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An estimation of the carbon footprint in Spanish credit institutions' business lending portfolio – Experimental statistics for credit institutions in Spain[1]

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[1] This presentation was prepared for the conference. The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the event.

An estimation of the carbon footprint in Spanish credit institutions' business lending portfolio

Experimental statistics for credit institutions in Spain

Luis Ángel Maza (Banco de España).

Abstract

This study proposes a set of indicators to estimate the carbon footprint of the business lending of Spanish credit institutions. The growing interest of our societies in environmental issues has brought into the general debate the need to analyse how financial institutions perform in their role to facilitate the fight against climate change and the green transition. In this respect, it is essential to have quality environmental information and to establish robust methodologies to assess the climate exposures of the financial sector. This paper seeks to contribute to this debate, offering experimental statistics to measure the degree of exposure of the banking sector in Spain to the risks involved in the transition towards a more sustainable economic model in the financing granted to companies.

Keywords: climate change, carbon footprint, financial risks.

JEL classification: Q50, Q56, G10, G20.

Contents

1. Introduction

The growing social demand regarding environmental issues observed in recent decades and the response from public authorities (including the establishment of climate targets) have driven reflections on **the role the financial system should play in this transformation towards more sustainable economic growth models.** The financial sector needs to prioritise efficiency when channelling the resources needed to drive this transformation and pay attention to the potential transition and physical risks that will affect companies and households in the near term and will, consequently, have a bearing on financial institutions as well.

One of the most significant international environmental public policy commitments of recent years has been the 2015 Paris Agreement. This Agreement set targets for reducing greenhouse gas (GHG) emissions, which have been established as being the main cause of global warming. Since then, important initiatives have emerged in the field of financial sector regulation to incorporate environmental and green transition considerations (for example, in relation to financial stability and prudential supervision) that are compatible with the climate targets. These new regulations flag a need to **assess the financial sector's behaviour and its environmental responsibility** and to pay greater attention to evaluating the exposures of financial institutions (in particular, credit institutions) through the use of environmental parameters. However, the initiatives for assessing financial institutions' environmental risks are still in an initial phase of specification and international harmonisation, which prevents a clear understanding of the efforts and progress needed to meet the climate change targets.

This paper presents a proposal for an indicator to quantify the GHG carbon footprint of Spanish credit institutions' portfolio of loans to resident firms, with the aim of evaluating the banking sector's behaviour in: (i) channelling financial resources towards less polluting activities and (ii) measuring the transition risks to which financial institutions will be subject in the coming years, due to the economic and financial performance of certain economic sectors in the face of the decarbonisation of the economy.

This proposal will thus contribute to the methodological debate that currently surrounds the selection of potential indicators to measure these transition risks, in the absence of an internationally agreed definition. So far, there are only experiences and initiatives of an autonomous nature in the selection of such indicators.

In the spirit of ensuring that **the proposed methodology can be reproduced** by other interested countries or agents, information sources and calculation procedures that are broadly available in other jurisdictions have primarily been used when defining the methodology.

To this end, the **second section briefly describes the data sources and the methodology used** to calculate this carbon footprint indicator. The **third section**

shows the main results obtained, in aggregate and individual terms. Lastly, in the **fourth section, possible refinements in and extensions** to the application of this procedure are reviewed. A final section of conclusions is also included.

2. Data sources and methodology

When describing the procedure and the methodology used to prepare the carbon footprint indicator, **it may be of interest first to carry out a detailed review of the sources of information used**. This description will allow a better understanding of the characteristics, benefits and limitations of the information content of the indicator and serve as a model for its replicability in other arenas and geographical areas.

Polluting emissions

In order to assess the carbon footprint of financial institutions' loan portfolio, it is key that **information on the GHG emissions generated by productive activity** (mainly, firms) is available. An **ideal approach to obtaining this information would be to have individual data** (at company level) on (i) the direct emissions (called, in this context, "scope 1" emissions) generated by companies in their direct consumption of fossil fuels, and (ii) their indirect emissions (called "scope 2 and 3" emissions), which derive from suppliers' fuel consumption in the inputs incorporated by companies into their production process. **However, the current situation regarding information availability is a long way off this approach**. The detailed information on **polluting emissions is limited to a small number of companies** (generally large corporations), and there are sometimes **difficulties in assigning emissions to specific companies**, as the data are disseminated in terms of business groups or installations, with no details on the company or their geographical allocation.

Such restrictions on access to information advise **the use of aggregate statistics on the atmospheric polluting emissions** of each sector of activity, which, while less accurate than the real data of each company, **will allow a homogeneous comparison** and provide complete information for the economy as a whole. These aggregate **data are available in the environmental accounts** that are usually drawn up by the national statistics institutes (in the case of Spain, by the Instituto Nacional de Estadística, or INE), following the methodology established by the United Nations for the System of Environmental-Economic Accounting.

The variable selected **for measuring these polluting emissions in Spain is total GHG emissions**, measured in thousands of tonnes of CO_2 equivalent in annual terms, which are available in the INE's Air Emissions Accounts. The level of detail used corresponds to **the breakdown of the 64 sectors of activity** according to the National Classification of Economic Activities (NACE Rev. 2).

Output level

In order to calibrate the degree of **pollution intensity of the sectors of activity**, **the emissions must be compared with a measure of the quantity of goods and**

services produced by each economic sector. Of the various indicators available for measuring the activity generated, **the level of output in a financial year**, measured in terms of monetary units (millions of euro), has been selected. This **variable is available in the annual National Accounting statistics** that the INE also prepares for Spain.

Input-output table

In this exercise, to calculate the carbon footprint of the sectors of activity, **the information on direct pollution needs to be completed with an assessment of indirect GHG emissions**, which derive from the resources incorporated into the production process. These **calculations can be made using the input-output table available in the National Accounts framework**. This statistic contains a very detailed description of the characteristics of the productive sectors of the economies. In the case of Spain, the most recent information drawn up by the INE corresponds to 2016.

Bank loan portfolio

As regards access to the **information on Spanish banks' credit exposures** to resident companies, the **quarterly financial reporting statement that credit institutions send to the Banco de España** is used. This reporting form contains details of the stock of loans according to the economic activity of the borrowers (NACE Rev. 2 sections).

This information has been **completed with aggregate data from the Banco de España's Central Credit Register (CCR)** for those sectors of activity not available in the reporting statements, to standardise the information on loans with the breakdowns at the level of the 64 sectors of activity available from other sources.

Direct and indirect polluting emission coefficients

In the proposed procedure for calculating the carbon footprint indicator, a decisive factor is **obtaining the carbon dioxide (CO_2) emission coefficients per unit of output** for each sector of activity. These coefficients or ratios seek to **assess the intensity of (direct and indirect) polluting emissions in the output of each economic sector**.

The **direct coefficients** (q^{direct}) are calculated as **the ratio between GHG emissions** (expressed in thousands of tonnes of CO_2 equivalent) **and the total output of each sector** (in millions of euro), according to formula 1:

$$(1) \qquad q^{direct}_{it} = \frac{\text{Greenhouse Gas Emission}_{it}}{\text{Total output}_{it}}$$

for each sector of activity (i) and year (t).

The **total coefficients** (q^{totals}) **are the sum of the direct coefficients and the indirect effect of the polluting emissions** produced in obtaining the intermediate

inputs used by each sector of activity, as expressed in formula 2. This estimate **draws on information from the National Accounts input-output matrix,** which includes how the final output of each sector is incorporated as inputs by the other sectors.

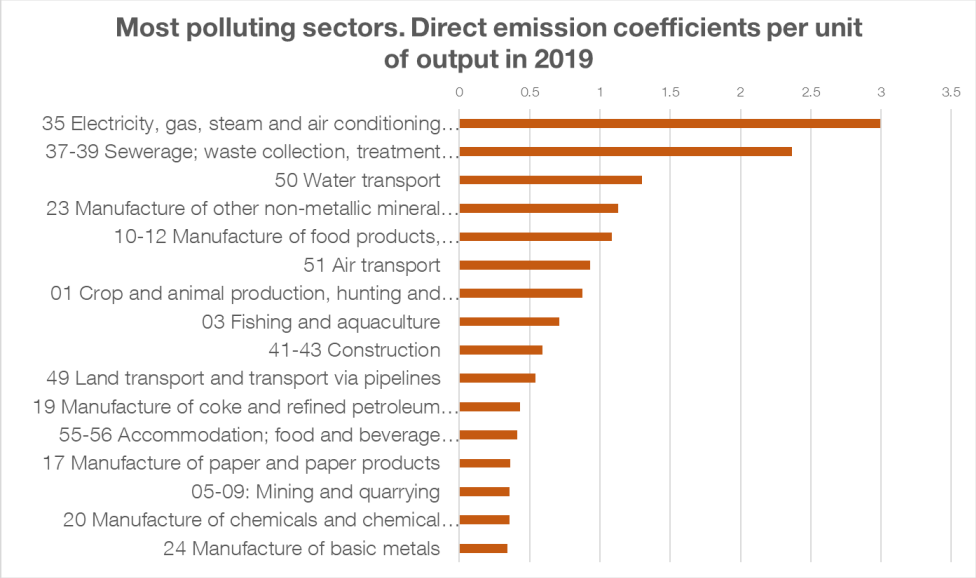
$$(2) \qquad q_{it}^{total} = (I - A)^{-1} q_{it}^{direct}$$

A: the coefficient matrix of the input-output table in the Annual National Accounts of Spain for 2016

$(I-A)^{-1}$: the **Leontief inverse matrix**

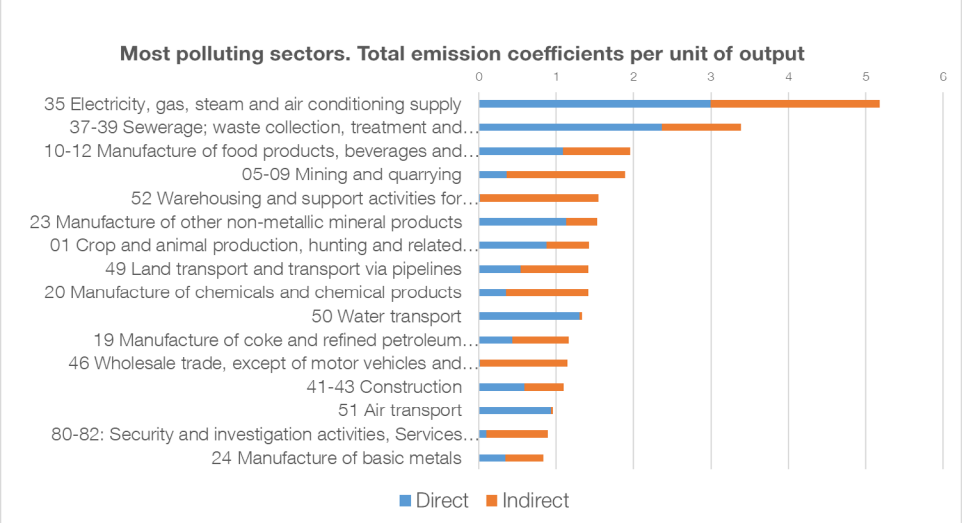
The values of the **direct coefficients will depend on the inherent characteristics of the productive structure of each sector of activity**. This means that the changes in the coefficients over time are small and that the changes in the sectors' relative positions in pollution intensity levels are also infrequent. **Chart 1 shows the results obtained from the direct coefficients** of the most polluting sectors in Spain. The results indicate that electricity and gas supply, transportation, manufacturing and agriculture are the productive sectors with the highest GHG emissions per unit of output.

Chart 1.



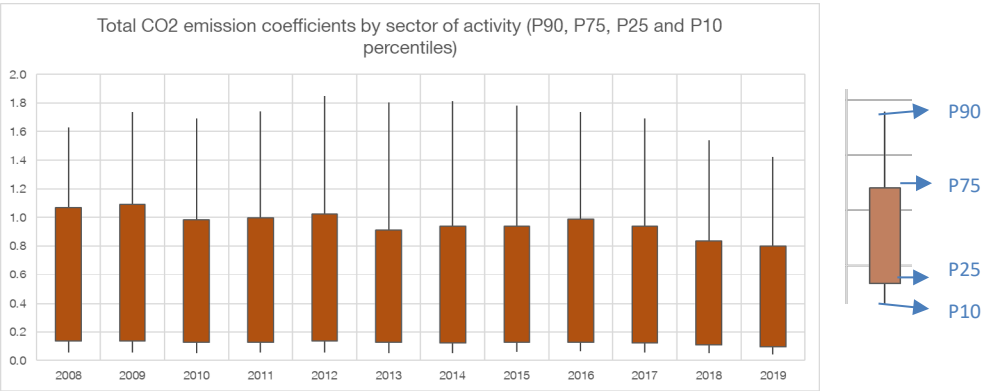
As regards the results of the **total coefficients by sector of activity** (i.e. direct emissions plus the polluting effects of the inputs), **there are small changes in the ranking of the most emission-intensive sectors**, although some new sectors are classified among the most polluting sectors (for example, mining and quarrying and storage activities). Turning to the indirect component, **electricity and gas supply** again stands out as the industry with the largest component stemming from emissions generated in obtaining the inputs used in its production process (see Chart 2).

Chart 2.



The time analysis of the total coefficients of the sectors of activity allows for an assessment of production efficiency over time and the degree of compliance with the GHG emission reduction targets. Chart 3 shows the results of the sectors' coefficients in the period 2008-2019 (represented through the percentiles observed in each year). According to this information, **emission intensity has decreased across the board in recent years, particularly in the most polluting sectors** (decrease in the 90th and 75th percentiles).

Chart 3.



Indicator of the carbon footprint intensity of loans

Once the information on the total GHG emission coefficients at the sector of activity level is available, **the indicator of the carbon footprint intensity of the business lending portfolio (IHCO2P)** is calculated as the average of the coefficient totals of the sectors of activity, weighted by the stock of financing granted to each sector in the bank loan portfolio, as expressed in formula 3.

$$IHCO2P_t = \frac{\sum_i P_{it} q_{it}^{total}}{\sum_i P_{it}} \qquad (3)$$

Pit: stock of loans from credit institutions at year-end by sector of activity (i) and year (t).

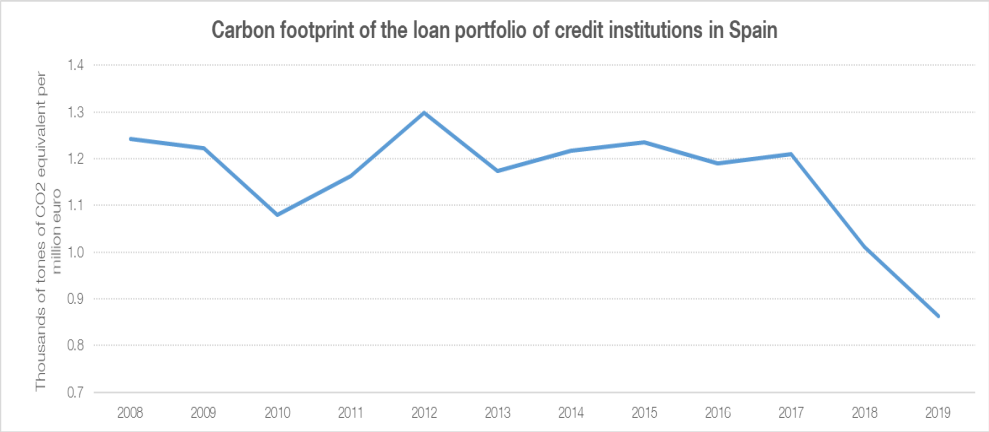
The **IHCO2P**, evaluated for all credit institutions, thus **represents the average ratio of polluting emissions of productive activities that obtain bank financing** to total bank loans granted in Spain.

This indicator is interpreted as follows: a drop in the level of the indicator signifies an improvement in the carbon footprint (relative reduction in polluting emissions), while an increase represents a worsening (increase in GHG pollution intensity).

3. Main results

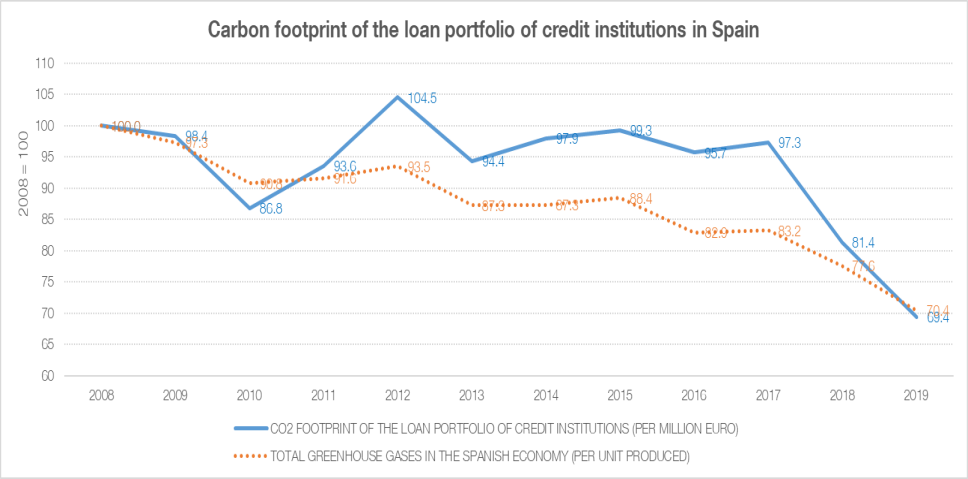
The methodology proposed in the previous section for calculating the **IHCO2P indicator for all credit institutions in Spain in the period 2008-2019** can be used to assess the behaviour of the polluting emission intensity of bank financing. Chart 4 shows the results of the IHCO2P and identifies how in recent years **the indicator has shown a downward trend, in line with the general improvement in the polluting emission coefficients**.

Chart 4.



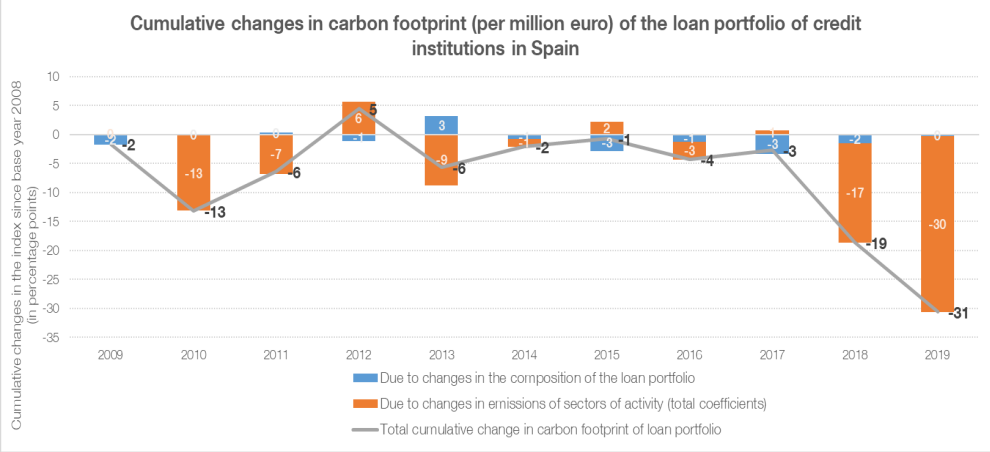
Given the difficulties in interpreting the indicator in its original units (tonnes of CO_2 per million euro) and for comparison purposes, the indicator is re-expressed in terms of an index (with a base year of 2008, the start of the series). A comparison of the IHCO2P with changes in the emission intensity of the Spanish economy in 2008-2019 shows a cumulative reduction of a very similar magnitude (see Chart 5).

Chart 5.



To identify the elements behind the changes in the IHCO2P, the factors underlying this behaviour have been analysed, identifying the influence of **(i) the changes in the polluting emission intensity** of the sectors and **(ii) the changes due to shifts in the composition of the loan portfolio** of all banks.

Chart 6.



To identify these effects, a simulation exercise has been carried out, where the baseline scenario envisages a stable composition of the base-year loan portfolio (data from 2008). The results obtained indicate that **the primary factor behind the improvement in the IHCO2P is the decrease in the emission coefficients**, while, in cumulative terms, the contribution of the changes in the composition of credit exposures (the result of a combination of supply and demand factors in bank financing during the period analysed) appears to be quite marginal.

A more detailed **analysis of the changes in the loan portfolio composition** can be carried out by classifying the sectors of activity according to the values of their total emission coefficients. In the absence of a fully accepted taxonomy for categorising

productive sectors based on their pollution intensity, in this exercise **the sectors of activity have been divided into two groups**: more or less polluting, depending on their average polluting emission intensity in 2008-2019. Thus, those sectors that exceed the median emission coefficient of the 64 analysed sectors are classified in the "more polluting" category, while those whose emission coefficients are below the median of the distribution are classified as "less polluting".

Chart 7 shows the result of this analysis and **evidences a slight shift in the composition of Spanish credit institutions' loan portfolio towards less polluting sectors** in the later years of the analysed period.

Chart 7.

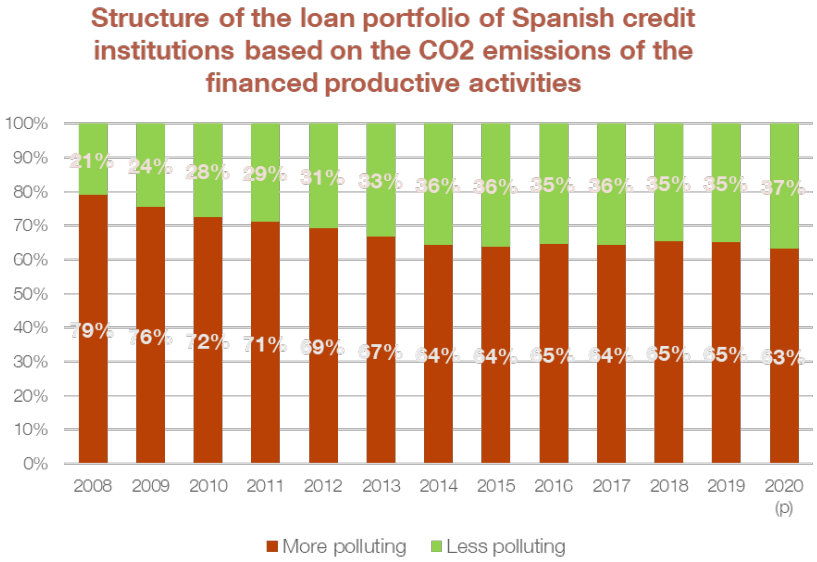
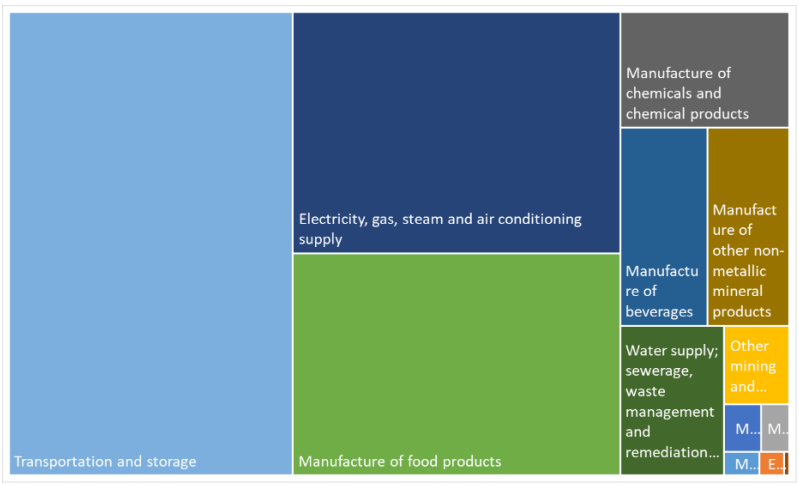


Chart 8.



(*) "Highly polluting" sectors of activity are those whose total emission coefficients exceed the 75th percentile of the distribution.

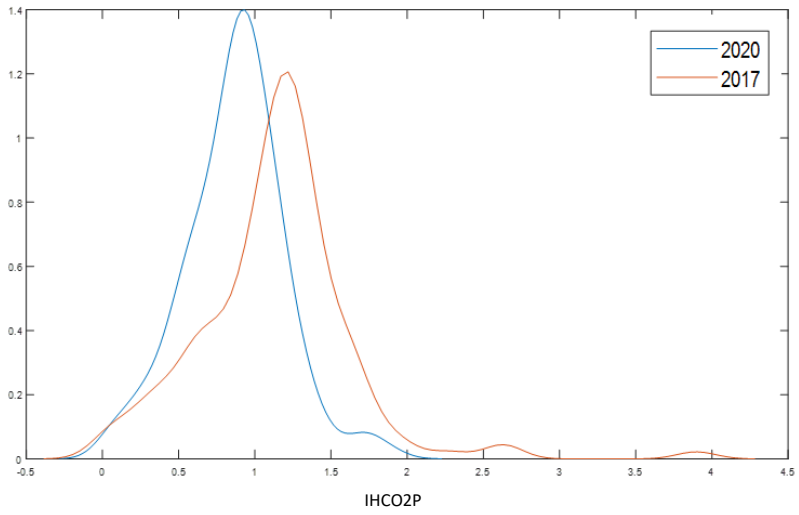
More specifically, the **bulk of financing granted to the more polluting** productive sectors was concentrated in **(i) transportation and storage, (ii) electricity, gas, steam and air conditioning supply and (iii) the food industries** (see Chart 8).

The results analysed above in the behaviour of the IHCO2P derive from the application of the methodology drawing on the aggregate information of the Spanish credit institutions sector. However, **the approach proposed in the carbon footprint calculation can be applied to the individual data of the loan portfolio of each credit institution** operating in the Spanish market, and the changes in this indicator can be evaluated individually. **This approach is complementary to the aggregate analysis** and can be used to analyse behaviours (for example, to identify influential observations) in the distribution of the IHCO2P for the entire sample of credit institutions in Spain.

To this end, the IHCO2P values have been calculated for each credit institution (160 banks) at two moments in time (in 2017 and 2020). **The results obtained have been represented by kernel density functions**, to show graphically the distribution of IHCO2P values within the population of institutions (see Chart 9).

Chart 9.

IHCO2P Analysis based on individual data (credit institution level)



This approach, which is complementary to the aggregate view and uses more granular information, would indicate a shift to the left of the density function in 2020 compared to 2017, suggesting that the improvement observed in **the IHCO2P in aggregate terms is compatible with a general reduction** in the carbon footprint of credit institutions' loan portfolio at an individual level, meaning that **the reduction in the carbon footprint is widespread** in the overall population of credit institutions in Spain in the most recent period.

4. Possible methodological extensions in the calculation of the indicator

The methodology proposed in the foregoing sections for the calculation of the loan portfolio carbon footprint to obtain this experimental statistic enables both aggregate and individual data to be obtained that can be used to assess the composition of the financial flows channelled towards more polluting activities and to analyse the risks assumed by the financial sector in these exposures. However, **this approach may be subject to refinement and extensions with potential complements**, depending on the additional information available and the approaches that are to be incorporated into the indicator's information content. **This section details a set of reflections and improvements of a methodological nature** that could be incorporated into the definition of the indicator.

Use of features related to the productive and financial structure of the sectors

When evaluating the carbon footprint in business financing, it may be interesting to **incorporate elements that estimate the impact on the granting of funds to carry out productive activities** and that, in turn, affect the level of polluting emissions. These factors could be related to the intrinsic characteristics of the economic activities and would refer to **(i) the productive structure of the economic sectors and (ii) their financial structures**.

As regards the productive structure, one highly conditioning element when gauging the influence of the financing granted is **the level of investment needed to carry out productive activities** (for example, the amount of capital goods needed). This is often specific to each sector of activity. For example, industrial sectors generally have higher capital goods investment needs than companies belonging to the services sectors.

Likewise, **financing structures are not unique to each company** and, on many occasions, they are also determined by the sector of activity in which the business project is developed. For example, companies engaged in retail trade can access financing sources with no financial cost for relatively larger volumes (financing granted by trade suppliers as a result of payment deferrals), while in other sectors of activity, financial liabilities are only available from external sources, at a cost (through bank financing).

Thus, both **the productive and the financial structure may be relevant when assessing the carbon footprint of bank loans**, given that the same volume of financing granted to two companies engaged in different activities may have a completely heterogeneous effect on the scale of the activity to be financed and its environmental impact.

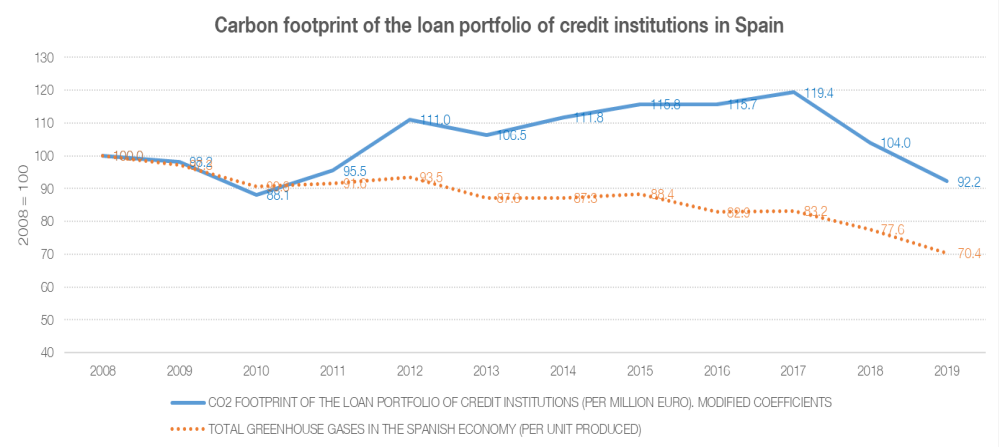
Formula 4 incorporates this modification into the definition of the **polluting emission coefficients by including information on the economic and financial characteristics** of the sectors of activity.

Given that these variables are often only available for samples of companies, rather than for the population as a whole, in the adjustment of the calculations of the corrected emission coefficients ($q^{totals\ modified}$), **ratios from representative information bases for non-financial corporations**, such as those prepared by the Central Balance Sheet Data Office of the Banco de España, are used. In order to facilitate reproducing this exercise for other countries, Spain's contribution to the BACH (Bank for the Accounts of Companies Harmonized) database of the European Committee of Central Balance Sheet Data Offices is used. **The ratios used to incorporate the productive and financial structures** of the sectors of activity into these calculations correspond to the **BACH** variables R41 (Asset-turnover ratio) and L (Liabilities), respectively. To establish a more structural nature for the data provided by these coefficients, the averages of these values in the period 2008-2019 for the sample of Spanish non-financial corporations have been used for the breakdown of the 64 sectors of activity.

(4) $$q^{modified\ totals}_{it} = q^{totals}_{it} \times \underbrace{\frac{Output\ (net\ turnover)_{it}}{Total\ balance\ sheet_{it}}}_{\text{Productive structure ratio}} \times \underbrace{\frac{Total\ balance\ sheet_{it}}{Financial\ liabilities_{it}}}_{\text{Leverage ratio}}$$

Applying this new definition of the polluting emission coefficients for the sectors of activity, **the results of the carbon footprint indicator have been obtained, making it possible to adjust the "true" influence of bank loans on the impact of the companies' polluting activities**. As can be seen in Chart 10, once these adjustments are included, the results would show a less pronounced decrease, almost nearing stability, in the IHCO2P throughout the analysed period.

Chart 10.



Limitations in the use of information on loans according to economic activity rather than purpose

One of the most significant limitations in analyses of the impact of the financial sector's actions on polluting emissions derives from **the restrictions on access to information on the specific environmental characteristics of the business projects that are being financed**, beyond the general activity carried out by the company. Usually, information on granted financing only contains reference data on the risk holder, not on the purpose for which the funds are used. The exercises to quantify the footprint could be enriched if the purpose of the loans were included in the loan portfolio classification (for example, the acquisition of electric vehicles, or energy efficiency or environmental sustainability projects carried out by companies), which would allow for a better measurement of the carbon footprint.

The current classifications of economic activities do not contain adequate details to assess polluting emissions

The **current international classifications of economic activities do not incorporate details of the sectors of activity** that would allow a detailed and tailored analysis of the carbon footprint. This hampers the availability of information on changes in production models that need to be identified and driven through public policy action. One example of such information deficits is the lack of differentiation of electricity generation activities through renewable energies within electricity production.

The significant shortcomings of the current international codes of economic activities (ISIC Rev 4 and NACE) are well known in the ongoing discussions on the reform and adaptation of these classifications. Thus, issues related to improving access to the details of environmental information have been incorporated into the deliberations on future updates of these classifications. **A successful adaptation of these details will enable higher quality statistical work to be prepared**, which is crucial for economic agents and public authorities in their decision-making.

Access to individual data on emissions and loans (at company level) could refine this measurement

The methodology proposed in this paper for calculating the carbon footprint exclusively uses aggregate information (at the sector of activity level) both in the analysis of the behaviour of polluting emissions and as regards the composition of loan portfolios. **One possible improvement** to the estimation of the carbon footprint of bank loans could be directed towards the use of information from those segments of companies (mainly, large companies) for which **detailed and comprehensive information on polluting emissions and on loans is available and can be incorporated into these calculations**. However, for the bulk of the population of companies, such detailed information will not be available on an individual basis, so aggregate data will always need to be used or **individual data will have to be estimated and imputed**.

Treatment of loans to holding companies and head offices

In these exercises to estimate the carbon footprint, there is some weakness which has a bearing on the perfect **calibration of the impact of the funds received by the holding companies and head offices** of business groups, corresponding to the NACE Rev. 2 sectors of activity 6420 and 7010, respectively. The companies classified under these groups frequently **channel the financing received** towards the group companies that actually carry out the business activities and that, therefore, effectively generate the polluting emissions. However, as a result of this channelling, the relationship between the initial classification of the credit exposures by sector carried out by the credit institutions and the final recipients of these funds is lost.

In order to overcome these limitations, one appropriate way to assign the carbon footprint to the bank loans granted to holding companies and head offices would be to have **detailed information on the economic activities carried out by the "productive" subsidiaries of their business groups** (for example, industrial or service activities) and to assign their environmental characteristics to the estimate of the carbon footprint of such credit exposures. In the case of Spain, bank financing granted to holding companies and head offices represents around 10% of the total financing to non-financial corporations and, as a result, the effect of incorporating this adjustment into the carbon footprint calculations would not be of great significance, but it would help to better calibrate the results.

5. Conclusions

The greater **social awareness of environmental deterioration and global concern about climate change** have been reflected in recent years in various initiatives undertaken by public authorities to set targets for reducing GHG emissions. Similarly, the need to calibrate the role that the financial system will play in fostering the green transition towards more sustainable economic models has been added to the environmental agenda of international forums.

In this respect, **establishing indicators that calibrate financial institutions' carbon footprint** will make it possible to analyse both developments in the funds channelled towards less polluting activities and the identification of the risks that financial agents will assume in this transformation of the consumption and production patterns of our economies. Within the current debate on the most appropriate indicators for measuring these phenomena, **this paper seeks to make a methodological contribution** and serve as an example for measuring the carbon footprint in credit institutions' business lending.

In the method selected in this proposal for **the experimental calculation of the carbon footprint of the Spanish credit institutions' portfolio of business loans**, elements that facilitate extrapolating this experience, both to other geographical areas (countries or jurisdictions) and to levels of aggregation (individual institutions or complete sectors), have been selected to make it easier to compare the results. To

this end, easily accessible information sources and reproducible calculation methods have been used. However, **this paper also flags the limitations of the methodology selected and suggests potential lines of improvement** for refining the results obtained.

The **carbon footprint index of Spanish credit institutions' loans shows some improvement** in the pollution intensity of the financing granted by banks **in recent years**. However, this is mainly a consequence of the reduction in the productive sectors' polluting emissions, while the influence of the shift in the composition of the credit portfolio towards more sustainable activities has been small.

The **experimental statistics obtained for measuring the carbon footprint of business loans** by credit institutions in Spain and the **methodological reflections** presented in this paper **seek to contribute to the current debate on the selection of indicators for measuring the financial sector's impact on environmental targets** and to be used for assessing climate change risks. They also have the potential to be extended to other instruments (for example, securities and household loans) and segments of the financial industry (such as investment funds and insurance companies).

Sources

- Guan, R., H. Zheng, J. Hu and Q. Fang (2017), "The Higher Carbon Intensity of Loans, the Higher Non-Performing Loan Ratio: The Case of China", Sustainability, vol. 9, No 4.
- International Monetary Fund (2021), "IMF Launches Climate Change Indicators Dashboard", press note, 7 April.

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Luis Ángel Maza

11TH BIENNIAL IFC CONFERENCE

25-26 August 2022

STATISTICS DEPARTMENT

OUTLINE

1. **Project objectives and basic characteristics**
2. **Information sources and methodology**
3. **Main results**
4. **Limitations and possible improvements**

oals

- This work is **an experimental statistics** for the quantification of the carbon footprint of the portfolio of loans to resident firms held by Spanish credit institutions.
- There is **no internationally agreed methodology**: only autonomous experiences and initiatives
- This first contribution tries to be an input to the debate on the **potential indicators** to be used in the climate change strategy and for the measurement of the **carbon footprint of the financial sector**.
- It would make it possible to assess the **transition risks** linked to the change in the production model (decarbonization of the economy) in the **credit exposures** of financial institutions

Basic features

- Information sources used contain **aggregated data** (not at firm or loan level)
- Important **assumptions** and the incorporation of **simplifying hypotheses**
- Potential **improvements** (extensions to other instruments and sectors) and **enrichments** (methodological and access to new data)

Data sources

Emissions

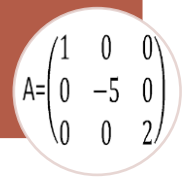
- Environmental accounts. Emissions into the atmosphere by branches of activity
- Indicator: Total greenhouse gases (thousands of tons of CO2 equivalent)
- Frequency: annual
- Source: INE (last data: 2020)

Production

- Annual national accounts of Spain: aggregates by branches of activity: Level of production (euro million)
- Indicator: Production level (millions of euros)
- Frequency: annual
- Source: INE (last data: 2019)

Input-Output Table

- Annual National Accounts of Spain: Input-Output tables
- Indicator: coefficients of the total inverse matrix
- Source: INE (last data: 2016)



Loans

- Statement FINREP with breakdown according to economic activity (NACE sections)
- For additional details (2-digit branches) in the manufacturing, mining and telecommunications sectors, the Central Credit Register (CCR) data are used.
- Indicator: balance amount of loans (euro millions)
- Frequency: quarterly
- Source: Bank of Spain (last data: June 2021)

- The information-sets contain **data aggregated by branches of activity**
- In general, we work with the detail of **64 branches** of activity according to NACE 2009 (when there is no perfect correspondence, we proceed to homogenization, merging or estimating details that allow us to work with greater granularity)
- The information on **loans to companies** corresponds to the amounts of the principal drawn down (balances) that are classified according to the **NACE** of the companies

Methodology (I)

1. **CO2 emission coefficients** per unit of production: try to identify the intensity of emissions (direct and indirect) of carbon dioxide in the production of an economic branch

   1. **Direct coefficients:** ratio between emissions and production

$$q^{direct}_{it} = \frac{\text{Greenhouse Gas Emission}_{it}}{\text{Total production}_{it}}$$

For each branch of activity (i) and year (t)

It is better to use the total coefficients to evaluate the contributions of each branch of activity to CO2 emissions

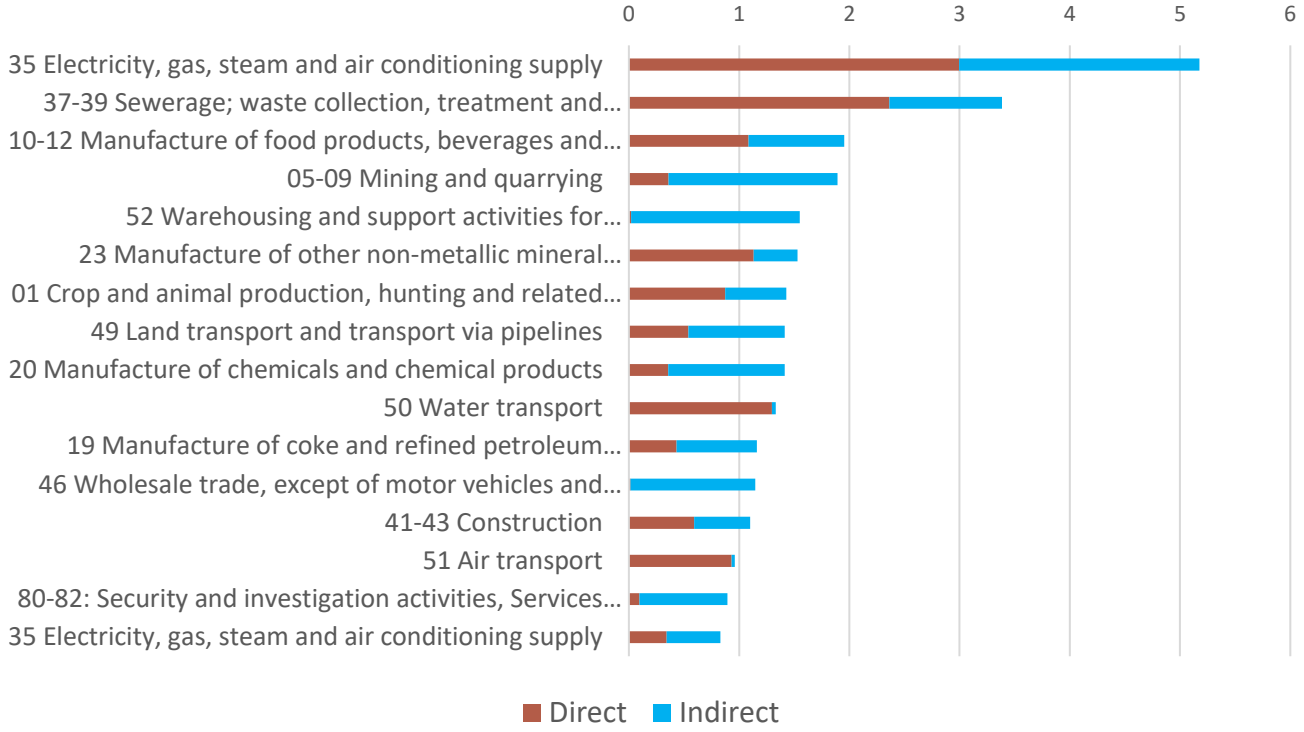
   2. **Total coefficients:** add to the direct coefficients the indirect effect of the emissions produced in obtaining the intermediate inputs used by each industry

$$q_{it}^{total} = (I - A)^{-1} q_{it}^{direct}$$

A: is the matrix of coefficients of the input-output table of the Annual National Accounts of Spain corresponding to 2016

$(I - A)^{-1}$: is the inverse Leontief matrix

Top of most polluting branches. Total emission coefficients per production unit



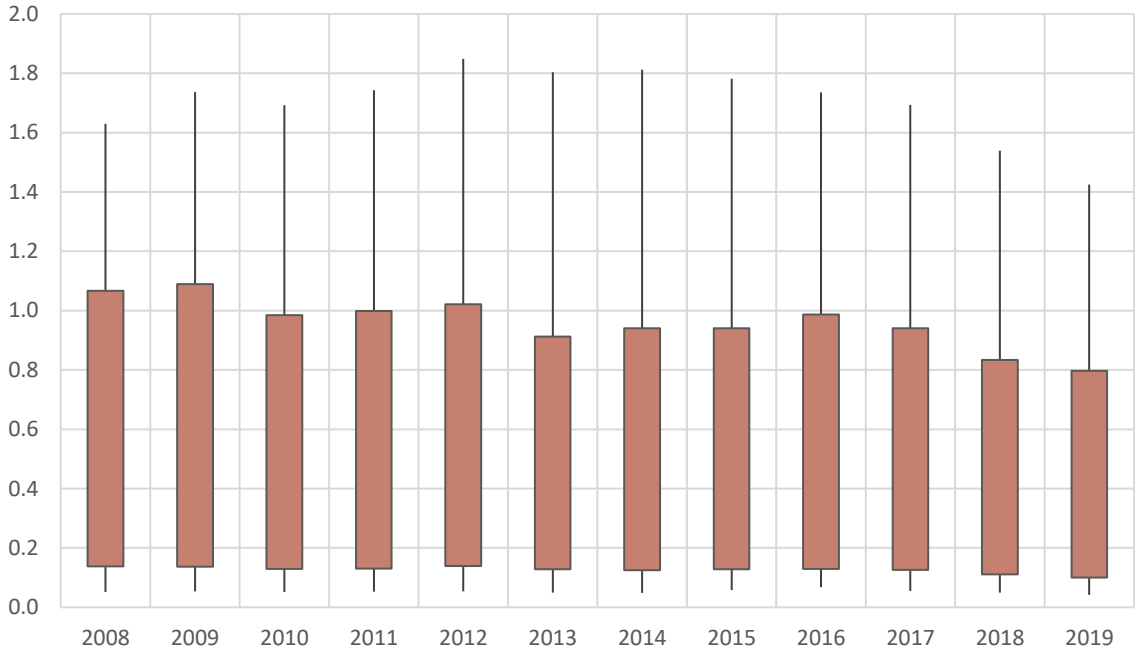
In the calculation of the **total coefficients** (incorporating the indirect effects)

The values of the coefficients will depend on the **characteristics inherent to the productive structure** of each branch of activity

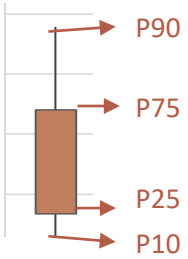
These coefficients **vary over time, although the modifications are of small magnitude** and the changes in the relative positions between branches are infrequent.

The branch of **electricity and gas supply is the industry with the largest indirect component**, derived from the effect of the emissions of the inputs used in its production process.

Evolution of the total CO2 emission coefficients by activity branch (percentiles p90, p75, p25, p10)



In recent years there has been **a decrease in the intensity of emissions** in all the branches of activity analysed, **especially in the most polluting ones** (fall in the 90th and 75th percentiles)



Methodology (II)

2. **Indicator of the intensity of the carbon footprint in the portfolio of loans to companies (IHCO2P):** it is calculated as the average of the total coefficients by NACE based on the weight of each branch in the portfolio of bank loans

The IHCO2P represents the average of the polluting emission ratios carried out by productive activities that obtain bank financing in relation to the total loans granted by credit institutions in Spain.

$$IHCO2P_t = \frac{\sum_i P_{it} q_{it}^{total}}{\sum_i P_{it}}$$

Pit: Stock of loans from credit institutions at the end of the year by branch of activity (i) and year (t)

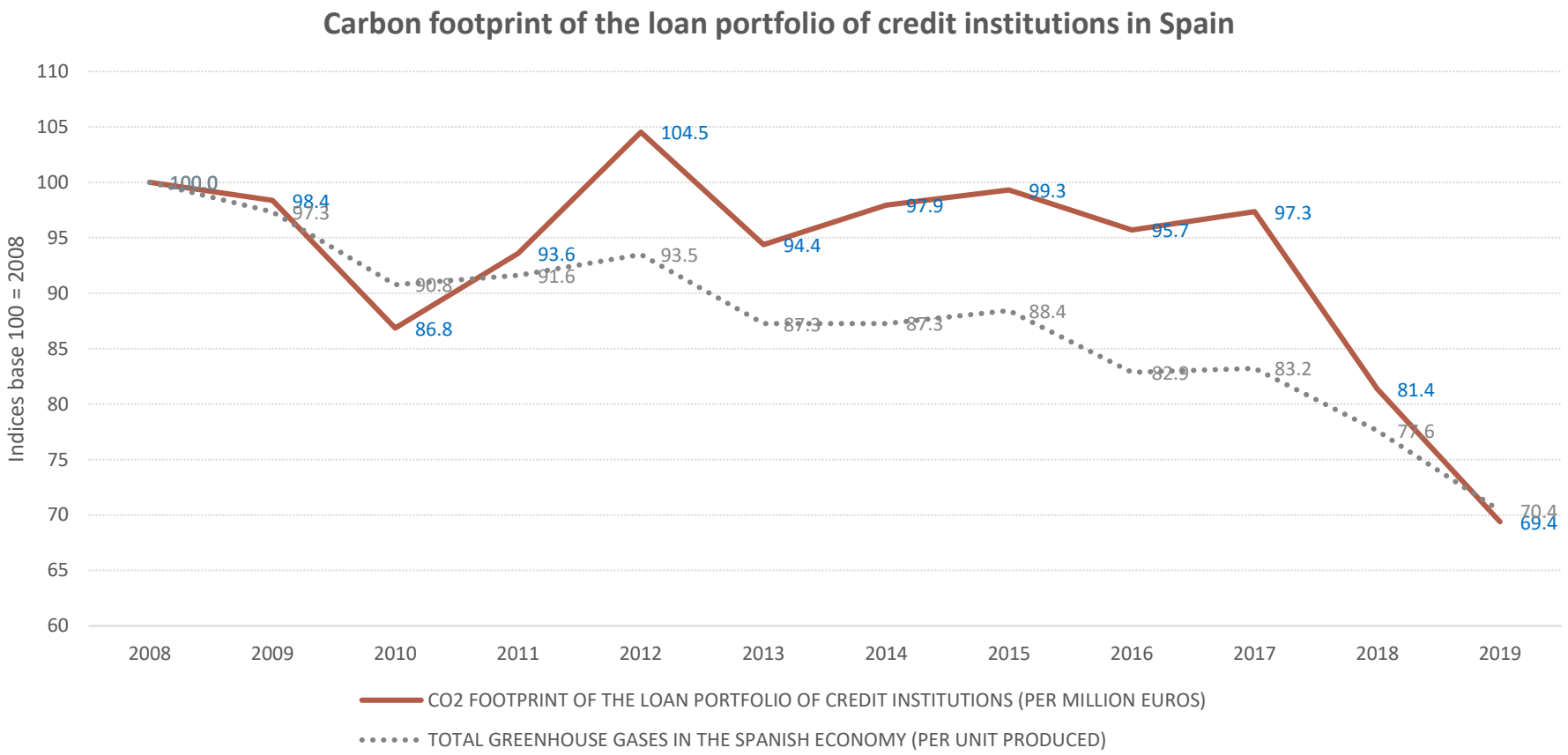
Indicator Interpretation:

- ↓ Falls → Improvement of the carbon footprint
- ↑ Rises → Represents a worsening

This is an approach similar to the one used in the works of:

- "The Higher Carbon Intensity of Loans, the Higher Non-Performing Loan Ratio: The Case of China (2017)" y;
- the **International Monetary Fund** (IMF) in its dashboard on climate change, in the block of financial indicators (link)

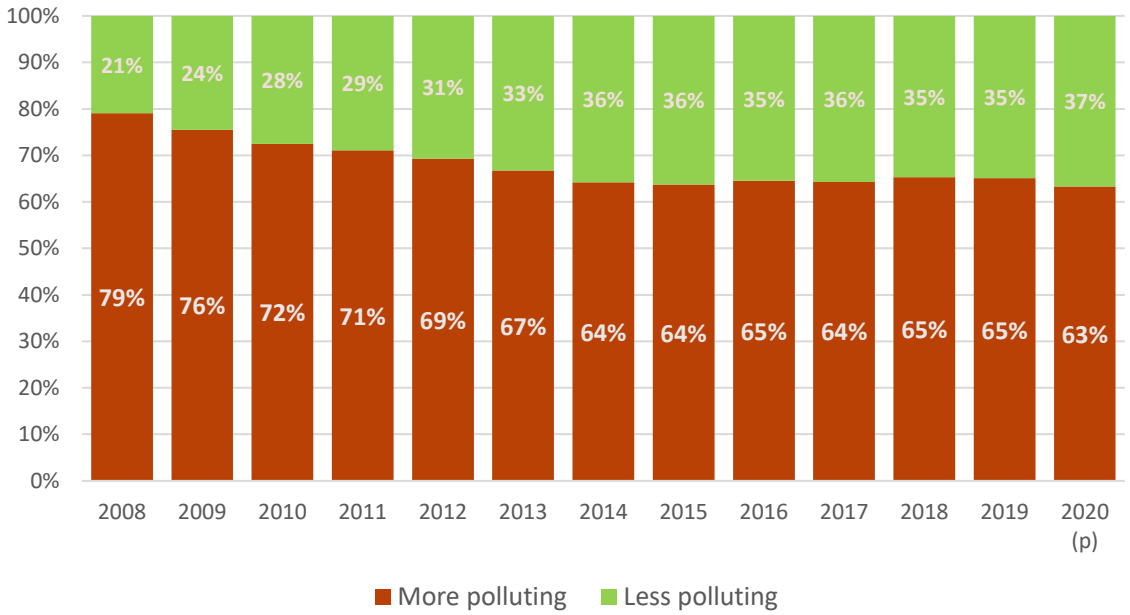
Comparison with the economy's total emissions intensity



Given the difficulty of interpreting the indicator in its original units (tons of CO2) and to facilitate its comparability, it is restated **in terms of an index** (base year: beginning of the 2008 series)

A comparison of the IHCO2P against the evolution of the intensity of emissions in the Spanish economy between 2008-2019 would show an **accumulated reduction of a very similar magnitude**

Structure of the loan portfolio of Spanish credit institutions based on the CO2 emissions of the financed productive activities

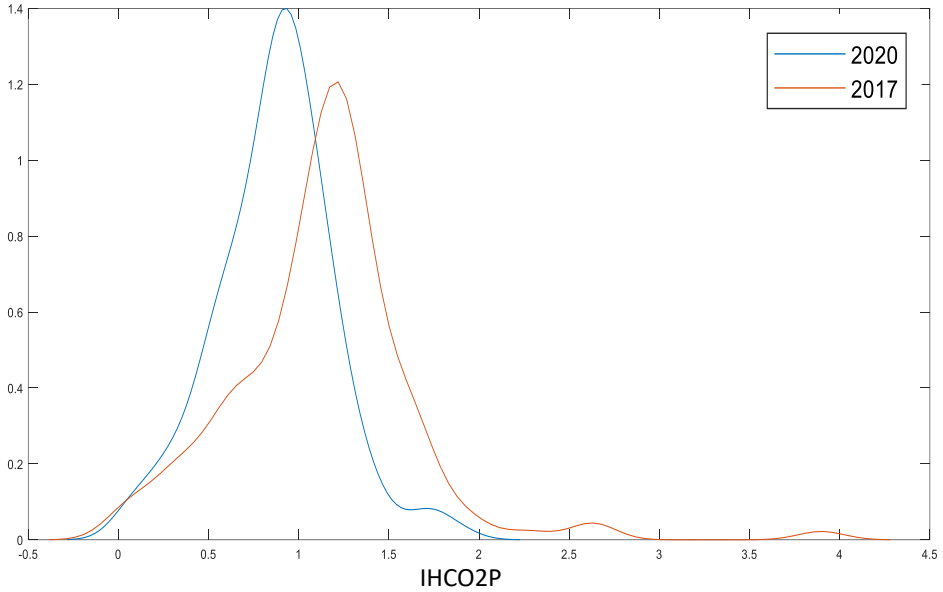


Classification of the productive branches based on the emission coefficient (average 2008-2020), in the absence of a standard, this rule is used:

- More polluting ≥ P50
- Less polluting < P50

A **slight recomposition of the loan portfolio of Spanish credit institutions towards less polluting** branches is identified

Analysis of the IHCO2P in individual data (at the credit institution level)



The carbon footprint of the loan portfolio has been **calculated for each credit institution in 2020** and 2017 (around 160 institutions)

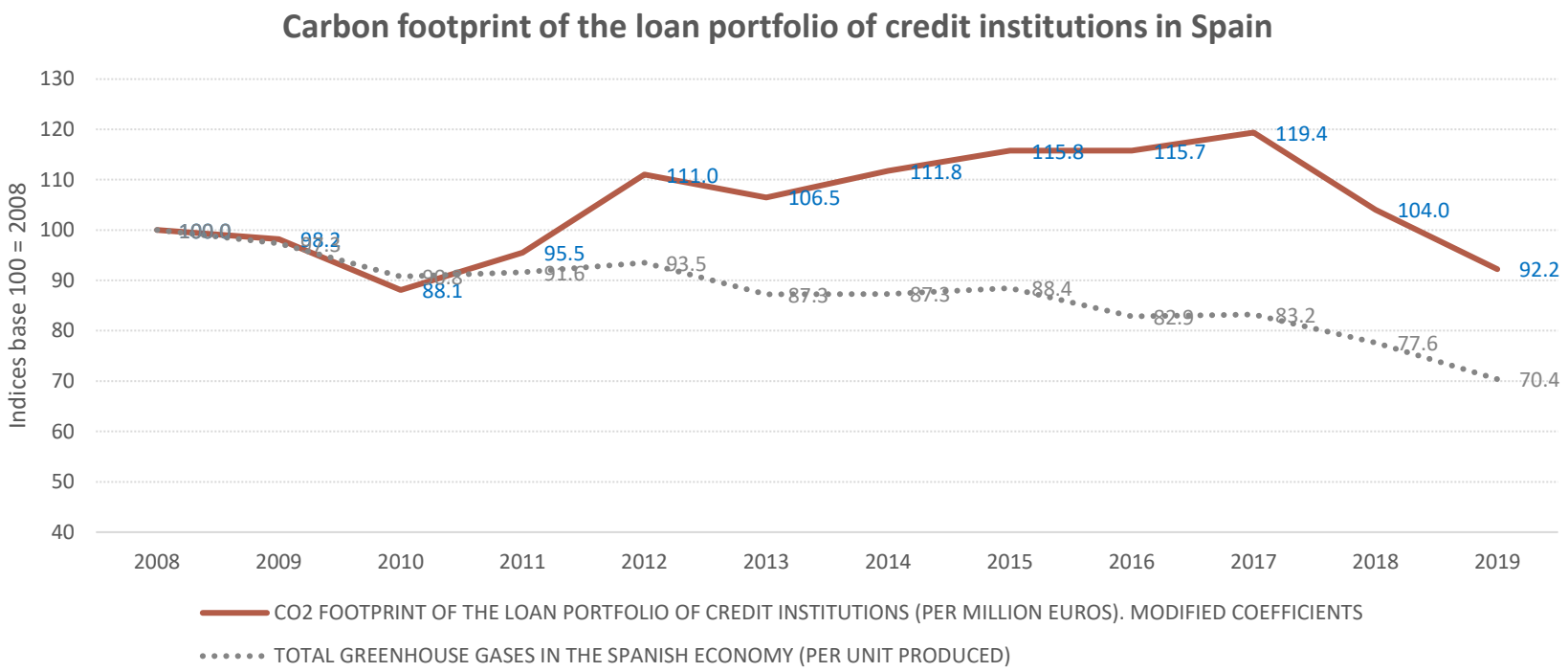
Through the representation of **Kernel functions**, a shift to the left of the density function is observed in 2020 compared to 2017

This information **would indicate a general decrease in the carbon footprint in the loan portfolio of credit institutions** in Spain in recent years

1. Incorporation in the calculation of the carbon footprint of the factors related to the productive and financial structure of the branches

$$q^{\text{modified totals}}_{it} = q^{\text{totals}}_{it} \times \underbrace{\frac{\text{Production (net turnover)}_{it}}{\text{Total balance sheet}_{it}}}_{\text{Productive structure ratio}} \times \underbrace{\frac{\text{Total balance sheet}_{it}}{\text{Financial liabilities}_{it}}}_{\text{Leverage ratio}}$$

Central Balance Sheet data: sample information and representative ratios from the BACH database (R41 and L ratios, respectively). Averages 2008-2019



This modification would make it possible to adjust the "**true" influence of bank loans** on the development of business activities in the calculation of emission coefficients.

The results would show a **less pronounced decline, almost stability**

LIMITATIONS AND POSSIBLE IMPROVEMENTS (II)

2. **The current NACE has significant limitations in capturing detailed information on economic activities and polluting emissions**

   An example is the non-differentiation in the electricity production branch of generation with renewable energies. It is known that the current international classifications of economic activities (ISIC rev 4) have important deficiencies. The climate issue has been incorporated into the discussion for future updates

3. **Treatment of loans to holding companies and headquarters:** assignment of the economic activity of the subsidiary companies

4. **Barriers to the use of loan information according to economic activity and non-purpose**

   The exercise of quantifying the footprint could be enriched if the **purpose of the loans were included in the classification** of the credit portfolio (for example, the acquisition of electric vehicles, energy saving investments) would allow a better measurement of the footprint of carbon

4. **Access to individual data on emissions and loans (at company or company group level) could refine this measurement**

   This improvement in the estimation of the footprint of bank loans should distinguish between segments of companies with **detailed and complete** information versus other groups of companies for which it would be necessary to make estimates and imputations (individual or aggregate)

5. **Extension to other financial instruments and sectors:** Loans to households, securities and investment fund portfolio

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THANKS FOR YOUR ATTENTION