DATING AND SYNCHRONISATION OF REGIONAL BUSINESS CYCLES IN SPAIN

2021

BANCO DE ESPAÑA
Eurosistema

Documentos Ocasionales
N.º 2107

Eduardo Bandrés, María Dolores Gadea
and Ana Gómez-Loscos

DATING AND SYNCHRONISATION OF REGIONAL BUSINESS CYCLES IN SPAIN (*)

Eduardo Bandrés

UNIVERSIDAD DE ZARAGOZA AND FUNCAS

María Dolores Gadea

UNIVERSIDAD DE ZARAGOZA

Ana Gómez-Loscos

BANCO DE ESPAÑA

(*) This article was published in a monographic issue of *Papeles de Economía Española* on Business Cycles (No 165, December 2020, Madrid, Funcas). The opinions and analyses in this paper are the responsibility of the authors and, therefore, they do not necessarily coincide with those of the Banco de España or the Eurosystem.

Documentos Ocasionales. N.º 2107

2021

The Occasional Paper Series seeks to disseminate work conducted at the Banco de España, in the performance of its functions, that may be of general interest.

The opinions and analyses in the Occasional Paper Series are the responsibility of the authors and, therefore, do not necessarily coincide with those of the Banco de España or the Eurosystem.

The Banco de España disseminates its main reports and most of its publications via the Internet on its website at: http://www.bde.es.

ISSN: 1696-2230 (on-line edition)

Abstract

The analysis of the regional business cycles in Spain highlights a high degree of similarity in the developments of most regions, but also shows idiosyncratic behaviour that mainly affects the duration and intensity of recessions. Such idiosyncratic behaviour would advise complementing national policies with specific policies aimed at certain territories. This paper adopts two complementary approaches in order to comprehensively date and analyse regional business cycles: the first uses an annual aggregate indicator such as GDP, for which a long series is available; the second focuses on a set of specific monthly indicators for a more recent period and provides a more accurate characterisation of the reference cycle

Keywords: regional cycles, synchronisation, clusters.

JEL classification: C32, E32, R11.

Resumen

El análisis del ciclo regional en España pone de relieve la existencia de una elevada coherencia en la trayectoria de la mayor parte de las regiones, pero también permite detectar comportamientos singulares, que, en su mayor parte, condicionan la duración e intensidad de las recesiones. Son estas singularidades las que aconsejarían completar las políticas de ámbito nacional con actuaciones específicas dirigidas a determinados territorios. Este trabajo adopta dos enfoques complementarios para datar y analizar el ciclo regional: el primero usa un indicador agregado de carácter anual, como el PIB, para el que se dispone de una serie larga y permite contextualizar los aspectos de más largo plazo, mientras que el segundo utiliza un conjunto de indicadores específicos mensuales para un período más reciente y proporciona una caracterización más precisa del ciclo de referencia.

Palabras clave: ciclos regionales, sincronización, *clusters*.

Códigos JEL: C32, E32, R11.

Contents

1 Introduction

In business cycle analysis the regional dimension is crucial owing to the sizeable degree of heterogeneity that may exist within a single country. In-depth study of the stylised facts of regional business cycles, the dating of such cycles and their degree of similarity may prove useful for better understanding the potential effects of general countercyclical policies in different regions, and for designing measures adapted to the specific needs of certain territories. In Spain, studying the business cycle is particularly important as the country has considerable regional disparities and strongly decentralised political arrangements. Such analysis is all the more important at a time when the economic outlook has been completely altered by the crisis caused by the COVID-19 pandemic. This entails strong disruption to economic activity, and its duration and intensity are very uncertain.

Despite the value of the analysis of regional business cycles, the literature identifying cyclical patterns has been mainly applied to countries;[1] analysis at a more disaggregated geographical level is less frequent, owing, among other things, to the absence of appropriate data.[2] However, several recent papers have focused on analysing the regional cycle in Europe using different approaches and methodologies. See, for example, Ozyurt and Dees (2015), Gadea, Gómez-Loscos and Bandrés (2018), Gadea, Gómez-Loscos and Leiva-León (2019) and Gómez-Loscos, Gadea and Bandrés (2020).

In the case of regional cycles in Spain, a series of papers offering pertinent contributions have been published in recent years. Among those most closely linked to the objective of this paper, Gadea, Gómez-Loscos and Montañés (2012) show that cycles in Spain, while evidencing some degree of synchronisation, are fairly heterogeneous. Further, they identify five groups of regions, with the most synchronised being those with a high industrial weight, higher per capita income, better human capital endowment and low unemployment rates. They also detect an inverse relationship between the business cycle and synchronisation, whereby the latter increases in recessions and declines in expansions. In turn, Bandrés and Gadea (2013) analyse the effect the Great Recession had on regional cycles. Their findings are that the Great Recession prompted a significant increase in the synchronisation of regional cycles, albeit with heterogeneity across the different responses. Hence, regions with greater synchronisation, higher initial per capita income, lower structural unemployment, a greater level of human capital and a greater degree of openness better withstood the impact of the crisis.

Finally, Camacho, Pacce and Ulloa (2019) characterise regional business cycles in Spain and find that their synchronisation has increased since the Great Recession. They also identify certain regions with lead or lag patterns in the transmission of cycles. Generally, the initial signs of a recession will begin to be seen in the islands and certain

1 See De Haan, Inklaar and Richard (2008) and Giannone, Lenza and Reichlin (2010) for a summary.

2 See Bandrés, Gadea-Rivas and Gómez-Loscos (2017) for a review of this literature.

other regions, spreading subsequently from the periphery to the centre, while the north-western regions would take longer to begin to recover.

Against this background, our paper aims to establish the dating of the regional business cycles in Spain and to analyse their behaviour, identifying their main characteristics and the degree of cross-regional synchronisation. To this end, we adopt two complementary approaches: the first uses an annual aggregate indicator such as GDP, for which a long series is available; and the second takes a set of specific monthly indicators, which allow a more accurate characterisation of the reference cycle, albeit for a shorter period.

The results of this paper show that cyclical correlation of Spanish regions (higher in recessions than in expansions) is higher in the Spanish mainland's central and northern regions and in the Balearic Islands, showing different profiles in the southern regions and in Asturias and the Canary Islands. Some regions have longer and more extensive recessions than others and, conversely, their recoveries are slower and shorter-lasting. There is certainly a very integrated core of 11 regions, with higher levels of per capita income, a greater weight of industry, better endowed human capital and lower structural unemployment, and at least another six regions, accounting for roughly one-quarter of national GDP, whose behaviour differs greatly, largely on account of the characteristics of their productive structure and factor endowment.

The paper is structured as follows. The second section describes the different series used in the analysis of regional cycles in Spain. They all provide different types of information on the economic situation and, taken as a whole, they provide for an appropriate characterisation of the regional business cycles. The third section describes the methodological tools available for identifying and dating the business cycle, its characteristics and the synchronisation measures used. The fourth section performs an initial dating of the regional cycles, taking an extensive time span (1955 to 2018), and the main characteristics of the regional cyclical phases and their degree of comovement are calculated. Focusing on the more recent period (from 1982 to early 2020), the fifth section uses the greater wealth and frequency of the information available to analyse the reference cycle. On this basis, a monthly dating is obtained, delving deeper into the territorial characteristics and into their synchronisation, with groups of regions defined by their cyclical correlations also being established. Finally, the last section draws the main conclusions.

2 The regional series

One of the main challenges researchers face in analysing the business cycle at the regional level is that of finding series of sufficient quality, high frequency and length. There are two alternatives for appropriately dating the reference cycle of a region, country or economic area: either using an aggregate series that is sufficiently representative of overall economic activity, usually GDP, or aggregating the results of a significant set of specific indicators. In the case of the Spanish economy, the National Statistics Institute (INE) compiles the Regional Accounts annually and the longest available series range from 2000 to 2018. Some researchers and institutions have disaggregated regional GDP series into quarterly data (see Bandrés and Gadea (2013) and AIReF (2015)). And more recently, De la Fuente and Ruiz-Aguirre (2020) have published long annual series of GVA and regional employment by sector for the 1955-2018 period.

Regarding the indicators, Table 1 shows the series in which monthly data of an acceptable length for performing conjunctural analysis are available. A significant series in view of its length and frequency is INE's monthly Industrial Production Index (IPI). By linking the different bases (1990, 2000, 2005 and 2010) it is possible to obtain a homogenous series for the 17 Spanish regions from October 1991 to November 2019.[3] Despite the fact that the weight of the industrial sector is currently small in all Spanish regions (15.8% of aggregate GVA), the IPI can serve as a representative series given its high sensitivity to the cycle and its high correlation with changes in GDP. The main problems are its high volatility and low representativeness, especially in those regions highly dependent on the services sector.

Another significant series is the number of Social Security registrations, which is available from January 1982 to the present day and which represents the changes in employment in each region. The characteristics of this series are the opposite of those of the IPI, since it is a highly inertial series which usually reflects the delay in the labour market reaction to the business cycle and, in particular, job creation in expansionary phases.

The remaining series, whose sources and periods are detailed in Table 1, are (with Spanish acronyms in brackets): retail consumption index (ICM), services sector activity indicator (IASS), new passenger car registrations (MATRI), commercial vehicle registrations (MATRICARG), mortgage loans (HIPOT), house sales and purchases (VIVI), overnight stays in hotels (PERNOC), foreign trade, including exports (EXPORT) and imports (IMPORT), new commercial companies (SMCONST) and dissolved commercial companies (SMDISUELT), government procurement (LICOFIC) and freight transport (TRANSP). All these series provide complementary information on the state of the regional economic situation and, therefore, on the business cycle, although they represent partial aspects and, in some cases, their scant length and atypical behaviour makes their use for dating the cycle difficult.

3 The main methodological changes refer to the classification of economic activities, CNAE, and, therefore, they do not affect the aggregate series.

Table 1
SHORT-TERM INDICATORS

	First figure	Latest figure	Source
Social Security Registrations (AFI)	Jan-82	Jan-20	Ministerio de Trabajo, Migraciones y Seguridad Social
Industrial Production Index (IPI)	Oct-91	Dec-19	INE
New Passenger Car Registrations (MATRI)	Apr-92	Dec-19	Anfac
New Commercial Vehicle Registrations (MATRICARG)	Apr-92	Dec-19	DGT
Retail Consumption Index (ICM)	Total: Jan-00 Regions: Jan-03	Dec-19	INE
Services Sector Activity Indicator (IASS)	Jan-02	Nov-19	INE
Mortgage loans (HIPOT)	Jan-94	Nov-19	INE (Real Estate Registry)
House sales and purchases (VIVI)	Jan-07	Nov-19	INE (Real Estate Registry)
Overnight stays in hotels (PERNOC)	Jan-99	Dec-19	INE (Hotel Occupancy Survey)
Foreign trade (EXPORT, IMPORT)	Jan-95	Nov-19	Datacomex (Ministerio de Industria, Comercio y Turismo)
New and dissolved registered companies (SMCONST, SMDISUELT)	Jan-08	Nov-19	INE (Central Mercantile Register)
Government procurement (LICOFIC)	Jan-89	Dec-19	Ministerio de Transportes, Movilidad y Agenda Urbana
Freight transport (TRANSP)	Jan-93	Dec-19	Ministerio de Transportes, Movilidad y Agenda Urbana

SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

The study covers the 17 Spanish regions (the autonomous enclave cities of Ceuta and Melilla are excluded). The regions and their related Spanish acronyms are, in this order: 01. Andalusia (AND), 02. Aragon (ARA), 03. Asturias (AST), 04. Balearic Islands (BAL), 05. Canary Islands (CAN), 06. Cantabria (CANT), 07. Castile-Leon (CYL), 08. Castile-La Mancha (CLM), 09. Catalonia (CAT), 10. Valencia (CVAL), 11. Extremadura (EXT), 12. Galicia (GAL), 13. Madrid (MAD), 14. Murcia (MUR), 15. Navarre (NAV), 16. Basque Country (PVAS) and 17. Rioja (LAR). In addition, analysis is also made of the national whole: 00. Spain (ESP).

3 Methodology

Two complementary approaches are adopted to date the regional business cycles. First, the historical series of De la Fuente and Ruiz-Aguirre (2020) are used to obtain a longer time perspective. For this purpose, a dating algorithm is used directly, based on an aggregate without any previous filter, since they are annual series and, therefore, there are no seasonality problems or other sources of distortion that might hamper the cycle's signals. Subsequently, business cycles are described and the methodology used to analyse the synchronisation of long-term regional cycles is presented.

Second, the methodology available to analyse the reference cycle based on indicators is reviewed. Given the idiosyncrasy of Spain's regional data, the Burns and Mitchell (1946) approach is used to identify peaks and troughs, and diffusion indices are calculated based on the work of Artis, Krolzig and Toro (2004).

3.1 Aggregate-based dating

This approach is used to define the business cycle as periodic, albeit irregular, movements in GDP above and below its long-term growth trend. Thus, we consider two phases: expansion and recession. In the expansion phase GDP grows until a (local) maximum is reached and the contraction phase begins when GDP starts to decline, reaching a (local) minimum after several periods of negative growth. These local maxima and minima are called peaks and troughs and they are the basis of many business cycle dating algorithms. The algorithm used in this paper is an adaptation for annual data of that developed by Bry and Boschan (1971) (hereafter, BB) for monthly series, which was subsequently applied to quarterly series by Harding and Pagan (2002). This algorithm consists of a set of filters and rules, applied to moving averages of the series with different windows, which separates the local minima and maxima in an aggregate series into levels. It is also subject to restrictions that may affect the length and amplitude of the expansion and recession periods. The result is a series of turning points (peaks and troughs) which delimit the cyclical phases.

3.2 Characteristics of the cycle

Once the business cycle chronology is established, it is possible to obtain important information on the characteristics relating to the duration, depth and shape of the cycles. Following Harding and Pagan (2002), we can define for each region i the duration D_{ij}^{R}, amplitude A_{ij}^{R}, cumulation C_{ij}^{R} and excess E_{ij}^{R} for each recession j and, analogously, the duration D_{ij}^{E}, amplitude A_{ij}^{E}, cumulation C_{ij}^{E} and excess of each expansion E_{ij}^{E}.

The first characteristic, duration, is defined, in the case of recessions, as the time elapsed between the j-th peak and the following trough, while in the case of expansions, it is the time elapsed between the j-th trough and the following peak. The second characteristic is amplitude, representing the total percentage of loss/gain during the recession/expansion in terms of GDP.[4] The third measure, cumulation, measures the severity of the recession/expansion, taking into account the cycle's duration, amplitude and shape; intuitively, it could be interpreted as the wealth lost/gained during the recession/expansion.[5] The shape of the recession or expansion is reflected precisely in the last characteristic noted, excess, which is defined as the difference between the real pattern of GDP growth during the cyclical phase and that which would arise with linear growth. This measure is particularly significant in the case of expansions, since it allows us to calibrate the recovery dynamic to the path of trend growth. A positive excess, with a concave shape, means that the recovery begins vigorously and, therefore, that the return to trend and job creation are faster. By contrast, a negative excess, with a convex shape, indicates a slower recovery. In the case of recessions, a negative excess indicates an initial collapse that moderates over the course of the recession, while a positive excess reflects gradual changes in the slope at the beginning of the phase that may become abrupt towards the end.

3.3 Synchronisation measures

There is ample literature on business cycle synchronisation measures.[6] Two different approaches are adopted in this paper. The first uses the original series, i.e. real GDP growth rates, and calculates the modified Moran spatial index (MSW) in accordance with the Stock and Watson formulation (2008). This index summarises in a single scaling the degree of comovements in economic activity across all the regions and over time. MSW has the following expression:

$$\widehat{MSM}t = \frac{\sum_{i=1}^{N}\sum_{j=1}^{i-1}\widehat{cov}\left(y_{it}\, y_{jt}\right)/N\left(N-1\right)/2}{\sum_{i=1}^{N}\widehat{var}\left(y_{it}\right)/N}$$

where

$$\widehat{cov}\left(y_{it}\, y_{jt}\right) = \frac{1}{k}\sum_{s=t-E[\frac{k}{2}]}^{t+E[\frac{k}{2}]}(y_{is} - \overline{y_{is}})(y_{js} - \overline{y_{js}})$$

$$\widehat{var}\left(y_{it}\right) = \sum_{s=t-E[\frac{k}{2}]}^{t+E[\frac{k}{2}]}(y_{is} - \overline{y_{is}})^2$$

$$\overline{y_{it}} = \sum_{s=t-E[\frac{k}{2}]}^{t+E[\frac{k}{2}]} y_{is}$$

4 Taking logs in the series in levels, this can be easily calculated as the difference between the log GDP in the peak minus the log GDP in the trough in the case of a recession and, analogously, as the difference between the log GDP in the trough minus the log GDP in the peak, for an expansion.

5 Harding and Pagan (2002) suggest calculating cumulation with a triangular approximation (multiplying duration by amplitude and dividing this by two) with a correction of the bias. This paper uses a more accurate method, calculating by means of numerical methods the area below the log GDP between the corresponding peak-trough (recession) or trough-peak (expansion).

6 See Harding and Pagan (2006) for a review of the literature on synchronisation measures.

where $\overline{y_{it}}$ is the annual GDP growth rate of region i in year t and k is the window that changes depending on the data frequency, length and smoothing to be introduced in the changes in comovements. This index ranges from 1 to -1; the higher its absolute value, the greater the degree of comovement. Positive/negative values indicate that the regions' economic activity moves in unison or in opposite directions.

The second group of measures considers the business cycle chronology. In other words, synchronisation is calculated once the turning points have been identified. Under this approach, Harding and Pagan (2006) suggest a correlation index between the cyclical situation of each pair of regions based on the phase they are in. This overcomes some of the shortcomings of other measures, such as the traditional concordance indices for binary variables (Harding and Pagan (2002)). Where S_{it} and S_{jt} are the binary variables that take the value of 1 when a region is in recession and of 0 when it is in expansion, the correlation index $\widehat{\rho_{S_{ij}}}$ may be estimated in the following regression:

$$\rho_{S_{it}}^{-1} \rho_{S_{it}}^{-1} S_{it} = \alpha + \rho_{S_{ij}} \rho_{S_{it}}^{-1} \rho_{S_{it}}^{-1} S_{jt} + \varepsilon_t$$

Also, it is possible to check for significance by means of the method of moments. In order for the inference to be robust in the presence of serial autocorrelation and heteroscedasticity, the Newey-West method, using the Bartlett window, is used. The index values can be calculated for each pair of regions and for each region with respect to Spain. They can also be shown in a scaled multidimensional map to observe similarities and differences across regions.

3.4 Dating the reference cycle

As mentioned earlier, the reference cycle may be obtained based on an aggregate indicator. However, it can also be calculated by taking a set of specific indicators that should coincide as much as possible with the cycle. The question of how to aggregate the turning points, peaks and troughs extracted from such indicators and compute the common cycle has been subject to discussion in the literature.

The pioneering work of Burns and Mitchell (1946) proposed performing a visual inspection of the turning points of each indicator. Subsequently, Harding and Pagan (2006, 2016) made more sophisticated proposals, developing an algorithm that minimises the distance between the possible reference turning points and those obtained with individual series. Stock and Watson (2010, 2014) also made important contributions to the literature. In the first paper, they assume that time is segmented into cyclical episodes and the data are given a panel structure. In the second, they consider turning points as population concepts, which allows them to make inferences about the estimated reference cycle. The main weakness of Stock and Watson's (2010, 2014) contributions is that previous knowledge of the reference cycle is required. Camacho, Gadea-Rivas and Gómez-Loscos (2020) overcome this limitation by considering each pair of turning points as the materialisation of a mixture or combination of bivariate normal distributions whose average, estimated by Bayesian methods, corresponds to the peak-trough (or trough-peak) of the reference cycle.[7]

However, given the limited quality of the data available at regional level, it is advisable to use methods providing more flexibility at the expense of greater econometric sophistication. Therefore, in this paper, in order to perform a regional cyclical dating we will take into account two approaches. First, following Burns and Mitchell (1946), heat maps will be displayed to identify clusters of peaks and troughs. Second, taking into account the proposal of Artis, Krolzig and Toro (2004), diffusion indices will be calculated. To this end, we will define expansion or recession in the regional reference cycle when a sufficiently high number of specific indicators are in the same cyclical phase. In order to take into account the degree of lead or lag of the series, the existence of a peak or trough over a period of around three months will be considered.

7 A good review of the literature is the recent contribution by Piger (in the press) which also includes highly innovative techniques related to machine learning. Pagan (2020) and Grigoras (2020) also summarise the different treatments relating to reference cycle estimation.

4 The long-term regional cycle

In this section we analyse the regional GDP historical series prepared by De la Fuente and Ruiz Aguirre (2020). For this purpose, the regional cycle is dated by applying the aggregate-based dating methodology. A series of features that characterise regional cyclical phases are calculated and their degree of similarity is analysed.

4.1 Determining the dating of regional business cycles

By applying the BB algorithm to the GDP annual historical series for 1955-2018, the business cycle for Spain as a whole and for its regions is obtained (see Chart 1). Several recessions are identified over the course of those 64 years, in the following periods: 1977, 1981, 1993, 2009 and 2011-2013. The first two reflect the effect of the supply shocks that were triggered by the 1974-1975 and 1979-1980 energy crises and the rise in labour costs, with the latter coinciding with the final years of the dictatorship and the beginning of the transition towards democracy. In the early 1990s the economic slowdown in Europe and the European monetary system crisis led to an intense, albeit brief, recessionary situation, which was delayed in the case of Spain in part owing to the effect of the high volume of public investment in those years. The last two recessions relate to the global financial crisis and the sovereign debt crisis in Europe. In the first case, Spain entered into recession somewhat later than the United States and most other European Union countries, while in the second it coincided in time with the other European economies. In both cases, the imbalances accumulated by the Spanish economy in the previous years exacerbated the intensity and duration of the recession, from which it only began to recover towards the end of 2013. This was followed by another period of economic recovery, until the outbreak of the COVID-19 pandemic in 2020 Q1.

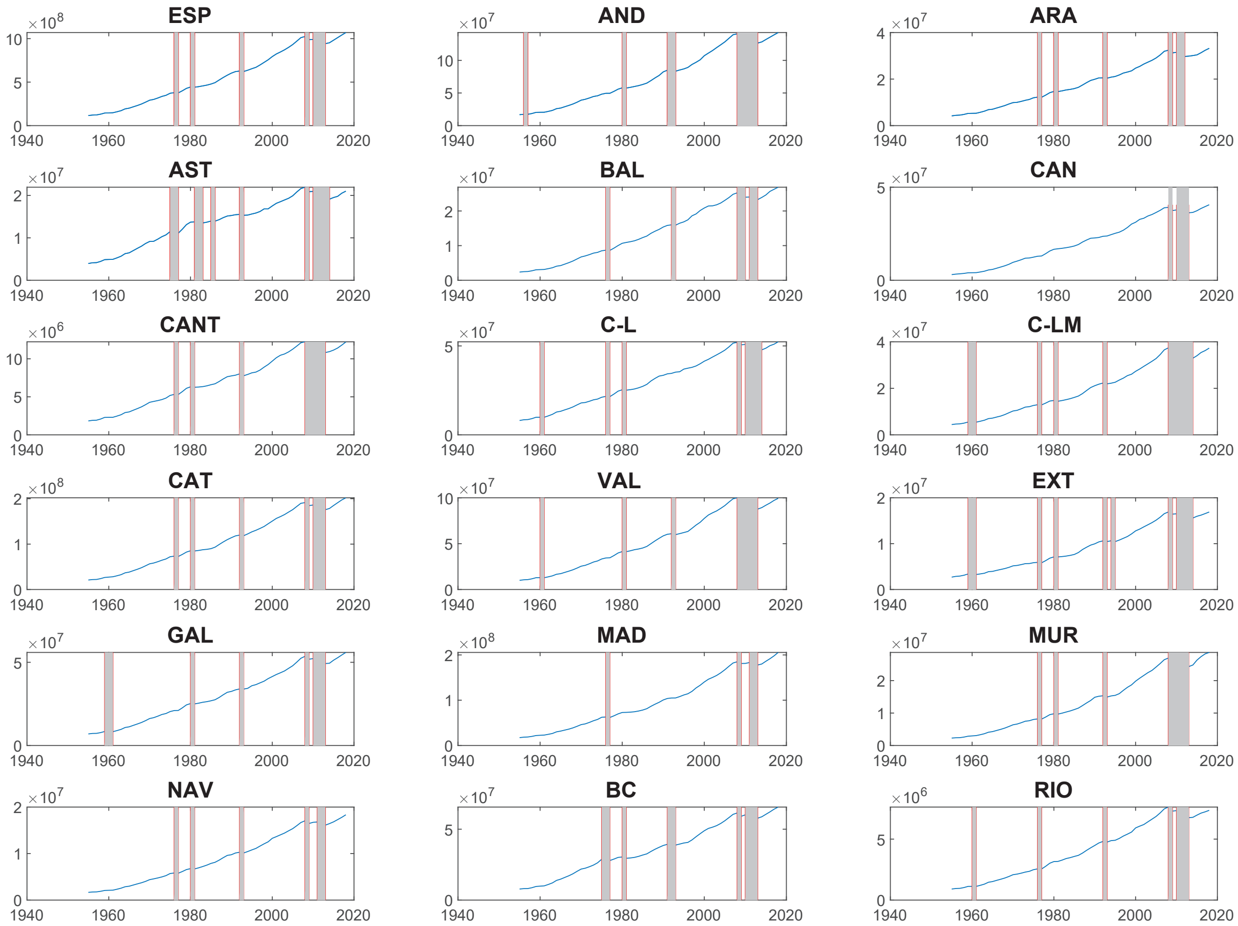
Although these results were obtained from annual data, they are in line with those provided by the Business Cycle Dating Committee of the Spanish Economic Association, which places the recessionary periods in 1978 Q4-1979 Q2, 1992 Q2-1993 Q3, 2008 Q3-2009 Q4 and 2011 Q1-2013 Q2.[8]

The dating pattern for Spain’s regions on the basis of this annual database is very similar, although there are some differences. Most of these regions bore the impact of the oil crisis in the 1970s and early 1980s, the 1992-1993 recession and, finally, the Great Recession. However, in this last case, the duration and presence of the characteristic double-dip differ. In some regions a recession around 1960, related to the initial effect of the 1959 Stabilisation Plan, is also identified. The most atypical behaviour is found in the Canary Islands, where only the global financial crisis appears to be detected, and in Madrid, which was not affected by the crisis of the early 1990s.

8 Details of the methodology can be found at http://asesec.org/CFCweb/.

Chart 1

REGIONAL BUSINESS CYCLES, 1955-2018



SOURCE: Own calculations based on data of De la Fuente and Ruiz Aguirre (2020).

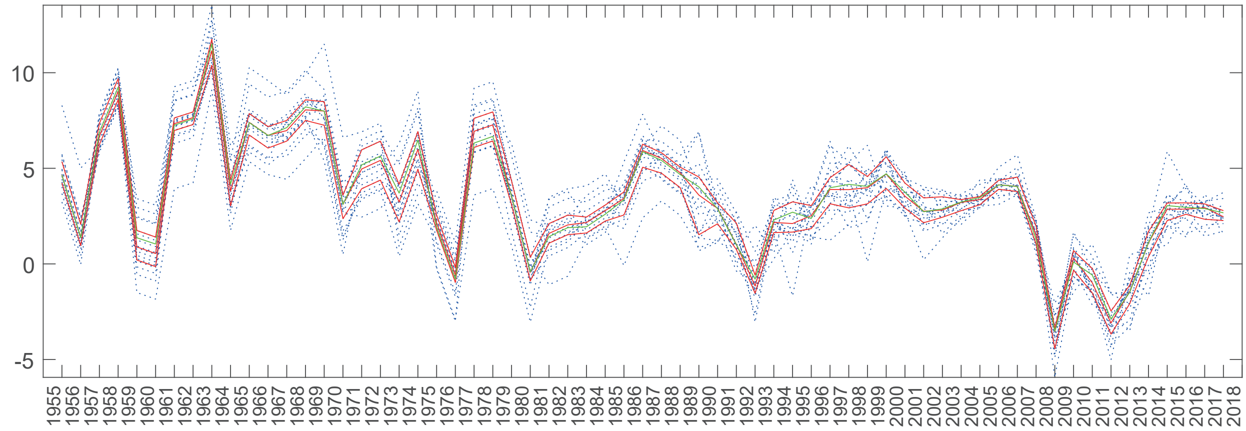
4.2 Synchronisation

The presence of some heterogeneity in the dating of the regional business cycles raises questions about cyclical synchronisation over the course of the last six decades. To analyse the degree of similarity in regional cycles we first analyse changes in comovements. Chart 2.1 depicts changes in Spanish GDP growth in green, the median and the 25th and 75th regional quartiles in red and, lastly, regional growth rates as a broken blue line. Although on average high cyclical synchronisation is observed, at times the regions show significant discrepancies.

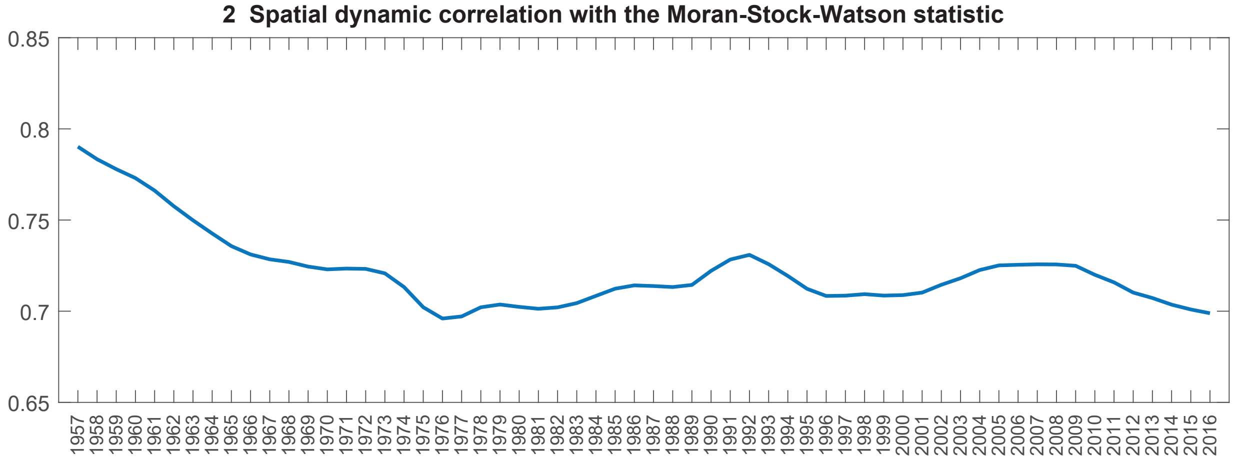
In order to more accurately measure synchronisation and pinpoint the periods of greater or lesser discrepancy, the Moran spatial correlation index modified by Stock and Watson (MSW) was calculated. The results are shown in Chart 2.2. It can be inferred from the statistic that the correlation has, in general, been high during the period analysed (0.72 on average), but at times the regional cycles have performed more unevenly. A

Chart 2
REGIONAL GDP COMOVEMENTS, 1955-2018

1 Changes in regional GDP growth rates in Spain



2 Spatial dynamic correlation with the Moran-Stock-Watson statistic

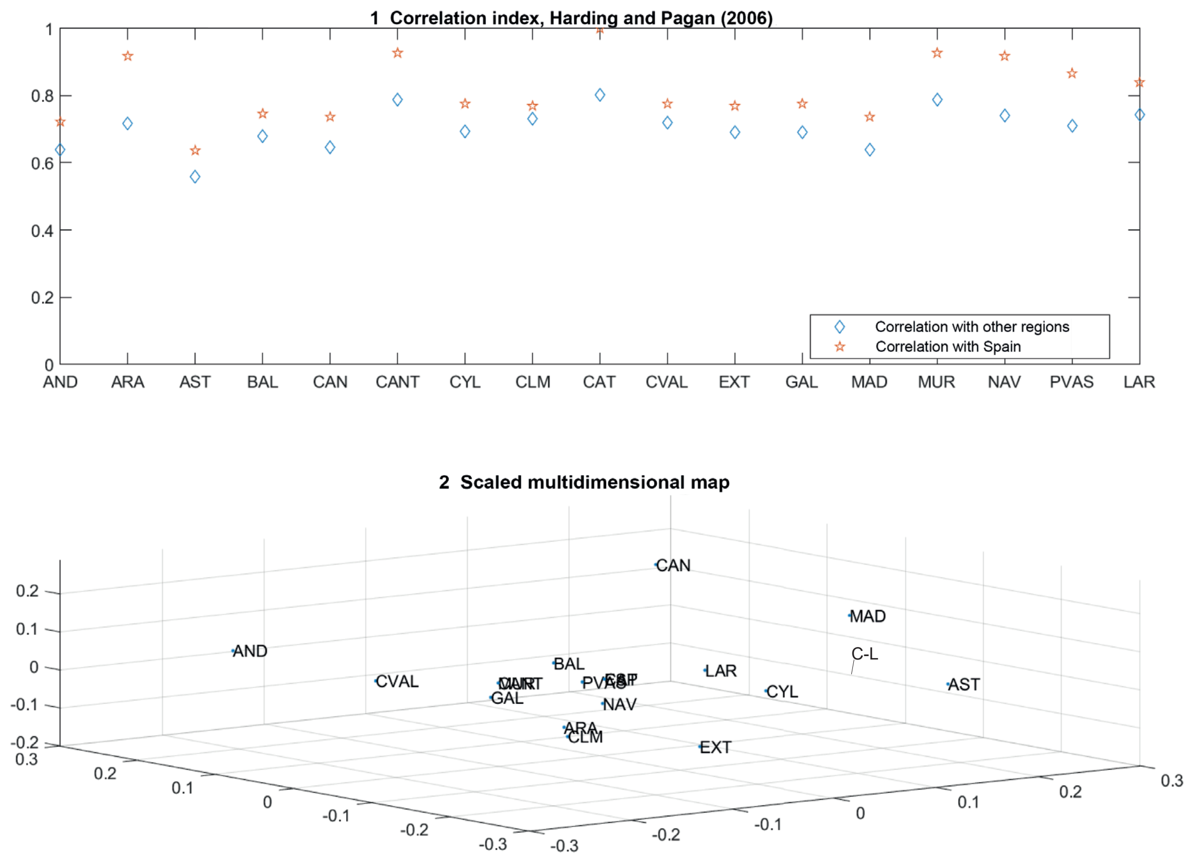


SOURCE: Own calculations drawing on data of De la Fuente and Ruiz Aguirre (2020).

decline in synchronisation is observed over the long economic development period which spans from the beginning of the sample until the mid-1970s. From then on, the index remains relatively stable, except during the recession of the early 1990s and the global financial crisis, when synchronisation between regions increased. Finally, regional synchronisation declined gradually in the latest expansionary phase, reaching the lowest value of the series in 2017.

To complement this analysis, we have calculated Harding and Pagan's (2006) correlation index, represented in Chart 3.1. Over the period analysed the correlation of the regions with Spain averages 0.81. Catalonia, Cantabria, Murcia, Navarre and Aragon are the regions whose business cycle is most similar to that of Spain overall, while Asturias has the most different cycle. The result of comparing the regions among themselves (0.70 on average) is very similar: Catalonia, Cantabria and Murcia show a higher correlation than the

Chart 3
SYNCHRONISATION BETWEEN REGIONAL CYCLES, 1955-2018



SOURCE: Own calculations based on data of De la Fuente and Ruiz Aguirre (2020).

others, while Asturias' cycle is, once again, the most different. To summarise this information, Chart 3.2 maps the distances between the different regional cycles.

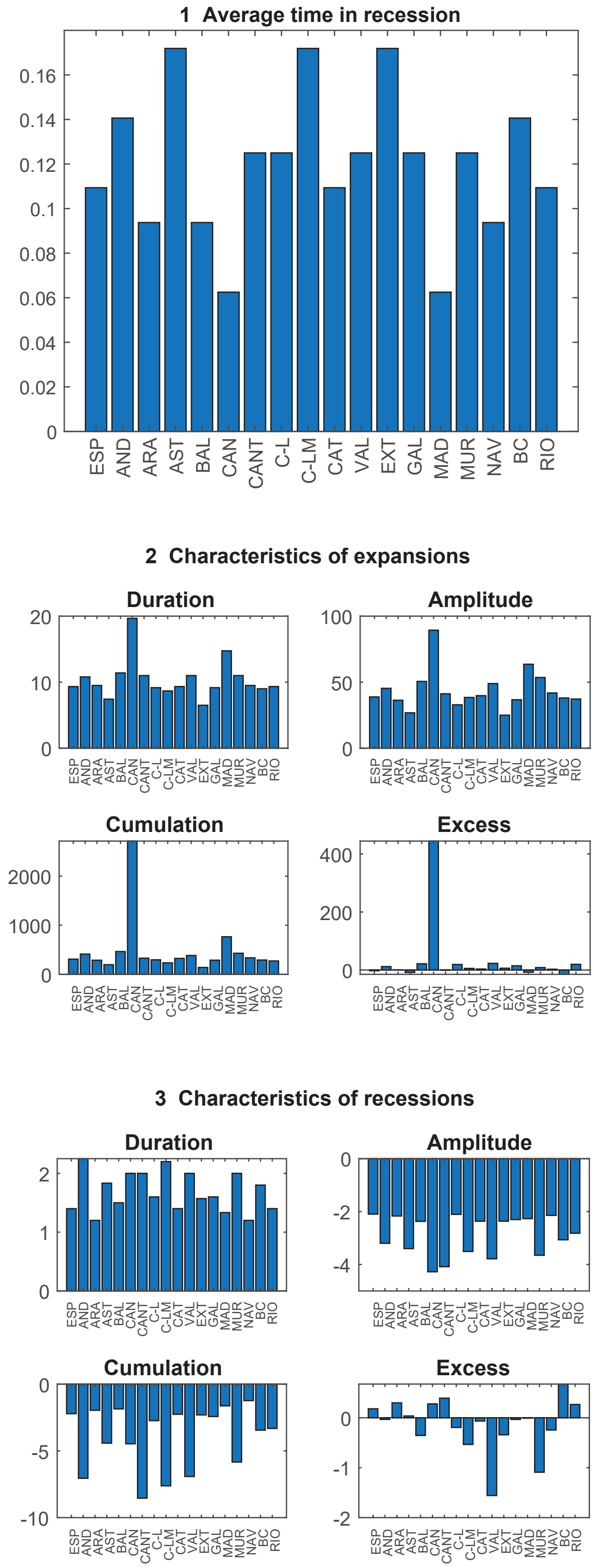
4.3 The characteristics of the regional business cycles

The typology of cyclical phases proposed by Harding and Pagan (2002) enables the characteristics of regional cycles to be studied in greater detail. Chart 4.1 depicts the time that each of the regions has been in recession during the period analysed. Asturias, Castile-La Mancha and Extremadura are notable as the regions that have spent most time in recession (11 years out of the 64 analysed), followed by Andalusia and the Basque Country (nine years). At the other extreme, Madrid and the Canary Islands are the regions which, with annual data, have spent the least time in recession (only four years).

Charts 4.2 and 4.3 show the characteristics of expansions and recessions, respectively. As regards expansions, their average duration is somewhat less than ten years,

Chart 4

CHARACTERISTICS OF SPANISH REGIONAL BUSINESS CYCLES



SOURCE: Own calculations based on data of De la Fuente and Ruiz Aguirre (2020).

with significant cross-regional differences. Standing above this figure are the Canary Islands, with almost double the duration, and Madrid, where the average expansion is 15 years. At the opposite extreme, expansionary phases in Extremadura and Asturias last on average six and seven years, respectively.

The amplitude of expansions averages 43.6%, with the Canary Islands, Madrid, Murcia and the Balearic Islands once again standing out. Conversely, Extremadura and Asturias evidence the lowest values. Cumulation follows the same regional pattern.[9] With regard to excess, the regions with bigger and positive excess are the Canary Islands, Valencia, the Balearic Islands and Rioja, i.e. recoveries in these regions begin with a high growth rate that subsequently eases. Madrid shows negative excess, with the Basque Country posting the worst value and, therefore, less dynamism in recovery following a recession.

In relation to recessions, the average duration is 1.7 years and, in this case, dispersion is much lower. The longest recessions are in Andalusia, the Canary Islands, Cantabria and Murcia. And in terms of excess, the most negative values are for Valencia and Murcia, i.e. these regions are characterised by a strong contraction in activity that progressively eases over the course of the recession. Conversely, the Basque Country, Cantabria, Aragon, the Canary Islands and Rioja show higher positive excesses, whereby their recessions are characterised by a gradual worsening at the beginning of the phase, which ultimately becomes more marked.

9 The Canary Islands evidence differential behaviour in relation to the other regions owing to the absence of recessions during the 1970s-80s; cumulation is higher than in other regions and influences the results of the excess measurements.

5 The reference cycle of Spanish regions

Examination of the regional cycle using annual GDP data provides a long-term perspective – of over 60 years – comprising the different phases through which Spanish regions have moved since the "pre-stabilisation" years (the mid-1950s), when Spanish economic policy began to take its first steps in the liberalisation of the economy and external openness. However, when analysing the cycle, whether at national or regional level, annual data can mask changes of a lower frequency, which would be countered by the calculation of average values. This might affect both the identification of the phases and their main characteristics.

This section uses all the information available to estimate the reference cycle on the basis of monthly indicators in the period running from 1982 to early 2020, employing the methodology described in the third section. Firstly, we locate the turning points of each of the series according to the BB algorithm. This is applied to the original series, which have been previously filtered using the Tramo-Seats procedure to obtain the trend-cycle component, stripping out seasonal and calendar effects and the irregular component, which might give rise to considerable distortions. Moreover, the algorithm's decision rules have been devised to avoid excessively short cycles.

5.1 Specific indicators: dating of the regional cycle 1982-2020

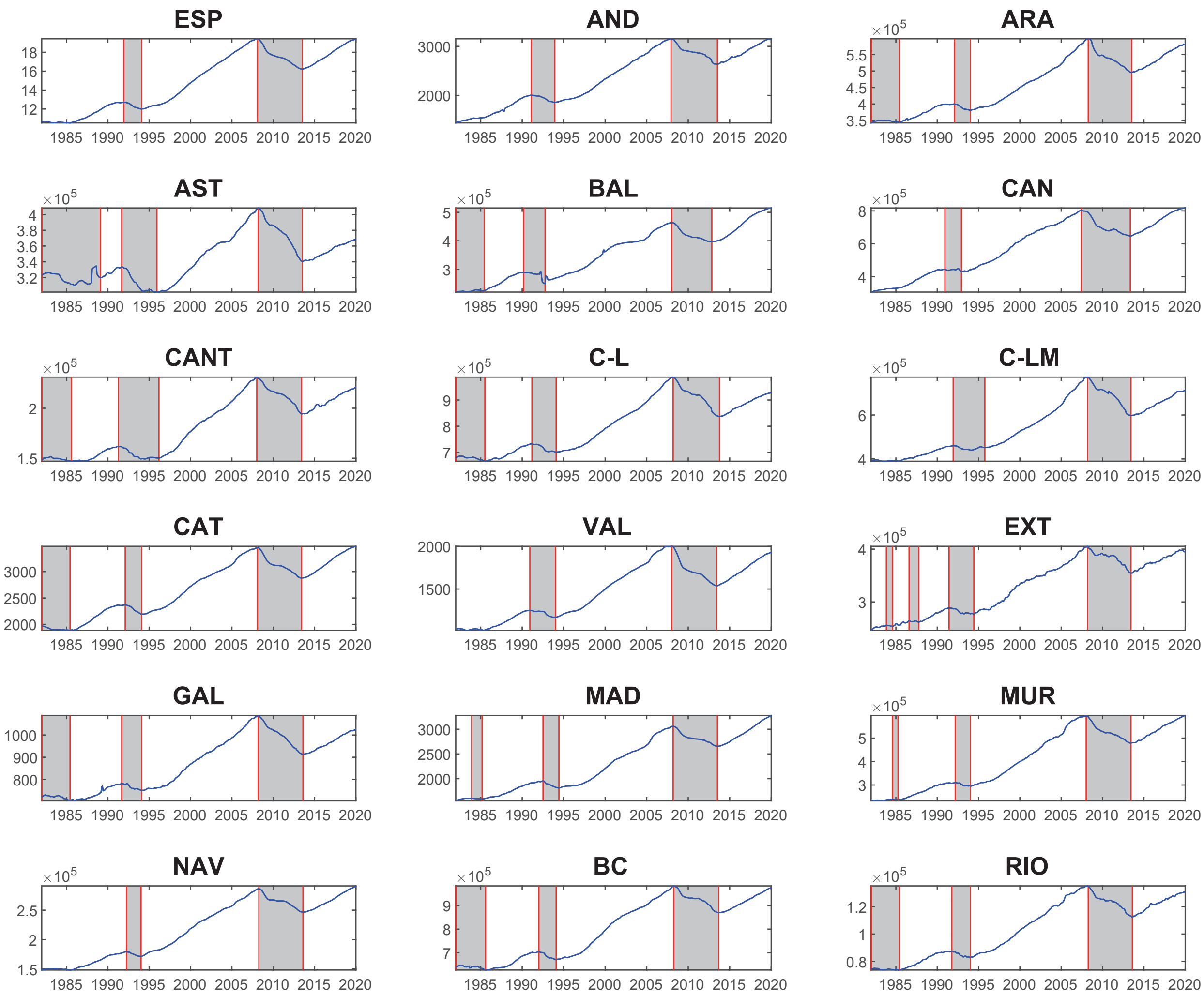
The two most representative indicators to determine the timing of the regional cycle are the IPI and Social Security registrations, which have been used for an initial identification of the regional business cycles. In both cases, states of recession are detected in a large part of the regions in the early 1980s, again at the start of the 1990s and, finally, during the global financial crisis (Charts 5 and 6). A more stable trajectory can also be seen in the registrations series than in that of industrial production. The former reveals cyclical behaviour with high inertia, and thus, for example, it does not enable the double dip of the last recession to be detected; the latter, in contrast, is very sensitive to the cycle and rapidly warns of the presence of new turning points.

Secondly, with the turning points of each of the series having been located, the heat map in Chart 7 depicts the distribution of the resulting states for each of the indicators used, which provides a very graphic approach to the incidence of the recessions. It highlights, more than in any other moment, a high concentration of indicators in recession around the time of the global financial crisis, although profile and duration differ significantly in each indicator. Over the rest of the period, the Social Security registrations indicator could be seen to be in recession in some regions at the outset of the 1980s – as a result of the greater difficulty of recovering from the two oil crises owing to the singularity of the regions' industrial structure – and, more broadly, in terms both of indicators and regions, around the start of the 1990s. During the 2000s, some regional indicators also identified the slowdown that came about in the Spanish economy at the end of the period under study.[10]

10 For greater details of the distribution of the indicators, see Chart A.1 in the annex.

Chart 5

REGIONAL BUSINESS CYCLES USING SOCIAL SECURITY REGISTRATIONS



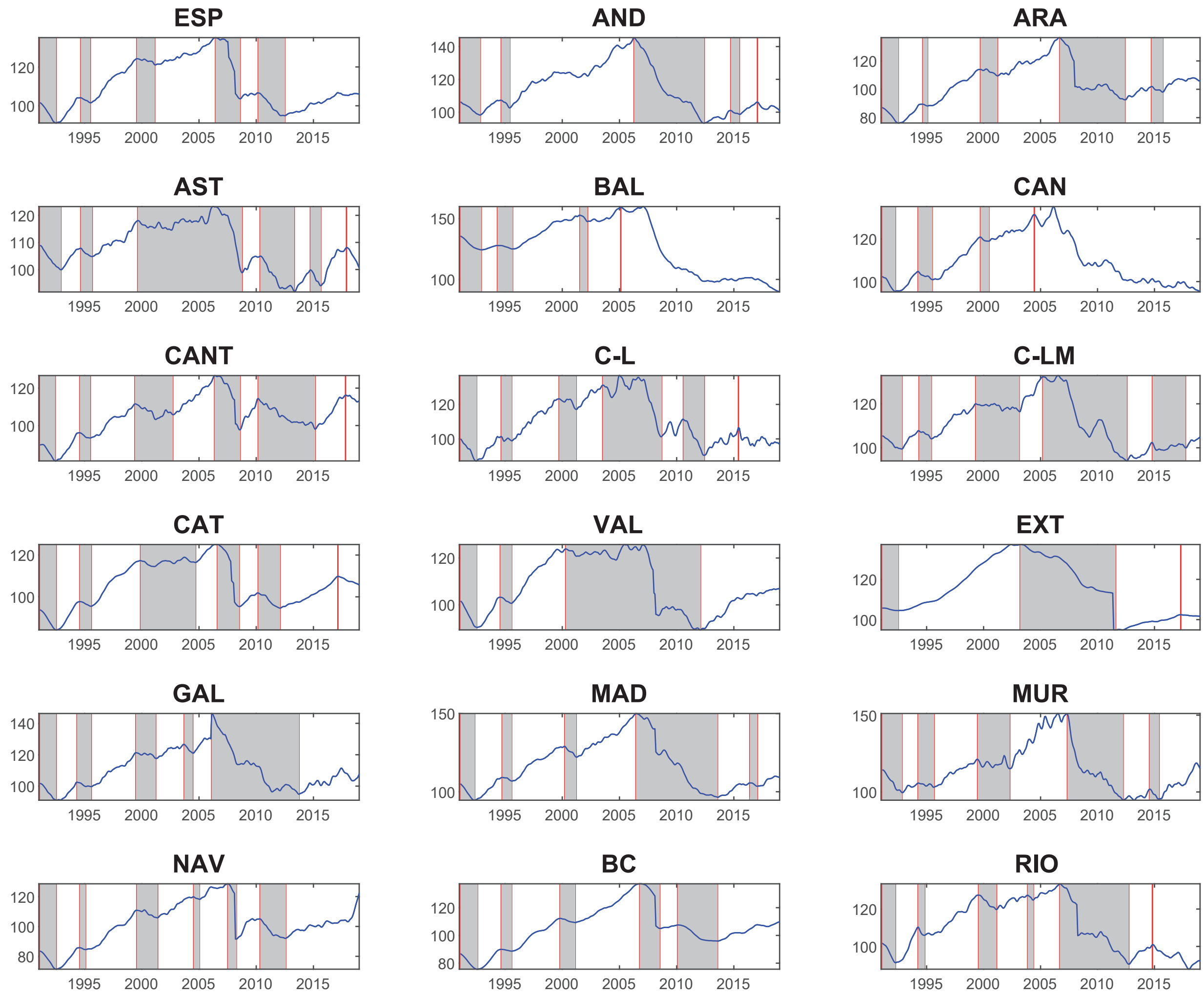
SOURCE: Own calculations based on data of Ministerio de Trabajo, Migraciones y Seguridad Social.

Thirdly, to establish the reference cycle of each region, it has been considered that, for each moment t, region i was in a state of expansion or recession when at least two-thirds of its indicators were in that state.[11] The final result is in Chart 8, which shows the cyclical dating differences arising from the distribution of the specific indicators. The industrial crisis in the early 1980s reared with particular intensity in those regions whose secondary sector had a greater weight, in Asturias and in other northern coastal regions such as Cantabria and the Basque Country, as well as in Aragon, Rioja and Catalonia. Although the recessionary period ran in these regions – and in others such as Castile-Leon, Galicia and the Balearic Islands – until mid-1985, in Asturias it extended practically throughout the 1980s. The brief

11 Although this threshold is somewhat higher than that used in other papers, the greater volatility of the regional series advises increasing the concentration of specific indicators to obtain appropriate dating.

Chart 6

REGIONAL BUSINESS CYCLES USING INDUSTRIAL PRODUCTION INDEX (IPI)



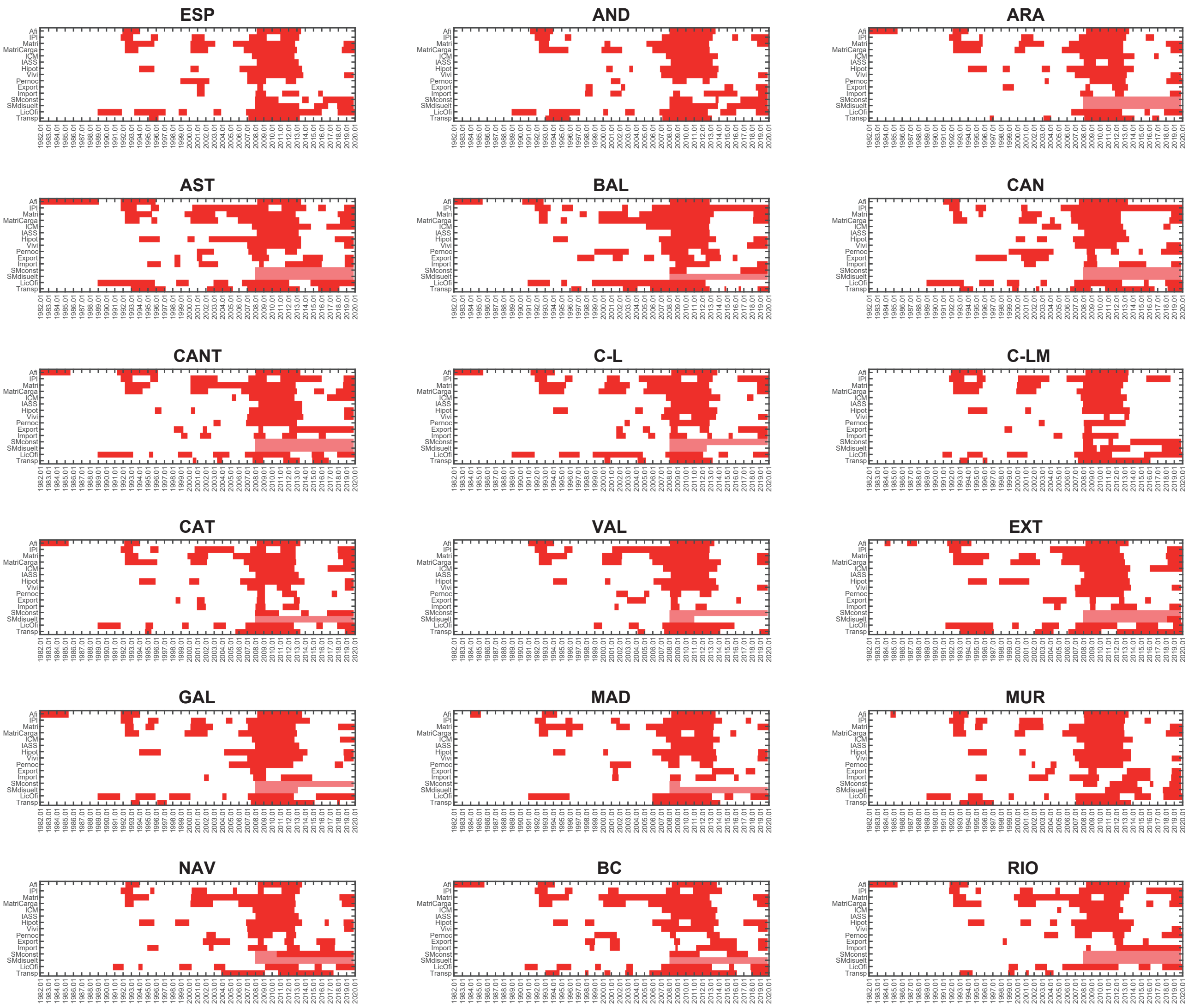
SOURCE: Own calculations drawing on INE data.

but acute subsequent crisis in the early 1990s had an across-the-board impact in Spain, but its duration was greater in Asturias, Extremadura, Andalusia, the Balearic Islands and the Canary Islands. Finally, the first recession stemming from the global financial crisis and the subsequent double-dip recession, associated with the sovereign debt crisis, spread to all regions, albeit with differing intensity. In terms of its duration, the two recessionary periods added up to a higher number of months in the Balearic Islands, Andalusia, Murcia, Castile-La Mancha and Galicia, regions which in the main also suffered the real estate bubble burst of those years.

Despite the extensive differences from one region to another, the identification of turning points with these monthly indicators, as opposed to the annual series, foreshadows the start of recessionary and expansionary phases. The 1993 recession was detected as early as 1992 Q2; the financial crisis, which with annual data was detected in 2009,

Chart 7

INDICATORS FOR THE REFERENCE CYCLE OF SPANISH REGIONS



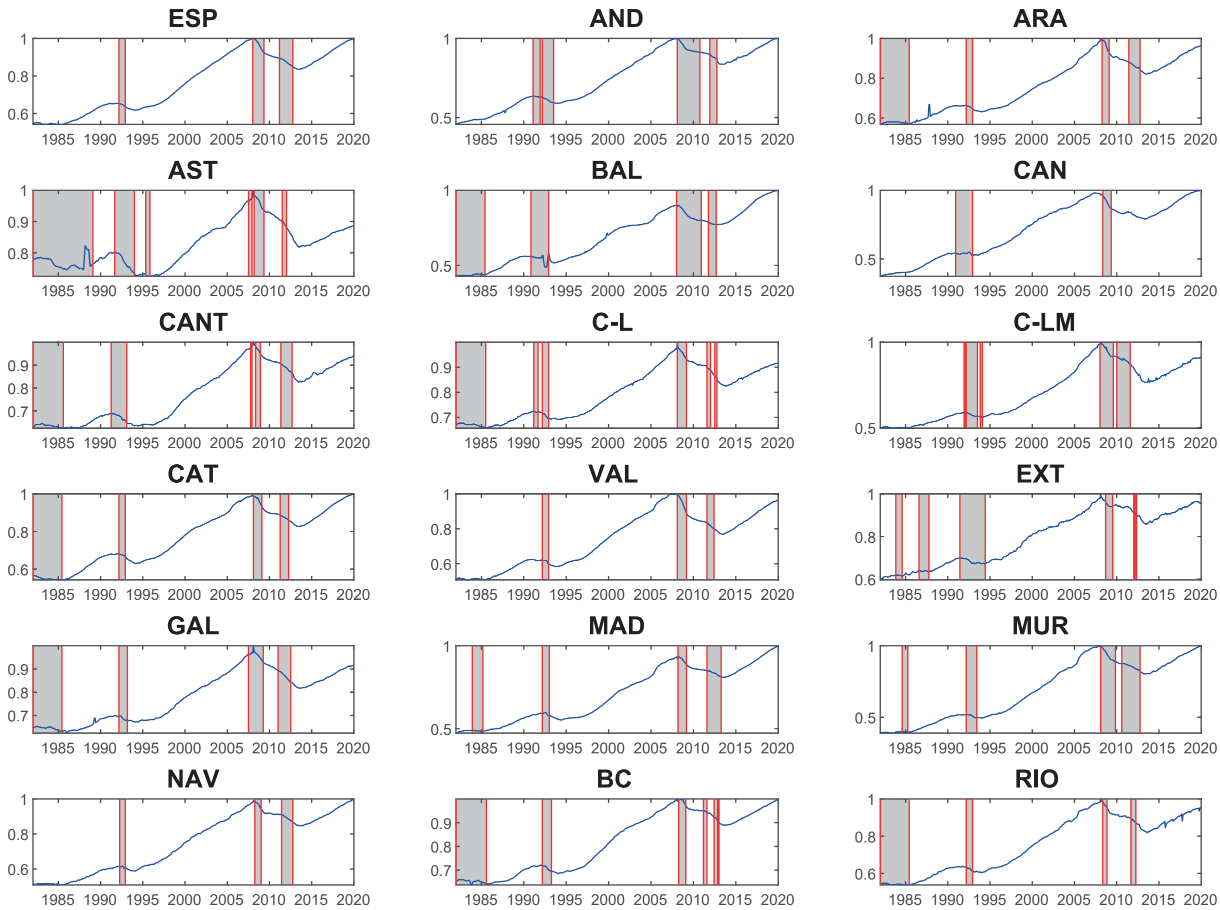
SOURCE: Own calculations drawing on data from the sources indicated in Table 1.
NOTE: The red shading denotes each of the series that is in recession in a specific period, in accordance with the BB algorithm.

was discernible already from early 2008, running to mid-2009; and, finally, the 2011-2013 recession was detected with greater intensity in 2011.

Overall, and for Spain on average, the dating coincides with that estimated by the Business Cycle Dating Committee. For comparative purposes solely, since what is involved here is not an official statistic, the BB methodology has been applied to the quarterly regional GDP estimated by AIReF from 2000. The results show very similar dating to that obtained on the basis of the monthly reference cycle (see Chart A.2 in the annex). It should be noted that the quarterly regional GDP series are available only for half the period for which the regional reference cycle has been obtained.

Chart 8

REFERENCE REGIONAL CYCLES, 1982-2020



SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

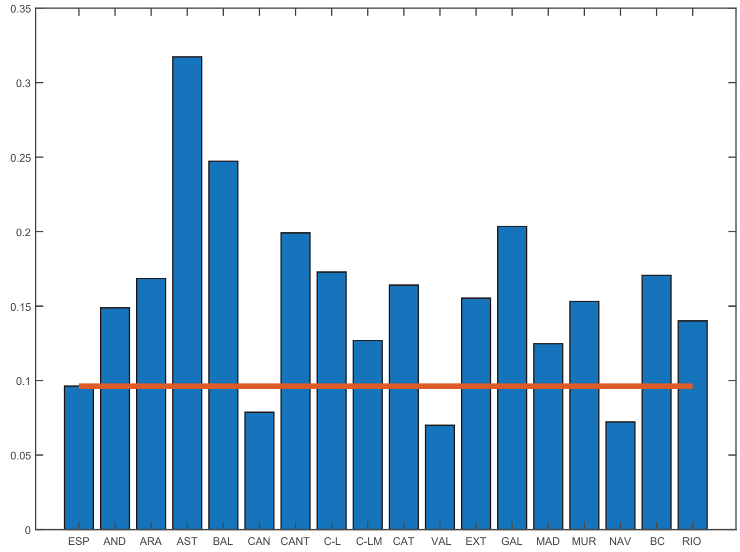
5.2 Regional business cycles in Spain: similarities and differences

A series of stylised features on the cyclical performance of Spain's regions may be extracted from the reference business cycle dating. First, there are important differences in the frequency with which the different regions go into recession. As Chart 9 shows, the regions on the Cantabrian coast – Asturias, Galicia, Cantabria and the Basque Country – are, together with the Balearic Islands, those which spent most time in recession in the period 1982-2019. At the other end of the scale are the Canary Islands, Navarre and Valencia.

Second, the chart also shows that although the cycle of the Spanish regions has common features, there are also important differences, as the Harding and Pagan (2006) correlation index depicted in Chart 10.1 shows. The regions with the business cycle most similar to that of Spain overall are Navarre, Valencia, Murcia and Madrid, while those with the most different business cycle are Asturias, Extremadura and Rioja. In the correlation between each region's business cycle and that of all the other regions, Aragon, Catalonia

Chart 9

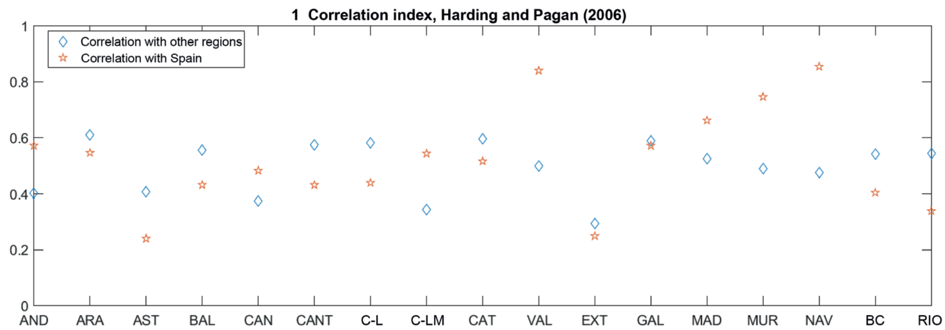
FREQUENCY OF RECESSIONS IN ACCORDANCE WITH THE REFERENCE CYCLE

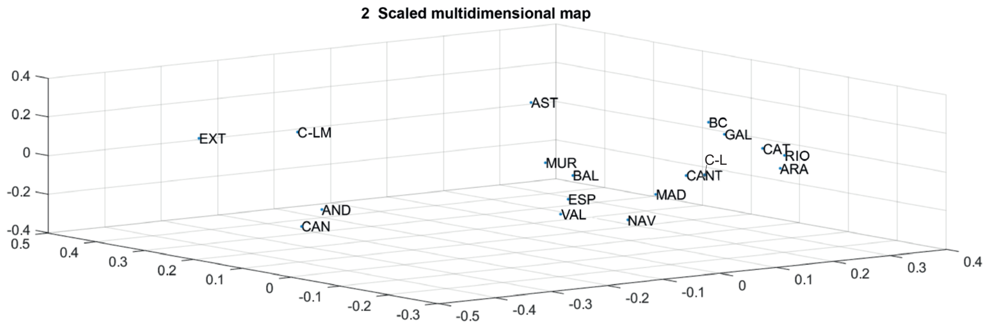


SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

Chart 10

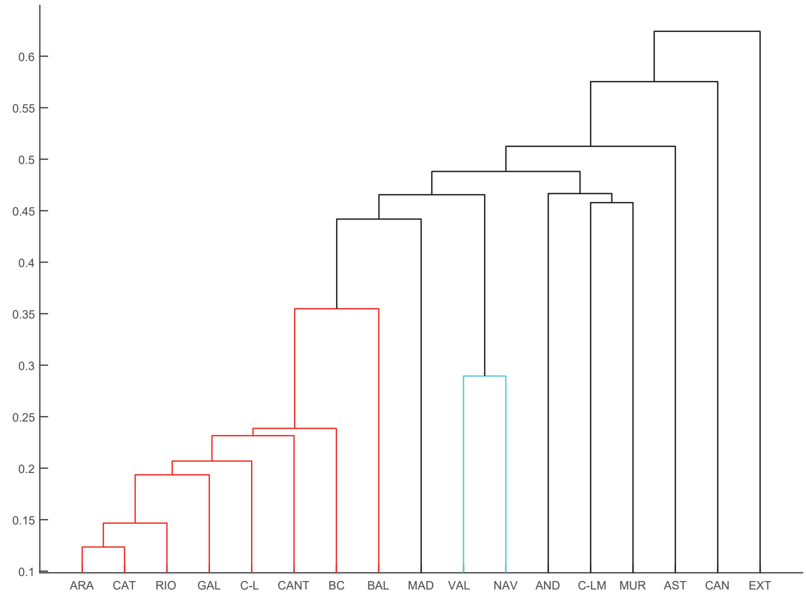
SYNCHRONISATION OF THE REFERENCE REGIONAL CYCLES





SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

Chart 11
HIERARCHICAL CLUSTER OF REGIONAL BUSINESS CYCLES (DENDROGRAM)



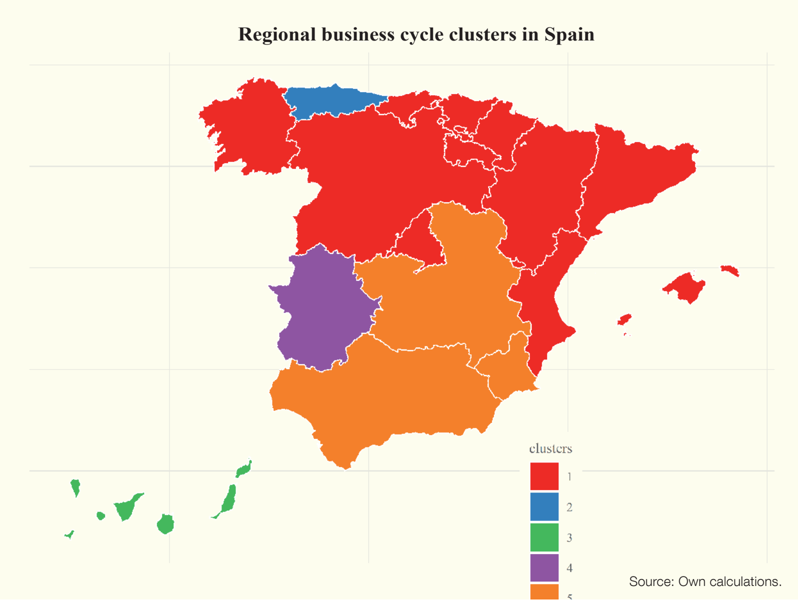
SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

and Galicia have the highest values, while Extremadura, Castile-La Mancha and the Canary Islands are the regions most distant from the Spanish cycle overall.[12] The correlation index is also depicted in Chart 10.2 in a rescaled multidimensional map which allows us to see the distances between regions. The map highlights the proximity of regions with high per capita income levels, such as Catalonia, Rioja and Aragon, which are also close to the Basque Country, Galicia, Castile-Leon, Cantabria and Madrid. By contrast, Extremadura, Castile-La Mancha, Andalusia, the Canary Islands and Asturias are all at a much greater distance.

A complementary method to determine the cyclical differences and similarities between regions is to search for clusters or groups of regions with similar cycles. Given the binary nature of the state – expansion and recession – variable, it is more appropriate to use hierarchical clustering than K-means. This method groups the data into a range of scales by creating a cluster tree or dendrogram whose y-axis depicts the distances between objects. The algorithm starts by grouping together Aragon and Catalonia, which have the smallest distance between them, and thus successively, as Chart 11 shows. The hierarchical grouping is very favourable, since the cophenetic correlation coefficient is 0.84, very close to unity, and the incoherence coefficients are relatively low. These threshold values may determine the number of clusters and their distribution. Applying this rule, we obtain five clusters, although these are really four small clusters which are outliers and one large cluster

12 Gadea, Gómez-Loscos and Montañés (2012) characterise these regions, which are grouped into two clusters that have similarities owing to their high unemployment rates or low percentage of population with tertiary education.

Chart 12
REGIONAL CLUSTER MAP



SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

made up of all the other regions. The first small cluster comprises Andalusia, Castile-La Mancha and Murcia. The other three small clusters are made up of Asturias, the Canary Islands and Extremadura, respectively. Chart 12 shows the geographical distribution.

6 Conclusions

An awareness of the cyclical patterns of the Spanish regions allows us to detect similarities and differences. This is important when designing economic policies at the national or European level. Although the average cyclical pattern is consistent, and has a high long-term correlation, synchronisation between the regions tends to increase in recessions, when the economic developments are very negative for all regions, and to decrease in expansions, when the patterns separate, revealing the structural constraints facing certain regions in achieving sustained growth rates.

Certain regions, such as Asturias, Extremadura and the Canary Islands, repeatedly show behaviour patterns that are different from the Spanish average, albeit for very different reasons. As a result of the industrial crisis of the 1980s, Asturias experienced an extremely long recession that lasted for most of the decade. The crisis of the early 1990s also lasted a year longer in that region in comparison with the Spanish average. In the case of Extremadura the pattern is very distinct. It spent the second half of the 1980s in recession, and the negative impact of the early 1990s lasted for more than one extra year. However, the Great Recession was shorter in Extremadura than in Spain on average. In both regions, the expansionary phases are shorter and have less amplitude than in the other regions. Conversely, the Canary Islands showed no signs of recession in the 1980s and the region was only negatively affected by the first part of the Great Recession. The high proportion of the services sector related to tourism and the region's productive specificities in all other sectors mean that its expansionary phases tend to be larger, whereas in recessions the deterioration is gradual and only becomes more intense over time.

Castile-La Mancha, Andalusia and Murcia also maintain certain specific profiles in their respective business cycles, but they share some similarities that place them in the same cluster. They suffer long recessions, and Castile-La Mancha and Murcia both record very negative excesses, which are a sign of severe contractions in activity in recessions which gradually moderate over time. Overall, this group of regions, together with the three regions mentioned above, account for slightly more than a quarter of Spanish GDP.

The other eleven regions are more integrated both into the national cycle and among themselves, with very close cyclical correlations between Aragon, Catalonia and Rioja, for Castile-Leon with Galicia, Cantabria and the Basque Country, and between Madrid and Valencia. In addition, they have higher per capita income levels than the other groups.

The conclusion we draw from this analysis of regional business cycles in Spain is that although most regions show a considerable level of synchronisation with the national cycle, there are specific features that advise that national or European policies be complemented with specific measures designed to stimulate recovery phases and cushion recessions. It is probably not a question so much of modulating the intensity of macroeconomic policies in regions such as Asturias, Extremadura, Andalusia or Castile-La Mancha, but rather of implementing supply-side policies aimed at remedying the shortfalls detected in some production factor endowments.

References

AIReF (2015). "Quarterly regional GDP flash estimates for the Spanish economy (METCAP model)". *Working Paper* DT/2015/3.

ALVAREZ, L. J., M. D. GADEA and A. GOMEZ-LOSCOS (2020). "El ciclo de la economía española en el contexto europeo". *Papeles de Economía Española,* 165.

ARTIS, M., H.-M. KROLZIG and J. TORO (2004). "The European business cycle". *Oxford Economics Papers,* 56, 1-44.

BANDRÉS, E. and M. D. GADEA (2013). "Crisis económica y ciclos regionales en España". *Papeles de Economía Española,* 138.

BANDRÉS, E., M. D. GADEA-RIVAS and A. GOMEZ-LOSCOS (2017). Regional business cycles across Europe. Banco de España *Occasional Paper* 1702.

BRY, G. and C. BOSCHAN (1971). *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs.* New York: NBER.

BURNS, A. F. and W. C. MITCHELL (1946). *Measuring Business Cycles.* New York: NBER.

CAMACHO, M., M. D. GADEA-RIVAS and A. GOMEZ-LOSCOS (2020). "A new approach to dating the reference cycle". *Journal of Business and Economic Statistics.*

CAMACHO, M., M. PACCE and C. ULLOA (2019). "Regional business cycle phases in Spain". *Estudios de Economía Aplicada,* 36(3), 875 – 896.

DE HAAN, J., R. INKLAAR and R. JONG-A-PIN (2008). "Will Business Cycles in the Euro Area Converge: A Critical Survey of Empirical Research". *Journal of Economic Surveys,* 22(2), 234-273.

DE LA FUENTE, A. and P. RUIZ AGUIRRE (2020). "Series largas de VAB y empleo regional por sectores, 1955-2018. RegData_Sect FEDEA-BBVA (v5.0_1955-2018)". *Studies on the Spanish Economy* 2020-08, FEDEA.

FRÜHWIRTH-SCHNATTER, S. and S. KAUFMANN (2008). "Model-Based Clustering of Multiple Time Series". *Journal of Business and Economic Statistics,* 26(1), 78-89.

GADEA, M. D., A. GÓMEZ-LOSCOS and E. BANDRÉS (2018). "Clustering regional business cycles". *Economics Letters,* 162, 171-176.

GADEA, M. D., A. GÓMEZ-LOSCOS and D. LEIVA-LEÓN (2019). "Increasing linkages among European regions. The role of sectoral composition". *Economic Modelling,* 80(C), 222-243.

GADEA, M. D., A. GÓMEZ-LOSCOS and A. MONTAÑÉS (2012). "Cycles inside cycles. Spanish Regional Aggregation". *SERIEs,* 3(4), 423-456.

GIANNONE, D., M. LENZA and L. REICHLIN (2010). *Business Cycles in the Euro Area,* in A. Alesina and F. Giavazzi (eds.), Europe and the Euro, 141-167, The University of Chicago Press.

GÓMEZ-LOSCOS, A., M. D. GADEA and E. BANDRÉS (2020). "Business cycle patterns in European regions". *Empirical Economics,* 59(6), 2639-2661.

GRIGORAS, V. (2020). "Una revisión de los métodos de datado del ciclo económico". *Papeles de Economía Española,* 165, 16-32, Funcas.

HARDING, D. and A. PAGAN (2002). "Dissecting the cycle: a methodological investigation". *Journal of Monetary Economics,* 49(2), 365-381.

— (2006). "Synchronization of cycles". *Journal of Econometrics,* 132(1), 59-79.

— (2016). *The econometric analysis of recurrent events in macroeconomics and finance.* New Jersey: Princeton University Press.

OZYURT, S. and S. DEES (2015). "Regional dynamics of economic performance in the EU: To what extent do spatial spillovers matter?" ECB *Working Paper* 1870.

PAGAN, A. (2020), "El ciclo económico: algunas reflexiones sobre la literatura". *Papeles de Economía Española,* 165, pp. 2-15, Funcas.

PIGER, J. (press), "Turning Points and Classification", in P. Fuley (ed.), *Macroeconomic Forecasting in the Era of Big Data,* Springer.

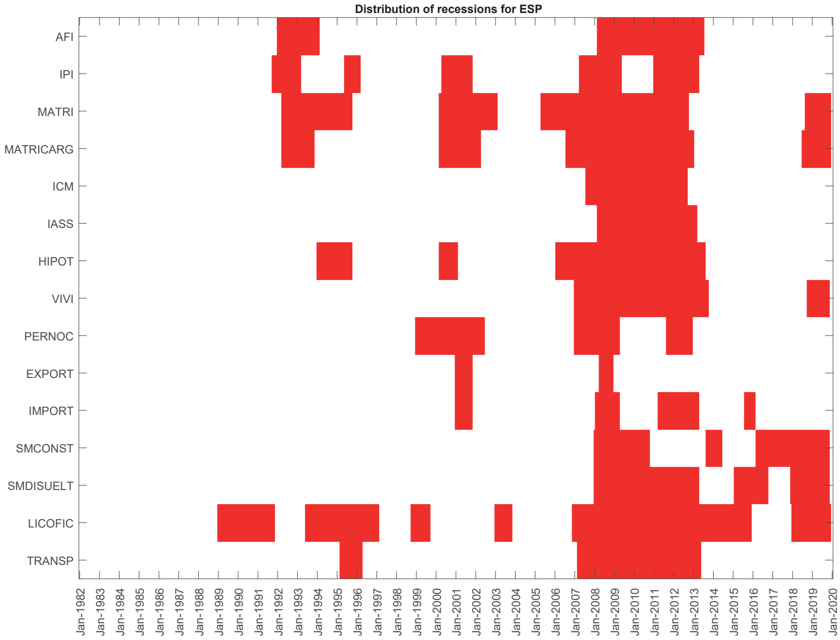
STOCK, J. H. and M. W. WATSON (2008). "The Evolution of National and Regional Factors in U.S. Housing Construction", in T. Bollerslev, J. Russell and M. Watson (eds.), *Volatility and Time Series Econometrics: Essays in Honor of Robert F. Engle.* Oxford: Oxford University Press.

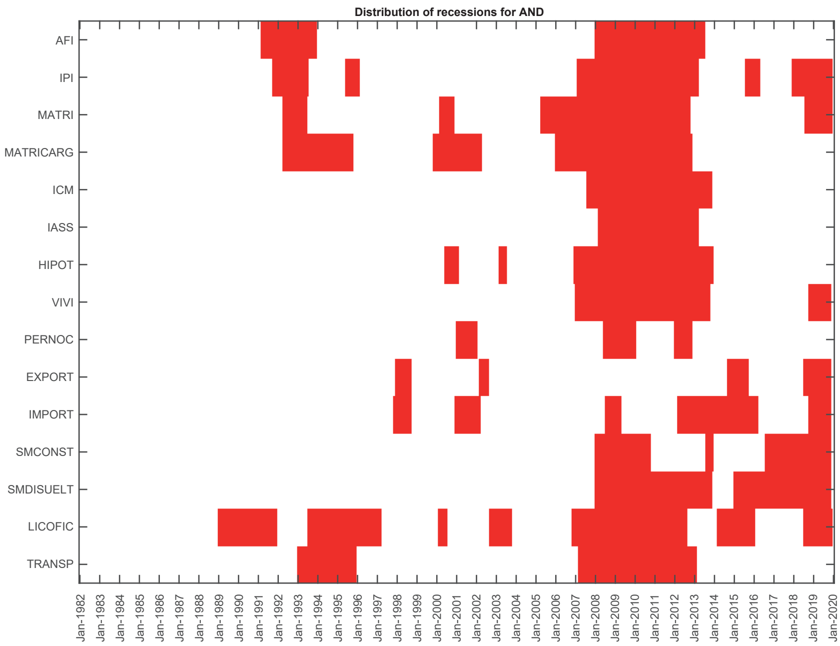
— (2010). *Distribution of quarterly values of GDP/GDI across months within the quarter*, at https://www.princeton.edu/~mwatson/mgdp_gdi/Monthly_GDP_GDI_Sept20.pdf.

— (2014). "Estimating turning points using large data sets". *Journal of Econometrics,* 178, 368-381.

Annex 1 Indicators for the reference cycle of Spanish regions

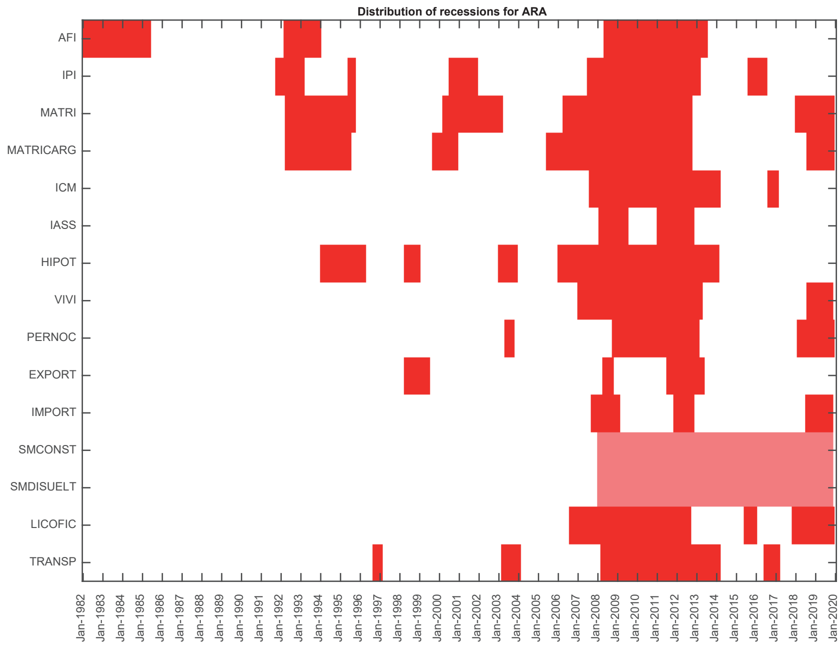
Chart A.1

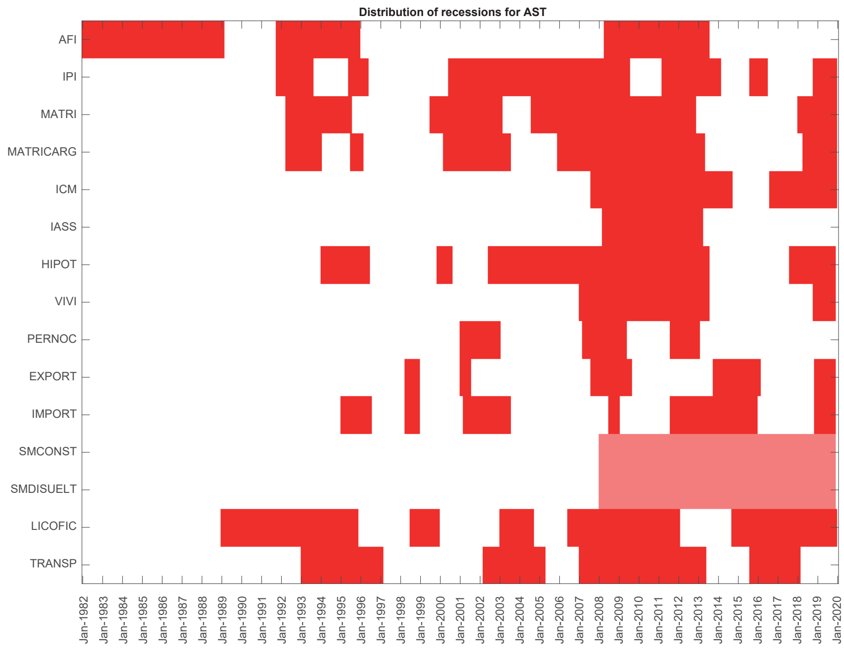




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

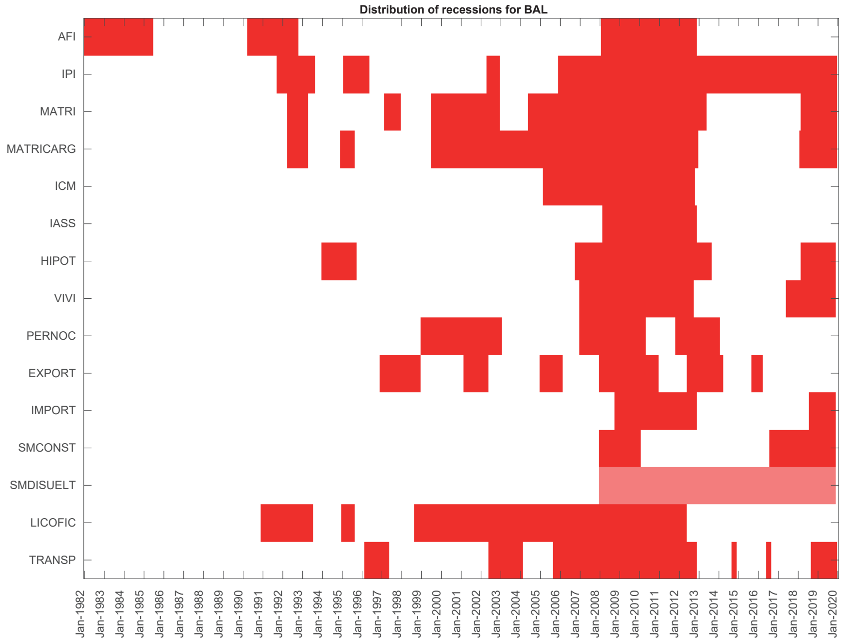
Chart A.1 (cont.)

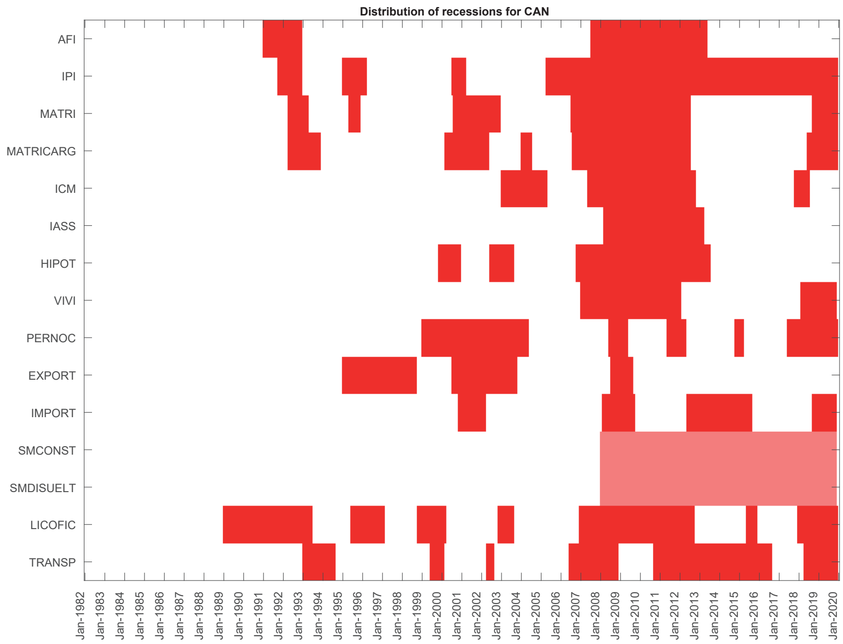




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

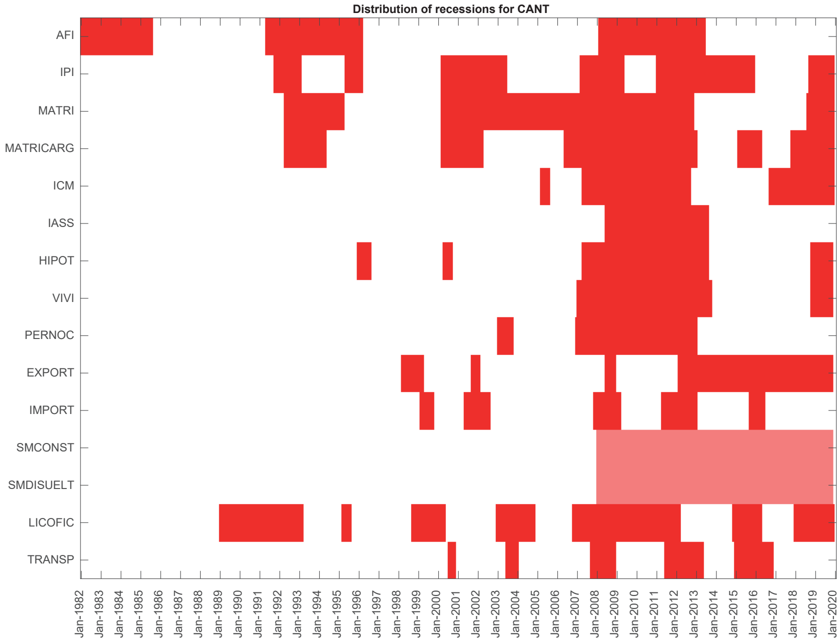
Chart A.1 (cont.)

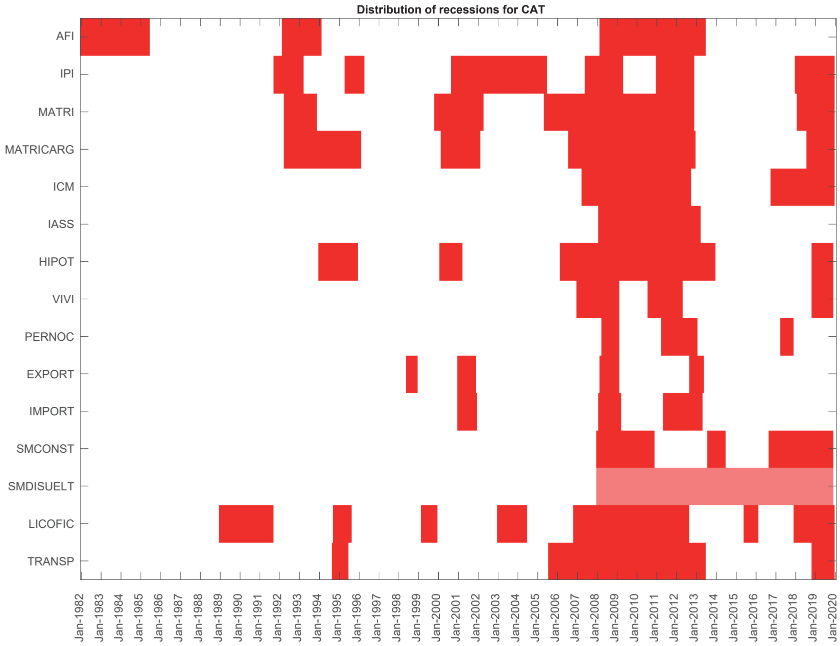




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

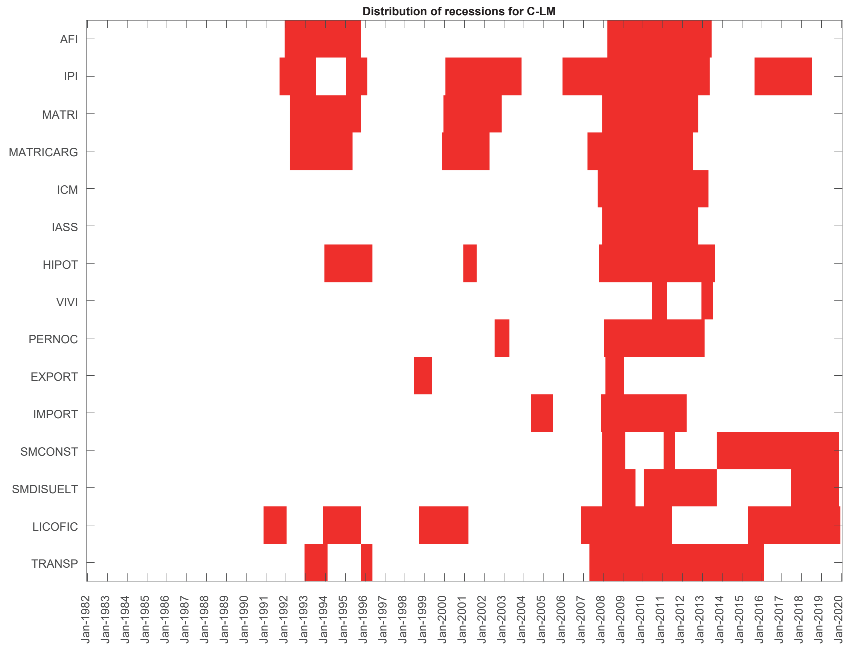
Chart A.1 (cont.)

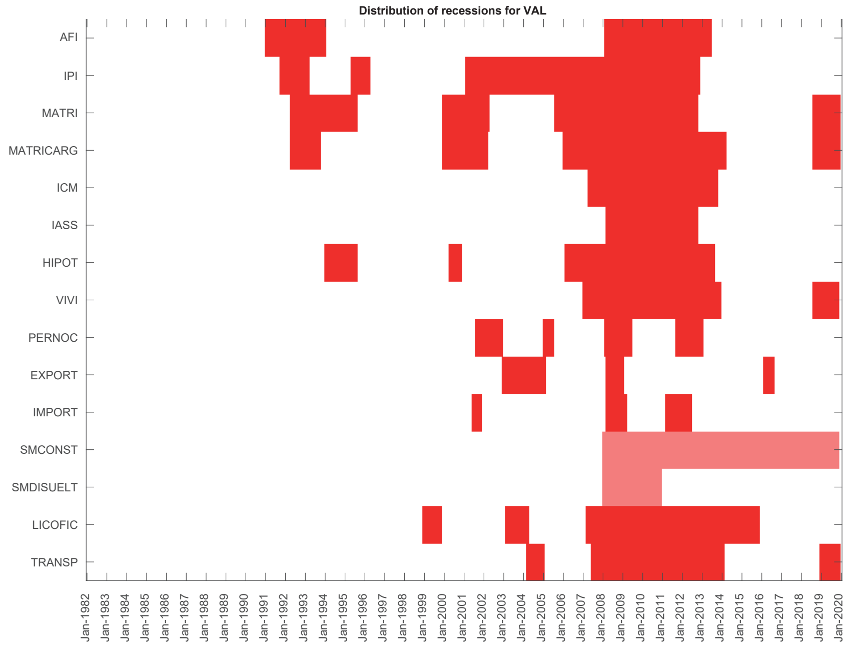




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

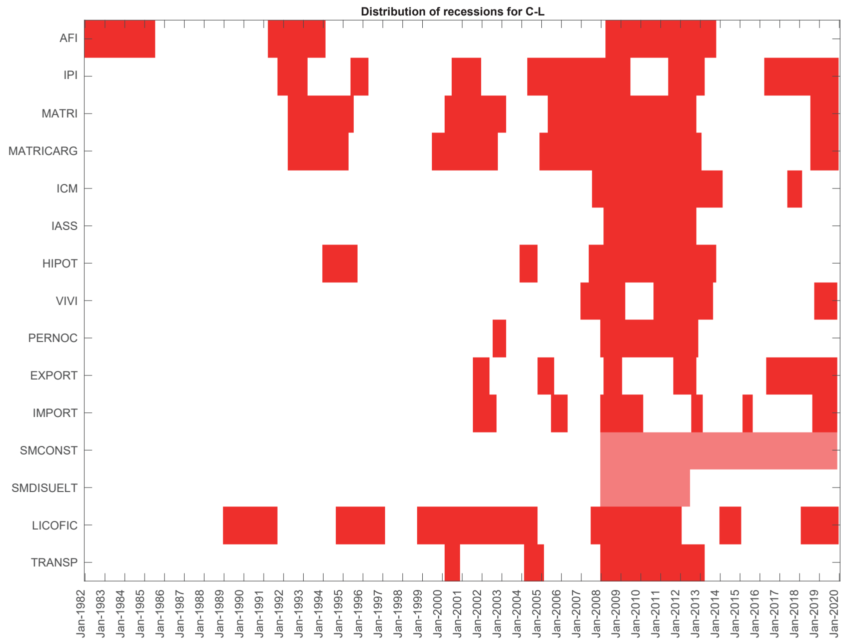
Chart A.1 (cont.)

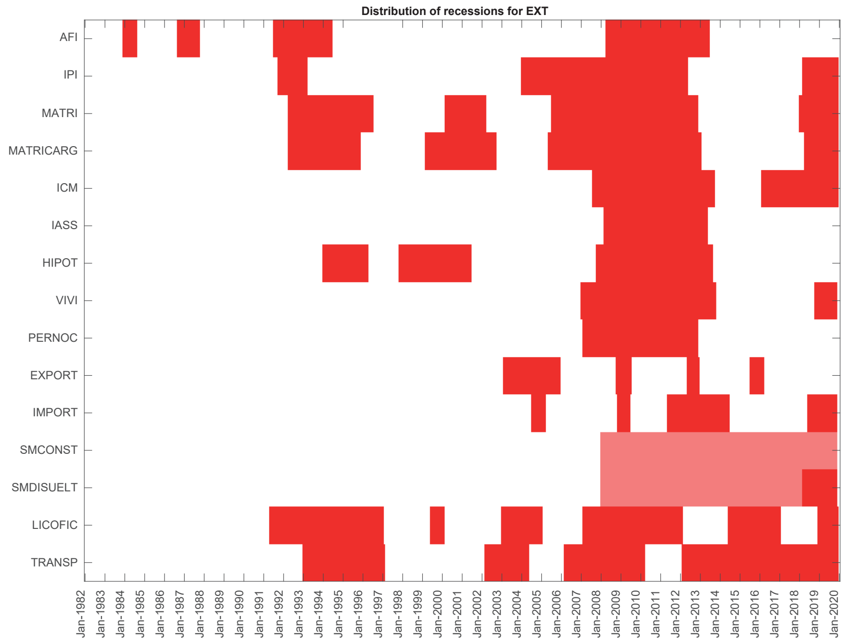




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

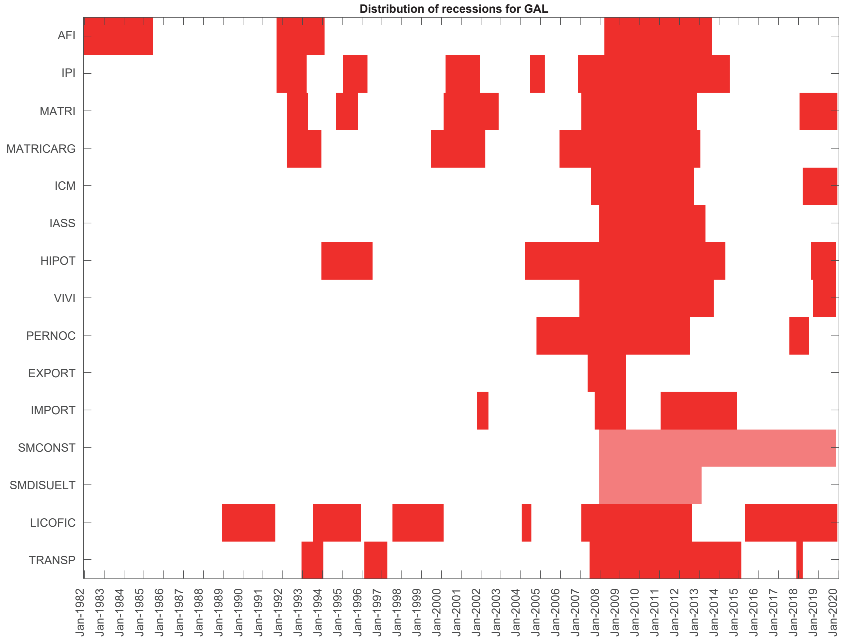
Chart A.1 (cont.)

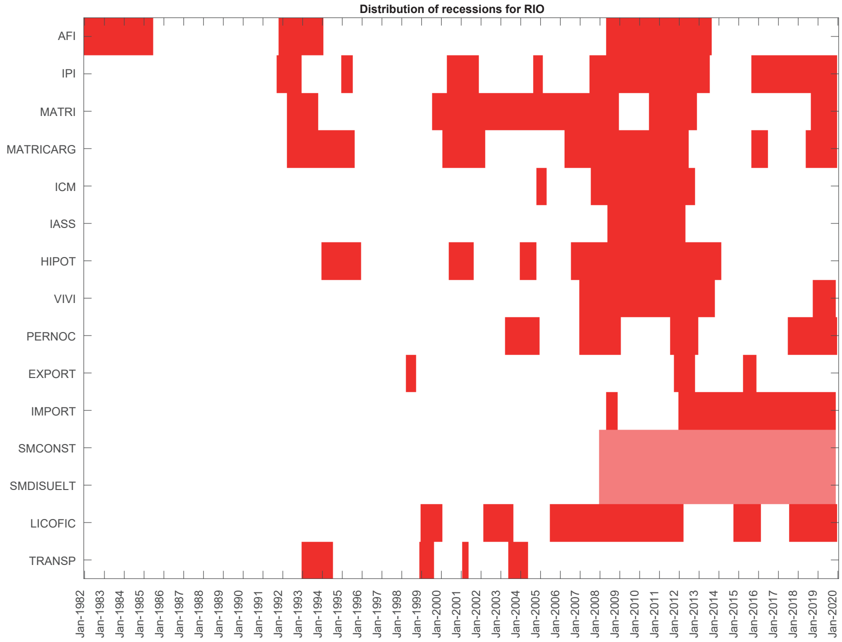




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

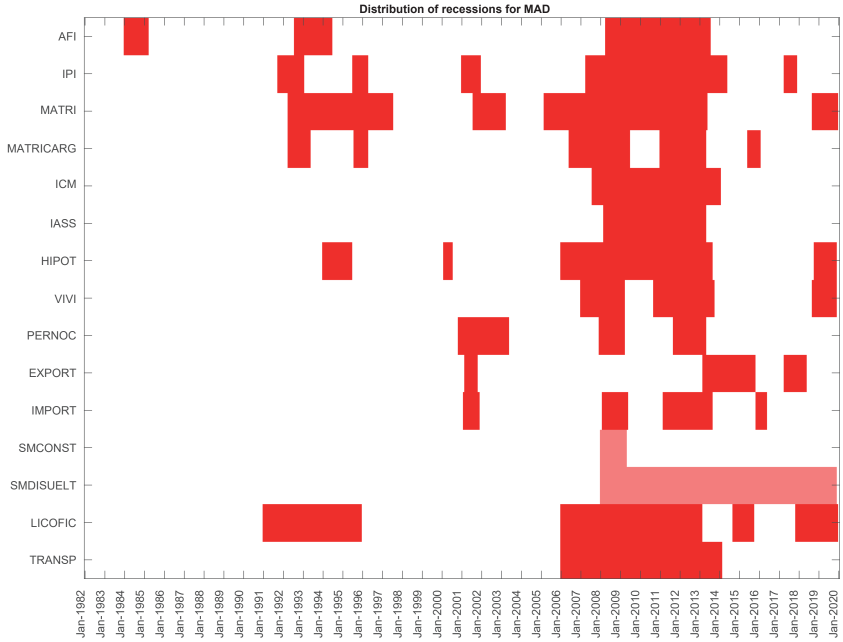
Chart A.1 (cont.)

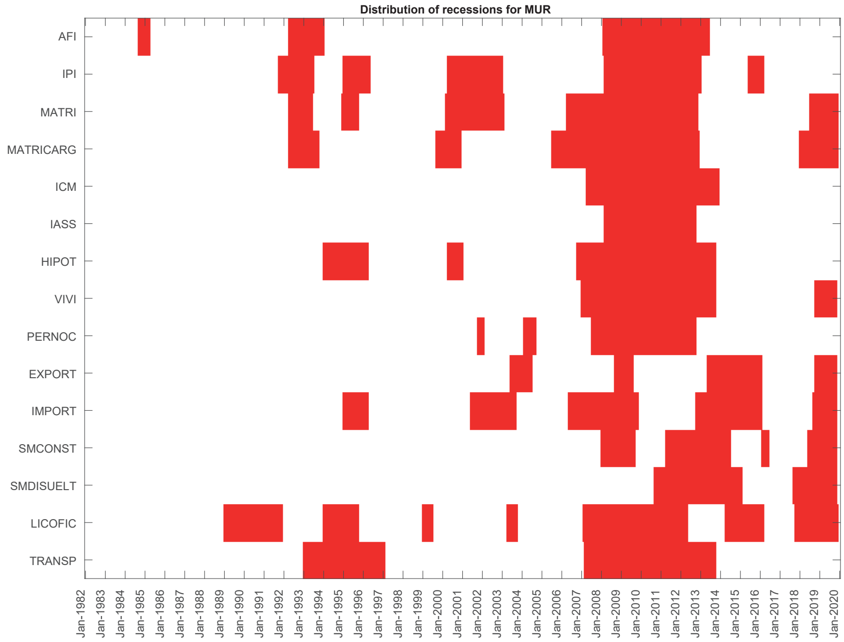




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

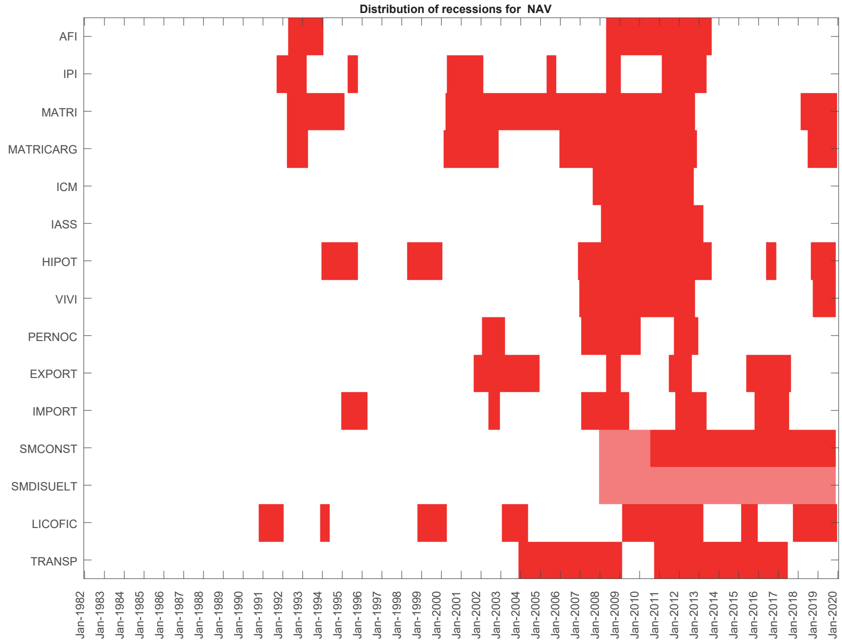
Chart A.1 (cont.)

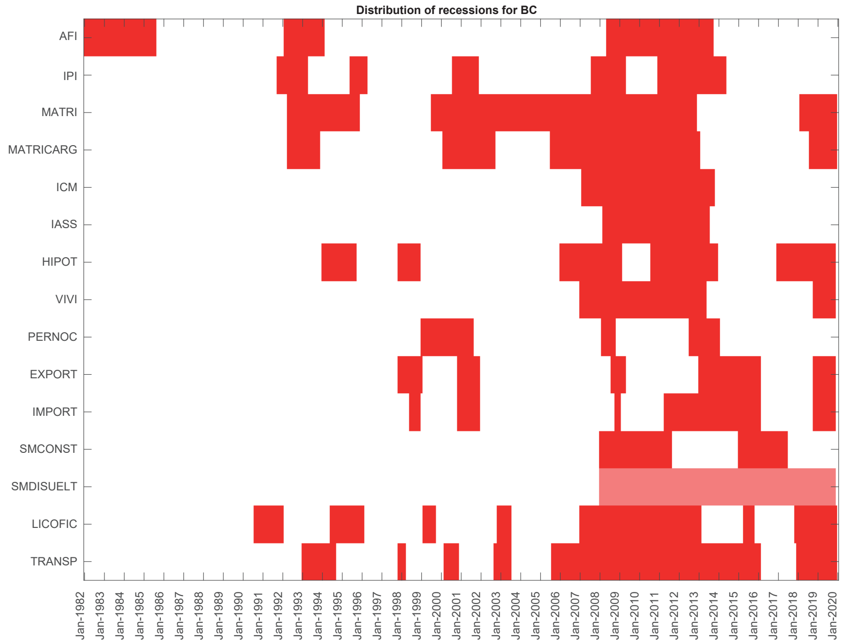




SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

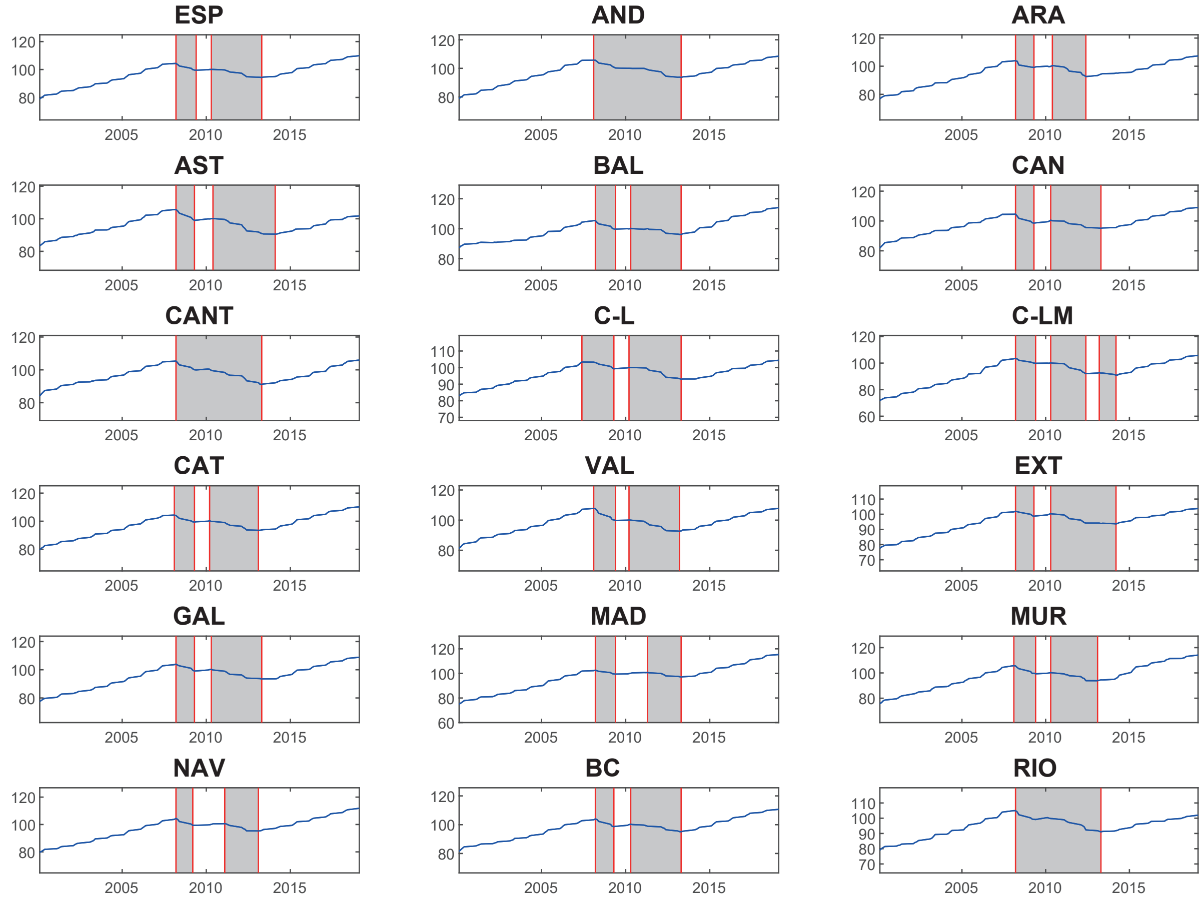
Chart A.1 (cont.)





SOURCE: Own calculations drawing on data from the sources indicated in Table 1.

Chart A.2



SOURCE: Own calculations drawing on AIReF data.

BANCO DE ESPAÑA PUBLICATIONS

OCCASIONAL PAPERS

1910 LUIS JULIÁN ÁLVAREZ: El índice de precios de consumo: usos y posibles vías de mejora.
1911 ANTOINE BERTHOU, ÁNGEL ESTRADA, SOPHIE HAINCOURT, ALEXANDER KADOW, MORITZ A. ROTH and MARIE-ELISABETH DE LA SERVE: Assessing the macroeconomic impact of Brexit through trade and migration channels.
1912 RODOLFO CAMPOS and JACOPO TIMINI: An estimation of the effects of Brexit on trade and migration.
1913 ANA DE ALMEIDA, TERESA SASTRE, DUNCAN VAN LIMBERGEN and MARCO HOEBERICHTS: A tentative exploration of the effects of Brexit on foreign direct investment vis-à-vis the United Kingdom.
1914 MARÍA DOLORES GADEA-RIVAS, ANA GÓMEZ-LOSCOS and EDUARDO BANDRÉS: Ciclos económicos y *clusters* regionales en Europa.
1915 MARIO ALLOZA and PABLO BURRIEL: La mejora de la situación de las finanzas públicas de las Corporaciones Locales en la última década.
1916 ANDRÉS ALONSO and JOSÉ MANUEL MARQUÉS: Financial innovation for a sustainable economy. (There is a Spanish version of this edition with the same number).
2001 ÁNGEL ESTRADA, LUIS GUIROLA, IVÁN KATARYNIUK and JAIME MARTÍNEZ-MARTÍN: The use of BVARs in the analysis of emerging economies.
2002 DAVID LÓPEZ-RODRÍGUEZ and M.ª DE LOS LLANOS MATEA: Public intervention in the rental housing market: a review of international experience. (There is a Spanish version of this edition with the same number).
2003 OMAR RACHEDI: Structural transformation in the Spanish economy.
2004 MIGUEL GARCÍA-POSADA, ÁLVARO MENÉNDEZ and MARISTELA MULINO: Determinants of investment in tangible and intangible fixed assets.
2005 JUAN AYUSO and CARLOS CONESA: An introduction to the current debate on central bank digital currency (CBDC). (There is a Spanish version of this edition with the same number).
2006 PILAR CUADRADO, ENRIQUE MORAL-BENITO and IRUNE SOLERA: A sectoral anatomy of the Spanish productivity puzzle.
2007 SONSOLES GALLEGO, PILAR L'HOTELLERIE-FALLOIS and XAVIER SERRA: La efectividad de los programas del FMI en la última década.
2008 RUBÉN ORTUÑO, JOSÉ M. SÁNCHEZ, DIEGO ÁLVAREZ, MIGUEL LÓPEZ and FERNANDO LEÓN: Neurometrics applied to banknote and security features design.
2009 PABLO BURRIEL, PANAGIOTIS CHRONIS, MAXIMILIAN FREIER, SEBASTIAN HAUPTMEIER, LUKAS REISS, DAN STEGARESCU and STEFAN VAN PARYS: A fiscal capacity for the euro area: lessons from existing fiscal-federal systems.
2010 MIGUEL ÁNGEL LÓPEZ and M.ª DE LOS LLANOS MATEA: El sistema de tasación hipotecaria en España. Una comparación internacional.
2011 DIRECTORATE GENERAL ECONOMICS, STATISTICS AND RESEARCH: The Spanish economy in 2019. (There is a Spanish version of this edition with the same number).
2012 MARIO ALLOZA, MARIEN FERDINANDUSSE, PASCAL JACQUINOT and KATJA SCHMIDT: Fiscal expenditure spillovers in the euro area: an empirical and model-based assessment.
2013 DIRECTORATE GENERAL ECONOMICS, STATISTICS AND RESEARCH: The housing market in Spain: 2014-2019. (There is a Spanish version of this edition with the same number).
2014 ÓSCAR ARCE, IVÁN KATARYNIUK, PALOMA MARÍN and JAVIER J. PÉREZ: Thoughts on the design of a European Recovery Fund. (There is a Spanish version of this edition with the same number).
2015 MIGUEL OTERO IGLESIAS and ELENA VIDAL MUÑOZ: Las estrategias de internacionalización de las empresas chinas.
2016 EVA ORTEGA and CHIARA OSBAT: Exchange rate pass-through in the euro area and EU countries.
2017 ALICIA DE QUINTO, LAURA HOSPIDO and CARLOS SANZ: The child penalty in Spain.
2018 LUIS J. ÁLVAREZ and MÓNICA CORREA-LÓPEZ: Inflation expectations in euro area Phillips curves.
2019 LUCÍA CUADRO-SÁEZ, FERNANDO S. LÓPEZ-VICENTE, SUSANA PÁRRAGA RODRÍGUEZ and FRANCESCA VIANI: Fiscal policy measures in response to the health crisis in the main euro area economies, the United States and the United Kingdom. (There is a Spanish version of this edition with the same number).
2020 ROBERTO BLANCO, SERGIO MAYORDOMO, ÁLVARO MENÉNDEZ and MARISTELA MULINO: Spanish non-financial corporations' liquidity needs and solvency after the COVID-19 shock. (There is a Spanish version of this edition with the same number).

2021 MAR DELGADO-TÉLLEZ, IVÁN KATARYNIUK, FERNANDO LÓPEZ-VICENTE and JAVIER J. PÉREZ: Supranational debt and financing needs in the European Union. (There is a Spanish version of this edition with the same number).

2022 EDUARDO GUTIÉRREZ and ENRIQUE MORAL-BENITO: Containment measures, employment and the spread of COVID-19 in Spanish municipalities. (There is a Spanish version of this edition with the same number).

2023 PABLO HERNÁNDEZ DE COS: The Spanish economy and the COVID-19 crisis. Appearance before the Parliamentary Economic Affairs and Digital Transformation Committee – 18 May 2020. (There is a Spanish version of this edition with the same number).

2024 PABLO HERNÁNDEZ DE COS: The main post-pandemic challenges for the Spanish economy. Appearance before the Parliamentary Committee for the Economic and Social Reconstruction of Spain after COVID-19/Congress of Deputies – 23 June 2020. (There is a Spanish version of this edition with the same number).

2025 ENRIQUE ESTEBAN GARCÍA-ESCUDERO and ELISA J. SÁNCHEZ PÉREZ: Central bank currency swap lines (There is a Spanish version of this edition with the same number).

2026 PABLO AGUILAR, ÓSCAR ARCE, SAMUEL HURTADO, JAIME MARTÍNEZ-MARTÍN, GALO NUÑO and CARLOS THOMAS: The ECB monetary policy response to the COVID-19 crisis. (There is a Spanish version of this edition with the same number).

2027 EDUARDO GUTIÉRREZ, ENRIQUE MORAL-BENITO and ROBERTO RAMOS: Tendencias recientes de la población en las áreas rurales y urbanas.

2028 ÁNGEL LUIS GÓMEZ: The effects of changes in the composition of employment on euro area wage growth: panel data analysis. (There is a Spanish version of this edition with the same number).

2029 MIGUEL GARCÍA-POSADA GÓMEZ: Analysis of insolvency proceedings in Spain against the backdrop of the COVID-19 crisis: insolvency proceedings, pre-insolvency arrangements and the insolvency moratorium. (There is a Spanish version of this edition with the same number).

2030 ÁNGEL GÓMEZ-CARREÑO GARCÍA-MORENO: Juan Sebastián de Elcano – 500 años de la Primera vuelta al mundo en los billetes del Banco de España. Historia y tecnología del billete.

2031 OLYMPIA BOVER, NATALIA FABRA, SANDRA GARCÍA-URIBE, AITOR LACUESTA and ROBERTO RAMOS: Firms and households during the pandemic: what do we learn from their electricity consumption?

2032 JÚLIA BRUNET, LUCÍA CUADRO-SÁEZ and JAVIER J. PÉREZ: Contingency public funds for emergencies: the lessons from the international experience. (There is a Spanish version of this edition with the same number).

2033 CRISTINA BARCELÓ, LAURA CRESPO, SANDRA GARCÍA-URIBE, CARLOS GENTO, MARINA GÓMEZ and ALICIA DE QUINTO: The Spanish Survey of Household Finances (EFF): description and methods of the 2017 wave.

2101 LUNA AZAHARA ROMO GONZÁLEZ: Una taxonomía de actividades sostenibles para Europa.

2102 FRUCTUOSO BORRALLO, SUSANA PÁRRAGA-RODRÍGUEZ and JAVIER J. PÉREZ: Taxation challenges of population ageing: comparative evidence from the European Union, the United States and Japan. (There is a Spanish version of this edition with the same number).

2103 LUIS J. ÁLVAREZ, M.ª DOLORES GADEA and ANA GÓMEZ LOSCOS: Cyclical patterns of the Spanish economy in Europe. (There is a Spanish version of this edition with the same number).

2104 PABLO HERNÁNDEZ DE COS: Draft State Budget for 2021. Testimony before the Parliamentary Budget Committee, 4 November 2020. (There is a Spanish version of this edition with the same number).

2105 PABLO HERNÁNDEZ DE COS: The independence of economic authorities and supervisors. The case of the Banco de España. Testimony by the Governor of the Banco de España before the Audit Committee on Democratic Quality / Congress of Deputies, 22 December 2020. (There is a Spanish version of this edition with the same number).

2106 PABLO HERNÁNDEZ DE COS: The Spanish pension system: an update in the wake of the pandemic. Banco de España contribution to the Committee on the Monitoring and Assessment of the Toledo Pact Agreements. 2 September 2020. (There is a Spanish version of this edition with the same number).

2107 EDUARDO BANDRÉS, MARÍA-DOLORES GADEA and ANA GÓMEZ-LOSCOS: Dating and synchronisation of regional business cycles in Spain. (There is a Spanish version of this edition with the same number).