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Composite indicators of inflationary pressures

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Abstract

This article analyses a broad set of relevant variables for monitoring inflationary pressures in the Spanish economy. On the basis of these variables, composite indicators are calculated that proxy inflation expectations, the degree of slack in the economy and other inflation pressures, domestic and external alike. On the information analysed, the recent period of low inflation in the Spanish economy is estimated to have come about in a setting in which domestic factors particularly eased, with a notable reduction in inflation expectations.

Keywords: inflation, inflation expectations, economic cycle, composite indicators.

JEL codes: E31, E32.

COMPOSITE INDICATORS OF INFLATIONARY PRESSURES

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Introduction

Since the start of the recent recession, inflation rates globally[1] have tended to ease across the board. Indeed, they have tended to stand below the price stability targets set by central banks. These developments in consumer prices are striking in the current environment of economic recovery and highly expansionary monetary policies. The strong moderation in inflation is not innocuous since, among other effects, it hampers the internal devaluation processes in those monetary union member countries that have to restore their competitiveness, it makes household and corporate deleveraging more complicated and it may prompt a de-anchoring of agents' inflation expectations, giving rise to a very long period of persistently low inflation. Also, a decline in inflation may entail an increase in real interest rates, checking the recovery in aggregate demand.

In the case of the Spanish economy, inflation has eased substantially since the start of the recession compared with previous cycles, and average growth in recent years of the measures of core inflation scarcely reaches 1%, approximately 2 pp below the pre-crisis period, despite the current expansionary phase. Against this background, it is worth investigating the determinants of the recent behaviour of consumer prices in the Spanish economy.

The standard framework for analysing these processes is a version of the so-called "Phillips curve"[2]. According to the Phillips curve, inflation would be determined by the degree of cyclical slack in the economy. Hence, a greater (smaller) amount of idle productive resources would correspond to a lower (higher) inflation rate, owing to agents' inflationary expectations, which may have backward-looking and forward-looking components, and to external pressures linked to factors such as commodities prices or the exchange rate.

However, concepts such as the degree of slack in the economy or inflation expectations do not correspond to directly observable variables; accordingly, empirical counterparts that indirectly estimate them have to be found. This article presents composite indicators of inflationary pressures that proxy these concepts, encapsulating a set of representative variables that approximate them.

Following this introduction, the article is structured as follows. The second section describes the base indicators of inflationary pressures. The third section presents a heat map that visually depicts the relative levels of these indicators at present compared with previous periods. The fourth section sets out the composite indicators used to analyse the period of low inflation.

Base indicators of inflationary pressures

As stated, neither expected inflation nor the degree of cyclical slack are observable variables. This section presents a broad set of indicators that proxy agents' inflation expectations, the degree of slack and other inflation pressures, domestic and external alike (see Table 1).

1 See Ciccarelli and Osbat (2017) for the euro area, and Berganza, Borrallo and del Río (2018) for the global economy.

2 See, for example, Álvarez and Urtasun (2013) for a simple description of this conceptual framework.

COMPOSITE INDICATORS OF INFLATIONARY PRESSURES

TABLE 1

Variable (a) (b)	Periodicity	Normalised	Starting date	Correlation	
				CPI	CPI excl. energy and unprocessed food prices
0 Consumer prices					
CPI	M	No	Jan-99		
CPI excl. energy and unprocessed food prices	M	No	Jan-99		
CPI (a)	M	No	Jan-99		
CPI excl. energy and unprocessed food prices (a)	M	No	Jan-99		
1 Expectations					
Professional forecasters	M				
Funcas panel - forecast year T (a)	M	No	Jan-99	0.8	0.9
Funcas panel - forecast year T+1(a)	M	No	Jan-99	0.8	0.9
Consensus Forecasts - forecast year T (a)	M	No	Jan-99	0.8	0.7
Consensus Forecasts - forecast year T+1(a)	M	No	Jan-99	0.7	0.8
Firms					
PMI prices paid for services (a)	M	Yes	Aug-99	0.7	0.7
PMI prices paid for manufactures (a)	M	Yes	Jan-99	0.6	0.3
PMI prices charged for services (a)	M	Yes	Aug-99	0.4	0.6
PMI prices charged for manufactures (a)	M	Yes	Aug-99	0.5	0.4
European Commission Surveys: prices - manufacturing (a)	M	Yes	Jan-99	0.7	0.6
European Commission Surveys: prices - services (a)	M	Yes	May-03	0.5	0.7
European Commission Surveys: prices - retail trade (a)	M	Yes	May-03	0.6	0.8
European Commission Surveys: prices - construction (a)	M	Yes	Jan-99	0.6	0.7
Consumers					
European Commission Surveys: prices - consumer (a)	M	Yes	Jan-99	0.8	0.9
Inflation swaps					
One-year inflation swaps (b)	D	No	Jul-04	0.8	0.8
Five-year in five years inflation swaps (b)	D	No	Jul-04	0.6	0.7
2 Domestic pressures					
Degree of slack					
Output gap (c)	Q	Yes	99 Q1	0.7	0.8
Capacity utilisation (c)	Q	Yes	99 Q1	0.4	0.6
Unemployment rate (c)	Q	Yes	99 Q1	-0.7	-0.8
Change in unemployment rate (c)	Q	Yes	99 Q1	0.1	0.1
Difference in unemployment rate compared with the minimum for the three previous years (c)	Q	Yes	99 Q1	-0.2	-0.4
GDP (c)	Q	Yes	99 Q1	0.3	0.5
Private consumption (c)	Q	Yes	99 Q1	0.3	0.4
Other domestic pressures					
Market-economy compensation per employee (c)	Q	Yes	99 Q1	0.5	0.6
Market-economy unit labour costs (c)	Q	Yes	99 Q1	0.5	0.7
Margins: GDP deflator/unit labour costs (c)	Q	Yes	99 Q1	0.1	-0.1
Producer prices: overall index (c)	Q	Yes	99 Q1	0.8	0.5
Producer prices: consumer goods (c)	Q	Yes	99 Q1	0.8	0.8
Producer prices: intermediate goods (c)	Q	Yes	99 Q1	0.7	0.5
Producer prices: capital goods (c)	Q	Yes	99 Q1	0.5	0.7
Producer prices: energy goods (c)	Q	Yes	99 Q1	0.7	0.3
Producer prices: processed food prices indicator (c)	Q	Yes	99 Q1	0.8	0.7
Producer prices: non-energy industrial goods prices indicator (c)	Q	Yes	99 Q1	0.7	0.8
Agricultural prices: fruit prices indicator (c)	Q	Yes	01 Q1	0.1	0.3
Agricultural prices: vegetable prices indicator (c)	Q	Yes	01 Q1	0.2	0.2
Agricultural prices: meat and egg prices indicator (c)	Q	Yes	01 Q1	0.5	0.4
3 External pressures					
Goods and services imports deflator (c)	Q	Yes	99 Q1	0.6	0.2
Nominal effective exchange rate vis-à-vis industrialised countries (c)	Q	Yes	99 Q1	0.2	0.3
Dollar/euro exchange rate (c)	Q	Yes	99 Q1	0.3	0.3
Oil price (euro/barrel) (c)	Q	Yes	99 Q1	0.7	0.3
Commodities prices (euro): overall index (c)	Q	Yes	99 Q1	0.4	0.2
Commodities prices (euro): food (c)	Q	Yes	99 Q1	0.5	0.4
Commodities prices (euro): industrials (c)	Q	Yes	99 Q1	0.3	0.0
Industrial product import prices: overall index (c)	Q	Yes	05 Q1	0.8	0.5
Industrial product import prices: processed food prices indicator (c)	Q	Yes	05 Q1	0.8	0.7
Industrial product import prices: non-energy industrial goods prices indicator (c)	Q	Yes	05 Q1	-0.2	-0.1

SOURCES: INE and Banco de España.

a The monthly series are calculated as a six-month moving average, the daily series as a 5-day moving average and the quarterly series as a 2-quarter moving average.
b Median, except in the CPI and the CPI excluding energy and unprocessed food prices, where they are year-on-year rates.
c Two-quarter moving average.

First, we consider fifteen measures of inflation expectations calculated by economic analysts, firms, households and those implicit in certain indicators relating to the financial markets. Specifically, with regard to the estimates by economic analysts, the forecasts in the Funcas[3] and Consensus Forecasts[4] panels are taken, both for the current and for the following year. Another group of expectations variables reflects firms' outlook for the future course of prices. Included in this group are the Purchasing Managers' Indices (PMI)[5] of prices paid and charged, in both the manufacturing and services sectors. Also included are price expectations for the coming months drawing on the European Commission's opinion-based surveys[6] of the manufacturing, services, retail trade and construction sectors. Household expectations are measured taking the European Commission survey that asks about the trend of prices over the next twelve months. Lastly, we consider a group of financial market variables that reflect inflation expectations. Specifically, one-year inflation swaps[7] have been taken as a measure of short-term expectations, and annual average inflation over five years estimated in five years as a measure of long-term inflation expectations. Generally, all these indicators evidence very high correlations with consumer prices, measured on the basis of the overall index or from a core inflation measure, such as the CPI excluding energy and unprocessed food prices (see Table 1)[8]. The lowest correlations are those of the indicators of firms' expectations.

Turning to the indicators of slack, we have selected seven measures of cyclical position. These are, namely, the output gap[9], capacity utilisation, the unemployment rate, the quarter-on-quarter change in the unemployment rate, the recession gap[10] proposed by Stock and Watson (2010), and the quarter-on-quarter changes in GDP and in private consumption. The correlations of the slack indicators with final prices are, except in the case of the output gap and the unemployment rate, fairly moderate.

In addition to the degree of slack, there are other variables that proxy domestic inflation pressures, such as labour costs, business mark-ups and domestic producer prices. Specifically, we have chosen two labour cost variables: market-economy compensation per employee and market-economy unit labour costs. Further, the ratio of the GDP deflator to market-economy unit labour costs is included as a base indicator of business mark-ups. Moreover, domestic producer costs are reflected using different measures of producer and agricultural prices. We specifically consider the producer price index and its main components by economic category: consumer goods, intermediate goods, capital goods and energy. Also included are indicators of producer prices for products consumed by households, both processed food and non-energy industrial goods. We consider the costs of agricultural products with three indicators of fresh food prices, respectively covering fruit, vegetables, and meat and eggs. The correlations with the CPI of the variables related to producer prices are high, while those of agricultural mark-ups or prices are fairly low (see Table 1).

3 Since 1999, Funcas has been publishing a set of forecasts by private and public analysts on a bi-monthly basis in a standardised format. See http://www.funcas.es.
4 See http://www.consensuseconomics.com/.
5 PMI Purchasing Mangers' Index is a Markit Economics monthly survey of purchasing professionals and company executives in the manufacturing and services sectors.
6 The European Commission conducts monthly opinion-based surveys aimed at households and firms from the European Union countries, containing qualitative questions about the expected course of prices.
7 Inflation swaps are financial derivatives where one of the parties undertakes to pay a fixed amount at a future date to the other party in exchange for receiving a payment linked to the future level of a price index.
8 The correlations are very similar if 6-month moving averages of final consumer prices are considered.
9 See Cuadrado and Moral-Benito (2016) for an estimation of the output gap.
10 This variable is defined as the difference between the unemployment rate and the natural rate, with the latter defined as the minimum unemployment rate of the current quarter and the 11 previous quarters.

Lastly, in an open economy, the prices of imported goods influence domestic price formation, either directly in the case of goods for final consumption, or indirectly through producer costs. To capture these external inflationary pressures, imported goods prices, whether of final products, intermediate goods or commodities, are taken into account. Specifically, we include the goods and services imports deflator, the nominal effective exchange rate vis-à-vis the industrialised countries and the euro exchange rate against the dollar. Also, for commodities prices, we take the oil price in euro, along with indices of food and industrial commodities prices. Lastly, we include the indices of industrial product import prices, along with indices of processed food and of non-energy industrial goods import prices. The correlations of these indicators of external pressures with inflation tend to be lower than those of inflation expectations or of other domestic pressures, but higher than those of slack.

The foregoing indicators are subjected to two types of transformation. First, to mitigate the effect of short-term movements, a two-quarter moving average[11] is applied. Further, to take into account the heterogeneity across the indicators both in terms of their average growth and their variability, they are normalised, i.e. from each series we deduct its average over the entire sample period, and the resulting difference is divided by its standard deviation.[12]

Heat map of the base indicators of inflationary pressures

One initial approach to process synthetically the signals from the 45 indicators analysed in the previous section is to summarise them in a "heat map", following the proposal by McGillicuddy and Ricketts (2015) (see Table 2). This "map" visually depicts standardised rates of change, with the scale of colours indicating the sign and magnitude of the deviations by each variable from its historical average, measured in terms of standard deviations. Specifically, the colour blue depicts a change below the long-term average, and red a change above this. The darker the colour, the greater the difference between that particular change and the average of the individually taken variable. Therefore, it should be mentioned that the case may arise at a given moment in time where two indicators show the same normalised value, and thus have the same colour, but in turn have different growth rates in this period. Hence, two normalised indicators may be identified with different colours in cells corresponding to the same time period, and post the same growth rate in the non-normalised base indicator that month.

Looking at the map, two differentiated periods – before and after the onset of the 2008 recession – can be seen. In the prior period, inflation and most of the indicators of inflationary pressures stood above their sample average, meaning that the colour red predominates. Conversely, since 2009 most of the indicators stand below the average, with blue most prevalent. This broad trend, however, is interrupted in certain periods, such as in 2010 and 2012, coinciding with increases in VAT rates, which were reflected in professional analysts' and firms' expectations. Domestic pressures arising from the degree of cyclical slack eased substantially after the recession and until the start of the upturn. The remaining domestic pressures in the post-crisis period have tended to diminish, on the whole, although at certain points discrete pressures may be identified in producer or agricultural market prices. The pattern of external pressures is somewhat less clear when this tool is used.

11 A two-quarter moving average is used for the quarterly series; a six-month moving average is used for the monthly series; and for the swaps series, which have a daily periodicity, a five-day moving average is considered.

12 In the case of the expectations indicators, the level of the series is informative; accordingly, the average has not been deducted from the series. In the case of the business and consumer expectations indicators, which are opinion-based, the level is recovered using regression techniques.

COMPOSITE INDICATORS OF INFLATIONARY PRESSURES. HEAT MAP

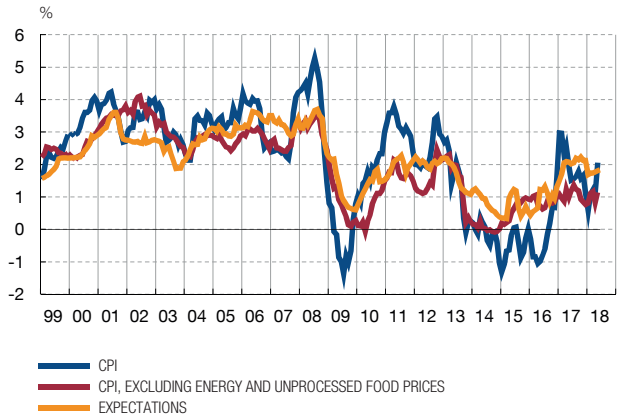
TABLE 2

SOURCES: INE and Banco de España.

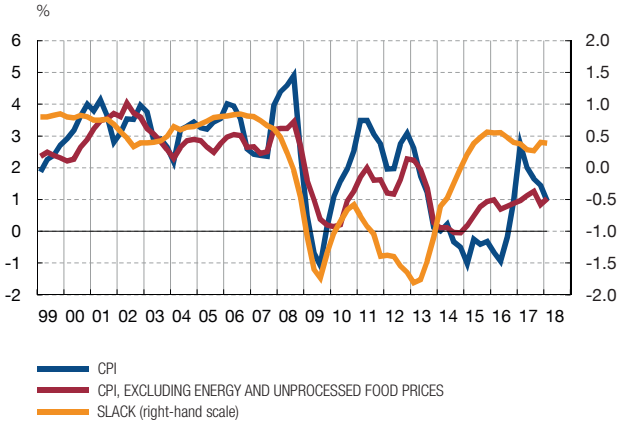
a The monthly series are calculated as a six-month moving average, the daily series as a 5-day moving average and the quarterly series as a 2-quarter moving average.
b Median, except in the CPI and the CPI excluding energy and unprocessed food prices, where they are year-on-year rates.
c Two-quarter moving average.

COMPOSITE INDICATORS OF INFLATIONARY PRESSURES CHART 1

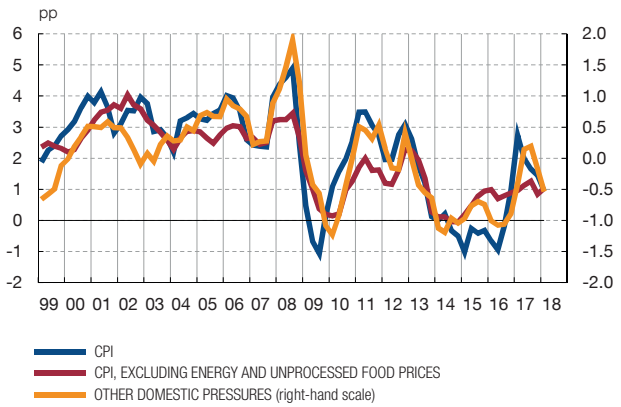
1 INFLATION AND EXPECTATIONS



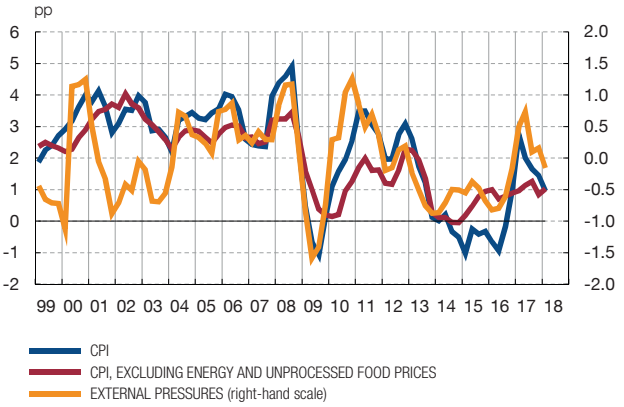
2 INFLATION AND DEGREE OF SLACK



3 INFLATION AND OTHER DOMESTIC PRESSURES



4 INFLATION AND EXTERNAL PRESSURES



SOURCES: INE and Banco de España.

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Composite indicators of inflationary pressures and their role in low inflation

Complementing the approximation provided by the heat map, this section calculates composite indicators using statistical methods that enable the 45 indicators considered to be directly summarised. In short, four such indicators are calculated, one for each general group of indicators: those that measure inflation expectations, the degree of slack, other domestic inflation pressures, and external inflation pressures. As a summary measure, the median of the normalised indicators of each group is considered. The use of the median, as opposed to other possible alternatives such as the average, the first principal component or a common factor, offers the advantage of not being affected by the presence of outliers, without any additional compilation being necessary.

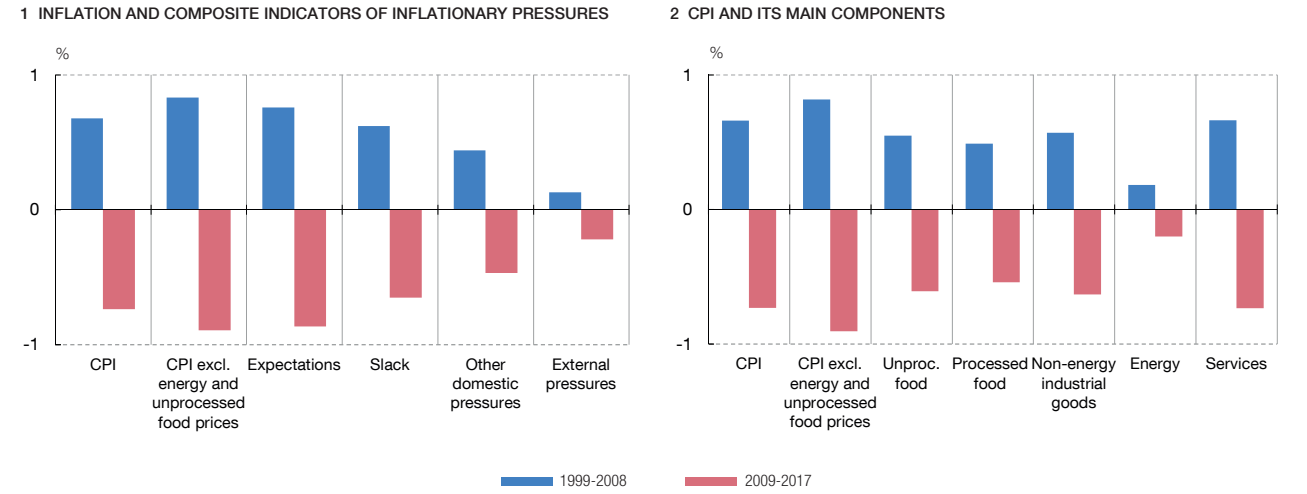
Chart 1 presents the time series of the four composite indicators. A simple correlation analysis reveals that the composite indicators of expectations and of other domestic pressures show high correlation with overall and core inflation, whereas that of the indicator of external pressures is lower, and that of the slack indicator substantially lower (see Table 3). The composite indicator of inflation expectations shows a correlation of 0.9, both with the overall index and with core inflation. In the latest data, expectations have drawn closer to the path of overall inflation, although they stand above core inflation. The composite indicator of slack shows lower correlation, this standing at 0.3 with the overall index and

CORRELATIONS OF THE COMPOSITE INDICATORS WITH INFLATION TABLE 3

	CPI	CPI excl. energy and unprocessed food prices
Expectations	0.87	0.88
Degree of slack	0.32	0.49
Other domestic pressures	0.84	0.79
External pressures	0.64	0.31

SOURCES: INE and Banco de España.

AVERAGE GROWTH OF THE CPI AND OF THE INFLATIONARY PRESSURE INDICATORS (a) CHART 2



SOURCES: INE and Banco de España.

a Averages of standardised year-on-year rates.

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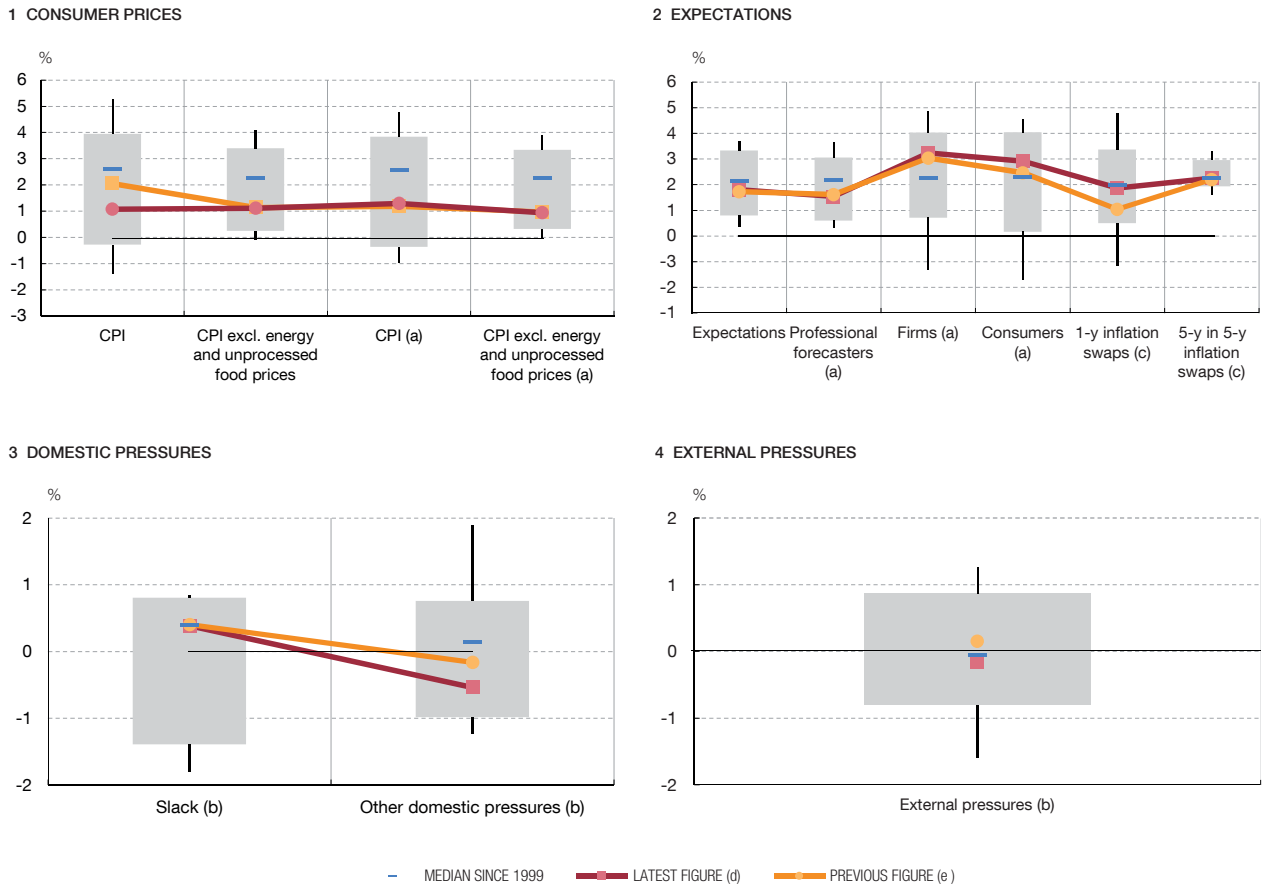
at 0.5 with core inflation. As can be seen in the chart, the greater association between slack and inflation came about with the 2008 recession. The current economic recovery might add pressures to price formation, given the course of the slack indicator; that said, to date these pressures are not taking the form of higher observed inflation. The composite indicator of other domestic pressures, for its part, evidences high correlation with inflation (0.8 with both the overall and core inflation indices). Finally, the indicator of external pressures shows somewhat greater simple correlation with overall inflation (0.6) than with core inflation (0.5), which may be explained by the inclusion of the energy component in the overall CPI, given that the effect of the oil price on the energy component is far greater than that on other goods and services.

By way of illustration, Chart 2 shows, in normalised or standardised terms, both inflation (overall and core) and the four composite indicators calculated for the period prior to and after the onset of the recent crisis. The lower inflation in the second period compared with the historical average came about against the background of the downward revision of the inflation expectations of the various agents in the Spanish economy, an increase in cyclical slack, diminished domestic pressures and a negative contribution of external price

COMPOSITE INDICATORS OF INFLATIONARY PRESSURES
Year-on-year rates of change

CHART 3



SOURCES: Eurostat, ECB and Banco de España.

a Six-month moving average.
b Two-quarter moving average.
c Five-day moving average.
d May 2018 for the monthly series, 2018 Q1 for the quarterly series and 29 June 2018 for the daily series.
e February 2018 for the monthly series, 2017 Q4 for the quarterly series and 13 March 2018 for the daily series.

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pressures. Indeed, in the 1999-2008 period, both inflation and the indicators of inflationary pressures grew on average above their long-term average, while from 2009 to date, all the variables have trended below their average in the 1999-2017 sample. This behaviour is also observed in the main CPI components, with the least difference being discernible in energy prices.

An alternative means of showing how these indicators of inflationary pressures trend is to use box plots (see Chart 3). These take the form of grey-coloured boxes bounded by the 10th (lower extreme) and 90th (upper extreme) percentiles of the distribution of each of the indicators, and their median is also indicated. Further, two lines highlighting the latest period (red line) and the situation of the indicators in the three previous months are included. The chart shows that the latest CPI figure is higher than that posted three months earlier, although core inflation has scarcely changed. Notably, there is an increase in the expectations indicators most related to the short term, such as those corresponding to consumers or those implicit in one-year swaps. The composite indicator of pressures in

respect of cyclical slack has held at a historically high figure, which would be indicative of domestic pressures bearing down on price formation. The composite indicator of other domestic pressures has fallen in the past three months, reaching a historically low level. Lastly, external pressures have eased in recent months.

18.10.2018.

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