to ensure the value of the common currency. Thus, it brings security and solidity to the banking system and stability to the European financial system and in each member country.

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[17] Secretary of State Ana de la Cueva (Madrid, España, 1966), currently in office since June 19, 2018.

[18] Minister Nadia María Calviño Santamaría (La Coruña, España, 1968), currently in office since January 13, 2020.

2.2.5. *European Banking Authority* (EBA).

At the level of the *European Union*, we find the *European Banking Authority* as an independent entity whose mission is to ensure a consistent and effective level of regulation and prudential supervision within the European banking system. It aims to maintain the financial stability of the EU and ensure the efficiency, integrity and proper functioning of banking.

This institution is a member of the *European Financial Supervision System* (EFSS) along with two other authorities that carry out supervisory tasks such as the *European Securities and Markets Authority*[19] (ESMA) and the *European Insurance and Retirement Pensions Authority*[20] (EIOPA). This system can also be extended to the *European Systemic Risk Board* (ESRB), to the *Joint Committee of European Supervisory Authorities*[21] (JCESA) and to the different national entities authorized to carry out supervisory tasks.

The role of the *European Banking Authority* is to promote the proper functioning of the European market by ensuring adequate, harmonized and efficient regulation and supervision. Its essential task is to establish, through binding technical guidelines and standards, a single regulatory code for the European banking sector. This code provides a series of harmonized prudential rules applicable to all EU financial institutions, thereby creating the ideal conditions of equity and protection for clients and investors. In addition, an important role is played by encouraging supervisory practices to converge towards harmonization in the application of prudential regulations. It also tries to assess risks and weaknesses in the banking sector through evaluation reports and stress tests.

Other activities entrusted to this authority are:

- Investigating deficiencies when applying European regulations by national authorities.
- Making decisions in an exceptional situation, such as an emergency.
- Mediating in cases of non-agreement between the different regulatory authorities.
- As an independent body, he advises the *European Parliament* (EP), the *European Council* (EUCO) and the *European Commission* (EC).

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[19] Independent authority whose mission is to protect markets and assets, ensuring transparency, efficiency and organization, as well as protecting the interests of investors.

[20] Supervisory authority responsible for the microprudential level in the EU. It is part of the ESFS. It replaced the former Committee of European Insurance and Occupational Pension Supervisors (CEIOPS).

[21] Forum created to strengthen cooperation between EBA, EIOPA and ESMA. It is known as "three European Supervisory Authorities" (ESAs).

2.3. Applicable supervision regulation in force.

In order to credit institutions can operate correctly, they need sufficient own resources to assume risks derived from their activity. These own resources are guaranteed thanks to the role carried out by the prudential regulation of these entities, contributing to the stability of the financial system.

The current regulations in force are included in the *Reglamento (EU) N.º 575/2013 del Parlamento Europeo y del Consejo, de 26 de junio de 2013, sobre los requisitos prudenciales de las entidades de crédito y las empresas de inversión, y por el que se modifica el Reglamento (UE) N.º 648/2012* and in the *Directiva 2013/36 / EU del Parlamento Europeo y del Consejo, de 26 de junio de 2013, relativa al acceso a la actividad de las entidades de crédito y a la supervisión prudencial de las entidades de crédito y a las empresas de inversión, por la que se modifica la Directiva 2002/87/CE y se derogan las Directivas 2006/48/CE y 2006/49/CE*, which establish the solvency requirements of credit institutions included in the Basel III agreement. At the same time, the Community regulations are transposed into the Spanish legal system through the *Ley 10/2014, de 26 de junio, de ordenación, supervisión y solvencia de entidades de crédito,* the *Circular 2/2014, de 31 de enero, del Banco de España, a las entidades de crédito, sobre el ejercicio de diversas opciones regulatorias contenidas en el Reglamento (UE) N.º 575/2013, del Parlamento Europeo y del Consejo, de 26 de junio de 2013, sobre los requisitos prudenciales de las entidades de crédito y las empresas de inversión, y por el que se modifica el Reglamento (UE) N.º 648/2012,* the *Real Decreto 84/2015, de 13 de febrero, por el que se desarrolla la Ley 10/2014, de 26 de junio, de ordenación, supervisión y solvencia de entidades de crédito* and the *Circular 2/2016, de 2 de febrero, del Banco de España, a las entidades de crédito, sobre supervisión y solvencia, que completa la adaptación del ordenamiento jurídico español a la Directiva 2013/36/ UE y al Reglamento (UE) N.º 575/2013* .

At a European level, the binding regulatory technical standards that aim to complement or modify non-essential elements of a Directive or Regulation stand out, as well as the technical implementing rules that seek uniformity in the application of the regulations.

Financial conglomerates have special institutional and operational characteristics and, therefore, are subject to additional solvency, reporting and supervisory requirements. The elementary regulation is found in *Directiva 2011/89 / EU, del Parlamento Europeo y del Consejo, de 16 de noviembre de 2011, por la que se modifican las Directivas 98/78/CE, 2002/87/CE, 2006/48/CE y 2009/138/CE en lo relativo a la supervisión adicional de las entidades financieras que formen parte de un conglomerado financiero* which has been fundamentally transposed by means of the modifications that both the *Ley 10/2014, de 26 de junio, de ordenación, supervisión y solvencia de entidades de crédito* and the *Real Decreto 84/2015, de 13 de febrero, por el que se desarrolla la Ley 10/2014, de 26 de junio, de ordenación, supervisión y solvencia de entidades de crédito* introduced respectively in the *Ley 5/2005, de 22 de abril, de supervisión de los conglomerados financieros y por la que se modifican otras leyes del sector financiero* and in the *Real Decreto 1332/2005, de 11 de noviembre, por el que se desarrolla la Ley*

5/2005, de 22 de abril, de supervisión de los conglomerados financieros y por la que se modifican otras leyes del sector financiero.

The regulations currently in force according to information provided by the *Banco de España* are as follows:

- *Ley 13/1994, de 1 de junio, de Autonomía del Banco de España*. (Artículo 7.6.).

- *Ley 10/2014, de 26 de junio, de ordenación, supervisión y solvencia de entidades de crédito.* (Títulos II y III, DA 1a, 4a, 5a, .15a, 16a, 18a y 19a, DT 4a, 5a, 7a a 9a, y 16a).

- *Ley 5/2005, de 22 de abril, de supervisión de los conglomerados financieros y por la que se modifican otras leyes del sector financiero*.

- *Real Decreto 1332/2005, de 11 de noviembre, por el que se desarrolla la Ley 5/2005, de 22 de abril, de supervisión de los conglomerados financieros y por la que se modifican otras leyes del sector financiero*.

- *Real Decreto-ley 2/2012, de 3 de febrero, de saneamiento del sector financiero.*

- *Real Decreto-ley 14/2013, de 29 de noviembre, de medidas urgentes para la adaptación del derecho español a la normativa de la Unión Europea en materia de supervisión y solvencia de entidades financieras.*

- *Real Decreto 84/2015, de 13 de febrero, por el que se desarrolla la Ley 10/2014, de 26 de junio, de ordenación, supervisión y solvencia de entidades de crédito.* (Títulos II y III).

- *Real Decreto-ley 22/2018, de 14 de diciembre, por el que se establecen herramientas macroprudenciales.* (Artículo Segundo).

- *Circular 2/2014, de 31 de enero, del Banco de España, a las entidades de crédito, sobre el ejercicio de diversas opciones regulatorias contenidas en el Reglamento (UE) N.º 575/2013, del Parlamento Europeo y del Consejo, de 26 de junio de 2013, sobre los requisitos prudenciales de las entidades de crédito y las empresas de inversión, y por el que se modifica el Reglamento (UE) N.º 648/2012.*

- *Circular 2/2016, de 2 de febrero, del Banco de España, a las entidades de crédito, sobre supervisión y solvencia, que completa la adaptación del ordenamiento jurídico español a la Directiva 2013/36/UE y al Reglamento (UE) N.º 575/2013.*

- *Real Decreto 102/2019, de 1 de marzo, por el que se crea la Autoridad Macroprudencial Consejo de Estabilidad Financiera, se establece su régimen*

jurídico y se desarrollan determinados aspectos relativos a las herramientas macroprudenciales.

2.4. Basel Agreements.

The Basel Agreements are a series of recommendations first issued in 1974 by the *Basel Committee*. This entity is made up of the different governors of the national central banks of the *G10*[22]. Its main mission is to try to avoid systemic risks when a state of bank panic occurs.

The basis on which this body is based and its activity rests on the idea that when a financial entity goes through difficulties these problems spread to other financial entities, thus amplifying the damage caused.

It should be noted that the agreements issued by this Committee do not have any kind of legal form, yet all the Basel documents have been approved by all supervisors and central bank governors of countries with developed economies. These documents kidnap mainly on the following topics:

- Principles on cross-border activity and cooperation between supervisors.
- Measures for capital adequacy.
- Basic principles.
- Risk management method.

2.4.1. Basel Agreement I.

The first agreement carried out by the *Basel Committee* was carried out in 1988. This agreement, known as the Basel I Agreement, established a limit on the issuance of credits granted by entities based on the capital they own. This limit indicated that the entity's minimum capital had to be at least 8 % of the risk-weighted assets.

To calculate this limit, own resources were divided into two different categories:

- *Tier 1* Capital and,
- *Tier 2* Capital.

Tier 1 Capital was fully considered as own resources, while the excess of *Tier 2* Capital over *Tier 1* Capital was not taken into account as own resources. As for investments, assets were weighted by risk based on of four categories: 0 %, 20 %, 50 % and 100 %.

[22] Group of industrially advanced countries whose central banks cooperate to regulate international finance.

The capital requirement established from the beginning tried to protect entities against credit risk, derived from the default of loans mainly. Subsequently, an amendment focused on market risk, thus seeking to increase the protection of entities against adverse market movements.

However, the most important recommendation was to limit the leverage of financial investments to 12.5 times the value of owned equity. This limitation was necessary in those years since, historically, banking entities obtained funds from the public and granted credits without taking into account the risks derived from the insolvency of individuals or companies.

2.4.2. Basel Agreement II.

The second agreement made by the *Basel Committee* was called the Basel II Agreement. This agreement was approved in 2004 based on the need to respond to the problems that arose in the financial markets as well as the shortcomings and gaps that the previous Agreement presented.

The Basel I agreement was not able to adequately recognize the risk that each borrower had. Furthermore, this agreement did not take into account another series of aspects that could pose a risk to the business continuity of financial entities.

Basel II proposed a set of recommendations based fundamentally on three pillars:

Minimum capital requirements.

The capital requirement was maintained at 8 % and the contemplation of operational risk was introduced. This risk takes into account the loss that occurs, directly or indirectly, as a result of the operation of different processes, human resources or systems that do not work properly, in addition to taking into account external events that may occur.

It was also allowed to use internal models to individually quantify the risk of each borrower in order to have more information and thus proceed to correctly manage these risks.

Supervision of own funds by the supervisory authority.

Central banks are now in charge of supervising the capital level of credit institutions and checking the methods used to calculate these capital levels.

The principles on which this pillar is based are as follows:

- *First principle*: Banks will have to have a process that allows them to assess whether their total capital is sufficient in relation to their level of risk.

- *Principle Two*: Supervisory entities will need to examine internal bank strategies and evaluations related to capital adequacy, as well as the ability to monitor and ensure compliance with regulatory capital ratios.

- *Third Principle*: Supervisors assume that banks will operate above the minimum established capital requirements and, therefore, they have the duty and the capacity to demand that this be so.

- *Fourth principle*: Supervisors will have to intervene quickly to prevent capital from falling below the minimum required levels. In addition, they must request the imminent adoption of corrective measures if the capital fails to stay at the required level.

Market discipline.

The third pillar that completes the Basel II agreement promotes transparency by periodically issuing risk exposure and the solvency situation of the different credit institutions, as well as other types of qualitative and quantitative information essential for understanding the situation of the entities at all times.

2.4.3. Basel Agreement III.

After the outbreak of the 2008 financial crisis, it became clear that the legislative framework proposed by Basel II needed urgent modification.

On the one hand, the banks' ability to manage their risks was underestimated. Furthermore, it was clear that the minimum liquidity and solvency requirements required were not sufficient. On the other hand, another of the failures of this stage was the use of more complex internal risk models by the entities, since in many cases they only made the work of the supervisors more difficult.

In order to correct the weaknesses of Basel II, the Basel III agreement was carried out, which includes the following changes:

- Although it maintains the minimum solvency ratio at 8 %, it has changed the capital weights required to meet the solvency ratio and *Tier 1* and *Tier 2* components. Now the highest quality *Tier 1* capital must represent at least 4.5 %, *Tier 2* must represent at least 6 % and the sum of *Tier 1* and *Tier 2* must represent at least 8%.

- It establishes a capital conservation buffer, which means an additional capital increase of 2.5 % to be covered with common equity and an "anti-cyclical capital buffer", which is no more than an additional percentage between 0 % and 2.5 % to fulfill in periods of bonanza and strong growth.

- It establishes a liquidity and leverage ratios.

These aforementioned reforms improve the quality and quantity of the regulatory capital required, and also improve risk coverage. On the other hand, the new leverage ratio limits excessive leverage in the banking sector and limits measurement errors and model risk. Other macroprudential reforms to contain systemic risks caused by procyclicality[23] and by the interconnection of financial entities have been implemented, as we will see later.

2.4.3.1. Greater quality, consistency and transparency of the capital base.

There must be good quality capital to be able to optimally support the different risk exposures that banks have. From the financial crisis of 2008 we learned that bank losses from investments in unpaid loans were offset by undistributed profits, forming part of ordinary capital. During these years it has also been observed how the definition of capital was not understood in the same way in all countries, each with its own jurisdiction. This allowed the market to be unable to evaluate and compare the quality of capital between entities.

For this reason, a series of changes have been introduced with respect to Basel II, summarized below.

- *Tier 1* capital must be formed mainly by ordinary shares and undistributed benefits. The rest of the capital may be subordinated instruments, and innovative hybrid capital instruments will be progressively limited.

- The assets of *Tier 2* capital are harmonized.

- *Tier 3* capital, whose sole purpose was to cover market risks, is eliminated.

- Finally, transparency is increased on the basis of capital. All capital elements are reported and accounts are provided in detail. All of this contributes to improving market discipline.

All these modifications have been introduced in such a way that it does not alter too much the capital assets that are currently in circulation.

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[23] Stock, bond and credit flows that are abundant in favorable situations but become scarce when situations are adverse. This causes very optimistic moments and other very pessimistic ones, with very excessive effects.

2.4.3.2. Leverage ratio as a complement to the risk-based capital requirement.

The excess that occurred in bank financial leverage during the 2007-2012 period led the sector to a situation of decline and extreme weakness that threatened the Spanish economy as a whole. An extreme adjustment in this sense was necessary, which caused the prices of financial assets to fall even more, increasing losses and decreasing the issuance of credit. That is why a leverage ratio is introduced whose objectives are basically to reduce the leverage of the banking sector to avoid damage to the real economy, and to carry out measures to protect against model risk[24] and measurement errors.

This leverage ratio is calculated in the same way in all countries even if they have different jurisdictions and was set for 2018 at a minimum of 3 %. For this, the different accounting regulations are taken into account.

In the numerator we find Tier 1 Capital, and in the numerator the sum of Positions within Balance Sheet, exposures to derivatives, financing transactions with securities and Out of Balance Sheet items.

2.4.3.3. Reduction of procyclicality and promotion of anticyclical buffers.

The banking sector has been dealing with situations of financial instability for several years. Financial shocks are now behaving in a cyclical dynamic, thus affecting financial markets and the real economy.

The *Basel Committee*, being aware of this, has established a series of measures in this last agreement in order to help improve this dynamic by absorbing shocks instead of transmitting all the risk that arises throughout the financial system.

We can summarize these measures in:

- Use of provisions of a more prospective nature.

- Promotion of the creation of a capital conservation buffer. This fund should be used in times of greater financial stress. Its amount should be 2.5 % of the total amount of the bank's risk exposure.

- Protection of the banking sector against moments of excessive credit growth.

2.4.3.4. Introduction of an international liquidity standard.

To guarantee the stability of the banking system, it is necessary, in addition to the minimum capital requirements, a minimum liquidity requirement. This was evident in

[24] Risk that an asset has been valued using an inadequate model or an adequate model with erroneous parameters.

the years after 2008, when many banking entities found themselves in financial difficulties even when they were at adequate solvency levels. The problem was that their liquidity levels were not necessary, going through moments of financial stress.

The *Basel Committee* has introduced two different liquidity standards with complementary objectives. These two standards are the Liquidity Coverage Ratio (LCR) and the Net Stable Financing Ratio (NSFR). We detail them below.

Liquidity coverage ratio

The design of this liquidity standard has been carried out to strengthen the banking system to face possible lack of liquidity in 30-day periods of time. In this way, the possession of high quality assets that are very liquid is encouraged to compensate in this way for the net cash outflows that may occur in times of stress. The liquidity coverage ratio has been gradually applied, starting at 60 % in 2015 and reaching 100 % in 2018.
The LCR takes into account a series of situations that can lead to moments of financial stress. Namely:

- Decrease in the credit quality of the entity.
- Loss of a large proportion of deposits.
- Loss of wholesale financing.
- Collateral margin increase for derivative products.

Net stable financing ratio

This liquidity standard forces the bank to have stable sources of financing, adapting these sources to the liquidity profile of the assets it has and to possible contingencies over a period of one year.

This is about limiting short-term wholesale financing at times when liquidity abounds in the financial markets.

2.4.3.5. Leverage ratio.

Another measure that was taken by the Basel Committee was to establish a Leverage Ratio as the banking sector was too leveraged. In the years of greatest incidence of the financial crisis, the markets pressured banks to reduce their leverage levels, which led to a drop in asset prices. This further aggravated the loss dynamic in which the sector found itself.

The objectives that are pursued with this measure are basically two. Firstly, the aim is to establish a limit to the level of bank leverage up to an optimal level that does not harm the rest of the financial system or the real economy. The second objective is to try to strengthen capital requirements with a measure that is not based on the level of risk.

A minimum leverage ratio of 3 % of Tier 1 Capital has been applied during the parallel application period (2013-2017). For the year 2018 this minimum coefficient was also established at 3 %.

2.5. The Banking Union (BU).

With the intention of promoting the creation of a single banking supervisor that would improve the quality of supervision in the euro area and favor the integration of the markets, the Heads of State and Government of the *European Union* (EU) met in June 2012. However, it was not until October 15, 2013 that the initiative for the creation of the *Single Supervisory Mechanism* (SSM) was finalized through the resolution of the *Reglamento (UE) 1024/2013, de 15 de octubre de 2013, que encomienda al Banco Central Europeo tareas específicas respecto de políticas relacionadas con la supervisión prudencial de las entidades de crédito,* in which it defines SSM as the European surveillance system for financial institutions, in which the supervisory function of the *European Central Bank* (ECB) is combined with the mediation of the competent national authorities (NCAs) of the countries of the euro area, including the *Banco de España*. And it was not until November 14, 2014 that the SSM became fully operational.

Therefore, we could affirm that the creation of the SSM was the first step towards the creation of a "*Banking Union*". Although two other pillars are also essential to complete this process:

- The *Single Resolution Mechanism* (SRM)*,* which became operational in 2015.

- A *Harmonized deposit guarantee* system, for which a creation proposal was presented in November 2015 by the *European Commission*.

- These three pillars of the *Banking union* mentioned are further reinforced by the creation of a single normative code, the *Single Rule Book*, based on the new capital requirements framework established by the *Reglamento (UE) 575/2013, de 26 de junio de 2013 , sobre los requisitos prudenciales de las entidades de crédito y las empresas de inversión, y por el que se modifica el Reglamento (UE) N. ° 648/2012* and by the *Directiva 2013/36/UE, de 26 de junio de 2013, relativa al acceso a la actividad de las entidades de crédito y a la supervisión prudencial de las entidades de crédito y las empresas de inversión, por la que se modifica la Directiva 2002/87/CE y se derogan las Directivas 2006/48/CE y 2006/49/CE*.

2.5.1. Single Rule Book.

The objective of the *Single Rule Book* is to establish a series of prudential regulations common to all the institutions of the *European Union*. This harmonization in prudential regulation guarantees, for instance, that the Basel III agreements are applied in the same way in all member countries. Furthermore, it will eliminate various loopholes in regulation thus contributing to improving the functioning of the *European Single Market* (ESM).

That is why this new *Single Rule Book* will make the banking sector a stronger, more efficient and transparent sector, since it indicates and requires the same methodology to be used to calculate requirements such as liquidity standards or capital ratios.

But this *Single Rule Book* should not be rigid, but rather this new regulatory framework should give flexibility to each country for the application of prudential regulation since economic and credit cycles do not go at the same timing throughout the *European Union*.

That is why European countries still have the power to compel financial institutions to raise their capital levels, especially in assets such as real estate loans, to cope with future financial bubbles. In addition, each country establishes its level of countercyclical buffer according to the economic situation to protect the national economy and the banking sector from any threat that puts financial stability in check.
Lastly, member states have reserved the power to establish the level of pillar 2 as they see fit, that is, they can compel entities to increase their capital levels after they have undergone the *Supervisory Review Process* (SREP) .

2.5.2. Single Supervisory Mechanism (SSM).

The SSM establishes a new financial supervision methodology thanks to the union of the different *Competent National Authorities* (CNAs) of the participating EU countries and the *European Central Bank*. This new supervisory mechanism has the fundamental objectives of guaranteeing a robust and stable European banking system, and increasing economic integration in Europe.

Participants are all those countries that are part of the *Eurosystem* in addition to the countries belonging to the EU that want to cooperate with the ECB and adhere to this supervision system.

In this supervisory system, the largest and most significant entities are directly supervised by the ECB. The rest of the entities are the ANCs that supervise them directly and the ECB indirectly. An entity is significant if one of the following criteria is met:

- Total consolidated assets of over 30,000 million Euros.

- Percentage of assets over GDP above 20 % as long as its consolidated total Assets do not exceed 5 billion Euros.

- It is the largest entity in the country or one of the three largest.

- It has subsidiaries in more than one member country of the SSM and that its Assets or Liabilities in the rest of the countries are greater than 20 % of its total Assets or Liabilities.

- An entity applying for or receiving aid funds from the European Stability Mechanism.

Regarding the SSM supervision model, the ECB is the competent authority that guarantees its effective operation. Furthermore, it is the ECB that supervises that the SSM works properly.

In the SSM, entities are classified into two groups. The first group corresponds to the entities identified as significant, and the second group corresponds to the other entities. Once classified, the ECB directly supervises the entities classified in the first group, articulating their actions through the *Joint Supervision Teams* (ECS). These teams are made up of employees of the ECB and the ANCs. The role of these teams is to assess risk profiles continuously, as well as to ensure that solvency and liquidity are adequate.

The ANCs, on the other hand, are the authorities with competence in direct supervision over the entities classified in the second group. However, the ECB may issue guidelines to try to ensure proper supervision of these less significant entities or even assume direct supervision of them when deemed necessary.

2.5.3. Harmonization of guarantee funds.

Another great step in the European Union has been to establish a Deposit guarantee fund in order to give savers security by depositing their money in entities in which their solvency status was questionable. This harmonization of guarantee funds in the EU countries and their minimum requirements is regulated in the *Directiva 1994/19/CE*, as amended by the *Directive 2009/19/CE*.

In recent years, especially in 2014 with the new *Directiva 2014/49/UE*, new measures have been added for the protection of European investors. However, these measures remain short-range from the point of view of investors and from Germany, according to the recent proposal by his Finance Minister Olaf Scholz. Both advocate a common Deposit Guarantee Fund for the entire European Union, since at present, although there is some harmonization, it is not enough.

3. Solvency regulation and bank profitability.

The increase that has been experienced in recent times on the pressure on regulation is a necessary and widespread issue throughout all the countries of the world. It is very difficult to know what is the degree and what type of regulation is necessary to face all those operational problems produced after the financial crisis of 2008.
It is very common for financial regulation to oscillate to try to achieve a balance that allows it to make the financial sector work properly, contributing to the development of the real economy without establishing too many restrictions.

This behavior in financial regulation is sometimes contradictory. The *G20*[25] summits during 2008 and 2010 argued the need for bank bailouts on the grounds that these were too large to fall. However, the intention was to overcome the past crisis by creating even larger financial institutions, protecting themselves behind the hypothesis that systemic risk only depends on bank size.

Among all the regulations related to the financial sector, the regulations regarding solvency are perhaps the most important. The Basel II agreement was unable to respond when the crisis came, and the emergency led to the opening of the Basel III agreement.

Until 2019, one of the most common doubts was knowing what impact this new Basel III agreement would have on the economic recovery. The impact on credit is probably the most questioned during these years of implementation of the measures. Basel III was created under the assumption that the banking sector could repeat the same failures committed in the years prior to the crisis, however the sector was already transforming in the years prior to 2008 as they were facing increasingly profitability downs and already too expensive operating structures.

The profitability crisis of the banking entities that will be analyzed below means that the banking sector is reorienting its business model where there will no longer be those oversized costs of the past and where the composition of the commercial network has been drastically reduced. It is very risky to accept that the regulation on the banking sector is going to change this situation since the architecture of this new regulation is not complete.

In short, the new banking business environment that is being created is an environment in which there is nothing clear about whether or not it is appropriate for banks to carry out their function and produce multiplicative effects of credit on investment.

The profitability of the banks has been falling year after year until reaching profitability that are more characteristic of low value institutions than of institutions dedicated to risk diversification and intermediation.

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[25] Group formed by the most developed countries in the world. They represent 85% of the world economy. It includes countries like the USA, Germany or China.

3.1. Profitability crisis.

Since 2012, a very deep process has been carried out that has consisted of a profound restructuring of the Spanish banking sector. Although we have been implementing reforms for several years, the market still perceives threats and challenges.

The result of the Spanish banks in 2018 has been slightly higher than in 2017. Paradoxically, during the first weeks of January 2019, the sector evolved favorably on the Stock Market, although after knowing the profit results for the 2018 financial year, the market reacted negatively. This is because although the profits of the entities have improved as a whole, the profitability indicators such as the RoE are relative, yielding insufficient returns that in many cases do not cover the cost of capital.

In this context, regulation plays a key role. The Spanish banking sector, and the European, is perhaps the most transversal economic sector, interconnected with other sectors through financial flows. That is why the great regulatory pressure it receives. If the GDP falls, it is immediately noticed in the banking business. This sector is especially vulnerable to weaknesses in growth or external threats.

By external threats we understand that they are currently made up of well-known institutional issues such as the Brexit resolution, the *Banking Union* or Italian political instability. All these external threats have a negative impact on European financial institutions, and even more so on Spanish banks, which have a large international presence.

Another of the important factors that have led the banking sector to this crisis situation are, on the one hand, the economic slowdown in the euro area, and on the other hand, the technological irruption of new, more flexible competitors in terms of structure and activity less regulated.
The sector's interest margin will remain very narrow and bank income will be pressured by the large number of costs of banking structures.

That is why the AEB employers criticize the excess of bank regulation in matters of solvency of Spanish banks. The *Banco de España* maintains that the highest quality capital in the Spanish banking sector is one of the lowest in Europe and, for this reason, it has requested that a reduction in the payment of dividends be made in order to strengthen the entities' own resources.
On the part of the banks, it is maintained that the sector is in a very robust solvency situation, alerting the regulatory authorities that this excessive regulatory pressure will end up restricting the issuance of credit.

The criticism is expressed in the form of surprise on the part of the banking association, when they see that contradictory policies are being carried out. On the one hand, interest rates have been lowered to increase credit in the economy, and on the other hand, more capital is required, reducing their profitability and depriving them of capital to issue the credit for which they are encouraged.

Capital requirements were initially set at 7 %, becoming 10 % and currently ending at 12 %. This increase in requirements makes the market penalize the banking sector in the Stock Market, since investors think that the regulator has located some fault that they have not been able to see.

Doubts regarding the solvency of the Spanish banking sector have always been very present, but now they must focus on profitability after more than ten years of destruction of shareholder value. Therefore, progress is necessary to improve profitability since it has become a concern of regulatory authorities. Mergers are requested in order to solve these profitability problems, believing that the synergies that occur will benefit the creation of value.

3.2. Banking Profitability.

Any bank takes steps to ensure value creation for its shareholders. This creation of value materializes when the profitability obtained by your business exceeds expectations.

The profitability, when we put it in the context of a bank, must indicate what has been the return or productivity of the capital that has been used in the banking business. Regardless of the analysis carried out to study profitability, it is necessary to obtain at least an economic indicator as a criterion in the measure and a reference on which to look to know if the profitability results obtained are positive or not. The *Banco de España* establishes that the most suitable indicator of profitability for banking entities is that which relates the entities' profit with their own resources.

According to *Muñoz* (2009), profitability is nothing more than a quotient between the results obtained over a period of time and the investment that has been made or with the financing used. However, there are different ways of defining this ratio in order to adapt it to the context or the type of economic activity that is carried out.

Archel, Lizarraga, Sánchez and Cano (2012) establish that two fundamental objectives are pursued when performing a profitability analysis. The first of these objectives is to try to evaluate the returns obtained from the investments. The second objective is to evaluate the return that is obtained for the shareholders. Therefore, the most used ratios to evaluate profitability are the financial profitability and economic profitability ratios.

Depending on the element included in the numerator or denominator of each ratio, we obtain the following combination of bank profitability ratios:

- $CashFlow/TotalAssets$
- $CashFlow/Equity$
- $NetBenefit/AverageTotalAssets$

- $NetBenefit/Equity$

On the one hand, we identify Cash Flow as the result before taxes, adding provisions and amortizations. These last two items are added so that the analysis is complete, however, in practice, Cash Flow is not used as an element of the numerator since both the provisions and depreciation items are susceptible to accounting manipulation resulting in an indicator of profitability little objective.

However, the regulations, being aware of this reality, establish that Net Profit is the element to be used in the profitability ratio numerator, since it incorporates all cost items and is the most basic result indicator.

Regarding the denominator, the regulations consider that it must be the item of the own resources of the entities and not the average total assets. This is due to the fact that the average total Assets is immersed in the Own Resources, through the following expression:

$$RoE = (\frac{NetBenefit}{ATA})x(\frac{ATA}{Equity})$$

Therefore, we are left with:

$$RoE = RoAxLevelofIndebtedness$$

This return on assets has the drawback that it is not useful for comparing entities focused on different businesses (investment banking, private, commercial, etc.) since their degree of leverage and their level of risks differ. The Return On Equity (RoE) is the indicator per excellence. In order to maximize its value, in recent years entities have been developing new methods to assess their profitability with respect to their level of exposure to different risks. This has been termed as risk-adjusted return.

3.3. Profitability evolution.

European banks have not seen double-digit profitability figures for years. This today is not the normal thing caused to a great extent by the great pressure in the regulation that exists on the banking entities to guarantee their solvency. Furthermore, the current situation of negative interest rates, which causes a smaller intermediation margin, already mentioned and the new competitive forces mean that profitability does not recover and remains stagnant.

Before the 2008 financial crisis, the profitability indicators of European banks were very high, with the banking sector being the sector that created the most value in the

markets. In recent years, this situation has changed and regulatory pressure began after 2008.

The most general response to alleviate this situation of declining profitability has been to reduce costs, trying to increase banking efficiency. Spain was among the countries with the best efficiency in 2008 and has continued in the same situation in recent years.

Below, in **Table 1** and **Table 2**, is the RoE for both the EU entities as a whole and a breakdown by country as a comparison with Spain.

Table 1. Return on equity of all credit institutions belonging to the EU (2008-2019).

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
RoE (%)	-2.78	1.02	3.91	-0.78	-1.57	2.10	3.20	4.35	3.50	5.79	6.08	-

Source: Consolidated Banking Data from ECB

Table 2. Return on equity in a sample of Eurozone countries (2008-2019).

%	Spain	France	Italy	Germany	Netherlands
2019	7.10	-	-	-	-
2018	8.19	6.71	5.85	2.22	8.30
2017	6.99	6.41	7.09	2.73	9.12
2016	5.03	6.46	-9.14	2.12	7.64
2015	6.59	6.78	3.13	1.72	7.55
2014	6.69	4.55	-3.16	2.50	3.56
2013	5.77	5.98	-12.79	1.32	5.49
2012	-24.88	3.38	-1.19	1.34	5.61
2011	0.16	5.63	-14.32	2.30	7.34
2010	8.54	8.33	3.77	2.33	7.19
2009	8.89	4.64	3.83	-2.68	-0.43
2008	12.36	2.22	4.91	-11.38	-12.53

Source: Consolidated Banking Data from ECB

Focusing now on Spain, in the following table we can see how the evolution of Spanish bank profitability is in an intermediate situation if we compare it with France, Italy,

Germany and the Netherlands. In 2008, Spain had the highest rate of return, well above France and Italy, which gave positive values for the same year.

This situation began to change from the year 2011 where the profitability of the Spanish banking system was no longer the highest, but was at a midpoint, surpassing only the Italian average.

For the last year that the *European Central Bank* presents data on RoE, we can see how Spain is placed again among the countries whose banking system is more profitable, but the difference with the rest of the countries has become narrower.

Table 3. Return on Equity of the Spanish's banking system (2008-2019)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
RoE (%)	12.36	8.89	8.54	0.16	-24.88	5.77	6.69	6.59	5.03	6.99	8.19	7.10

Source: Consolidated Banking Data from ECB and Financial Stability Report of the BdE year 2020.

If we break down these data, we see in the following table how RoE has evolved for the different Spanish banks of greater size.

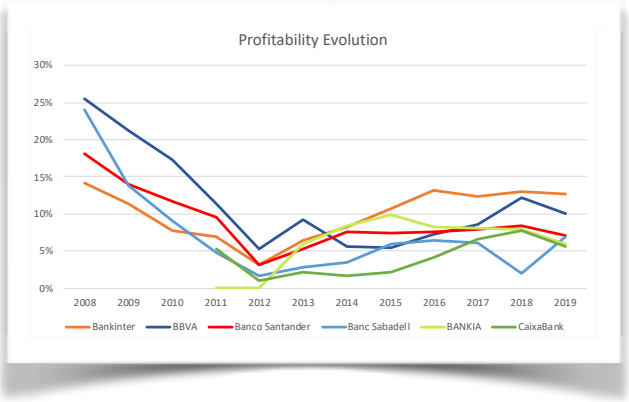
Table 4. Return on Equity and its variation of the largest Spanish banks (2008-2019)

%	Bankinter	Δ	BBVA	Δ	Banco Santander	Δ	Banco Sabadell	Δ	BANKIA	Δ	Caixa Bank	Δ
2008	14.10	-	25.50	-	18.12	-	24.08	-	-	-	-	-
2009	11.30	-19.86	21.20	-16.86	14.01	-22.68	13.75	-42.90	-	-	-	-
2010	7.78	-31.15	17.20	-18.87	11.75	-16.13	9.02	-34.40	-	-	-	-
2011	6.84	-12.08	11.30	-34.30	9.47	-19.40	4.71	-47.78	0	-	5.20	-
2012	3.09	-54.82	5.30	-53.10	3.06	-67.69	1.63	-65.39	0	-	1.00	-80.77
2013	6.49	110.03	9.20	73.58	5.23	70.92	2.76	69.33	5.90	-	2.20	120.00
2014	8.28	27.58	5.60	-39.13	7.64	46.08	3.54	28.26	8.40	42.37	1.70	-22.73
2015	10.65	28.62	5.40	-3.57	7.40	-3.14	5.96	68.36	9.90	17.86	2.20	29.41
2016	13.23	24.23	7.20	33.33	7.66	3.51	6.47	8.56	8.20	-17.17	4.10	86.36
2017	12.30	-7.03	8.50	18.06	7.87	2.74	6.05	-6.49	8.10	-1.22	6.60	60.98
2018	13.00	5.69	12.20	43.53	8.43	7.12	1.97	-67.44	7.90	-2.47	7.70	16.67
2019	12.64	-2.77	10.10	-17.21	7.02	-16.73	6.92	251.27	6.00	-24.05	5.60	-27.27

BANKIA in 2011 and 2012 had losses so the RoE is 0.
CaixaBank does not have data prior to 2011 as it is the old Caixa and the data is not comparable.

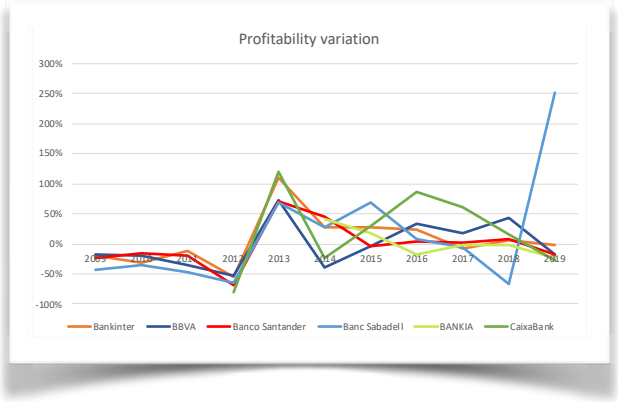
Source: Cinco días Daily. https://cincodias.elpais.com/cincodias/2019/11/15/companias/1573843554_432640.html

Figure 1. RoE evolution



Source: Own Elaboration

Figure 2. RoE variation



Source: Own Elaboration

3.4. Actions of the Spanish banking system to guarantee profitability.

Since its origins, the banking sector has had a business based fundamentally on trying to maximize the net interest margin. This brokerage margin is nothing more than the difference between the interest rate charged to customers for lending money and the interest rate paid to the savings of depositors. The key behind this type of business is to try to obtain a higher profitability thanks to a greater interest margin. The fact that bank entities carry an interest rate higher than the interest rate they pay is justified by the risk that these entities assume, either due to term or volume conditions.

Today this model is practically finished as it does not manage to be an attractive business in terms of profitability. As we could see in section **3.3**. bank financial profitability has been declining. This is because interest rates have been reduced to practically zero and even be negative.

This reduction in the intermediation margin of banks leads to the only possible solution to increase profitability is the issuance of a greater volume of credits and the capture of a greater volume of deposits. The cooling that occurred in economic activity after 2007 implied that the demand for loans fell, making this possible solution not possible.

As we have seen, since the origin of the past financial crisis it has led supervisory authorities to raise capital requirements. Banks have had to maintain high amounts of capital in the form of reserves to face possible future losses, making it impossible to allocate these funds to the issuance of credits and, therefore, to increase their net interest margin.

In this context of difficulty to guarantee a minimum profitability, banks have been implementing a series of measures to try to cope with the profitability crisis experienced in recent years. Some of these measures can be summarized in the following:

Increase in commissions.

This type of income is an ideal source of income for the banking sector since it does not carry any type of risk. The gratuitousness of some of the banking services has become history since at present the very low interest margins do not compensate the cost of these services. This has had a significant impact in Spain as it is one of the EU countries with the most expensive banking services.

Automation and digitization of the sector.

Million-dollar investments are increasingly being made in digitization and bank automation processes. The arrival of smartphones in our lives has led to the development of mobile applications with which customers can manage their bank accounts or perform any service in person.

The simplicity with which the banking websites have been developed has led to a simplification when contracting a loan or operating on the stock exchange. Customer self-sufficiency has led to a "Self service" model that makes physical offices unnecessary.

On the other hand, automation is being key in the banking business. New software and new technologies in Machine Learning[26] and Big Data[27] are beginning to replace human labor. Automated credit granting is proof of this as it reduces the time in the contracting of a credit using artificial intelligence in the evaluation of applicants.

Dismissal of staff.

Spain has been the European country with the highest number of commercial bank offices per inhabitant. The technological revolution and all the matters carried out to restructure the entities has led to the closure of most of these entities. As a consequence, the workers in these branches have become an excessive cost, carrying out large dismissal processes throughout the banking sector.

Self-competition.

The new paradigm has led banks to take advantage of the low operating costs of all those financial services offered through applications. The great competition of online banking has turned out to be yet another threat that further limited the profitability of traditional banking. That is why traditional entities have strived to acquire digital competitors or to create their own subsidiaries.

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[26] Branch of artificial intelligence that allows machines to learn without being expressly programmed to do so.

[27] New Science that pursue to treat large data sets that exceed the ability of traditional computer applications to deal with them in a reasonable amount of time.

In this way it is possible to attract and retain the young customer to those called digital natives who are not attracted to the bank of a lifetime.

3.5. Banking situation derived from the current health emergency situation by COVID-19.

The world is currently experiencing a health crisis caused by the pandemic caused by the *SARS-CoV-2*[28] virus. The high speed of spread of this virus, as well as the mortality and incidence that it is having especially in western countries led the *World Health Organization* (WHO) to classify the situation as a pandemic on March 11, 2020.

The great social and economic impact has brought about the total paralysis of the world economy, dedicating most of the countries' resources to the fight against the disease. As an exceptional measure in view of the great increase in the number of cases of contagion in Spain, the Spanish Government, chaired by Pedro Sánchez Pérez-Castejón (Madrid, February 29, 1972), held an extraordinary session on March 14, 2020 to vote to approve the alarm status. After its approval by majority, the main measure carried out was the imposition of the national quarantine. This measure came into force on March 15 at 00:00, where since then Spain and all its citizens have given their confidence to the effectiveness of the measure.

This health crisis has already affected all sectors of the world economy. Banking has been one of those sectors affected and will continue to suffer the consequences in the medium term. This situation, in addition, has reached a situation of weakness in economic growth and where all businesses face this new threat caused by *Covid-19*.

The banking sector has been preparing itself, evaluating the possible adversities that may arise, such as an increase in defaults, an increase in provisions, lower income, less credit. All this added to the pressure of a negative interest rate scenario.

For its part, the *Banco de España* in its recent publication of the statistics on the supervision of credit institutions referring to the last quarter of 2019 shows positive results in terms of the quality of the solvency of the entities during this year, where the highest quality capital ratio (CET 1) was 12.79 % compared to 12.46 % in 2018. Thus, entities have more capacity to grant credit and deal with defaults.

The same statistics also show negative data regarding bank profitability. The RoE of 2019 was 7.10 % compared to 8.19 % of 2018, again showing that the sector suffers from a problem of low profitability, which has worsened significantly during the last year, especially due to the impact of the pandemic. Investors are now demanding a higher risk premium and therefore the difference between return and cost of capital is increased, which is what is required for investing in the business.

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[28] New type of coronavirus that affects humans first detected in December 2019 in Wuhan (China). For the most part, in 80% of cases it only produces mild respiratory symptoms.

But, this situation is not affecting all banking entities in the same way. The largest significant entities that are under the direct supervision of the *European Central Bank* had capital levels of 15.57 %, and the smaller entities of 22.90 %. In addition, its default ratio has improved to stand at 3.23 % for significant entities, and 2.55 % for less significant ones.

Need for new financing

Turning to the issue of bank liquidity, entities have experienced a decrease in their liquidity coverage indicator, which is 164.84 % at the end of 2019. This indicator has been calculated according to the indications of the Bank of Spain, placing the liquidity buffer in the numerator and the net outflow of liquidity in the denominator, all taking into account an adverse scenario of liquidity need of 30 calendar days.

This decrease in the liquidity of the sector places banks in a less favorable position to face the current *Covid-19* crisis. The final impact will depend on how much GDP falls during 2020 and how long it will take for this economic growth to recover in the coming years. The measures that have been taken regarding the relaxation of the regulation on capital, provisions and liquidity, and the granting of public guarantees, have lessened the negative impact, but even so the banking sector will experience significant losses.

***Covid-19* Prudential Response**

Covid-19 has brought about a macro-financial disruption. This disjunction can already be seen in different indicators, especially in the case of systemic risk, which have led to a series of supervisory actions. These measures range from deciding which macroeconomic and microeconomic instruments to use, to how to adapt this adversity situation in accounting.

In this context, the Systemic Risk Indicator (IRS) has increased sharply as the volatility of the financial markets has increased. This IRS has already been rebounding since the *Brexit* referendum in 2016, falling from that year and until 2019 to historic lows. Again in 2020 it has been rebounding as the *Covid-19* has greatly strained financial markets and volatility has soared.

A series of macroprudential measures have been taken in order to mitigate the negative impact that the banking sector will have to bear in the coming months. Below I list the most important ones:

- Construction of capital buffers and guaranteeing that the conditions for granting loans are adequate. This contributes to smoothing the financial cycle and limiting systemic risk during expansionary stages and mitigating the adjustment of banks'

credit during recessionary stages. The countercyclical capital buffer (CCB) has been placed by the *Banco de España* at 0 %, with the intention of keeping it at that level until the economic and financial effects derived from the impact of *Covid-19* disappear.

- Temporary possibility to work with macroprudential requirements lower than those required. For this, the use of the capital and liquidity buffers already available is facilitated.

- The adoption of the new methodology to identify entities of global systemic interest is delayed one year until 2023, as well as the full implementation of the Basel III agreement.

- The transition period for the floor of the capital requirements calculated through internal models is also delayed until 2028.

Regarding the microprudential field, a series of measures have also been taken to try to give flexibility to the sector in aspects such as operations, prudential and regulatory requirements, in order to try to establish a situation of comfort for the banking sector to guarantee its correct operation. For example, the following ones:

- Guarantee the continuity of the banking business using all those resources released after the adaptation of all those activities related to supervision. For example, the delay in the bank stress exercises or the inclusion of the pandemic risk in the contingency plans of the entities in order to be able to request extensions in the terms to fulfill the requirements currently in force.

- Try to use the different buffers available in the most effective way possible to mitigate the losses derived from the *Covid-19* pandemic.

On the other hand, and for accounting purposes, the pandemic has also influenced the way in which entities report their accounting and financial information. That is why the different national and international regulatory bodies have allowed a series of measures to try to give an optimal response to the effects of the pandemic on accounting and financial information. Among these measures is the relaxation of accounting regulations to try to calculate adequately the deterioration of credit risk during 2020.

All these measures are aimed at preventing the issuance of the loan from falling and trying to mitigate the negative impact that the *Covid-19* will have on the profitability of the entities. This last aspect is very important since the sector, as previously seen in this same work, has been going through a profitability crisis for years. Therefore, both the public guarantees and the moratoriums that are being allowed will make private agents more able to pay, thus reducing defaults and, as a consequence, banks will not have to make excessive provisions that will make profitability fall extremely.

Finally, another of the last measures adopted has been to eliminate the distribution of dividends related to the years 2019 and 2020, and limit bonuses to employees. Furthermore, both the *Banco de España* and the *European Banking Authority* have recommended avoiding repurchasing shares to remunerate shareholders.

4.Effect of the solvency regulation on the profitability of the Spanish banking sector.

4.1.Structural equation models.

We begin this last chapter by implementing a typology of multivariate statistical models used to estimate what effect and what relationships exist between various variables. These models are known as S*tructural Equation Models* (SEM) and are alternative models to the traditional, more flexible and less restrictive regression models. This flexibility underlies the possibility of being able to introduce measurement errors in both endogenous and exogenous variables.

However, SEM models are more laborious and more complex to implement than traditional factor analysis or regression models, but today, thanks to the new software that exists in the market, we can estimate them with some ease using new graphical environments such as the AMOS belonging to the SPSS software or in R with its package lavaan.

The undoubted advantage of using SEM models is that it is possible to establish what type and what direction exists between the relationships of the different variables that we introduce in the model, in order to then estimate the corresponding parameters.

We can find a different variety of models derived from this type of methodology. There are as many SEM models as there are purposes or levels of complexity in the different studies that you want to carry out. Here are some examples:

- Multiple regression with multicollinearity
- Confirmatory factor analysis
- Second order factor analysis
- Path Analysis
- Complete causal model with latent variables
- Latent curve model
- Multilevel models

- Multi-group models
- Models based on means
- Mediation analysis

The present chapter focuses mainly on SEM Path Analysis models since it is a typology in which all the variables are observable except for prediction errors. Therefore, for its application, the same methodology and method of execution of the model established in Fruet, J., Millán, J., Caridad and Ocerin, J and Pérez, J. (2019) will be followed.

4.2.Types of variables.

Structural equation models have some peculiarities regarding the type of variables they use. These variables can be classified according to the role they play and according to the way in which they are measured. Therefore, below, we list the different types of variables that we can find in a structural equation model:

- *Variable observed*. This type of variable measures individuals, for example, questions on a questionnaire.

- *Latent variable*. With this type of variable we can introduce into the model a characteristic that we would like to observe but that we cannot and that does not have any type of error in its measurement (Factor in an exploratory factor analysis).

- *Variable error*. With this variable we collect the measurement errors of any variable, both individually and jointly. These errors are those that are not included in the model and that can affect the measurement of an observed variable. They are latent variables since they cannot be observed directly.

- *Grouping variable*. Categorical variable that indicates the different subpopulations to be compared.

- *Exogenous variable*. They are the independent variables of the model, those that affect the exogenous variable and that are not affected by other variables.

- *Endogenous variable*. It is the variable or variables to be explained by the model. These types of variables are always accompanied by an error and receive the effect of one or more other variables.

In structural equation systems, it is common to visually represent variables and their different relationships through what is called “path diagrams”. We indicate below the way in which this technique visually represents the different parts of the process that carries out the SEM models.

1. The relationships between the different variables are represented by arrows. The direction of each arrow is from the cause variable to the effect variable.

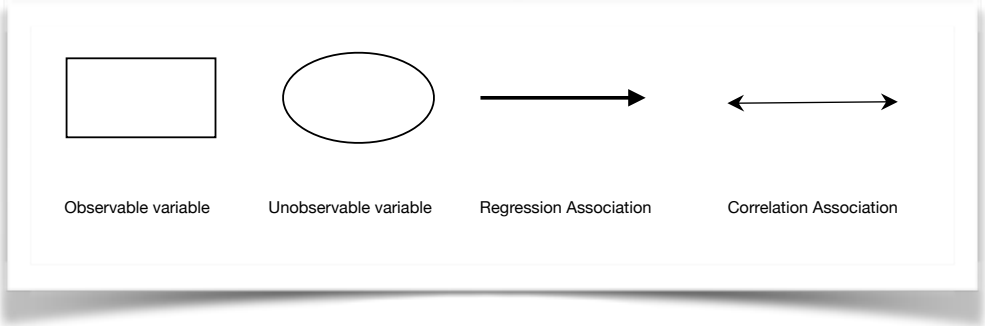
2. The relationship between two independent variables or between two error terms that do not have a causal interpretation, is represented by a bidirectional arrow.

3. Observable variables are represented within a square.

4. Latent variables are represented within circles.

These visual diagrams should be simple and contain only those relationships between variables that have a consistent theoretical basis. Some of the most important figures are shown below.

Figure 3. Diagram's figures of SEM



Source: own elaboration

4.3.Sampling and specification of variables.

The sample selected to perform the statistical analysis proposed in the following section **4.4**. It has been prepared thanks to the database provided by the *Banco de España* regarding accounting and financial aspects of the different Spanish deposit institutions (Banks, Savings Banks and credit institutions).

The different accounting information provided by the *Banco de España* used the consolidated balance sheet and the consolidated profit and loss account of the Spanish deposit institutions for the period 2007-2019. Based on this accounting information, different financial ratios have been established in order to analyze what effect these ratios have on the solvency of the entities (Rose, 2002).

Table 5 shows the ratios selected for the analysis, differentiating the type of variable that each ratio represents.

Table 5. Variables and ratios selected for analysis

Acronym	Ratios	Type of variables
X1	Increase in ROE	Exogenous
X2	Capital increase	Exogenous
X3	Equity/Assets	Exogenous
X4	Liabilities/Assets	Exogenous
X5	Equity/Liabilities	Exogenous
Y1	Net Benefit	Endogenous
Y2	ROA	Endogenous
Y3	Administrative Costs/Operating Income	Endogenous
Y4	Intermediation Margin	Endogenous
e1		Error variable
e2		Error variable
e3		Error variable
e4		Error variable

Source: Own elaboration.

4.3.1.Consolidated Balance Sheet.

Table 6 shows the consolidated assets for the period analyzed. It can be seen how these have decreased by -11.24 % from 2,836,829,634 € in 2007 to 2,517,898,986 € in 2019.

In 2007, the Credits section was the largest asset investment, being 77.86 % of total assets. However, over the years, investment in loans has been reduced, becoming 65.90 % of total assets in 2019.

Table 6. Consolidated assets from December 31, 2007 to December 31, 2019

ASSETS	2007	2010	2012	2015	2017	2019
CREDITS	2,208,872,743.00 €	2,268,404,055.00 €	2,090,466,054.0	1,676,013,301.00 €	1,680,260,216.00 €	1,659,409,374.00 €
Credit System	229,823,701.00 €	188,441,535.00 €	229,550,279.00 €	135,626,425.00 €	214,793,432.00 €	178,199,615.00 €
Public Administrations	38,755,249.00 €	74,491,997.00 €	96,890,356.00 €	85,708,582.00 €	74,339,530.00 €	63,785,565.00 €
ORS	1,691,933,135.00 €	1,782,291,283.00 €	1,537,748,013.0	1,274,652,552.00 €	1,199,106,319.00 €	1,135,589,579.00 €
External Sector	248,360,658.00 €	223,179,240.00 €	226,277,406.00 €	180,025,742.00 €	192,020,935.00 €	281,834,615.00 €

VALUES OTHER THAN SHARES and PARTICIPATIONS	256,938,573.00 €	377,801,449.00 €	489,462,384.00 €	398,320,348.00 €	318,530,468.00 €	307,576,732.00 €
Residents in Spain	176,056,951.00 €	313,915,760.00 €	406,653,886.00 €	323,717,990.00 €	247,449,970.00 €	219,685,642.00 €
Residents in the rest of the world	80,881,622.00 €	63,885,689.00 €	82,808,498.00 €	74,602,358.00 €	71,080,498.00 €	87,891,090.00 €
SHARES AND PARTICIPATIONS	183,388,969.00 €	180,188,964.00 €	257,153,693.00 €	245,516,660.00 €	258,418,505.00 €	250,035,912.00 €
Residents in Spain	101,607,778.00 €	102,877,982.00 €	166,986,497.00 €	133,401,336.00 €	145,383,054.00 €	131,335,186.00 €
External Sector	81,781,191.00 €	77,310,982.00 €	90,167,196.00 €	112,115,324.00 €	113,035,451.00 €	118,700,726.00 €
OTHER NOT SECTORISED	187,629,349.00 €	292,862,123.00 €	419,303,812.00 €	325,642,016.00 €	292,654,914.00 €	300,876,968.00 €
Cash	8,541,647.00 €	7,882,548.00 €	7,433,738.00 €	7,957,872.00 €	8,071,726.00 €	9,315,633.00 €
Others	179,087,702.00 €	284,979,575.00 €	411,870,074.00 €	317,684,144.00 €	284,583,188.00 €	291,561,335.00 €
TOTAL ASSETS	2,836,829,634.00 €	3,119,256,591.00 €	3,256,385,943.00 €	2,645,492,325.00 €	2,549,864,103.00 €	2,517,898,986.00 €

Source: Own elaboration and consolidated data based on Bank of Spain data.

If we look at the total assets of the banking system we can see how during the last nine years they have been decreasing, going from 3,119,256,591 € in 2010 to 2,517,898,986 € in 2019. The main reason we can explain this reduction in assets is due to mainly to the deterioration produced in the portfolios of the entities.

Regarding liabilities and equity, in **Table 7** we can see how these have been decreasing during the analyzed period. This reduction has been 11.24%, from a total of 2,836,829,582 € in 2007 to 2,517,903,626 € in 2019.

The largest section over the years has been the Deposits section. This section went from being 72.14 % of total liabilities and equity in 2007 to being 70.97 % at the end of 2019.

Table 7. Consolidated liabilities and equity from December 31, 2007 to December 31, 2019

LIABILITIES	2007	2010	2012	2015	2017	2019
DEPOSITS	2,046,684,600.00 €	2,244,624,468.00 €	2,224,677,498.00 €	1,887,280,517.00 €	1,805,740,472.00 €	1,787,099,432.00 €
Credit system	222,760,416.00 €	236,123,047.00 €	524,074,376.00 €	274,080,774.00 €	293,383,380.00 €	214,414,505.00 €
Public Administrations and Provisions	74,470,976.00 €	75,287,050.00 €	67,341,464.00 €	76,097,156.00 €	60,910,483.00 €	68,816,882.00 €
ORS	1,319,390,781.00 €	1,434,103,776.00 €	1,304,172,269.00 €	1,255,068,129.00 €	1,193,835,580.00 €	1,252,423,294.00 €
External sector	430,062,427.00 €	499,110,595.00 €	329,089,389.00 €	282,034,458.00 €	257,611,029.00 €	251,444,751.00 €
FIXED INCOME SECURITIES ISSUED	395,916,341.00 €	377,454,686.00 €	324,418,474.00 €	184,175,805.00 €	200,289,371.00 €	226,864,748.00 €
ACCRUALS AND OTHER LIABILITIES	192,057,582.00 €	224,072,203.00 €	315,982,676.00 €	220,408,672.00 €	196,857,668.00 €	192,717,340.00 €
TOTAL LIABILITIES AND EQUITY	2,836,829,582.00 €	3,119,257,058.00 €	3,256,385,942.00 €	2,645,492,331.00 €	2,549,864,103.00 €	2,517,903,626.00 €

Source: Own elaboration and consolidated data based on Bank of Spain data.

4.3.2.Consolidated income statement.

This section shows the consolidated income statement during the analysis period. If we look at **Table 8** we can see how the financial products section has decreased dramatically during these last 13 years. Its decrease has accounted for 71 %.

Table 8. Consolidated income statement from December 31, 2007 to December 31, 2019

REVENUE AND EXPENSES	2007	2010	2012	2015	2017	2019
Financial products	113,599,765.00 €	77,091,165.00 €	80,464,525.00 €	43,462,892.00 €	32,976,000.00 €	32,950,000.00 €
Financial expenses	81,458,355.00 €	42,798,951.00 €	47,725,067.00 €	17,052,142.00 €	9,798,000.00 €	9,801,000.00 €
Interest Margin	32,141,410.00 €	34,292,214.00 €	32,739,458.00 €	26,410,750.00 €	23,178,000.00 €	23,149,000.00 €
Income from equity insert. & other products & expenses	32,977,549.00 €	29,020,664.00 €	26,767,975.00 €	25,121,253.00 €	23,467,000.00 €	26,238,000.00 €
Gross margin	65,118,959.00 €	63,312,878.00 €	59,507,433.00 €	51,532,003.00 €	46,646,000.00 €	49,387,000.00 €
Operating expenses	28,074,471.00 €	29,431,088.00 €	26,951,058.00 €	26,261,172.00 €	26,625,000.00 €	26,327,000.00 €
Staff costs	17,086,805.00 €	17,642,567.00 €	15,586,920.00 €	14,181,977.00 €	13,931,000.00 €	13,874,000.00 €
Net provisions	1,446,421.00 €	3,963,156.00 €	6,421,662.00 €	1,766,069.00 €	3,623,000.00 €	2,659,000.00 €
Loss due to impairment of financial assets	8,029,270.00 €	16,718,935.00 €	82,547,485.00 €	10,697,927.00 €	9,105,000.00 €	3,963,000.00 €
Net operating income	27,568,797.00 €	13,199,699.00 €	-56,412,772.00 €	12,806,835.00 €	7,294,000.00 €	16,438,000.00 €
Losses due to impairment of other assets	1,232,835.00 €	5,290,339.00 €	33,444,028.00 €	3,414,162.00 €	9,286,000.00 €	2,026,000.00 €
Other income or loss	2,983,446.00 €	1,927,240.00 €	2,723,650.00 €	1,361,640.00 €	1,318,000.00 €	717,000.00 €
Profit before tax	29,319,408.00 €	9,836,600.00 €	-87,133,150.00 €	10,754,313.00 €	-674,000.00 €	15,128,000.00 €
Companies Tax	4,118,036.00 €	133,823.00 €	-13,441,420.00 €	1,396,573.00 €	3,227,000.00 €	1,255,000.00 €
Provisions for social and charitable work	89,373.00 €	30,049.00 €	14,304.00 €	45,354.00 €	56,000.00 €	73,000.00 €
NET BENEFIT	25,111,999.00 €	9,672,728.00 €	-73,706,034.00 €	9,312,386.00 €	-3,957,000.00 €	13,800,000.00 €

Source: Own elaboration and consolidated data based on Bank of Spain data.

If we focus on the operating income section in 2007, we appreciate how its participation in total financial products was 24.27 %. On the other hand, operating expenses represented 24.71 % of total financial products.

We especially highlight the year 2012. In this year, operating income was negative, mainly due to the great restructuring process carried out during this year, where the sector had to get rid of a large amount of toxic assets that accumulated on its balance sheets over the past years.

In the last year of analysis, operating income represented 49.89 % of total financial products and financial expenses were 79.90 %, evidencing the strong increase in the structural cost of entities.

4.4.Path analysis application.

The statistical method Path Analysis, also known as route analysis, is an extension to the multiple regression model with which it is possible to evaluate theoretical statistical models where there are a series of dependency relationships between the different variables. The most important aspects of this statistical method are:

- The researcher can establish all those regressions that he considers in order to study the relationship between the different dependent and independent variables. The dependent variables can in turn act as independent variables of other variables that are included in the model.

- It seeks to know the fit of the proposed model, that is, how well the model represents the relationships that exist between the variables.

- A theoretical model is proposed through the study of the different variables involved. This model can be represented through mathematical expressions (formulas) or through diagrams in order to graphically observe the proposed relationships between the variables.

- In these graphic diagrams the relationships are established using arrows. These arrows are the routes established by the model and the estimated coefficient is represented on them.

Being considered as an extension of the Multiple Regression Model, it is necessary that the basic assumptions of the latter are fulfilled, as well as other assumptions specific to the Path Analysis method.

- First, an exploratory analysis is necessary to determine the quality of the data. Thus we can determine if there are missing values or extreme value data so as not to distort the analysis.

- An analysis of the sample size, normality, independence in errors and multicollinearity, among others, is also necessary.

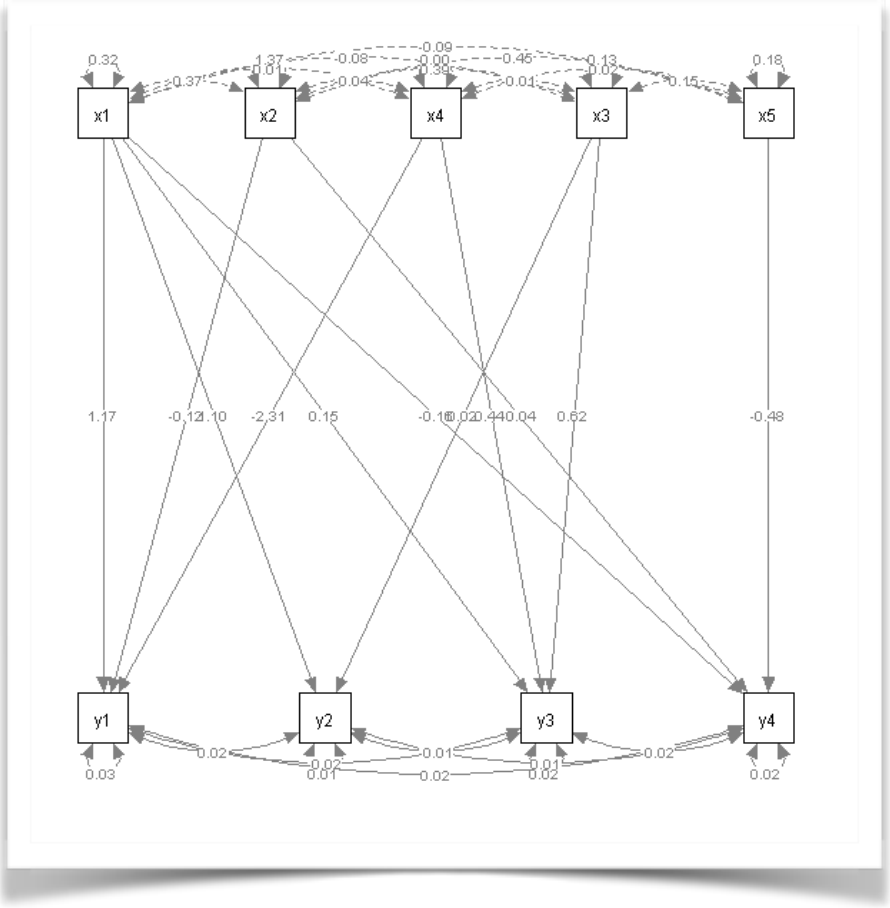
The distribution is assumed to be multivariate normal. If this requirement is not met, the statistical tests performed may not be accurate, leading to a situation of poor fit to the data. To verify compliance with this hypothesis, the shape of the distribution of each variable can be analyzed by studying the skewness and kurtosis coefficients. On the other hand, the Mardia test can be performed.

Regarding multicollinearity, it is possible to detect it by making correlations between each pair of variables. If there is a correlation with values greater than 0.85, we may be facing a multicollinearity problem.

4.5.Implementation of the model.

The R software has been used to create the diagram. The lavaan package allows estimation and evaluation of the specified model in order to extract hypothetical associations between the proposed variables. The code used can be found in the Annexes section of this work.

Figure 4. Goodness of fit of the model.



Source: R output

The diagram shows a statistical model that adequately fits the hypothesis. The banks' capital increases have led to an increase in both solvency and profitability.

4.6.Results of the regression.

After estimating the different parameters of the proposed model, we can see how they are generally significant at 5 %. This estimate has been made using the maximum likelihood estimate. The results obtained are shown in **Table 9** below.

Table 9. Estimated parameters

Regressions:	**Estimate**	**Std.Err**	**Z-value**	**P(>|z|)**
y1 ~				
x1	1.171	0.087	13.457	0.000
x2	-0.122	0.024	-5.012	0.000
x4	-2.315	0.278	-8.333	0.000
y2 ~				
x1	1.098	0.060	18.159	0.000
x3	0.020	0.067	0.303	0.762
y3 ~				
x1	0.149	0.065	2.291	0.022
x3	0.621	0.068	9.101	0.000
x4	0.439	0.209	2.102	0.036
y4 ~				
x1	-0.160	0.069	-2.317	0.020
x2	-0.039	0.013	-3.142	0.002
x5	-0.476	0.047	-10.092	0.000

Source: R output

Regarding the global significance of the model, we can see in **Table 10** how the p-value associated with the chi-square statistic is less than 5 %, indicating that the hypothesis of global significance of the model is accepted.

Table 10. Chi-square statistic

Model Test User Model:	
Test statistic	54.023
Degrees of freedom	15
P-value (Chi-square)	0.000
Source: R output	

4.6.1.Goodness-of-fit measures.

Finally, in this section we will interpret the different measures of goodness of fit derived from the SEM model estimates. We can divide these measures into three different typologies, differentiating between those measures derived from the variance and covariance matrix, from the measures that are purely statistical that try to compare the model that has been proposed with the independence model, and the measures that are derive from the probability function.

Among the measures derived from the variance and covariance matrix of the observed data we find the mean quarter error (RMSEA). This measure differentiates between the observed and estimated covariances, in order to be able to judge the impact of the residuals.

Table 11 presents the estimated RMSEA whose value amounts to 0.062. For this measure to be considered optimal, its value must be as close to 0. As a general rule, it is accepted that this measure is good when its value is less than 0.1.

Furthermore, we can find in **Table 11** the SRMR measure, which is a similar measure to the RMSEA and is interpreted in the same way. Its value is 0.035, again indicating a good measure of goodness of fit of the estimated model.

Table 11. RMSEA and SRMR

Root Mean Square Error of Approximation:	
RMSEA	0.062
90 Percent confidence interval - lower	0.467

90 Percent confidence interval - upper	0.785
P-value RMSEA <= 0.05	0.000
Standardized Root Mean Square Residual:	
SRMR	0.035

Source: R output

Among the second group of goodness-of-fit measures in **Table 12**, we highlight basically two. On the one hand, we have the Tucker-Lewis (TLI) measure with a value of 0.862 and, secondly, we find the measure called the Bentler index (CFI) with a value of 0.914.

Both measures are related to the covariance ratio that explains the estimated model, with a value of 1 being the optimal covariance that would lead to a perfect fit. The values of our estimates are quite high and very close to 1, so we can affirm that these measurements again indicate a good fit of the model to the data.

Table 12. CFI and TLI

User Model Vs baseline Model	
Comparative Fit Index (CFI)	0.914
Tucker-Lewis Index (TLI)	0.862

Source: R output

Regarding the last category of measures that indicate the quality of the fit, we find two well-known traditional measures, such as the Akaike information criterion (AIC) and the Schwarz-Bayesian information criterion (BIC).

Both are based on the probability function and with them we can make comparisons between models with different number of parameters. An alternative model should be specified where the number of estimated parameters is different from that proposed in this Chapter 4. Thus we would choose the model whose AIC or BIC was of lesser value.

In **Table 13** we find that the AIC shows a value of -138,254 and that the BIC shows a value of -126,390.

Table 13. AIC and BIC

Loglikelihood and Information Criteria:	
Loglikelihood user model (H0)	90.127

Loglikelihood unrestricted model (H1)	117.139
Akaike (AIC)	-138.254
Bayesian (BIC)	-126.390
Sample-size adjusted Bayesian (BIC)	-190.124

Source: R output

5. Conclusions of the investigation.

As we mentioned in the introductory section after the outbreak of the 2008 financial crisis, the vast majority of banking systems in all the countries of the world were faced with conditions of excessive leverage and lack of liquidity. This prevented refinancing in the short term, causing a situation of instability in the financial system and, therefore, in the real economy in general.

Faced with this situation, regulatory agencies urged the creation of new regulations related to the solvency of banking entities. This new regulation has placed great regulatory pressure on deposit institutions, leading the sector to undergo a profitability crisis.

That is why the present work has focused on conducting an analysis that allows the different solvency requirements to be related to the impact that this regulation has had on profitability to try to analyze whether this hyper-protection carried out by regulators it has affected profitability levels even more or if, on the contrary, it has benefited them.

The objectives proposed in the introduction have been to review the different regulations on bank solvency that have been established since 2007, highlighting the different Basel III Agreements currently in force, on the other hand, another objective has been to expose in a way the situation that the banking sector has experienced since 2007 in terms of the evolution of its financial profitability is clear and direct, evidencing the crisis experienced by the sharp falls in this ratio; and finally, another objective has been to try to draw conclusions through the implementation of a statistical model that tries to relate the different capital requirements with the profitability of the entities. The data used comes from the statistical databases of the ECB and the Bank of Spain, in a study period that spans from 2007 to 2019.

Banking supervision is an essential activity since it allows to establish a control over the financial stability of the entities in particular, and therefore, of the financial stability of the economy in general. All existing banking supervision regulations have been reviewed, both at European and national level, and the evolution of the Basel agreements, from Basel I to Basel III currently in force, has been reviewed. Said agreement places great emphasis on liquidity control, on the leverage of entities, on a minimum solvency ratio and on the creation of capital buffers to face unforeseen events.

From February 2020, the banking sector faces the umpteenth problem resulting from the current pandemic that the world is experiencing caused by the SARS-CoV-2 virus. This has led the sector to need financing again, as liquidity has decreased. In addition, it is necessary to carry out a prudential response to guarantee the solvency of the entities to overcome this health emergency. Measures include creating new capital buffers or temporarily relaxing macroprudential requirements. All these measures aimed at guaranteeing the continuity of the banking business and at mitigating as much as possible the possible losses derived from the situation.

In conclusion, as results of the statistical analysis we have the following:

A. The model is significant as a whole. The Chi-Square test yields a p-value less than 0.05.

B. The parameters estimated individually are generally significant with a value less than 0.05.

C. The adjustment quality measures are all close to 1. The RMSEA has a value of 0.062, and the CFI of 0.914. This makes our data well explained by the proposed model.

With these data, we can affirm that the hypothesis that we proposed in the methodology section is fulfilled. The new solvency regulations and the new capital requirements imposed on banks have helped to improve the situation of declining entities' profitability. It has not been possible to recover the levels of profitability prior to 2008, but this downward trend could be corrected since 2012.

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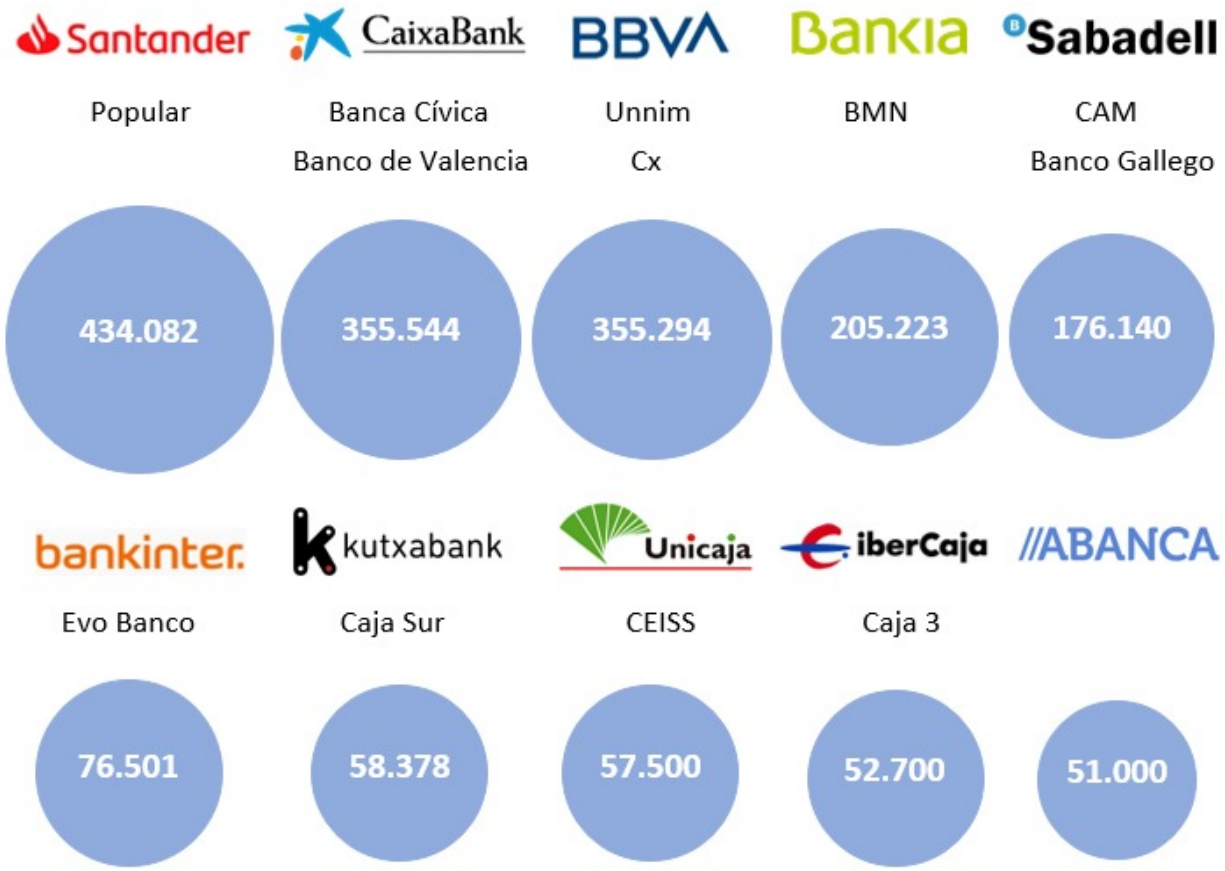
ANNEXES

Annex 1: Recent mergers of the different Spanish banking entities.



Source: Expansion Daily. https://www.expansion.com/empresas/banca/2019/03/21/5c92ae78e5fdeab4668b4625.html

Annex 2: Basel III implementation schedule.

Compromisos en curso (las zonas sombreadas son periodos de transición; todas las fechas comienzan a 1 de Enero)									
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Ratio de apalancamiento (1)	Control de los supervisores		Ejecución en paralelo (3% Tier 1) de 1 de Enero de 2013 a 1 de Enero de 2017. Divulgación comienza 1 de Enero de 2015.				Ajuste final	Migración al Pilar 1	-
Ratio mínimo de capital ordinario (2)	-	-	3.50 %	4.00 %	4.50 %	4.50 %	4.50 %	4.50 %	4.50 %
Colchón de conservación (3)	-	-	-	-	-	0.625 %	1.25 %	1.875 %	2.50 %
(2) + (3) = (4)	-	-	3.50 %	4.00 %	4.50 %	5.125 %	5.75 %	6.375 %	7.00 %
Deducciones transitorias sobre el CET 1 (5)	-	-	-	20.00 %	40.00 %	60.00 %	80.00 %	100.00 %	100.00 %
Tier 1 Capital (6)	-	-	4.50 %	5.50 %	6.00 %	6.00 %	6.00 %	6.00 %	6.00 %
Ratio Capital Total (7)	-	-	8.00 %	8.00 %	8.00 %	8.00 %	8.00 %	8.00 %	8.00 %
(7) + (3) = (8)	-	-	8.00 %	8.00 %	8.00 %	8.625 %	9.25 %	9.875 %	10.50 %
Elementos no válidos para incluirlos en Tier 1 o Tier 2	-	-	Retirados de forma paulatina en un horizonte temporal de 10 años, comenzando en 2013.						
Coeficiente de cobertura de liquidez a corto plazo	Comienza el periodo de observación	-	-	-	Se introduce el estándar mínimo	-	-	-	-
Coeficiente de financiación estable neta	-	Comienza el periodo de observación	-	-	-	-	-	Se introduce el estándar mínimo	-
Source: Millám, J.R. (2017). Análisis de la evolución de la solvencia y de la rentabilidad de las entidades de depósito españolas									

Annex 3: Consolidated assets of Spanish deposit institutions (2008-2019).

ACTIVO	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
CRÉDITOS	2208872743	2329235078	2284463351	2268404055	2224230435	2090466054	1808428718	1700261573	1676013301	1632263358	1680260216	1642428872	1659409374
Sistema crediticio	229823701	239046544	215657096	188441535	199244887	229550279	165059869	113516149	135626425	141412542	214793432	196986723	178199615
AAPP	38755249	47688165	61227692	74491997	82989189	96890356	76626614	94697014	85708582	83866560	74339530	65739894	63785565
OSR	1691933135	1795108548	1776532628	1782291283	1715036540	1537748013	1392383771	1328188686	1274652552	1222510780	1199106319	1150227684	1135589579
Sector Exterior	248360658	247391821	231045935	223179240	226959819	226277406	174358464	163859724	180025742	184473476	192020935	229474571	281834615
VALORES DISTINTOS A ACCIONES Y PARTICIPACIONES	256938573	314367735	405460816	377801449	397306864	489462384	464360068	469853782	398320348	352261168	318530468	315504407	307576732
Residentes en España	176056951	232077185	311923327	313915760	338966696	406653886	389590970	388415052	323717990	280504630	247449970	233589016	219685642
Residentes en el extranjero	80881622	82290550	93537489	63885689	58340168	82808498	74769098	81438730	74602358	71756538	71080498	81915391	87891090
ACCIONES Y PARTICIPACIONES	183388969	171658815	183818902	180188964	250540167	257153693	279997521	261043953	245516660	243047221	258418505	235466684	250035912
Residentes en España	101607778	91990252	99198603	102877982	160409176	166986497	188717990	156946579	133401336	129552238	145383054	126228845	131335186
Sector Exterior	81781191	79668563	84620299	77310982	90130991	90167196	91279531	104097374	112115324	113494983	113035451	109237839	118700726
OTROS NO SECTORIZADOS	187629349	280994286	249090509	292862123	378148063	419303812	321389991	347969772	325642016	313559802	292654914	282948369	300876968
Efectivo	8541647	9006968	8517102	7882548	7486153	7433738	7280030	7604037	7957872	7469389	8071726	8654754	9315633
Otros	179087702	271987318	240573407	284979575	370661910	411870074	314109961	340365735	317684144	306090413	284583188	274293615	291561335
TOTAL ACTIVO	2836829634	3096255914	3122833578	3119256591	3250225529	3256385943	2874176298	2779129080	2645492325	2541131549	2549864103	2476348332	2517898986

Source: Boletín Estadístico del Banco de España.

Annex 4: Liabilities and Consolidated net equity of Spanish deposit institutions (2008-2019).

PASIVO Y PN	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
DEPÓSITOS	2046684600	2262196394	2267890615	2244624468	2245317169	2224677498	1999035737	1938813406	1887280517	1806954181	1805740472	1773708831	1787099432
Sistema crediticio	222760416	265744281	270897221	236123047	340065731	524074376	333422041	276373477	274080774	256567319	293383380	251850367	214414505
AAPP y Dotaciones	74470976	75057760	77873472	75287050	66470059	67341464	61796163	73448988	76097156	53441195	60910483	70862506	68816882
OSR	1319390781	1428936047	1422781151	1434103776	1358356390	1304172269	1307975514	1283799281	1255068129	1234175905	1193835580	1203245591	1252423294
Sector Exterior	430062427	492458306	496338771	499110595	480424989	329089389	295842019	305191660	282034458	262769762	257611029	247750367	251444751
VALORES DE RENTA FIJA EMITIDOS	395916341	355875221	390791009	377454686	368620088	324418474	234984837	196334405	184175805	174674430	200289371	206744252	226864748
PN, AJUSTES Y CORRECCIONES DE VALOR	199177480	232757752	259750277	269888252	350125924	389230211	414009790	392410266	353534122	345286544	346869395	314267023	311078471
OBS	2993579	3136134	3313822	3217449	3022143	2077083	1592719	85838	93215	97469	107197	125235	143635
PERIODIFICACIONES Y OTROS PASIVOS	192057582	242289597	201088429	224072203	283140425	315982676	224553223	251485197	220408672	214118934	196857668	181503471	192717340
TOTAL PASIVO Y PN	2836829582	3096255098	3122834152	3119257058	3250225749	3256385942	2874176306	2779129112	2645492331	2541131558	2549864103	2476348812	2517903626

Source: Boletín Estadístico del Banco de España-

Annex 5: Consolidated P&G account of Spanish deposit institutions (2008-2019).

CUENTA DE RESULTADOS	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Productos financieros	113599765	141653582	103088812	77091165	83962904	80464525	65027621	54733574	43462892	36234000	32976000	32647000	32950000
Costes Financieros	81458355	106495695	60054197	42798951	54398120	47725067	38211797	27616046	17052142	11937000	9798000	9370000	9801000
Margen de intereses	32141410	35157887	43034615	34292214	29564784	32739458	26815824	27117528	26410750	24297000	23178000	23277000	23149000
Rto. Inst. cap. Y otros ptos. Y gtos.	32977549	31224201	24517059	29020664	27560852	26767975	28728107	28300061	25121253	24132000	23467000	24499000	26238000
Margen bruto	65118959	66382088	67551674	63312878	57125636	59507433	55543931	55417589	51532003	48429000	46646000	47777000	49387000
Gastos de explotación	28074471	29507583	29399650	29431088	28463764	26951058	26798217	26115603	26261172	26388000	26625000	25990000	26327000
Gastos de explotación de personal	17086805	17901334	17742200	17642567	16889388	15586920	15108343	14328646	14181977	13943000	13931000	13648000	13874000
Dotaciones netas	1446421	3404692	1351278	3963156	1804705	6421662	2184836	1869423	1766069	3495000	3623000	2187000	2659000
Pérdida por deterioro de activos financieros	8029270	15245052	19551323	16718935	22668057	82547485	21799915	14499828	10697927	8344000	9105000	3140000	3963000
Rdo. De explotación	27568797	18224761	17249423	13199699	4189110	-56412772	4760963	12932735	12806835	10202000	7294000	16460000	16438000
Pérd. Det. Resto de activos	1232835	947767	7494074	5290339	21738130	33444028	4109818	1528482	3414162	3968000	9286000	2189000	2026000
Otros rdos.	2983446	3112089	4611212	1927240	112790	2723650	3505291	1659114	1361640	458000	1318000	137000	717000
BAI	29319408	20389083	14366561	9836600	-17436230	-87133150	4156436	13063367	10754313	6691000	-674000	14408000	15128000
IS	4118036	1903006	1365014	133823	-2743076	-13441420	-4658407	1677930	1396573	643000	3227000	1985000	1255000
Dot. OBS	89373	64768	45478	30049	24207	14304	25196	42331	45354	45000	56000	66000	73000
Bº contable	25111999	18421309	12956069	9672728	-14717361	-73706034	8789647	11343106	9312386	6003000	-3957000	12356000	13800000

Source: Boletín Estadístico del Banco de España-

Annex 6: Ratios used in the practical application of structural equation models.

	Y1	Y2	Y3	Y4	Y5	Y6	X1	X2	X3	X4
2007	1	1	1	1	1	1	1	1	1	1
2008	0.62773346	1.19537898	1.09522165	1.07068157	0.99466235	1.07642716	0.73356601	0.67210265	0.96086907	1.09385018
2009	0.39561813	1.04513948	0.94942063	1.18467766	0.98605462	1.20143209	0.51593141	0.46867996	0.78212755	1.33891497
2010	0.28426536	1.42535926	1.2963029	1.23232682	0.98245645	1.25433227	0.38518351	0.35030783	0.98257144	1.06691691
2011	-0.3333993	2.63431953	2.29926066	1.53427706	0.95965514	1.59877961	-0.5860689	-0.5115268	1.10222679	0.91983469
2012	-1.5019499	4.0202874	3.5023092	1.70240816	0.94695895	1.79776342	-2.9350923	-2.5569318	0.94244861	1.01860678
2013	0.16839135	4.32888138	4.27263247	2.05158837	0.92059125	2.22855516	0.35001781	0.34546973	1.14411083	0.83430764
2014	0.22927177	4.49050437	4.58373667	2.01105831	0.92365181	2.1772905	0.45170064	0.46107889	1.10256272	0.84369441
2015	0.20892412	3.27855734	3.51568157	1.90334648	0.93178546	2.04268746	0.37083412	0.39765499	1.13837857	0.82170477
2016	0.13789472	3.25539589	3.63420915	1.93528766	0.92937348	2.0823573	0.23904907	0.26686595	1.24338941	0.7559407
2017	-0.0904813	2.94206819	3.27317296	1.93750115	0.92920633	2.08511402	-0.1575741	-0.1753077	1.3151249	0.7211258
2018	0.31184446	2.71710341	3.11263136	1.80750746	0.93902278	1.92488138	0.4920357	0.56366119	1.27829949	0.72420594
2019	0.35185853	2.62964215	2.96272679	1.75964344	0.94263892	1.86672055	0.54953809	0.61914555	1.30203447	0.72022354

Source: own elaboration.

Annex 7: R code that implements the SEM model in its Path analysis modality.

```
X1=c(1.0000000,
    0.6277335,
    0.3956181,
    0.2842654,
    -0.3333993,
    -1.5019499,
    0.1683913,
    0.2292718,
    0.2089241,
    0.1378947,
    -0.0904813,
    0.3118445,
    0.3518585)

X2=c(1.0000000,
    1.1953790,
    1.0451395,
    1.4253593,
    2.6343195,
    4.0202874,
    4.3288814,
    4.4905044,
    3.2785573,
    3.2553959,
    2.9420682,
    2.7171034,
    2.6296422)
```

```
X3=c(1.0000000,
     1.0706816,
     1.1846777,
     1.2323268,
     1.5342771,
     1.7024082,
     2.0515884,
     2.0110583,
     1.9033465,
     1.9352877,
     1.9375012,
     1.8075075,
     1.7596434)

X4=c(1.0000000,
     0.9946623,
     0.9860546,
     0.9824564,
     0.9596551,
     0.9469590,
     0.9205912,
     0.9236518,
     0.9317855,
     0.9293735,
     0.9292063,
     0.9390228,
     0.9426389)

X5=c(1.0000000,
     1.0764272,
     1.2014321,
     1.2543323,
```

1.5987796,
1.7977634,
2.2285552,
2.1772905,
2.0426875,
2.0823573,
2.0851140,
1.9248814,
1.8667206)

Y1=c(1.0000000,
0.7335660,
0.5159314,
0.3851835,
-0.5860689,
-2.9350923,
0.3500178,
0.4517006,
0.3708341,
0.2390491,
-0.1575741,
0.4920357,
0.5495381)

Y2=c(1.0000000,
0.6721027,
0.4686800,
0.3503078,
-0.5115268,
-2.5569318,
0.3454697,
0.4610789,

0.3976550,
0.2668660,
-0.1753077,
0.5636612,
0.6191455)

Y3=c(1.0000000,
0.9608691,
0.7821275,
0.9825714,
1.1022268,
0.9424486,
1.1441108,
1.1025627,
1.1383786,
1.2433894,
1.3151249,
1.2782995,
1.3020345)

Y4=c(1.0000000,
1.0938502,
1.3389150,
1.0669169,
0.9198347,
1.0186068,
0.8343076,
0.8436944,
0.8217048,
0.7559407,
0.7211258,
0.7242059,

```
    0.7202235)


X1
X2
X3
X4
X5
Y1
Y2
Y3
Y4

Datos=cbind(X1,
            X2,
            X3,
            X4,
            X5,
            Y1,
            Y2,
            Y3,
            Y4)
Datos


install.packages("lavaan")
install.packages("semPlot")

library(lavaan)
library(semPlot)
```

```
model<-'

Y1~X1+X2+X4
Y2~X1+X3
Y3~X1+X3+X4
Y4~X1+X2+X5

Y1~~Y1
Y2~~Y2
Y3~~Y3
Y4~~Y4
X1~~X1
X2~~X2
X3~~X3
X4~~X4
X5~~X5
'
?lavOptions

fit<-lavaan(model,data=Datos, auto.var=TRUE, check.gradient=FALSE)
summary(fit,fit.measures=TRUE)
parameterEstimates(fit,standardized=TRUE)

semPaths(fit,what="paths",whatLabels="par")
```

Annex 8: Correlation Matrix.

	X1	X2	X3	X4	X5	Y1	Y2	Y3	Y4
X1	1.00	-0.56	-0.38	0.38	-0.37	0.98	0.98	0.03	0.06
X2	-0.56	1.00	0.91	-0.91	0.91	-0.43	-0.43	0.45	-0.60
X3	-0.38	0.91	1.00	-1.00	1.00	-0.22	-0.21	0.70	-0.78
X4	0.38	-0.91	-1.00	1.00	-1.00	0.22	0.21	-0.70	0.78
X5	-0.37	0.91	1.00	-1.00	1.00	-0.20	-0.20	0.70	-0.78
Y1	0.98	-0.43	-0.22	0.22	-0.20	1.00	1.00	0.15	-0.05
Y2	0.98	-0.43	-0.21	0.21	-0.20	1.00	1.00	0.16	-0.07
Y3	0.03	0.45	0.70	-0.70	0.70	0.15	0.16	1.00	-0.97
Y4	0.06	-0.60	-0.78	0.78	-0.78	-0.05	-0.07	-0.97	1.00

Source: own elaboration