# INDIVIDUAL AND SECTORAL ANALYSIS FRAMEWORK FOR THE IMPACT OF ECONOMIC AND FINANCIAL RISKS

2023

BANCO DE ESPAÑA
Eurosistema

Documentos Ocasionales
N.º 2313

Carlos Pérez Montes, Alejandro Ferrer,
Laura Álvarez Román, Henrique Basso,
Beatriz González López, Gabriel Jiménez,
Pedro Javier Martínez-Valero, Sergio Mayordomo,
Álvaro Menéndez Pujadas, Lola Morales,
Myroslav Pidkuyko and Ángel Valentín

# INDIVIDUAL AND SECTORAL ANALYSIS FRAMEWORK FOR THE IMPACT OF ECONOMIC AND FINANCIAL RISKS

# INDIVIDUAL AND SECTORAL ANALYSIS FRAMEWORK FOR THE IMPACT OF ECONOMIC AND FINANCIAL RISKS

## Coordination

CARLOS PÉREZ MONTES
carlos.perezmontes@bde.es

ALEJANDRO FERRER
alejandro.ferrer@bde.es

## Authors and contributions (*):

### Directorate General Financial Stability, Regulation and Resolution

ALEJANDRO FERRER
alejandro.ferrer@bde.es

GABRIEL JIMÉNEZ
gabriel.jimenez@bde.es

CARLOS PÉREZ MONTES
carlos.perezmontes@bde.es

### Directorate General Economics, Statistics and Research

LAURA ÁLVAREZ ROMÁN
laura.alvarezroman@bde.es

HENRIQUE BASSO
henrique.basso@bde.es

BEATRIZ GONZÁLEZ LÓPEZ
beatrizgonzalez@bde.es

SERGIO MAYORDOMO
sergio.mayordomo@bde.es

ÁLVARO MENÉNDEZ PUJADAS
alvaro.menendez@bde.es

MYROSLAV PIDKUYKO
myroslav.pidkuyko@bde.es

### Directorate General Operations, Markets and Payment Systems

LOLA MORALES
lola.morales@bde.es

### Directorate General Banking Supervision

PEDRO JAVIER MARTÍNEZ-VALERO
pedro.martinez-valero@bde.es

ÁNGEL VALENTÍN
angel.valentin@bde.es

(*) The authors are grateful to Olga P. Blázquez García, Beatriz Blázquez Godoy, Javier Cabrera Molina and María Calonge Pinilla for the comments received, and to José Alonso, José Cebrián and Patricia Stupariu for their collaboration.

Documentos Ocasionales. N.º 2313

July 2023

https://doi.org/10.53479/34812

ISSN: 1696-2230 (on-line edition)

## Abstract

The Banco de España uses various microeconomic models, mostly of an empirical nature, to support its decision-making in relation to the analysis of economic and financial risks and economic policy advice. These models, which complement those of a macroeconomic nature, seek to identify the potentially heterogeneous impact on different groups of agents of certain economic, financial or public policy scenarios. This analysis covers many areas, including the study of the behaviour of households and non-financial corporations, the internal credit rating of companies, the study of the demand for and supply of bank credit, top-down bank stress tests, supervisory review and evaluation processes (SREP) and the study of non-bank financial intermediaries. This paper shows how these models have been applied to analyse two recent crisis events, the onset of the COVID-19 pandemic and the Russian invasion of Ukraine, illustrating their practical utility and the need for their development and continuous adaptation.

**Keywords:** microeconomics, microeconometrics, non-financial private sector, banks, other financial intermediaries, risks, impact.

**JEL classification:** D12, D22, D40, G10, G21, G28, G32.

## Resumen

El Banco de España utiliza distintos modelos de carácter microeconómico, mayoritariamente de naturaleza empírica, para sustentar su toma de decisiones en relación con el análisis de los riesgos económicos y financieros y del asesoramiento de la política económica. Esta familia de modelos, que complementan a los de corte macroeconómico, busca identificar el impacto potencialmente heterogéneo sobre distintos grupos de agentes de determinados escenarios económico-financieros o de políticas públicas. Este análisis se extiende a múltiples áreas: estudio del comportamiento de hogares y empresas no financieras, calificación crediticia interna de empresas, estudio de la demanda y oferta de crédito bancario, realización de pruebas de resistencia bancarias *top-down,* proceso de revisión y evaluación supervisora (PRES) y estudio de los intermediarios financieros no bancarios. El documento muestra la aplicación de estos modelos en el análisis de dos eventos de crisis recientes: los inicios de la pandemia de COVID-19 y de la invasión rusa de Ucrania, ilustrando su utilidad práctica y la necesidad de un desarrollo y adaptación continua de los mismos.

**Palabras clave:** microeconomía, microeconometría, sector privado no financiero, bancos, otros intermediarios financieros, riesgos, impacto.

**Códigos JEL:** D12, D22, D40, G10, G21, G28, G32.

## Contents

## 1 Introduction

This paper aims to compile the essentially empirical models and methods that comprise the reference framework for the Banco de España's regular analysis of the impact of the materialisation of economic and financial risks on particular groups of agents and specific sectors. The Banco de España uses not only macroeconomic models[1] but also this broad set of specialised microeconomic models and methods to discharge its functions of economic and financial analysis and advising on economic policy.

An initial modelling area focuses on analysis of the private non-financial sector (households and firms). These agents play a key role in the course of macro-financial developments, on account of their investment and spending decisions, both during economic upswings and in periods of adverse economic and financial shocks. Such decisions are considerably heterogeneous across both households and firms, affected by idiosyncratic, sectoral and geographical factors and how they interact with macro-financial variables. Identifying and measuring the determinants of these agents' behaviour helps to better calibrate the different economic policies and anticipate their potential impact, via households and firms, on the financial sector.

The Banco de España has also developed an in-house credit quality assessment framework for risk management purposes and for use in some of its monetary policy procedures, such as receiving corporate bonds as collateral. This firm-centric framework comprises a quantitative and qualitative assessment following a structured procedure and considers sectoral heterogeneity, firm size and, where possible, financial position (balance sheets).

As regards analysis of the banking sector, close attention is paid to bank lending given that it plays a key role in the banking sector's profitability and financial position, it is the nexus between real activity and financial activity and it is the channel for monetary policy transmission. The Banco de España's empirical research has focused on bank lending volumes and prices and the associated risks, on identifying the different bank loan supply and demand-side factors and on the impact of different forms of regulation, such as dynamic provisioning. To do so, it has harnessed its different granular databases, such as the Central Credit Register (CCR) and the Central Balance Sheet Data Office (CBSO).

The ongoing individual analysis of banks' risk profiles draws on the inspection work conducted as part of the supervisory review and evaluation process (SREP). Each bank is assessed on the basis of four elements: business model, internal governance and risk management, risks to capital and risks to liquidity and funding. The aim is to thoroughly assess a bank's risk level and the controls established to manage it. The SREP is a cornerstone of the microprudential assessment and underpins decision-making for key quantitative and qualitative measures, including the Pillar 2 Requirement (P2R) and the Pillar 2 Guidance (P2G).

1 See Pérez Montes et al. (2023) for a review of the macro-financial models used by the Banco de España to analyse the systemic impact of risks.

With regard to analysis of the banking sector, the Banco de España has gone to great lengths to design its own stress-testing framework, the Forward Looking Exercise on Spanish Banks (FLESB). Under this framework, which comprises a broad set of statistical models, the Banco de España assesses for macroprudential purposes the system's overall solvency in the face of macroeconomic scenarios of varying degrees of severity. Despite focusing on the overall Spanish banking system, this method also estimates the cross-bank heterogeneity of the effects of different macro-financial scenarios. This heterogeneity is observed, for example, in the different sources of revenue (net interest income, fees, net trading income, etc.) and impairment losses (loan portfolio, bonds, foreclosed assets, etc.), and in risk-weighted assets. Their combined effect determines the distribution among banks of the impacts on solvency.

To complement the FLESB, the Banco de España has also analysed competition in the banking sector. First, because of its most direct financial stability implications, due to its impact on risk-taking, profitability and, ultimately, banks' solvency. Competition has also been studied from the wider economic perspective of banking sector analysis: the determinants of supply, demand, costs, margins and efficiency, which impact the level of economic value generated and its distribution among banks and among the different agents that interact with them (e.g. households and non-financial corporations (NFCs), as depositors or borrowers).

Assessment of the financial system is completed with the analysis of the non-bank financial intermediaries – such as insurance firms and investment or pension funds, among others – that are also part of the financial system and may impact its stability. In this case, in addition to fluid communication with the supervisory and regulatory bodies that are directly responsible for the regulation and supervision of the non-bank segments of the financial system, the Banco de España analyses their interconnections with the banking sector: both direct exposure (bilateral links) and indirect exposure (common links to third parties). The new digital operators and the growing use and ownership of crypto-assets are also a focal point of the microeconomic analyses in this area.

Lastly, it should be noted that the crises of recent years in Spain, Europe and globally have called for the use and, where applicable, updating, adjustment and development of microeconomic models to analyse risks. The economic and financial system has, in a short period, been impacted by a considerable set of shocks: the crisis triggered by the COVID-19 pandemic, together with the effects of the broad package of tax, monetary and macroprudential measures implemented in response, and, more recently, the global value chain bottlenecks, rising commodity prices, the Russian invasion of Ukraine, higher and more persistent inflation and the attendant monetary policy response. All these shocks have raised significant questions as to their scale and economic and financial impact, and models and methods of this kind, focused on the differential behaviour of certain sub-sets of economic agents and markets, have contributed to this analysis.

The remainder of this paper is structured as follows. Section 2 studies the developments geared to households and firms, including the monetary policy-focused

credit risk assessment model developed by the Banco de España. Section 3 addresses the analysis of the banking sector, specifically in terms of lending and generally under the FLESB framework, in addition to studying competition in the banking sector. Section 4 focuses on banking supervisory analysis from a microsupervisory perspective, while Section 5 includes the developments for non-bank financial intermediaries and their relationship to banks. Section 6 sets out some examples of the use of the methods and models prior to the COVID-19 and war in Ukraine crises. Lastly, Section 7 presents the conclusions.

## 2 Analysis of households and firms

### 2.1 Microeconometric models for households

Over their life cycle, households experience fluctuations in their income and wealth that affect their spending and saving decisions. The Banco de España uses different panel data empirical models that enable the estimation of the consequences of these different shocks and their uneven effects across different kinds of households.

#### Household income dynamics

Considering first the changes in household income, it is useful to distinguish between anticipated and unanticipated shocks, and to incorporate into the analysis the effects of households' different demographic characteristics. For example, Basso, Bover, Casado, Gálvez and Hospido (2020) incorporate both aspects into an income dynamics model estimated drawing on data from the Spanish Survey of Household Finances (EFF). The authors assess whether the temporal dynamics of changes in household income (measured as a relative percentage point drop in income) vary depending on the relative size of the income shock and on the household's actual income level. They also propose a methodology for estimating these dynamics based on the responses to a question on subjective expectations for future income included in the 2014 and 2017 editions of the EFF. Most of the survey respondents (at least 60% in 2014 and 2017) replied that they expected their total household income to remain stable over the following 12 months, but there was a not insignificant set of households that expected a greater (upward or downward) change, which helps identify differential effects.

One of the ways to estimate the risks to income facing households is to measure their persistence. Low persistence would mean that past income is less important for predicting its future path and, therefore, income shocks would tend to result in more movement between income levels. The above-mentioned authors estimate this persistence on the basis of the current income level and income shock size, using two econometric models: one that only uses realised income and another that combines actual income with subjective expectations for future income. Using data on realised income, differentially low persistence is estimated when there is (i) an unusually adverse impact on high-income earners, or (ii) an extraordinarily positive impact on low-income earners. Using expectations data, persistence is high (close to one) irrespective of income level and shock size. Therefore, the non-linearities estimated using actual data are not observed when using income expectations data.

#### Response of household consumption to income shocks

Previous papers show that the consumption response to income changes varies, depending on their persistence and degree of anticipation and household characteristics.

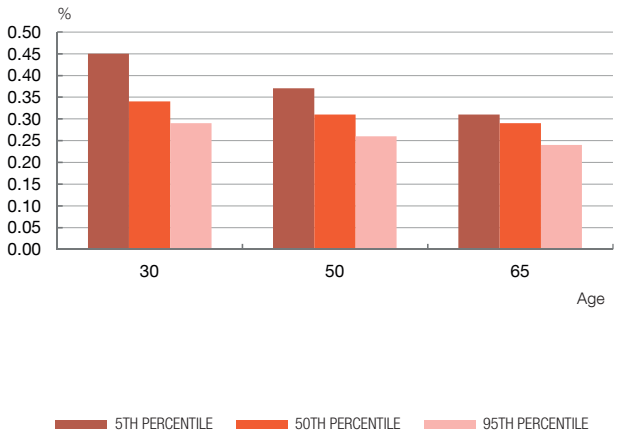
Browning and Collado (2001) harness the Spanish Household Budget Survey and observe that the summer and winter "extra" payments,[2] considered anticipated fluctuations

2 Spanish wages and pensions are generally paid in 14 rather than 12 monthly payments.

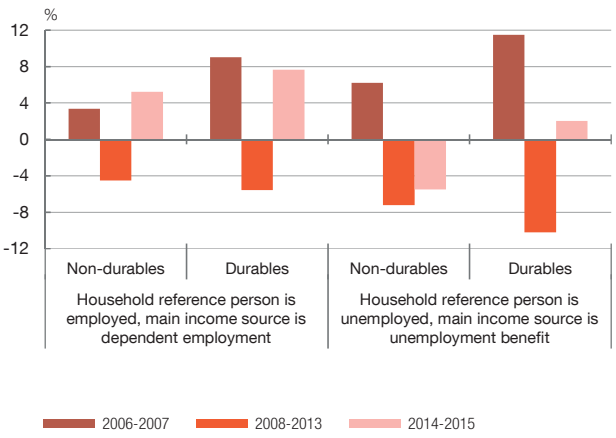
Chart 1

**ANALYSIS OF THE IMPACT ON HOUSEHOLDS**

1 EFFECTS OF CHANGES IN INCOME ON CONSUMPTION (a)




2 CHANGES IN CONSUMPTION ACCORDING TO HOUSEHOLDS' EMPLOYMENT STATUS AND SOURCE OF INCOME (b)




**SOURCES:** INE and Banco de España.

**a** Estimates of the average derivative of the conditional mean of consumption with respect to income assessed at different ages and wealth levels, which correspond to wealth percentiles, and which are averaged according to income levels.
**a** Measured in each period as the average of the annual rates of median consumption expenditure in each category.

in income, do not affect monthly expenditure patterns. Casado (2011) analyses how consumption responds to anticipated and unanticipated income shocks in Spain, and finds that consumption is highly elastic (0.78) to permanent income shocks, whereas temporary changes do not produce significant effects. He also finds that the degree to which households are insured against these fluctuations varies, with it being statistically higher for more highly educated and homeowner households.

Basso, Bover, Casado, Gálvez and Hospido (2020) analyse how the effects of changes in income on consumption may vary depending on the age of the household reference person and wealth level. Chart 1.1 shows some of their results, such as the fact that wealthier households see their consumption relatively less affected by fluctuations in their income. For example, for households whose reference person is 30 years old and that are in a low wealth percentile (5%), a 1% drop in income generates a 0.45% fall in their consumption, compared with a smaller decline (0.29%) for households in a high wealth percentile (95%).

Meanwhile, Anghel, Barceló and Villanueva (2019) also identify heterogeneity in household spending and saving behaviour. For example, they show that households with a lower education level increased their saving rate more between 2007 and 2013 in response to the financial crisis than the group with a higher education level (10.9 percentage points (pp), versus 9.6 pp). In terms of home ownership, homeowners with loans increased their saving rate between 2007 and 2013 by 19.3 pp, followed by an increase of 14.5 pp among

tenants and of 5.2 pp among homeowners without loans. Lastly, the authors show that the youngest households (aged 18 to 34) increased their saving rate by 19.9 pp, compared with an increase of 11.1 pp among older households (aged 65 to 74). All these findings identify groups that were relatively more exposed to the risks that materialised in the global financial crisis and that were forced to make greater adjustments to their consumption and saving habits during the crisis.

Focusing on the 2008-2011 period of the crisis, Arce, Prades and Urtasun (2013) and Martínez-Matute and Urtasun (2017) also show that the changes in saving and consumption during the crisis (and the subsequent recovery) differed according to income level, education level and employment status, as depicted in Chart 1.2 which draws on the latter of the cited papers. Lastly, Banco de España (2015) likewise shows that more indebted households recorded a greater fall in consumption in the crisis of 2008-2011.

**Response of household consumption to wealth shocks**

Changes in household wealth also trigger significant and uneven changes in consumption patterns.

Bover (2005) uses EFF data to estimate the relationship between household consumption and different measures of household wealth (value of the principal residence, value of other properties, financial assets and total assets). The study finds a very moderate average wealth effect of 0.02, measured as the ratio of the change in consumption to the change in wealth. The estimated effect ranges from 0.01 to 0.05, depending on the breadth of the wealth and consumption metrics used. These effects do not control for households' demographic characteristics, which are incorporated, in an extension of the analysis, into the estimation of a linear equation in which wealth is also instrumented via local house prices and inheritance indicators. The estimation of the ratio of the sensitivity of consumption to wealth then falls to 0.013, with estimates ranging from 0.01 to 0.019 depending on the specific metrics used. Bover (2005) also finds that the value of the principal residence has a greater effect on consumption than that of other real estate wealth.

In a similar exercise, Trivin (2022) uses EFF data for the period 2002-2011 to estimate the marginal propensity to consume (MPC) of wealth (the change in average consumption relative to change in average wealth). He finds that the size of the effect is 0.01 (an increase in wealth equal to €100 would give rise to an increase of €1 in annual consumption), in line with the estimates of Bover (2005). He also finds asymmetries of sign and size in the estimates of MPC: the effect decreases across the wealth distribution (from 0.07 for the lower quintile to 0.005 for the upper quintile) and is asymmetric (consumption falls by 5.3 euro cents if wealth decreases by €1, but only increases by 3.1 euro cents when wealth rises by €1).

Lastly, Barceló and Villanueva (2016) identify, once again via the EFF, the link between income, wealth and consumption by exploiting the response of household wealth accumulation to changes in the risk of job loss. They find that households with a greater risk

of job loss respond by accumulating more financial assets, and estimate that the size of the response of wealth to exposure to the risk of unemployment can amount to 40% of gross annual employment income. In addition, they find that the size of this effect varies across the household wealth distribution.

## 2.2 Microeconometric models for non-financial corporations

Different empirical frameworks are applied to this group of agents in order to analyse their liquidity and solvency, with the aim of assessing the potential vulnerabilities to financial stability that they represent, in addition to their decisions on real goods and services markets, in particular their investment behaviour, which is crucial to the path of GDP.

### Solvency and liquidity of non-financial corporations

The literature on predicting insolvencies began with the seminal paper by Altman (1968), which defines an indicator called Z-score that serves to predict corporate bankruptcy by drawing on a linear combination of five financial ratios selected via a discriminant analysis. The Z-score indicator was initially estimated for listed US industrial firms[3] and, according to the indicator's value, a firm can be classified into three risk groups: distress zone, safe zone and grey zone. Subsequently, Altman, Haldeman and Narayanan (1977) and Altman (2000) developed variants of the Z-score indicator for other types of firms: those not traded on stock exchanges, those not belonging to the manufacturing sector and those from emerging market economies. Ohlson (1980) is another of the most influential articles in the literature on predicting insolvencies. The author proposes an alternative measure (the O-score), which is also a weighted sum of financial ratios, obtained via the estimation of a conditional logit model.

Bellovary, Giacomino and Akers (2007) conduct an extensive review of the literature initiated by Altman (1968). More recent studies, such as Shumway (2001), Campbell, Hillscher and Szilagyi (2008) and Li and Faff (2019), also use market information and not just accounting ratios. Methodological advances in neural networks, machine learning and artificial intelligence have also been applied to this area (for example, Pan, 2012, and Wang and Wu, 2017). The Banco de España has also contributed to the literature with different empirical analyses.

For example, Blanco, Mayordomo, Menéndez and Mulino (2020) analysed the short-term liquidity needs of Spanish NFCs to stay current with their payments throughout 2020, drawing on CBSO information (with data on some 500,000 firms) and applying three alternative macroeconomic scenarios, corresponding to those published in Banco de España (2020d). The three scenarios incorporate assumptions of a reduction in activity, to varying degrees across sectors based on information on gross value added (GVA), to reflect the uneven impact of the COVID-19 pandemic on firms' income statements.

3 To do so, Altman (1968) used a sample of 66 listed industrial firms of a similar size, of which half had filed for bankruptcy and the other half were non-bankrupt.

The liquidity needs estimated included both the shortfall arising from operating activities (turnover and financial revenue less staff costs and purchases together with financial costs and other items) and that associated with investments in fixed assets and with financial debt repayments. The impact of the macroeconomic scenarios is applied to the different determinants of liquidity needs either via estimated statistical relationships between GVA and the variables of interest, or via expert judgement. The paper also provides a methodology for analysing NFC solvency (capacity to fulfil medium and long-term financial obligations), incorporating cross-sector and firm-level factor heterogeneity.

Blanco, Mayordomo, Menéndez and Mulino (2021) continued with the aforementioned line of work, but incorporated new assumptions and scenarios. To do so they used (i) statistics on turnover available from the Spanish tax authorities to estimate earnings performance in 2020 and (ii) the projections published by the Banco de España in March 2021 to proxy earnings performance in the period 2021-2023. Based on the simulations, the authors estimated a gradual decline in the percentages of financially distressed firms compared with those recorded in 2020, in line with the expected recovery in activity up to 2023. The results also identified that, as a result of the COVID-19 crisis, the proportion of firms at risk of becoming non-viable and the proportion of those that would remain viable but struggle to repay their debts out of their expected future earnings (overindebted firms) would rise.

In a subsequent Banco de España working paper, Álvarez, García-Posada and Mayordomo (2022) use CBSO and CCR data to develop a taxonomy of financially distressed firms and zombie firms in Spain[4] and to monitor them over time (see Chart 2.1). The findings show a negative correlation between insolvency and the probability of being granted a new bank loan. However, they also find that, in order to avoid an increase in their NPL ratio and provisions, the main banks of insolvent firms are more reluctant to restrict loan supply to them than banks without prior exposure. This financial support contributes towards zombie firms continuing to operate in the market for longer than insolvent firms without new bank lending.

Meanwhile, Ferrer, García Villasur, Lavín, Pablos Nuevo and Pérez Montes (2021) conduct an initial analysis for the Spanish banking sector of the impact of energy transition risks on corporate loan portfolios. To do so, they use a highly granular (in terms of firm-size and economic sector) probability of default (PD) model under different transition scenarios. This granularity allows the authors to obtain evidence that, while the effect on firms' PD may be moderate in the portfolio overall, there is significant cross-firm heterogeneity, particularly when considering their economic sector.

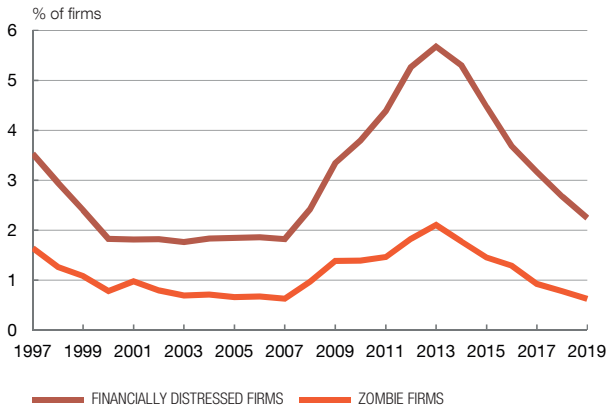
Lastly, it is important to highlight that the effect of NFC solvency and liquidity on their ability to pay has also been assessed at the Banco de España for other purposes, such as internal risk management and stress tests, as described in more detail in subsequent sections.

4 In the definition used, a financially distressed firm exhibits both cash-flow (it is unable to pay its debts as they fall due) and balance-sheet insolvency (the value of its assets is less than the amount of its liabilities), whereas a zombie firm is a distressed firm that has received new bank lending.

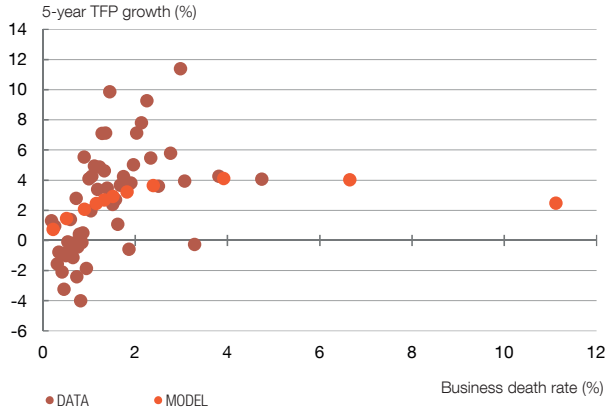
Chart 2

**ANALYSIS OF THE IMPACT ON FIRMS**

1 FINANCIALLY DISTRESSED AND ZOMBIE FIRMS IN SPAIN, 1997-2019




2 NON-LINEAR RELATIONSHIP BETWEEN BUSINESS DEATH RATES AND 5-YEAR TFP GROWTH AT SECTORAL LEVEL (a)




**SOURCES:** Álvarez, L., M. García-Posada and S. Mayordomo (2022), and González, B., E. Moral-Benito and I. Soler (2022).

**a** The chart depicts the sector-level business death rates in the year t (x-axis) and total factor productivity (TFP) growth in that sector between t and t+5 (y-axis). The brown dots stem from the categorised data and the orange dots from the model described in González, B., E. Moral-Benito and I. Soler (2022).

### Behaviour of non-financial corporations on real goods and services markets

Firms' financial positions, considered in more detail in the preceding section, are an important determinant of their decisions on real goods and services markets. For example, using granular CBSO data Hernando and Martínez-Carrascal (2008) show that the deterioration in firms' financial positions has a non-linear effect on their employment and investment decisions, which is greater when it affects a critical number of firms and seriously damages economic activity.[5] The paper stresses the usefulness of granular data that enable pockets of financially distressed firms to be identified, which might not be detected using macro data. In a similar vein, Bentolila, Jansen and Jiménez (2018) find that the credit restrictions imposed on firms by weak banks during the 2008 financial crisis had a significant impact (close to 24%) on the employment of the credit-restricted firms.

Using CBSO and Central Business Register (DIRCE) micro data, González, Moral-Benito and Soler (2022) show that an increase in the business death rate has non-linear effects on overall productivity: at low levels of business destruction, business death is associated with productivity gains related to the creative destruction phenomenon; however, at high levels of destruction, this association becomes negative and any increase in the death rate results in productivity losses (see Chart 2.2).

5 See also the related papers by Estrada and Vallés (1998) and Benito and Hernando (2007).

On account of its influence on inflation, price setting by firms is also crucial in analysing economic policy. For example, Vermeulen et al. (2012) document the empirical patterns of producer prices for six euro area countries, showing, among other stylised facts, that they are more flexible than consumer prices, which are heterogeneous across sectors, and that they are correlated with cost and competition factors. Lastly, Álvarez, Burriel and Hernando (2010) analyse the same matter for the Spanish economy and also find evidence of producer prices being more flexible than consumer prices.

Firms' capital investment decisions are also affected by monetary policy decisions. Using CBSO micro data for Spain, Albrizio, González and Khametshin (2021) show how expansionary monetary policy can improve the allocation of productive capital, with investment by the most productive firms increasing thanks to an easing of financial frictions. Quantifying this benefit of expansionary monetary policy means it can be compared with its other costs and benefits, thus contributing towards the information available for determining monetary policy.

## 2.3 Banco de España non-financial corporation credit quality assessment model for risk management purposes

As part of the Eurosystem's monetary policy framework, the Banco de España has an in-house credit assessment system (ICAS BE). The ICAS BE[6] performs credit assessments of public and private Spanish NFCs,[7] with the main aim of allowing the loans extended to them to be used as collateral by the counterparties, typically credit institutions, in their monetary policy operations.

The scope of the ICAS BE depends on the assessment systems formally authorised by the Eurosystem. The ICAS BE may currently assess Spanish firms of any size. At present around 500 large firms[8] are assessed, via a two-stage system: a statistical model and an expert model.

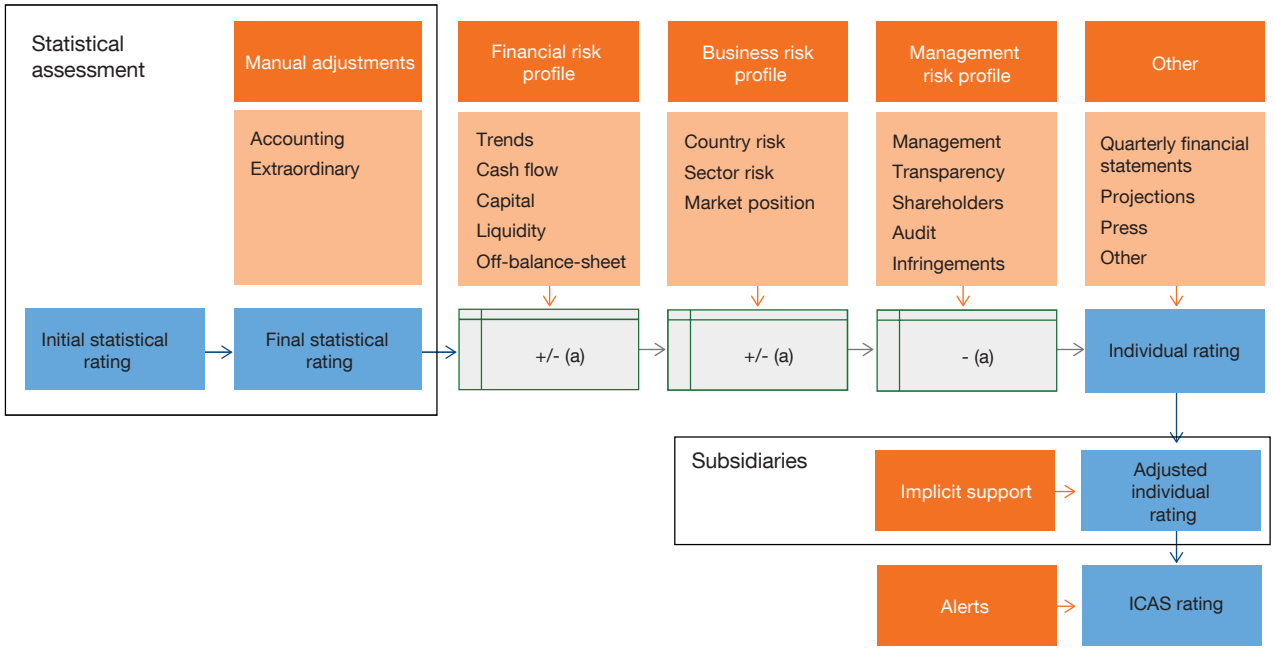
The statistical model has two distinct stages: development and calibration. The aim of the development stage is to automatically rank the firms on the basis of their creditworthiness, drawing on the information in their financial statements, with the final output being a score. To do so, econometric techniques (specifically, logistic regressions) are used to determine the financial ratios and their weights that help explain the percentage of defaulted loans by each firm in the Spanish banking system. When selecting the final model, the analysts' opinion is incorporated and, as far as possible, all the different data blocks are represented (liquidity ratios, profitability, costs structure and financial structure), thereby avoiding model discrimination being concentrated on a specific block.

6 For more details on the ICAS BE, see Gavilá, Maldonado and Marcelo (2020).

7 Classified within the non-financial corporations institutional sector as defined in the ESA 2010 manual.

8 Meaning those that do not satisfy the European Commission's definition of SME (see Article 2 of the Annex to Recommendation 2003/361/EC).

Figure 1
**ICAS BE EXPERT MODEL**




**SOURCE:** Banco de España.

**a** The effect of the financial and business risk profile on the final statistical assessment may be either positive or negative.

The aim of the second stage (calibration) is to quantify the firms' default risk, so that it is possible to map the model's score to the probability of a firm defaulting on its loan obligations 12 months ahead, i.e. they are assigned a PD. Additionally, the estimated models are validated both within and outside the estimation sample, assessing both the discriminatory power and the consistency between the calibrated PDs and the defaults observed in each rating class.

The ICAS BE has statistical models for firm type, economic groups and large firms (depending on the availability/unavailability of separate or consolidated financial statements).

In the second stage, the ICAS BE's business analysts complete the automated assessment obtained in the statistical model with a case-by-case review of the firm based on the expert model framework. Specifically, the expert model comprises five areas, required to obtain the firm's individual rating, each with a set of risk indicators (see Figure 1).

The aim of including this additional information is to incorporate into the credit assessment the latest events related to the firm – such as market information, economic projections based on public information or press information – that are not reflected in the financial statements due to the financial reporting time lag. In the case of firms belonging to an economic group, the parent undertaking's potential decisions in relation to the assessed

firm ("implicit support") are also considered. Lastly, the existence of adverse warnings in the CCR, in addition to possible discrepancies with the assessments available from other external sources, such as external credit assessment institutions (ECAIs) or internal ratings-based (IRB) systems, can result in the rating being changed during the expert model assessment.

The ICAS BE also has specific models to assess another 900,000 smaller firms (SMEs). These models are implemented similarly to the procedure described above. However, the assessment is strictly automated, i.e. without analyst participation. The lack of analyst participation is mainly because of the impossibility of an individual assessment by an SME analyst, on account of both the high volume of firms to be assessed and the lack of available public information on them additional to that already incorporated into the automated assessment system. Instead, this assessment system complements the statistical model's evaluation of the financial risk profile with those aspects of the expert model that allow for an automated assessment (sector risk, implicit support and warnings).

Lastly, it is important to note that the performance of the ICAS BE is reviewed annually by the Eurosystem, in order to identify and correct in advance any potential shortcomings.

## 3 Modelling the banking sector

### 3.1 Econometric analysis of bank lending

Analysing bank lending developments is key to monitoring financial stability, as banking crises are often preceded by a strong and sustained increase in bank lending, which tends to coincide with a certain easing of credit standards by banks (Kindleberger, 1978; Gourinchas and Obstfeld, 2012; Schularick and Taylor, 2012; Jordà, Schularick and Taylor, 2013). Moreover, in a financial system such as Spain's, where firms (especially SMEs, which account for a large share of total firms) are heavily dependent on bank lending, its cyclical behaviour, and its response to monetary policy changes or to the introduction of regulatory measures or reforms affecting banks, are passed through particularly strongly to the real sector and may generate negative externalities. That is why empirical research on the response of bank credit supply to external shocks is so important from both the micro and the macroprudential standpoint.

From the empirical perspective, two econometric identification challenges must be addressed to ensure that this kind of analysis can provide a satisfactory answer and is not influenced by other concurrent factors.

First, credit supply and demand components need to be separated. Shocks affecting demand, stemming, for example, from monetary policy changes or disruptions in real economic activity, may also affect supply. Furthermore, there may be a bank selection bias, whereby the borrowers most affected by the shock under analysis (e.g. a shift in economic policy) would be associated with the banks that are likewise most affected by that shock. Accordingly, in order to determine the impact of this economic policy on credit supply, its effect on the borrowers must first be isolated.

Second, it is necessary to identify shocks that are as exogenous as possible (i.e. that do not depend significantly on decisions adopted by the banks themselves and are, at least to some degree, unexpected). For example, monetary policy changes cannot be considered entirely exogenous when central banks change policy interest rates in response to changes in their jurisdiction's macroeconomic situation, as macroeconomic conditions also affect commercial banks' policies. Thus, the exogenous component of monetary policy changes needs to be identified. Also, for instance, analysing the effect of an increase in bank capital on credit supply is complicated by the possibility that a bank that plans to pursue an expansionary credit policy over several years may first need to increase its capital to maintain its regulatory ratios. In this case, the rise in credit supply would not be the result of the capital increase. Rather, both changes would arise from an earlier decision of the bank linked to other latent factors.

Various Banco de España papers have addressed these identification problems relating to bank credit dynamics. First, the separation of supply and demand factors has been analysed in various studies drawing on the Banco de España's CCR. This database contains granular monthly information on all loans extended in Spain (over a €6,000 threshold in the

full historical series).[9] Moreover, since 2002 the CCR also has information on borrowers' loan applications to banks with which they had no previous relationship at the time of the application. This sub-database makes it possible to analyse not only loan applications that are accepted but also those that are refused by a large number of banks over a long period, further helping to identify demand and supply factors.

To this end, the basic strategy is to exploit the information on borrowers (particularly firms)[10] that have submitted more than one loan application in the period under analysis, even in a specific month. Based on the work of Khwaja and Mian (2008), one way to control for demand factors in this data environment is to introduce firm fixed effects, which absorb time-invariant observed and unobserved characteristics. The identification of demand factors may be further improved by introducing firm and year-month fixed effects into the estimations to control for time-variant demand conditions, thus reducing potential biases.

Meanwhile, in some of these papers the exogeneity of the shocks analysed is guaranteed by the fact that the relevant monetary policy for Spanish credit institutions is based only partially on Spain's macroeconomic conditions, as it is part of the Eurosystem and shares a common monetary policy with the euro area. In other studies, the exogenous shock consists of measures imposed on banks by the regulator (for example, the introduction of dynamic provisioning).

The paper by Jiménez, Ongena, Peydró and Saurina (2012) studies the influence of monetary policy and economic conditions on the supply of bank credit and whether this effect depends on the strength of banks' balance sheets (proxied by their capital and liquidity ratios relative to total assets). To this end, the authors use panel data on loan applications by non-financial corporations to banks with which they have no other loans at that time for the period 2002-2008, which covers years of both economic upswings and downturns.

Jiménez, Ongena, Peydró and Saurina (2012) show that credit supply is highly influenced by interest rates and by the economic situation. Thus, in response to an expansionary monetary policy or during economic booms, banks increase their supply of credit, demonstrating their pro-cyclical nature. The empirical evidence also shows that the bank credit supply channel, as defined, for example, in Bernanke and Blinder (1988), plays an essential role, since the stronger the banks (that is, the higher their capital and liquidity ratios), the smaller the effects of economic circumstances on credit dynamics (see Chart 3.1). Moreover, Jiménez, Ongena, Peydró and Saurina (2012) find that the credit constraints faced by Spanish firms in the period analysed, which was marked by very adverse monetary and economic conditions, cannot be avoided by resorting to other financial intermediaries.

In a subsequent paper (Jiménez, Ongena, Peydró and Saurina, 2014), the same authors extend the previous results and analyse how the composition of credit supply

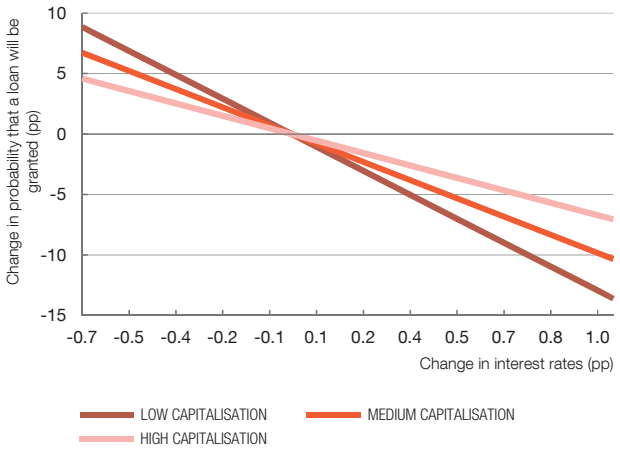
9 Circular 1/2017 establishes as a general rule that direct exposure counterparties shall be reported individually to the CCR, excluding all performing exposures up to a threshold of €6,000.

10 This type of analysis favours consideration of firms for which additional financial information is available other than the characteristics of their loans recorded in the CCR. The CBSO is the main additional source of such information.

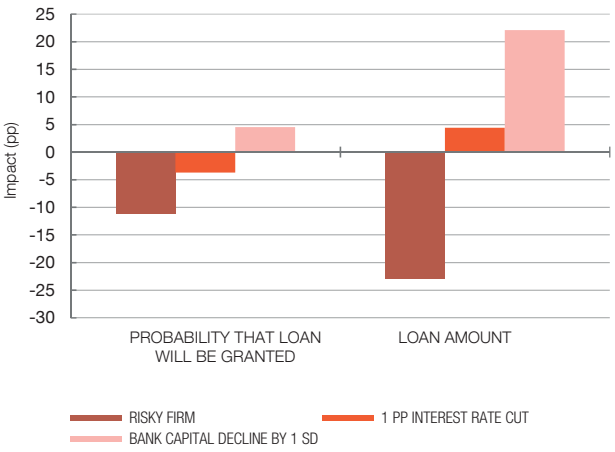
Chart 3

**MICROECONOMETRIC ANALYSIS OF THE EFFECTS OF MONETARY AND PRUDENTIAL POLICIES ON CREDIT SUPPLY**

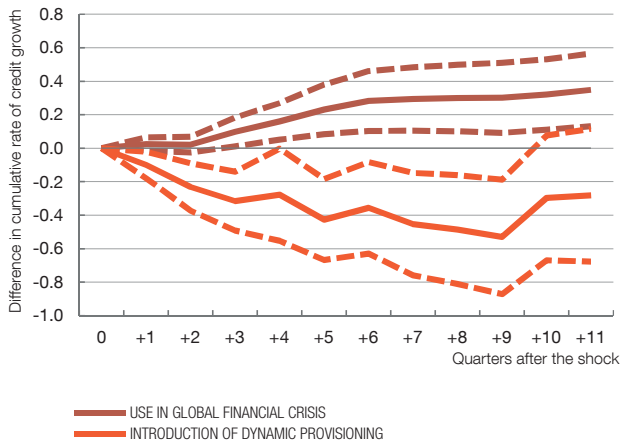
1 EFFECT OF INTEREST RATES AND BANK CAPITAL ON LOAN ORIGINATION (a)



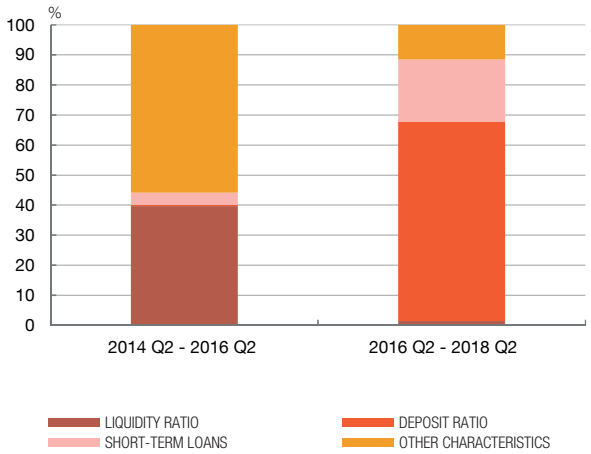

2 EFFECT OF INTEREST RATES, BANK CAPITAL AND FIRM-LEVEL RISK ON CREDIT SUPPLY (b)




3 EFFECT OF DYNAMIC PROVISIONING ON CREDIT GROWTH (c) (d)




4 EXPLANATORY POWER OF CHARACTERISTICS THAT DEFINE BANKS AFFECTED BY NEGATIVE INTEREST RATES. EURO AREA BLS SAMPLE




**SOURCE:** Banco de España.

**a** Banks with high (low) capitalisation are defined as those two standard deviations above (below) the average.
**b** The first three bars show the effect on the probability that a loan will be granted, while the other three show the impact on the amount granted. For each three-bar set, the first bar identifies the effect of a firm being classified as risky (defined as having previous defaults in the last four years); the second identifies the combined effect of this classification and a 1-pp decline in benchmark interest rates; and the third, the combined effect of the two previous factors and a decline (by one standard deviation) in the capital of the bank making the decision to lend. Each second and third bar shows the cumulative effect of the previous factors.
**c** The orange line shows the effect of the introduction of dynamic provisioning on the rate of change of firm-bank credit, where t=0 is 2000 Q1. The brown line shows the effect of using the dynamic provisioning buffer on the rate of change of firm-bank credit, where t=0 is 2008 Q1. The 90% confidence intervals are shown.
**d** Difference between most and least affected banks.

changes in response to changes in monetary policy. In particular, they measure whether an expansionary monetary policy encourages greater risk-taking, with credit focusing on riskier firms ex ante, and if this behaviour depends on banks' degree of capitalisation. The identification is again based on the inclusion of firm and time (year-month) fixed effects,

which isolate the demand effects and allow the study to focus on credit supply factors. Moreover, this study includes a triple interaction (interest rates, firm risk[11] and banks' capital ratios) and an estimation of a ground-breaking two-stage selection model. In the first stage the probability that a loan application will be granted is studied, while in the second stage the focus is on the loan outcomes (the volume of lending, collateral and future loan behaviour).

The results show that, during low interest rate periods, banks increase supply in terms of both the number of firms to which they lend (extensive margin) and the volume of credit associated with each lending relationship (intensive margin), particularly credit to riskier firms (with a worse credit history, which all else being equal are less likely to be granted loans), and, above all, from less capitalised banks (see Chart 3.2). Moreover, these loans are extended with fewer collateral requirements and are found to result in higher future defaults.

Another paper by the same authors (Jiménez, Ongena, Peydró and Saurina, 2017) provides empirical evidence of the effect of dynamic provisioning in Spain (so called because it varies with the cycle, but also known as "statistical" or "generic" provisioning, as its implementation is based on a closed and known formula) on banks' performance and its real effect on the economy. Thus the authors' findings suggest that the banks most affected by dynamic provisioning, introduced in 2000, reduced their supply of credit more than those least affected and that the buffer generated as result of this requirement during the economic boom partly mitigated the effects of the 2008 financial crisis, improving firms' performance in terms of both employment and survival.

In this study, the supply-side factors in the boom period are identified by using the average composition of each bank's credit portfolio prior to the entry into force of the measure (at December 1998), to ensure that this control variable is exogenous to the introduction of the measure. By way of exception, for the 2008 crisis period, the buffer level reached mechanically prior to that crisis (at December 2007) is used. As banks were affected differently depending on the composition of their credit portfolio or the level of their provisioning buffer, the identification depends both on the time of measurement (before and after the shock) and the differential impact of the shock on banks.

These authors' findings show that, for a given borrower firm, the banks most affected by the introduction of dynamic provisioning reduced their credit to a greater extent than those less affected. But this effect at firm-bank level, which lasts for about two years (see Chart 3.3), disappears in a firm-level analysis, as dynamic provisioning entered into force at a time of strong economic growth, when it was easier for firms to find new lenders, allowing them to mitigate its impact. An analysis of the effect of the measure to mitigate the global financial crisis shows that banks with a higher provisioning buffer at the start

11 Measured through their credit history (possible defaults) prior to the date of the loan application.

of the crisis reduced their supply of credit less than other banks. This had strong positive aggregate effects on credit at firm level and on employment and firms' survival.

Lastly, the authors compare this behaviour with that seen after an ad hoc provisioning requirement introduced in 2012 for banks whose exposures were more concentrated in the construction and real estate development sectors. The purpose of this extension of the analysis is to compare the effect on credit supply of setting aside a loss-absorption buffer before a crisis with that of doing so in the midst of a crisis, when increasing these buffers is costlier. The authors find that increasing loss-absorption fund requirements at the worst point of the economic cycle leads to a significant credit crunch. In particular, these results highlight that capital buffers need to be set up during good times and used during bad times, rather than new capital requirements being introduced when losses start to materialise, which would lead to a worsening of the macro-financial situation.

Other papers have also studied the impact on credit of the low interest rate environment in Europe in the years prior to the COVID-19 pandemic. Thus, in a Banco de España working paper Arce, García-Posada, Mayordomo and Ongena (2018) examine the impact of negative interest rates on the supply of credit to Spanish firms in the period 2014-2019. The probability of a bank being affected by the negative interest rates is first estimated by combining a Bank Lending Survey (BLS) question[12] with characteristics of 123 euro area banks using a probit regression. The paper finds that affected banks are characterised by having a high share of liquid assets in the period 2014-2016 and a high deposit ratio in the period 2016-2018 (see Chart 3.4). This may be because retail deposit interest rates were close to zero at end-2017, while other forms of bank financing reached negative remuneration levels.

In this first estimation stage a sample of 23 Spanish banks is classified as either affected or unaffected by the negative interest rates.[13] Based on this classification, the paper uses a regression analysis to study whether affected and unaffected banks' credit supply differs. The analysis reveals that less capitalised affected banks[14] reduced their supply of credit, especially to risky firms[15] (compared with unaffected banks), and that they increased interest rates on their loans in the last sub-period (2018-2019). However, no effect is seen for the previous years. This suggests that a prolonged period of negative interest rates may ultimately have a negative effect on the supply of credit, especially at banks with little loss-absorbing capacity. However, additional analyses show that firms whose main lender was an affected bank did not experience credit restrictions, which could indicate that they may have compensated for this effect by seeking more financing from unaffected banks.

---

12 Using a dummy that takes the value 1 if the bank responds that the negative marginal deposit facility rate has led to a reduction in its net interest income over the last six months and 0 otherwise.

13 A given Spanish bank is considered to be affected by the negative interest rates if the probability of being affected, obtained from the coefficients estimated for euro area banks, is greater than or equal to the median of the sample of Spanish banks (0.75).

14 Banks whose capital ratio was below the median in December 2013.

15 Firms whose debt-to-income ratio was above the median.

## 3.2 Banking sector stress tests

The Banco de España also analyses the banking sector through its own stress-testing framework – the Forward-Looking Exercise on Spanish Banks (FLESB) – which aims to ascertain the resilience of the Spanish financial sector to the materialisation of hypothetical macro-financial scenarios of varying severity. In addition to its usefulness as a macroprudential tool applied to the system as a whole, the FLESB framework makes it possible to analyse cross-bank heterogeneity in terms of resilience and the factors behind it, and the distribution of credit risk across borrowers from different sectors of activity.

The FLESB stress-testing framework has a top-down approach, meaning that it is the Banco de España that makes the projections of the parameters of interest, using its own models and databases, which include the regulatory reporting statements and the CCR. Depending on the macro-financial scenario and time horizon assumptions, this methodological framework calculates Spanish banks' solvency, measured as the ratio of common equity tier 1 (CET1) capital to risk-weighted assets. In this exercise, this ratio sums up the impact of the scenarios on banks' different income and loss items and on the size and composition of their balance sheets[16] In particular, the financial elements for which heterogeneous bank-specific information is generated include:

1 Projected paths for credit risk parameters (probability of default, expected loss given default, etc.) to obtain the estimated loss of the loan portfolio in Spain. The determination of expected loss given default may be considered the core component of the FLESB, given the high weight of this component in risks to Spanish banks. The methodology yields heterogeneous projections for different portfolios classified by counterparty, loan purpose and, most notably, the counterparty's economic sector.

2 Projections for other losses, such as those associated with foreclosed assets or corporate and sovereign bond portfolios.

3 Projected changes in income statement items, including, inter alia, net interest income and fees and commissions.

4 Other elements of the calculation, such as changes in risk-weighted assets or, for banks with significant international activity, the projected net profit from business abroad.

Cross-bank heterogeneity is due to various factors. First, banks' different starting points in terms of their balance sheet size and composition by sector, product type, credit quality or level of collateralisation, inter alia. Second, the different response of each bank's

16 Banco de España (2013) and other subsequent Financial Stability Reports describe the main characteristics of this framework in more detail. See also the additional description of this framework in Pérez Montes et al. (2023).

credit risk parameters to the economic cycle, based on the historical patterns captured by the models. Section 6 below presents, by way of illustration, the distribution across different types of banks, classified according to their systemicity and level of international diversification, of the estimated potential impacts of the risks associated with the outbreak of the COVID-19 pandemic.

### 3.3 Bank competition

Analysing competition between banks is relevant not only because it measures how efficient their activity is and the well-being of market participants, but also because of the close relationship in the banking sector between competition and financial stability.

The theoretical framework of this link has been explored in numerous papers, including Allen and Gale (2004), Boyd and De Nicoló (2005) and Martínez Miera and Repullo (2010). In short, and under certain assumptions, too much competition could be a long-term incentive for greater and more uncertain risk-taking and could reduce banks' profit generation and, thus, their solvency, making them more vulnerable to shocks and the system as a whole more unstable. However, a very low level of competition may also be associated with greater risk-taking, for example, because of larger banks' expectation that they would be more likely to obtain government aid in the event of a financial crisis, due to their criticality for the banking system as a whole. Thus, all theoretical research subsequent to the findings of Martínez Miera and Repullo (2010) suggests that the relationship between competition and financial stability is not monotonic.

Some empirical research has addressed this relationship between competition, financial stability and economic performance in the case of Spain. Jiménez, Saurina and López (2013) study, using granular CCR data, whether the relationship between competition and risk-taking described in Martínez Miera and Repullo (2010) is observed in the data for the Spanish banking sector. These authors' findings support this hypothesis and find that the level of competition is optimal for financial stability purposes. However, these results are more robust when competition is measured in terms of concentration rather than through price margin metrics.

Meanwhile, Mayordomo, Pavanini and Tarantino (2020) focus on the banking consolidation process that took place in Spain between 2009 and 2011 and assess its impact on market power and risk-taking. The evidence obtained suggests that the process may have decreased credit supply and increased interest rates on lending, but that it has reduced risk-taking, lowering NPL ratios. Under a structural model, they conclude that the gains from the banking consolidation in terms of financial stability and efficiency offset the costs arising from the tightening of credit supply.

Competition has also been analysed in terms of demand, costs, margins and efficiency for the case of Spain. Thus, Pérez Montes (2014) also assesses the process of banking consolidation in Spain triggered by the global financial crisis, as in the above-

mentioned paper, but focusing on the mortgage market, and finds no evidence that a higher concentration per se creates incentives for a significant increase in mortgage spreads to collusive levels.

Gutiérrez de Rozas (2007) also studies the level of bank competition in Spain, in this case in the period 1986-2015, and finds no significant evidence that competition decreased despite the increase in the Spanish financial system's concentration during this period.

Lastly, Castro and Galán (2019) study the productivity of the Spanish banking system from 2000 to 2015 and identify the level of competition in that period as an influential factor that favours cost efficiency but also reduces intermediation margins, particularly during the expansionary years preceding the 2008 crisis, although banks were able to increase these margins again during the subsequent banking consolidation process.

## 4 Microprudential analysis framework for the banking sector

The supervisory review and evaluation process (SREP) assesses the systems, strategies, procedures and mechanisms used by supervised institutions to comply with the Capital Requirements Directive (Directive 2013/36/EU) and its implementing regulation (Regulation (EU) No 575/2013), transposed into Spanish law in Law 10/2014 of 26 June 2014 on the regulation, supervision and solvency of credit institutions, Royal Decree 74/2015 of 13 February 2015 implementing this law, and Banco de España Circular 2/2016 of 2 February 2016. In Spain, this process is carried out by the Banco de España as the national supervisory authority for less significant institutions and, as a participant in the Single Supervisory Mechanism, as the Eurosystem's supervisory authority for significant institutions.

The SREP aims to keep the supervisory authority's knowledge on the institutions under their remit up to date, to determine each institution's supervisory risk profile and, where appropriate, take the necessary measures to improve it. Specifically, it seeks to determine the extent to which each institution's systems, strategies, procedures and mechanisms, along with their level of own funds and liquidity, contribute to the sound management and coverage of their risks and, consequently, to decide whether additional capital or liquidity measures or other qualitative supervisory requirements are needed.

To this end, the risks to which each institution is or could be exposed must be measured, along with potential risks to the financial system and any additional risk identified by the stress tests. This process follows a harmonised methodology set out in the EBA Guidelines on common procedures and methodologies for the SREP (EBA/GL/2014/13, revised in 2018), whose implementation takes into account the principle of proportionality. Figure 2 summarises the SREP's general framework.

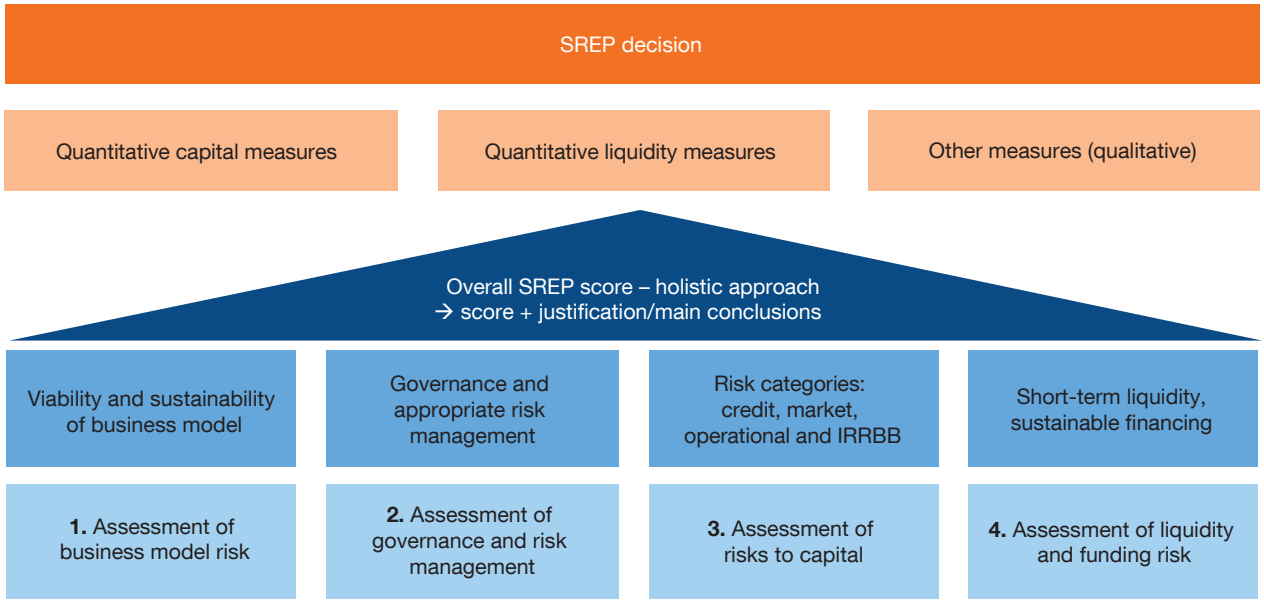
One of the main characteristics of the SREP is that it is a continuous and holistic process for reviewing each institution's risk profile. It uses both quantitative and qualitative sources, includes forward-looking information and also incorporates supervisory expert judgement as a basic element in the final assessment. Thus, the SREP summarises in a single score the risk, according to the supervisor, of a credit institution having solvency, profitability or liquidity problems in the future. It is a key element to determine the supervisory intensity to be applied to each institution, as the higher the risk profile, the higher the supervisory intensity needed.

The SREP includes an assessment of four main elements:

1 Business model: the extent to which the institution's business model is robust, allowing the bank to remain viable and sustainable in a changing business environment.

2 Internal governance and risk management: the bank's organisational arrangements, senior management and governing bodies, risk management and control, and technological infrastructure.

Figure 2
**SREP METHODOLOGY**




**SOURCE:** Banco de España.

3 Risks to capital: credit risk, market risk, operational risk (including risks associated with information and communication technologies and ICT risk management) and interest rate risk.

4 Liquidity and funding risks.

These elements can be assessed using two approaches: the level of risk, which is approximated using basic indicators, and/or control measures for those risks. The supervisor's analysis for these approaches is carried out in three stages:

1 Compiling the information available to the supervisor or provided by the institution.

2 Assigning an automatic score based on several basic indicators and questionnaires to assess compliance with the applicable prudential regulations.

3 Supervisory assessment: the supervisor's expert judgement is incorporated at this stage and the assessment is adapted to each institution's specificities.

In the case of risks to capital, and liquidity and funding risks, account will also be taken of the content and conclusions of two reports prepared annually by banks, namely the internal capital and liquidity adequacy assessment process (ICAAP and ILAAP) reports, both of which should include at least one stressed scenario.

The process described results in the determination of a score for each of the elements and risks, ranging from 1 to 4, such that the higher the score, the lower the rating. The global score for the institution is then assigned. To this end, all these elements and risks and their interconnections and mitigating measures are assessed jointly and holistically, and the final overall SREP score is determined by the supervisor using their in-depth knowledge and expert judgement.

Once the scores for each institution have been determined and the areas requiring greater monitoring or corrective action have been identified, the quantitative and qualitative measures to be taken are specified. Quantitative capital measures include the Pillar 2 requirement (P2R) and the Pillar 2 guidance (P2G), which basically consists of a recommendation for banks to maintain a specific amount of additional capital, bearing in mind the impact on their solvency of the risks identified under a stressed scenario.

This process ends when a letter is sent to the institution informing it of the supervisory measures agreed and the minimum capital and liquidity levels that it will have to maintain the following year. Dialogue with the institution in this last stage of the process is essential.

In sum, the SREP is a harmonised process that summarises institutions' risk profile through a limited set of scores and makes it possible to: (i) compare institutions under a common methodological framework, (ii) determine and plan the extent of supervisory action, and (iii) justify the supervisory measures and capital and liquidity requirements that are notified annually to the institution.

## 5 Analysis of non-bank financial intermediaries

In general, the assessment and monitoring of non-bank financial intermediaries is important for analysis of financial stability, given the size of their balance sheets and their direct and indirect interactions both with each other and with the banking sector.

As Chart 4.1 shows, at end-2021 in Spain the banking sector accounted for around half of the financial system in terms of total assets, followed (among private agents) by the insurance sector and the pension fund industry. All other private financial institutions combined (including specialised lending institutions and investment funds) accounted for around 17% of the total. This distribution is similar to that of other developed economies, such as France, Germany or Italy, whose financial systems serve mainly to support their domestic economies (see Chart 4.2).

Generally speaking, direct exposures are those that stem from commitments – to lend or borrow – entered into by different financial agents, such that any deterioration in the solvency or liquidity of either party can undermine that commitment, resulting in a loss for the other party. In turn, indirect exposures stem from common holdings of assets or liabilities of third parties, which in the event of their deterioration would result in a loss in several financial sectors.

Alonso and Stupariu (2019) describe the main mechanisms through which financial sectors are interconnected, the importance of this issue in recent years in the ambit of the European Central Bank (ECB) and the European Systemic Risk Board (ESRB), and the empirical evidence for Spain, both as regards direct and indirect interconnections, considering the banking sector, the insurance sector and the investment fund and pension fund industries. The importance of the non-bank sectors and their interconnections for analysing financial stability is also reflected in the fact that the Banco de España devotes a regular section of its *Financial Stability Report* to them.[17]

Drawing on this monitoring framework, several empirical patterns can be identified. In the case of direct interconnections, on the assets side of the balance sheet, the banking sector has significant exposure to insurance companies, mainly through shareholdings and loans, and is also exposed – albeit significantly less so – to other intermediaries such as pension funds, through loans, or investment funds, through shares or units. Accordingly, through this channel, any potential deterioration in these financial sub-sectors would also affect deposit-taking institutions. On the liabilities side of the balance sheet, banking sector deposits held by other financial intermediaries are the main direct interconnection. Moreover, insurance companies and pension funds also hold a significant proportion of banking sector debt securities issues.

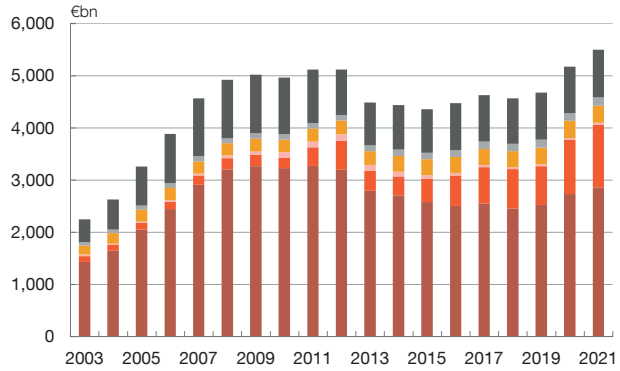
Banks and other financial intermediaries may also be exposed to common shocks in the case of valuation adjustments in assets where there are indirect interconnections.

17 For example, see section 2.2 of the Spring 2022 and Autumn 2022 *Financial Stability Report.*

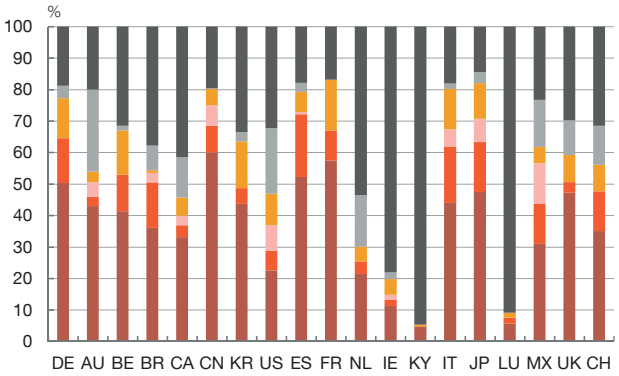
Chart 4

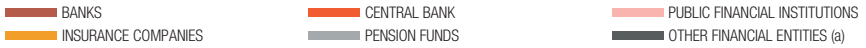
## SIZE AND COMPOSITION OF FINANCIAL SYSTEM SECTORS

1 GROWTH OF SPANISH FINANCIAL SYSTEM SECTORS
Total assets, individual entities




2 INTERNATIONAL COMPARISON OF COMPOSITION OF FINANCIAL SYSTEM
Total assets, individual entities (2020 data)




**SOURCES:** FSB and Banco de España.

**a** According to the methodology used by the FSB in its annual monitoring report on the non-bank intermediation sector, "Other financial entities" comprise several financial accounting sectors: "Other financial intermediaries" (which include securities dealers, securitisation vehicles, private equity firms, real estate investment trusts and central counterparties), specialised lending institutions, investment funds (money market and non-money market funds), financial auxiliaries (securities agencies, appraisal companies, mutual guarantee companies, asset management companies, clearing and settlement companies and financial group headquarters), and captive financial institutions and money lenders (holding companies holding shares of financial and non-financial corporations and special purpose vehicles, as well as others that issue securities and are subsidiaries of financial institutions).

In addition, if a sub-sector is forced to dispose of certain assets should an initial valuation be corrected (for instance, investment funds' mandates may require that they invest only in assets with a certain credit rating), a further downward price adjustment may follow that would also affect all other sub-sectors holding those assets. The empirical evidence available[18] shows that the banking sector has the highest absolute volume of common holdings of marketable securities with other sub-sectors. Yet they account for a smaller proportion of its total holdings than for other sub-sectors, with the highest proportion held by pension and investment funds.

Besides analysing the level and development over time of direct and indirect exposures, some studies have also explored the interlinkages in the network of financial intermediaries as a result of these exposures. For instance, Carro and Stupariu (2022) examine direct interconnections by analysing one of the possible contagion channels in the interbank market – namely the credit quality channel – whereby any perceived deterioration in a bank's solvency leads to a fall in the value of counterparties' exposures to that bank. This in turn may damage their own solvency, and that of their respective counterparties, triggering contagion.

18 See, for example, the Spring 2020 *Financial Stability Report*.

The above-mentioned paper argues that the way in which shocks are transmitted depends on (i) the uncertainty of banks' assessments of the probability of default of their respective counterparties, and (ii) the non-linear correlation between the increased probability of default of a bank and the scale of the reduction applied by its counterparties to the value of their exposures to the bank. In turn, at the system level, these dynamics are affected by banks' capitalisation levels in proportion to their total assets.

Moreover, among the most relevant non-bank financial sectors, account must be taken of the growing role being played by the new digital operators – *fintech* and *bigtech* – in the financial sector, and of the potential competition they pose for commercial banks, which may result in customer – and hence revenue – migration to these operators. The effect of this competition on financial stability must also be considered, particularly given the more limited scope both of the information on these new operators and the regulatory and supervisory tools applicable to them.

Martínez Resano (2022) documents the boom in this sector and the challenges it poses for the regulatory framework, especially given the global nature of these new sector players, the constant technological advances underpinning their activities and the new channels for the provision of banking services that may arise in response to or in connection therewith. Carbó, Cuadros and Rodríguez (2020) explore the characteristics of these digital operators in Spain and find that the majority are focused on B2B transactional services and obtain the bulk of their income from fees and commissions.

Lastly, mention must be made of the emergence of crypto-assets as a disruptive element, owing to their novelty value and to the new financial intermediaries linked to these assets. Although the crypto-asset market is still immature and is in constant change, and although there is still very limited information available on the exposures and risks, its potential impact on financial stability has already attracted regulatory and supervisory attention. Indeed, the special chapter in Banco de España (2022b) analyses the potential economic functions of these instruments, the incipient regulatory developments, the intermediaries specialising in crypto-asset-related services and the level and characteristics of other agents' exposure to these instruments in Spain and in Europe overall. For their part, Carbó and Gorjón (2022) analyse the determinants of Bitcoin prices via machine learning techniques.

## 6 Practical applications of the analytical frameworks

### 6.1 The COVID-19 crisis

The emergence of the global pandemic in early 2020 and the necessary social and health measures rolled out in response, gave rise to one of the sharpest, fastest and most widespread contractions in economic activity in recent history and led governments and other national and supranational authorities to introduce significant fiscal, monetary and macroprudential support packages. More than three years since the onset of the COVID-19 crisis, and despite the lifting of the direct restrictions imposed in 2020 and 2021, some of the economic effects (such as higher public debt) persist, although the effects on economic activity have disappeared.

Throughout the crisis, the Banco de España used its analytical tools to assess individual agents, to gain a better picture of how each was being affected by the crisis and of their prospects for recovery as it unfolded. It also used these tools to assess the efficacy of the support measures deployed and the resilience of the financial sector, to ensure that it could continue to provide essential intermediation services to the real economy and to absorb the substantial pandemic-related risks should they materialise. The Banco de España published these analyses in its *Financial Stability Report* and *Annual Report,* and in other individual analytical papers and articles.

For instance, Box 1.1 of the Autumn 2020 *Financial Stability Report* (Banco de España, 2020c) discussed in detail firms' financial vulnerability after the onset of the pandemic, by economic sector and level of indebtedness. In addition, Box 1.2 of the Report analysed the characteristics of households and banks associated with access to the public loan moratoria programmes adopted in response to the pandemic. In particular, it examined the effect of the distribution by population of the bank debt-to-income ratio, which is crucial for characterisation of the financial risk associated with the programme.

Also presented in the Autumn 2020 *Financial Stability Report* were the results of the stress test under the FLESB framework, which envisaged a particularly severe adverse scenario given the highly uncertain setting at the start of the pandemic. The stress test concluded that the solvency of the system overall was sufficient, although it also revealed a high degree of heterogeneity across banks that advised a capital conservation policy.

Along the same lines, the *Annual Report* published in 2020 (Banco de España, 2020a) focused particularly on the COVID-19 crisis, with the whole of Chapter 3 devoted to the uneven impact of the pandemic on the business sector. This effect was analysed using different financial metrics (debt, profitability and liquidity) and by firm characteristics, such as firm size and, above all, economic sector. Indeed, much of the discriminant analysis conducted in response to the crisis focused on the degree to which each economic sector was affected by the pandemic.

As the crisis continued through 2020 and 2021, various risks materialised, including loss of corporate profitability and employment. These effects were highly uneven across

economic sectors, with hospitality and leisure being the industry most affected, as discussed in Chapter 1 of the Spring 2021 *Financial Stability Report* (Banco de España, 2021b). Moreover, Box 1.2 of the Report analysed in detail how firms' and individuals' bank debt evolved during the first year of the health crisis, depending on their socio-economic characteristics. It also examined the differential behaviour of the business sectors most affected by the health crisis and of the individuals who had taken advantage of the moratorium measures.

Chart 5.1 sets out part of this analysis for individuals, drawing on data obtained by matching census data to CCR data, and shows that the biggest drop in total credit was among the unemployed, foreign nationals, older individuals and those in lower income groups, but with no significant differences by gender. Likewise, the impact of the moratoria programme on the stock of credit of individuals was broadly positive.

The Spring 2021 *Financial Stability Report* (Banco de España, 2021b) also examined, in its Box 2.1, the Official Credit Institute (ICO) guarantee programme for loans to firms and sole proprietors, one of the main support measures implemented in Spain. The box analysed the differential characteristics (profitability, debt, credit quality, etc.) of the firms that took advantage of the guarantee scheme (see Chart 5.2 below). In turn, Box 2.2 of the Report examined the debt moratoria introduced in response to the COVID-19 crisis, finding, inter alia, a positive correlation between the proportion of non-performing and Stage 2 loans and the initial debt level of households that took advantage of these measures. This issue is analysed in greater detail in Jiménez, Pérez Asenjo, Vegas and Trucharte (2021).

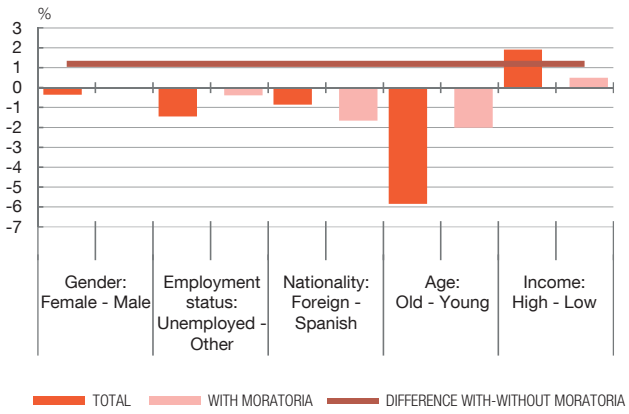
Analysis of the uneven impact of the health crisis continued in the Autumn 2021 *Financial Stability Report* (Banco de España, 2021c), which, for example, addressed the ICO loan programme in Boxes 2.1 and 2.2. In addition to re-examining the firm characteristics associated with these loans (firm size, ex ante credit risk, etc.), Box 2.1 analysed the effect of pre-existing banking relationships on the incentives to grant these loans, estimating that there was a significant and positive correlation between these relationships and the granting of ICO-backed loans, which to a certain extent replaced pre-existing loans (see Chart 5.3). In turn, Box 2.2 studied the take-up, by firms and banks, of the maturity extensions and payment holidays permitted under the regulations implemented as the health crisis continued into 2021.

The results of the annual banking sector stress tests were also presented in autumn 2021, focused in this case on the possible macro-financial risks to the economic recovery following the initial impact in 2020. Chart 5.4 depicts the CET1 ratios estimated under different scenarios for December 2023 (together with the starting ratios in December 2020 and the difference between them), classified by bank type, degree of systemic importance and level of international diversification. One of the key results obtained is that, under a baseline scenario of gradual economic recovery, banking solvency could increase overall, whereas under the adverse scenario that envisaged a continuation of the pandemic-induced economic crisis in 2021-2023, solvency decreases at banks with international activity and at all other SSM-supervised entities and increases only slightly at those under direct supervision, with business models less exposed to cyclical risks.

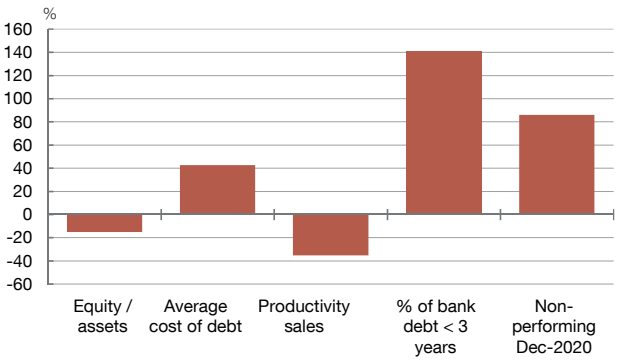
Chart 5

**ANALYSIS OF THE IMPACT OF THE COVID-19 CRISIS**

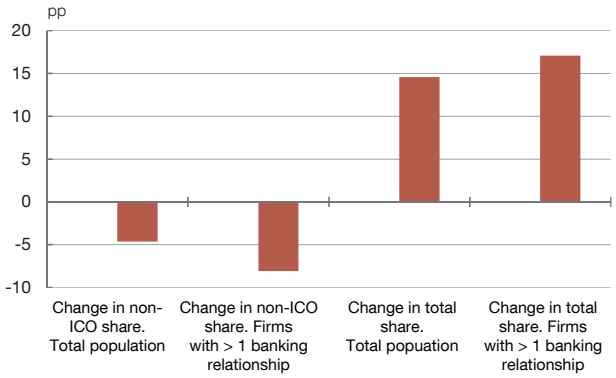
1 YEAR-ON-YEAR CHANGE IN BANK LENDING IN 2020. DIFFERENCES BY INDIVIDUALS' CHARACTERISTICS. INDIVIDUAL DATA
Business in Spain (a)



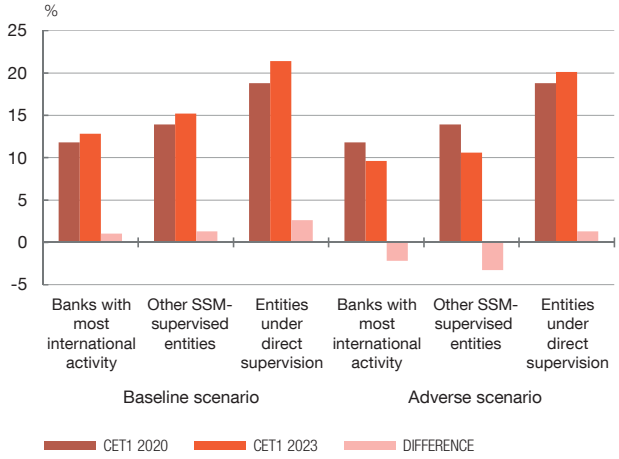

2 FINANCIAL CHARACTERISTICS OF FIRMS MAKING USE OF THE ICO GUARANTEE SCHEME (b)




3 IMPACT OF AN ICO-BACKED LOAN BEING GRANTED ON THE SHARE OF FUNDING BETWEEN THE FIRM AND THE LENDING BANK (c)
Dec-2019 to Jun-2021




4 CHANGE IN THE CET1 RATIO, BY SCENARIO AND BANK TYPE. 2021 FLESB exercise. Consolidated data (d)




**SOURCE:** Banco de España.

**a** Differences (in pp) in the rates of change for individuals, grouped by income and ability to pay characteristics. Each characteristic is either dichotomous or provides for classification into two groups (high/low), based on each individual's position relative to the median. The Moratoria indicator identifies whether the individual benefited from a loan moratorium at any time in 2020. An individual's income is attributed by data matching with National Statistics Institute (INE) data on income by postcode. The differences based on each individual's characteristics are compared both for the overall total and for individuals who have made use of at least one moratorium.

**b** For each financial characteristic, the chart shows the relative difference (expressed as a %) between the average value for firms that have obtained an ICO-backed loan and the average value for firms with no ICO-backed loans.

**c** Each bar depicts the impact (in pp) of a bank having granted a firm at least one ICO-backed loan between December 2019 and June 2021 on the change in the share of funding between the bank and the firm in that period. The impact is estimated using a differences-in-differences model drawing on CCR and CBSO data and regulatory reporting statements.

**d** For more details, see the Autumn 2021 *Financial Stability Report*.

From a different standpoint, and as regards in-house credit assessment systems, the measures approved by the Eurosystem in response to the COVID-19 crisis allowed Spanish SMEs to be included in the firms assessed by the ICAS BE described in section 2.3 ahead of schedule. These measures included extending the scope of the eligible credit assessment systems, in the case of the ICAS BE temporarily permitting assessments of

Spanish non-financial corporations using purely statistical models, provided that the approach adopted was sufficiently conservative to mitigate the risk of dispensing with expert analysis. As a result, the number of ICAS BE assessments available for counterparties increased significantly, and thus the number of loans potentially eligible as collateral.

Lastly, micro-supervisory activities continued during the pandemic but adapted to the new circumstances, replacing in-person meetings with virtual meetings. Close contact with banks was maintained, focusing on the problems stemming from the health crisis, but information had to be passed on faster, to enable the possible impact of the ongoing crisis to be measured and changes in banks' financial situation to be monitored in real time. In this difficult setting, supervisory monitoring continued, while at the same time endeavours were made to avoid overloading banks' operational capacity, to underpin their solvency and support their role in sustaining the real economy throughout the crisis.

More details of how banking supervision adapted to the pandemic may be found in Eirea, Oroz and Díez (2021). One of the key points discussed there is that, following the onset of the pandemic, credit institutions were asked to provide more frequent reporting of certain information on the risks most affected by the crisis (liquidity, operating and credit risk, basic balance sheet, income statement and capital information), as well as other specific data on their use of public moratoria or moratoria provided by the banking sector and on loans granted with the backing of public guarantee schemes to support the economic sectors hardest hit by the crisis.

## 6.2 The Ukraine crisis

The Russian invasion of Ukraine in late February 2022 triggered a war in Europe whose duration and economic and geopolitical consequences remain uncertain. Moreover, the fact that this fresh crisis has emerged when some of the economic consequences of the pandemic still linger (for instance, high debt levels in some sectors, especially the public sector) may be fertile ground for latent risks to materialise and for at least some groups of firms and households to become more vulnerable.

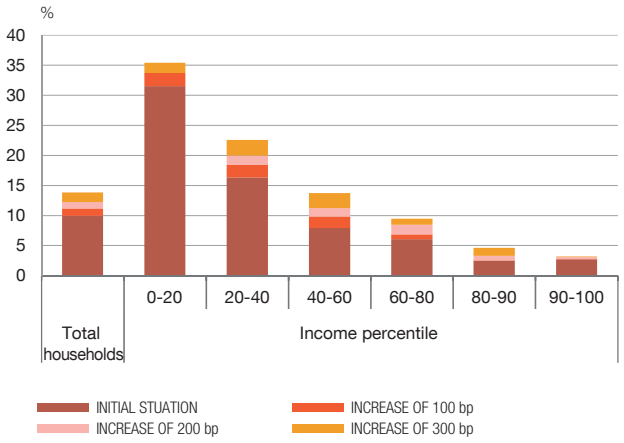
One of the distinguishing features of this new crisis is the emergence of higher and more persistent inflation, to which monetary policy has responded with interest rate rises, in an attempt to control inflation. In this setting it is particularly useful to analyse the uneven impact that price rises and interest rate hikes have on different types of agents, to measure their possible effects not only on activity but also on financial stability.

Thus, the Spring 2022 *Financial Stability Report* (Banco de España, 2022b) presented an analysis of the impact of the interest rate hikes on households' interest burden. As Chart 6.1 shows, when interest rates rise, the estimated increase in the proportion of households with a high interest burden relative to their income varies by income decile, with the largest increases concentrated between the 20th and 40th deciles. Box 1.4 of the Report examined the impact of a 25% increase in energy prices on the GVA of various business

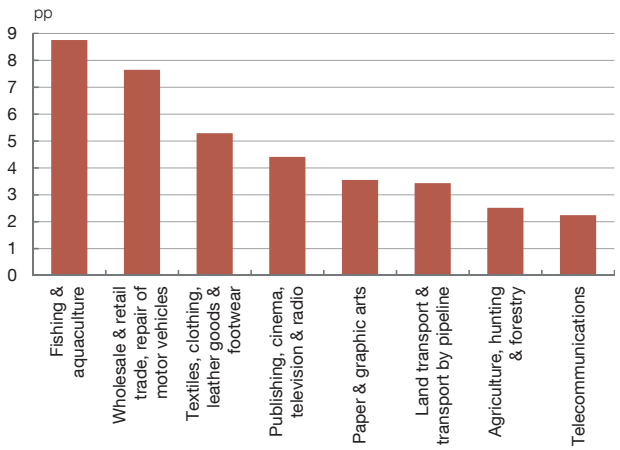
Chart 6

**ANALYSIS IN SPRING 2022 OF THE IMPACT OF THE CRISIS TRIGGERED BY THE INVASION OF UKRAINE**

1 IMPACT OF AN INTEREST RATE RISE ON THE PERCENTAGE OF HOUSEHOLDS WITH A HIGH NET INTEREST BURDEN. BREAKDOWN BY INCOME PERCENTILE (a) (b)




2 HEAVILY INDEBTED FIRMS IN 2023. CHANGE IN THEIR SHARE OF TOTAL GROSS DEBT DUE TO RISING ENERGY PRICES. SECTORS WITH THE LARGEST INCREASE (c) (d)




**SOURCE:** Banco de España.

**a** The increase in debt service expenses is calculated for households with floating rate debt. It is assumed that short-term interest rate hikes are passed through in full to the interest rate on floating rate debt. In the case of deposits, it is assumed that 15% is passed through to sight deposits and 76% to fixed-term deposits.
**b** The net interest burden is considered high when the ratio of (debt service expenses - interest income from deposits) / household income is over 40%. Households without debt are excluded from this calculation.
**c** A 22% rise in energy prices is assumed for 2022, with a further 3% increase in 2023.
**d** Heavily indebted firms are defined as those whose net financial debt / (gross operating profit + financial revenue) ratio is greater than 10, or which have positive net financial debt and zero or negative earnings. Net financial debt is defined as interest-bearing borrowing minus liquid assets and short-term financial investments.

sectors, with the primary sector, transportation and the automotive industry being those most adversely affected. The box also studied the impact of this increase on other firm metrics, such as the foreseeable growth in the total gross debt of firms that were already heavily indebted (see Chart 6.2).

The Report also presented a banking sector stress test (Boxes 1.3 and 2.1), focused in this case on different economic slowdown and interest rate hike scenarios that could arise as a consequence of the war in Ukraine. The results of the stress test indicated that the aggregate resilience of the banking sector overall is adequate. However, they also showed that under the most adverse risk scenarios there could be capital depletion, encouraging banks to maintain loss-absorbing resources in what was a highly uncertain environment in the wake of the Russian invasion of Ukraine.[19]

The *Annual Report* published in spring 2022 (Banco de España, 2022a) also paid special attention to the surge in inflation and its uneven impact across households and

19 The Autumn 2022 *Financial Stability Report* included further analysis of the Ukraine crisis. Specifically, the spring stress test conducted was updated, together with the micro-simulation analyses of households and firms.

firms, particularly in Section 3.5. The Report indicates that the overall effect of price rises on the ability to save, and the effect of the tax measures introduced to contain inflation, affect households differently according to their income level, with both having the most impact on lower income households. By contrast, in the case of firms, the uneven increase in their production costs by sector and firm size is driven by how energy-intensive they are.

In subsequent publications, the Banco de España has continued to analyse how the macro-financial risks stemming from the new geopolitical environment and the higher inflation momentum are unfolding.[20] This section does not seek to provide a comprehensive review of these developments, but rather to focus on certain early examples of analysis conducted after the Russian invasion of Ukraine, to illustrate the flexibility and adaptability of the analytical tools currently available.

20 See, for example, the *Annual Report 2022* (Banco de España, 2023a) or the Spring 2023 *Financial Stability Report* (Banco de España, 2023b).

## 7 Conclusions

To fulfil its responsibilities to provide economic and financial analysis and economic policy advice, the Banco de España needs to have at its disposal a wide range of analytical tools – including microeconomic tools – consisting of models and methodologies focusing on the differential behaviour of certain sub-sets of economic agents and markets. This approach is essential to obtain a clearer picture of the inherent heterogeneity of economic and financial agents, including households and firms, banks and other financial intermediaries, in order to gain a profound understanding of their response and resilience to shocks, and to better calibrate the policies to be implemented in response and better measure the impact and efficacy of such policies.

As shown here, the microeconomic methodologies and models used in the Banco de España's regular tasks cover a broad range of areas, including the supervisory assessment process, in-house credit risk assessment and stress tests, and also the stance adopted as regards the introduction and subsequent withdrawal of monetary, fiscal and macroprudential measures.

As the various extreme events that have impacted the macro-financial environment in recent years have shown, these models and methodologies have been developed in response to real, practical needs. This means that it is essential that they be regularly updated, improved and extended to adjust to changing circumstances. In particular, models of this kind, with the necessary development of databases and methodological innovations, will be needed to analyse the medium-term challenges facing the banking sector, such as those stemming from climate change and technological transformation.

## References


Albrizio, Silvia, Beatriz González and Dmitry Khametshin. (2021). "A Tale of Two Margins: Monetary Policy and Capital Misallocation". Documentos de Trabajo, 2302, Banco de España. http://dx.doi.org/10.2139/ssrn.4323645

Allen, Franklin, and Douglas Gale. (2004). "Competition and Financial Stability". *Journal of Money, Credit and Banking,* 36(3), pp. 453-480. https://www.jstor.org/stable/3838946

Alonso, José, and Patricia Stupariu. (2019). "Financial system interconnectedness". *Financial Stability Review - Banco de España,* 37, pp. 181-200. https://repositorio.bde.es/bitstream/123456789/11179/1/Financial_system_interconnectedness.pdf

Altman, Edward. (1968). "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy". *The Journal of Finance,* 23(4), pp. 589-609. https://doi.org/10.1111/j.1540-6261.1968.tb00843.x

Altman, Edward. (2000). "Predicting Financial Distress of Companies". *American Journal of Industrial and Business Management,* 10(12), pp. 15-22. https://pages.stern.nyu.edu/~ealtman/PredFnclDistr.pdf

Altman, Edward, Robert Haldeman and Paul Narayanan. (1977). "Zeta analysis: A new model to identify bankruptcy risk of corporations". *Journal of Banking & Finance,* 1(1), pp. 29-54. https://doi.org/10.1016/0378-4266(77)90017-6

Álvarez, Laura, Miguel García-Posada and Sergio Mayordomo. (2022). "Distressed firms, zombie firms and zombie lending: a taxonomy". Documentos de Trabajo, 2219, Banco de España. http://dx.doi.org/10.2139/ssrn.3949415

Álvarez, Luis J., Pablo Burriel and Ignacio Hernando. (2010). "Price-setting Behaviour in Spain: Evidence from Micro PPI Data". *Managerial and Decision Economics,* 31(2/3), pp. 105-121. https://www.jstor.org/stable/40606983

Anghel, Brindusa, Cristina Barceló and Ernesto Villanueva. (2019). "The household saving rate in Spain between 2007 and 2016: decomposition by population group and possible determinants". *Economic Bulletin - Banco de España,* 4/2019, Analytical Articles. https://repositorio.bde.es/handle/123456789/10792

Arce, Óscar, Miguel García-Posada, Sergio Mayordomo and Steven Ongena. (2018). "Adapting lending policies in a negative-for-long scenario". Documentos de Trabajo, 1832, Banco de España. http://dx.doi.org/10.2139/ssrn.3255441

Arce, Óscar, Elvira Prades and Alberto Urtasun. (2013). "Changes in household saving and consumption in Spain during the crisis". *Economic Bulletin - Banco de España,* September. https://repositorio.bde.es/bitstream/123456789/7993/1/art3e.pdf

Banco de España. (2013). *Financial Stability Report. 11/2013.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/13/IEF_Ing_Noviembre2013.pdf

Banco de España. (2015). *Annual Report 2014.* https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesAnuales/InformesAnuales/14/Files/inf2014e.pdf

Banco de España. (2020a). *Annual Report 2019.* https://www.bde.es/wbe/es/publicaciones/informes-memorias-anuales/informe-anual/informe-anual-2019.html

Banco de España. (2020b). *Financial Stability Report. Spring 2020.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/20/ficheros/FSR_Spring2020.pdf

Banco de España. (2020c). *Financial Stability Report. Autumn 2020*. https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/20/ficheros/FSR_Autumn2020.pdf

Banco de España. (2020d). *Macroeconomic projections for the Spanish economy (2020-2022): the Banco de España's contribution to the Eurosystem's June 2020 joint forecasting exercise.* https://www.bde.es/f/webbde/SES/AnalisisEconomico/AnalisisEconomico/ProyeccionesMacroeconomicas/ficheros/be08062020-proye.pdf

Banco de España. (2021a). *Annual Report 2020.* https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesAnuales/InformesAnuales/20/Files/InfAnual_Ing_2020.pdf

Banco de España. (2021b). *Financial Stability Report. Spring 2021.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/21/FSR_Spring2021.pdf

Banco de España. (2021c). *Financial Stability Report. Autumn 2021.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/21/FSR_Autumn2021.pdf

Banco de España. (2022a). *Annual Report 2021.* https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesAnuales/InformesAnuales/21/Files/InfAnual_2021_En.pdf

Banco de España. (2022b). *Financial Stability Report. Spring 2022.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/22/FSR_Spring2022.pdf

Banco de España. (2022c). *Financial Stability Report. Autumn 2022.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/22/FSR_Autumn2022.pdf

Banco de España. (2023a). *Annual Report 2022.* https://www.bde.es/f/webbe/SES/Secciones/Publicaciones/PublicacionesAnuales/InformesAnuales/22/Files/InfAnual_2022_En.pdf

Banco de España. (2023b). *Financial Stability Report. Spring 2023.* https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/23/FSR_Spring2023.pdf

Barceló, Cristina, and Ernesto Villanueva. (2016). "The response of household wealth to the risk of job loss: Evidence from differences in severance payments". *Labour Economics,* 30, pp. 35-54. https://doi.org/10.1016/j.labeco.2016.02.001

Basso, Henrique, Olympia Bover, José María Casado, Julio Gálvez and Laura Hospido. (2020). "Subjective Income Expectations and Consumption Dynamics", mimeo.

Bellovary, Jodi L., Don E. Giacomino and Michael D. Akers. (2007). "A Review of Bankruptcy Prediction Studies: 1930 to Present". *Journal of Financial Education,* 33, pp. 1-42. http://www.jstor.org/stable/41948574

Benito, Andrew, and Ignacio Hernando. (2007). "Firm behaviour and financial pressure: Evidence from Spanish panel data". *Bulletin of Economic Research,* 59(4), pp. 283-311. https://doi.org/10.1111/j.0307-3378.2007.00266.x

Bentolila, Samuel, Marcel Jansen and Gabriel Jiménez. (2018). "When Credit Dries Up: Job Losses in the Great Recession". *Journal of the European Economic Association,* 16(3), pp. 650-695. https://doi.org/10.1093/jeea/jvx021

Bernanke, Ben, and Alan S. Blinder. (1988). "Credit, Money, and Aggregate Demand". *The American Economic Review,* 78(2), pp. 435-439. http://www.jstor.org/stable/1818164

Blanco, Roberto, Sergio Mayordomo, Álvaro Menéndez and Maristela Mulino. (2020). "Spanish non-financial corporations' liquidity needs and solvency after the COVID-19 shock". Documentos Ocasionales, 2020, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosOcasionales/20/Files/do2020e.pdf

Blanco, Roberto, Sergio Mayordomo, Álvaro Menéndez and Maristela Mulino. (2021). "Impact of the COVID-19 crisis on Spanish firms' financial vulnerability". Documentos Ocasionales, 2119, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosOcasionales/21/Files/do2119e.pdf

Bover, Olympia. (2005). "Wealth effects on consumption: Microeconomic estimates from the Spanish Survey of Household Finances". Documentos de Trabajo, 0522, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosTrabajo/05/Fic/dt0522e.pdf

Boyd, John H., and Gianni De Nicoló. (2005). "The Theory of Bank Risk Taking and Competition Revisited". *Journal of Finance,* 60(3), pp. 1329-1343. http://www.jstor.org/stable/3694928

Browning, Martin, and M. Dolores Collado. (2001). "The Response of Expenditures to Anticipated Income Changes: Panel Data Estimates". *The American Economic Review,* 91(3), pp. 681-692. http://www.jstor.org/stable/2677887

Campbell, John Y., Jens Hillscher and Jan Szilagyi. (2008). "In Search of Distress Risk". *The Journal of Finance,* 63(6), pp. 2899-2939. https://doi.org/10.1111/j.1540-6261.2008.01416.x

Carbó, José Manuel, and Sergio Gorjón. (2022). "Application of machine learning models and interpretability techniques to identify the determinants of the price of bitcoin". Documentos de Trabajo, 2215, Banco de España. http://dx.doi.org/10.2139/ssrn.4087481

Carbó, Santiago, Pedro J. Cuadros and Francisco Rodríguez. (2020). "Taxonomy of the Spanish FinTech ecosystem and the drivers of FinTechs' performance". *Financial Stability Review - Banco de España,* 38, pp. 27-51. https://repositorio.bde.es/bitstream/123456789/13552/1/Taxonomy_Fintech_en.pdf

Carro, Adrián, and Patricia Stupariu. (2022). "Uncertainty, non-linear contagion and the credit quality channel: an application to the Spanish interbank market". Documentos de Trabajo, 2212, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosTrabajo/22/Files/dt2212e.pdf

Casado, José María. (2011). "From income to consumption: measuring households partial insurance". *Empirical Economics,* 40(2), pp. 471-495. https://doi.org/10.1007/s00181-010-0337-z

Castro, Christian, and Jorge E. Galán. (2019). "Drivers of Productivity in the Spanish Banking Sector: Recent Evidence". *Journal of Financial Services Research,* 55, pp. 115-141. https://doi.org/10.1007/s10693-019-00312-w

Eirea, Sonsoles, María Oroz and Carlos Díez. (2021). "Adapting the supervision of credit institutions to the COVID-19 crisis". *Financial Stability Review - Banco de España,* 40, pp. 61-81. https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/21/3_Supervision_FSR.pdf

Estrada, Ángel, and Javier Vallés. (1998). "Investment and financial structure in Spanish manufacturing firms". *Investigaciones Económicas,* 22(3), pp. 337-359. https://www.fundacionsepi.es/investigacion/revistas/paperArchive/Sep1998/v22i3a2.pdf

Ferrer, Alejandro, Javier García Villasur, Nadia Lavín, Irene Pablos Nuevo and Carlos Pérez Montes. (2021). "An initial analysis of energy transition risks using the Banco de España's FLESB stress-testing framework". *Financial Stability Review - Banco de España,* 41, pp. 21-43. https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/21/2_Climatico_FSR41.pdf

Gavilá, Sergio, Alfredo Maldonado and Antonio Marcelo. (2020). "The Banco de España in-house credit assessment system". *Financial Stability Review - Banco de España,* 38, pp. 95-121. https://www.bde.es/f/webbde/GAP/Secciones/Publicaciones/InformesBoletinesRevistas/RevistaEstabilidadFinanciera/20/mayo/en/Banco_Espana_in_house_credit.pdf

González, Beatriz, Enrique Moral-Benito and Isabel Soler. (2022). "Schumpeter meets Goldilocks: the scarring effects of firm destruction". Documentos Ocasionales, 2216, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosOcasionales/22/Files/do2216e/do2216e.pdf

Gourinchas, Pierre-Olivier, and Maurice Obstfeld. (2012). "Stories of the Twentieth Century for the Twenty-First". *The American Economic Journal: Macroeconomics,* 4(1), pp. 226-265. https://www.aeaweb.org/articles?id=10.1257/mac.4.1.226

Gutiérrez de Rozas, Luis. (2007). "Testing for competition in the Spanish banking industry: The Panzar-Rosse approach revisited". Documentos de Trabajo, 0726, Banco de España. http://dx.doi.org/10.2139/ssrn.1005116

Hernando, Ignacio, and Carmen Martínez-Carrascal. (2008). "The impact of financial variables on firms' real decisions: Evidence from Spanish firm-level data". *Journal of Macroeconomics,* 30(1), pp. 543-561. https://doi.org/10.1016/j.jmacro.2006.08.004

Jiménez, Gabriel, Steven Ongena, José Luis Peydró and Jesús Saurina. (2012). "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications". *The American Economic Review,* 102(5), pp. 2301-2326. http://www.jstor.org/stable/41724622

Jiménez, Gabriel, Steven Ongena, José Luis Peydró and Jesús Saurina. (2014). "Hazardous Times for Monetary Policy: What do Twenty-Three Million Bank Loans say about the Effects of Monetary Policy on Credit Risk-Taking?". *Econometrica,* 82(2), pp. 463-505. https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA10104

Jiménez, Gabriel, Steven Ongena, José Luis Peydró and Jesús Saurina. (2017). "Macroprudential Policy, Countercyclical Bank Capital Buffers, and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments". *Journal of Political Economy,* 125(6), pp. 2126-2177. https://www.jstor.org/stable/26550491

Jiménez, Gabriel, Eduardo Pérez Asenjo, Raquel Vegas and Carlos Trucharte. (2021). "Support measures in the banking sector: loan moratoria". *Financial Stability Review - Banco de España,* 40, pp. 9-42. https://www.bde.es/f/webbde/Secciones/Publicaciones/InformesBoletinesRevistas/InformesEstabilidadFinancera/21/1_Moratorias_FSR.pdf

Jiménez, Gabriel, José A. López and Jesús Saurina. (2013). "How does competition affect bank risk-taking?". *Journal of Financial Stability,* 9(2), pp. 185-195. https://doi.org/10.1016/j.jfs.2013.02.004

Jordà, Óscar, Moritz Schularick and Alan M. Taylor. (2013). "When Credit Bites Back". *Journal of Money, Credit and Banking,* 45(2), pp. 3-28. https://doi.org/10.1111/jmcb.12069

Khwaja, Asim Ijaz, and Atif R. Mian. (2008). "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market". *The American Economic Review,* 98(4), pp. 1413-1442. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1294908

Kindleberger, Charles P., and Robert Z. Aliber. (1978). "Manias, Panics and Crashes: A History of Financial Crises". Basic Books. https://doi.org/10.1057/9780230628045

Li, Leon, and Robert Faff. (2019). "Predicting corporate bankruptcy: What matters?". *International Review of Economics and Finance,* 62, pp. 1-19. https://doi.org/10.1016/j.iref.2019.02.016

Martínez-Matute, Marta, and Alberto Urtasun. (2017). "The recovery of private consumption in Spain by product type and household". *Economic Bulletin - Banco de España,* 2/2017, Analytical Articles. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/InformesBoletinesRevistas/ArticulosAnaliticos/2017/T2/files/beaa1702-art17e.pdf

Martínez Miera, David, and Rafael Repullo. (2010). "Does Competition Reduce the Risk of Bank Failure?". *The Review of Financial Studies,* 23(10), pp. 3638-3664. http://www.jstor.org/stable/40865571

Martínez Resano, José Ramón. (2022). "Regulating for competition with BigTechs: banking-as-a-service and 'beyond banking'". *Financial Stability Review - Banco de España,* 41, pp. 103-138. https://repositorio.bde.es/bitstream/123456789/21156/1/6_BigTechs_FSR41.pdf

Mayordomo, Sergio, Nicola Pavanini and Emanuele Tarantino. (2020). "The impact of alternative forms of bank consolidation on credit supply and financial stability". Documentos de Trabajo, 2021, Banco de España. https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/PublicacionesSeriadas/DocumentosTrabajo/20/Files/dt2021e.pdf

Ohlson, James A. (1980). "Financial Ratios and the Probabilistic Prediction of Bankruptcy". *Journal of Accounting Research,* 18(1), pp. 109-131. https://doi.org/10.2307/2490395

Pan, Wen-Tsao. (2012). "A new Fruit Fly Optimization Algorithm: Taking the financial distress model as an example". *Knowledge-Based Systems,* 26, pp. 69-74. https://doi.org/10.1016/j.knosys.2011.07.001

Pérez Montes, Carlos. (2014). "The effect on competition of banking sector consolidation following the financial crisis of 2008". *Journal of Banking and Finance,* 43, pp. 124-136. https://doi.org/10.1016/j.jbankfin.2014.03.004

Pérez Montes, Carlos, Jorge E. Galán, María Bru, Julio Gálvez, Alberto García, Carlos González, Samuel Hurtado, Nadia Lavín, Eduardo Pérez Asenjo and Irene Roibás. (2023). "Systemic analysis framework for the impact of economic and financial risks". Documentos Ocasionales, 2311, Banco de España. https://repositorio.bde.es/handle/123456789/33568

Schularick, Moritz, and Alan M. Taylor. (2012). "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870-2008". *The American Economic Review,* 102(2), pp. 1029-1061. https://www.jstor.org/stable/23245443

Shumway, Tyler. (2001). "Forecasting Bankruptcy More Accurately: A Simple Hazard Model". *Journal of Business,* 74(1), pp. 101-124. https://doi.org/10.1086/209665

Trivin, Pedro. (2022). "The wealth-consumption channel: evidence from a panel of Spanish households". *Review of Economics of the Household,* 20, pp. 1377-1428. https://link.springer.com/article/10.1007/s11150-021-09586-3

Vermeulen, Philip, Daniel A. Dias, Maarten Dossche, Erwan Gautier, Ignacio Hernando, Roberto Sabbatini and Harald Stahl. (2012). "Price Setting in the Euro Area: Some Stylized Facts from Individual Producer Price Data". *Journal of Money, Credit and Banking,* 44(8), pp. 1631-1650. https://www.jstor.org/stable/23322076

Wang, Lu, and Wu Chong. (2017). "Business failure prediction based on two-stage selective ensemble with manifold learning algorithm and kernel-based fuzzy self-organizing map". Knowledge-Based Systems, 121, pp. 99-110. https://doi.org/10.1016/j.knosys.2017.01.016

# BANCO DE ESPAÑA PUBLICATIONS

## OCCASIONAL PAPERS

2130 PABLO HERNÁNDEZ DE COS: Testimony before the Congress of Deputies Budget Committee on 25 October 2021 and before the Senate Budget Committee on 30 November 2021 in relation to the Draft State Budget for 2022. (There is a Spanish version of this edition with the same number).

2131 LAURA AURIA, MARKUS BINGMER, CARLOS MATEO CAICEDO GRACIANO, CLÉMENCE CHARAVEL, SERGIO GAVILÁ, ALESSANDRA IANNAMORELLI, AVIRAM LEVY, ALFREDO MALDONADO, FLORIAN RESCH, ANNA MARIA ROSSI and STEPHAN SAUER: Overview of central banks' in-house credit assessment systems in the euro area.

2132 JORGE E. GALÁN: CREWS: a CAMELS-based early warning system of systemic risk in the banking sector.

2133 ALEJANDRO FERNÁNDEZ CEREZO and JOSÉ MANUEL MONTERO: A sectoral analysis of the future challenges facing the Spanish economy. (There is a Spanish version of this edition with the same number).

2201 MANUEL A. PÉREZ ÁLVAREZ: New allocation of special drawing rights. (There is a Spanish version of this edition with the same number).

2202 PILUCA ALVARGONZÁLEZ, MARINA GÓMEZ, CARMEN MARTÍNEZ-CARRASCAL, MYROSLAV PIDKUYKO and ERNESTO VILLANUEVA: Analysis of labor flows and consumption in Spain during COVID-19.

2203 MATÍAS LAMAS and SARA ROMANIEGA: Designing a price index for the Spanish commercial real estate market. (There is a Spanish version of this edition with the same number).

2204 ÁNGEL IVÁN MORENO BERNAL and TERESA CAMINERO GARCÍA: Analysis of ESG disclosures in Pillar 3 reports. A text mining approach.

2205 OLYMPIA BOVER, LAURA CRESPO and SANDRA GARCÍA-URIBE: Household indebtedness according to the Spanish Survey of Household Finances and the Central Credit Register: a comparative analysis. (There is a Spanish version of this edition with the same number).

2206 EDUARDO GUTIÉRREZ, ENRIQUE MORAL-BENITO and ROBERTO RAMOS: Population dynamics during the COVID-19 pandemic. (There is a Spanish version of this edition with the same number).

2207 JULIO GÁLVEZ: Measuring the equity risk premium with dividend discount models.

2208 PILAR CUADRADO, MARIO IZQUIERDO, JOSÉ MANUEL MONTERO, ENRIQUE MORAL-BENITO and JAVIER QUINTANA: The potential growth of the Spanish economy after the pandemic. (There is a Spanish version of this edition with the same number).

2209 PANA ALVES, SERGIO MAYORDOMO and MANUEL RUIZ-GARCÍA: Corporate financing in fixed-income markets: the contribution of monetary policy to lowering the size barrier. (There is a Spanish version of this edition with the same number).

2210 PABLO BURRIEL, IVÁN KATARYNIUK and JAVIER J. PÉREZ: Computing the EU's SURE interest savings using an extended debt sustainability assessment tool.

2211 LAURA ÁLVAREZ, ALBERTO FUERTES, LUIS MOLINA and EMILIO MUÑOZ DE LA PEÑA: Fund raising in the international capital markets in 2021. (There is a Spanish version of this edition with the same number).

2212 CARLOS SANZ: El peso del sector público en la economía: resumen de la literatura y aplicación al caso español.

2213 LEONOR DORMIDO, ISABEL GARRIDO, PILAR L'HOTELLERIE-FALLOIS and JAVIER SANTILLÁN: Climate change and sustainable growth: international initiatives and European policies. (There is a Spanish version of this edition with the same number).

2214 CARMEN SÁNCHEZ and JARA QUINTANERO: Las empresas *fintech:* panorama, retos e iniciativas.

2215 MARÍA ALONSO, EDUARDO GUTIÉRREZ, ENRIQUE MORAL-BENITO, DIANA POSADA, PATROCINIO TELLO-CASAS and CARLOS TRUCHARTE: In-person access to banking services in Spain: a comparison with other countries and other types of services. (There is a Spanish version of this edition with the same number).

2216 BEATRIZ GONZÁLEZ, ENRIQUE MORAL-BENITO and ISABEL SOLER: Schumpeter Meets Goldilocks: the Scarring Effects of Firm Destruction.

2217 MARIO ALLOZA, JÚLIA BRUNET, VICTOR FORTE-CAMPOS, ENRIQUE MORAL-BENITO and JAVIER J. PÉREZ: Government spending in spain from a european perspective. (There is a Spanish version of this edition with the same number).

2218 PABLO AGUILAR, BEATRIZ GONZÁLEZ and SAMUEL HURTADO: Carbon tax sectoral (CATS) model: a sectoral model for energy transition stress test scenarios.

2219 ALEJANDRO MUÑOZ-JULVE and ROBERTO RAMOS: Estimation of the impact of changes in the period used to calculate the regulatory base on new retirement pension amounts. (There is a Spanish version of this edition with the same number).

2220 LUIS ÁNGEL MAZA: An estimation of the carbon footprint in Spanish credit institutions' business lending portfolio. (There is a Spanish version of this edition with the same number).

2221 SUSANA MORENO SÁNCHEZ: The EU-UK relationship: regulatory divergence and the level playing field.

2222 ANDRÉS ALONSO-ROBISCO and JOSÉ MANUEL CARBÓ: Inteligencia artificial y finanzas: una alianza estratégica.

2223 LUIS FERNÁNDEZ LAFUERZA, MATÍAS LAMAS, JAVIER MENCÍA, IRENE PABLOS and RAQUEL VEGAS: Analysis of the usability of capital buffers during the crisis precipitated by COVID-19. (There is a Spanish version of this edition with the same number).

2224 SONSOLES GALLEGO, ISABEL GARRIDO and IGNACIO HERNANDO: IMF precautionary facilities and their use in Latin America. (There is a Spanish version of this edition with the same number).

2301 LAURA HOSPIDO, CARLOS SANZ and ERNESTO VILLANUEVA: Air pollution: a review of its economic effects and policies to mitigate them.

2302 IRENE MONASTEROLO, MARÍA J. NIETO and EDO SCHETS: The good, the bad and the hot house world: conceptual underpinnings of the NGFS scenarios and suggestions for improvement.

2303 ADRIÁN LÓPEZ GONZÁLEZ: Inteligencia artificial aplicada al control de calidad en la producción de billetes.

2304 BELÉN AROCA MOYA: Conceptos, fundamentos y herramientas de neurociencia, y su aplicación al billete.

2305 MARÍA ALONSO, EDUARDO GUTIÉRREZ, ENRIQUE MORAL-BENITO, DIANA POSADA and PATROCINIO TELLO-CASAS: Un repaso de las diversas iniciativas desplegadas a nivel nacional e internacional para hacer frente a los riesgos de exclusión financiera.

2306 JOSÉ LUIS ROMERO UGARTE, ABEL SÁNCHEZ MARTÍN and CARLOS MARTÍN RODRÍGUEZ: Alternatives to the evolution of wholesale banking operations in the Eurosystem. (There is a Spanish version of this edition with the same number).

2307 HENRIQUE S. BASSO, OURANIA DIMAKOU and MYROSLAV PIDKUYKO: How inflation varies across Spanish households.

2308 LAURA CRESPO, NAJIBA EL AMRANI, CARLOS GENTO and ERNESTO VILLANUEVA: Heterogeneidad en el uso de los medios de pago y la banca *online:* un análisis a partir de la Encuesta Financiera de las Familias (2002-2020).

2309 HENRIQUE S. BASSO, OURANIA DIMAKOU and MYROSLAV PIDKUYKO: How consumption carbon emission intensity varies across Spanish households.

2310 IVÁN AUCIELLO-ESTÉVEZ, JOSEP PIJOAN-MAS, PAU ROLDAN-BLANCO and FEDERICO TAGLIATI: Dual labor markets in Spain: a firm-side perspective.

2311 CARLOS PÉREZ MONTES, JORGE E. GALÁN, MARÍA BRU, JULIO GÁLVEZ, ALBERTO GARCÍA, CARLOS GONZÁLEZ, SAMUEL HURTADO, NADIA LAVÍN, EDUARDO PÉREZ ASENJO and IRENE ROIBÁS: Systemic analysis framework for the impact of economic and financial risks (There is a Spanish version of this edition with the same number).

2312 SERGIO MAYORDOMO and IRENE ROIBÁS: The pass-through of market interest rates to bank interest rates. (There is a Spanish version of this edition with the same number).

2313 CARLOS PÉREZ MONTES, ALEJANDRO FERRER, LAURA ÁLVAREZ ROMÁN, HENRIQUE BASSO, BEATRIZ GONZÁLEZ LÓPEZ, GABRIEL JIMÉNEZ, PEDRO JAVIER MARTÍNEZ-VALERO, SERGIO MAYORDOMO, ÁLVARO MENÉNDEZ PUJADAS, LOLA MORALES, MYROSLAV PIDKUYKO and ÁNGEL VALENTÍN: Individual and sectoral analysis framework for the impact of economic and financial risks. (There is a Spanish version of this edition with the same number).