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The spread of inflation from energy to other components

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Rationale

Inflation has risen continuously since December 2020. The increase was initially confined to the energy component, but has subsequently spread to food and the other components. It is important to understand the extent to which the spread of inflation is the result of higher energy prices.

Takeaways

- The influence of energy prices on underlying inflation has increased.
- This is partly due to the larger size of recent shocks, but also to an intensification of the pass-through of the changes in energy prices to other consumer prices.

Keywords

Inflation, energy, vector autoregression.

JEL classification

C11, C32, E31.

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Introduction

In Spain and in other economies, consumer prices were characterised by relatively low growth rates between 2013 and 2020, prompting a highly expansionary monetary policy stance throughout that period. However, this protracted period of low global inflation ended in early 2021, making way for particularly sharp price growth (which has brought about a shift in the monetary policy stance). In Spain the average rate of change in the harmonised index of consumer prices (HICP) between 2013 and 2020 was 0.6%. Yet between December 2020 and September 2022 this rate rose continuously, from -0.6% to 9%, reaching its highest value since September 1984 in July 2022.

There are manifold explanations for this price acceleration,[1] including, primarily, the swift and strong recovery in demand after the most stringent pandemic-related restrictions were lifted (thanks in part to the forcefulness of the economic policies supporting activity). The restrictions also made it difficult for certain services to be consumed. As a result, some of the demand for such services shifted to the acquisition of goods, generating surplus demand for them. Lastly, supply has encountered obstacles to meeting this demand, due to a wide range of factors, including the logistical difficulties stemming from the health crisis, the scarcity of certain production inputs and, more recently, the war in Ukraine.[2]

The rise in inflation was initially confined to the energy price component, due to increases in oil prices (which affected fuel prices) and in natural gas and CO2 emissions allowance prices (which drove electricity prices up sharply). However, from autumn 2021, it began to spread to the food and – to an increasing degree – other non-energy goods and services components. The timing suggests that the spread of the rise in inflation could, to some extent, be the result of the indirect effects stemming from higher energy prices.[3]

To shed light on such possibility, this article uses three complementary methodological approaches. The first exercise aims to quantify the increase in the contribution of the HICP energy index to the variability of the different non-energy HICP components. The second develops a less granular model, but which, in contrast, takes into account changes in other macroeconomic variables, allowing us to assess the contribution of energy to underlying inflation. These two analyses offer some evidence of a recent increase in the impact of energy price changes on the prices of other goods and services. The last exercise is designed to try to distinguish whether this

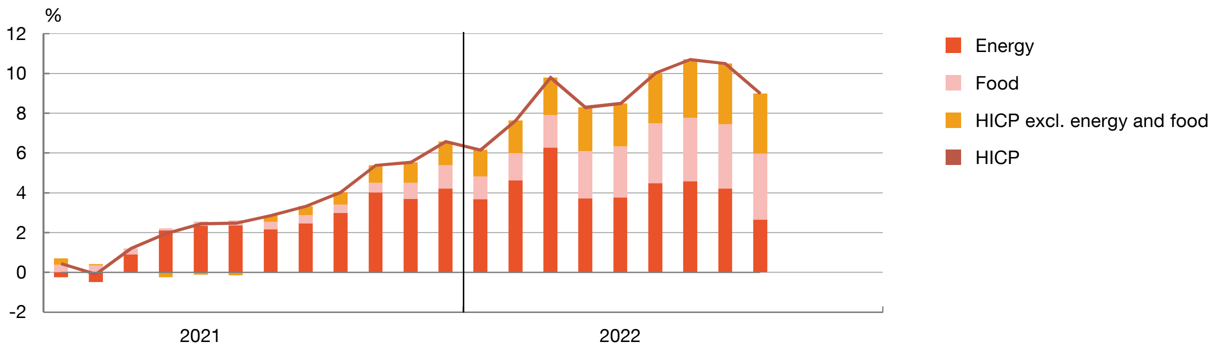
1 For a more detailed description of the determinants of the increase in the rates of change of consumer prices globally, see Banco de España (2022).

2 See Alonso, Kataryniuk and Martínez-Martín (2021), who conduct a quantitative assessment of the relative share of supply and demand-side factors in recent producer price index developments.

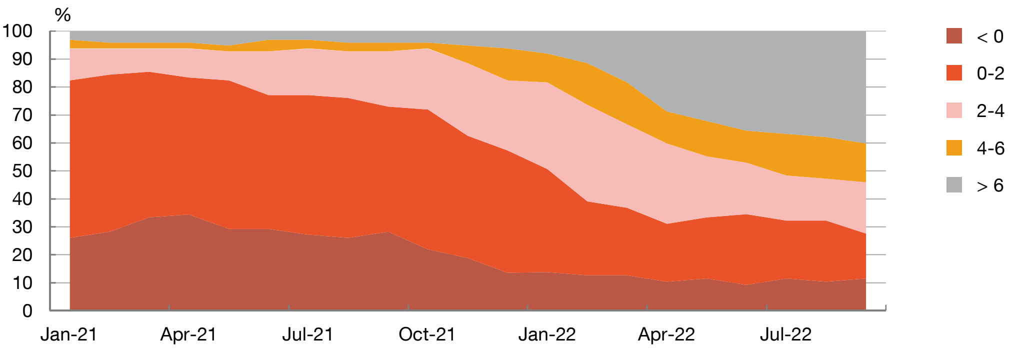
3 Indirect effects reflect the transmission of higher energy input prices to non-energy consumer prices. In this article we assume that the HICP energy component appropriately proxies the prices of those energy inputs. The correlations between the year-on-year rates of (i) oil prices and the HICP fuel component and (ii) gas prices and the HICP electricity component are roughly 85%.

Chart 1
The spread of the rise in inflation

1.a Headline HICP: contributions



1.b Overall index excluding energy: percentage of items in each growth range



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SOURCES: Eurostat and Banco de España.

increase in indirect effects owes to a larger pass-through of energy prices or to such shocks having been larger recently (or to a combination of the two factors). The findings suggest that they have both been important in this episode: recent energy price shocks have been larger and the pass-through of energy prices to other consumer prices has increased.

The spread of the increase in inflation

Chart 1.a depicts the contributions of the different Spanish HICP components to the sharp rise in this indicator since early 2021. Specifically, the contribution of energy goods, food and underlying inflation (which combines non-energy goods and services) are depicted separately.

In 2021 H1, the acceleration in consumer price growth was entirely attributable to energy prices, as a result of the increase in oil prices (which was passed through to fuel prices) and in gas prices

Table 1
Inflation in the United States, the euro area and Spain

	United States	Euro area	Spain
Rate of change between August 2022 and January 2021			
Headline CPI	13,2	11,9	13,5
Food	14,7	12,0	13,5
Energy	48,8	52,0	54,7
Non-energy industrial goods	14,8	5,9	5,5
Services	8,6	6,5	7,0
CPI excl. energy and food	10,2	6,3	6,6

SOURCES: US Bureau of Labor Statistics, Eurostat and Banco de España.

(which impacted consumer prices mainly via the cost of electricity for retail consumers).[4] However, the increase in the pace of growth of other goods and services prices has lagged somewhat, beginning in late 2021 and surging throughout 2022.

Indeed, when the HICP excluding energy is broken down into a total of 96 goods and services categories, we see that, from mid-2021 and, above all, the end of that year, a growing proportion of such categories have high inflation rates (see Chart 1.b).[5] For example, the percentage of these items with year-on-year rates above 4% increased from around 6% up to mid-2021 to over 50% in September 2022. These figures illustrate the marked spread of inflation – which was initially confined to energy goods –, suggesting a possible causal relationship between the increase in energy prices and that in the consumption basket as a whole.

The increase in inflationary pressures has affected most geographical areas, to varying degrees.[6] Within the euro area, prices initially accelerated faster in Spain, given the greater share of energy goods in the consumption basket, the characteristics of the mechanism for setting retail electricity prices and the larger impact of oil price fluctuations on fuel prices.[7] However, in cumulative terms since early 2021, inflation (headline and that recorded in the main goods and services categories) in the euro area as a whole and in the United States is now relatively similar to that observed in Spain (see Table 1).[8]

4 See Pacce, Sánchez and Suárez-Varela (2021).
5 Four-digit level Classification of Individual Consumption According to Purpose (COICOP).
6 See Pacce, del Río and Sánchez (2022) for a description of the phenomenon in Spain and in the euro area as a whole.
7 The more pronounced impact of oil price fluctuations on vehicle and other fuel prices in Spain than in other European countries is due to the lower excise duties on those products in Spain. This means that a given percentage change in the oil market price has a smaller percentage impact on oil product prices. See, for example, Álvarez, Sánchez and Urtasun (2017).
8 The most notable difference is the greater growth of underlying inflation in the United States than in either Spain or the euro area.

Table 2
HICP components included in the model

Processed food (incl. alcohol and tobacco)
Unprocessed food
Non-energy industrial goods
Energy
Communications (services)
Housing (services)
Transport (services)
Recreation and culture, health and repairs (services)
Other services

SOURCES: Eurostat and Banco de España.

Estimation of the effects of the rise in energy prices on the non-energy components of consumer prices

As stated in the introduction, this article uses three different analytical approaches to measure the contribution of higher energy prices to the rise in inflation in the non-energy components of the household consumption basket.

The first exercise aims to analyse the interplay between the prices of different groups of goods and services and, in particular, between such groups and the energy component. It is based on a breakdown of the HICP goods and services into the nine categories listed in Table 2.[9] The influence of each category's prices on the others can be assessed by estimating a vector autoregression (VAR) model on the month-on-month inflation rates for these nine categories of goods and services.[10] Specifically, we quantify[11] the contribution of the variability of the shocks associated with the equation of a given variable to the intensity of the future changes in the other variables included in the model. The sample covers the period from January 2001 to August 2022.

The exercise focuses on the proportion of the changes in the prices of each non-energy component that is explained by the unexpected changes in the energy component. To this end, we perform a forecast error variance decomposition. In addition, instead of obtaining the average contribution for the period as a whole, we perform recursive estimations of the model, using ten-year windows, in order to assess how much the contribution of energy consumer goods price surprises to the variability of inflation in the other components has changed over time.

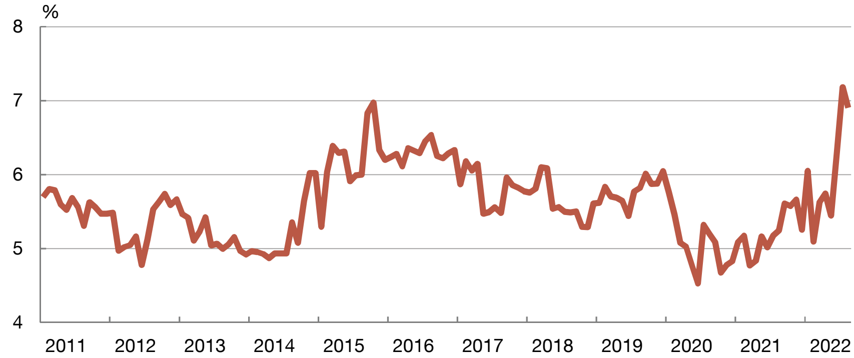
9 This Eurostat classification is based on the ECOICOP 5-digit sub-class level. However, with regard to this classification, durables, non-durables and semi-durables have been grouped together under the non-energy industrial goods heading.

10 We previously examined the possible existence of seasonality patterns in each of these nine HICP components. The series for which seasonality was detected were adjusted using the TRAMO-SEATS program before being used in the estimation of the VAR model.

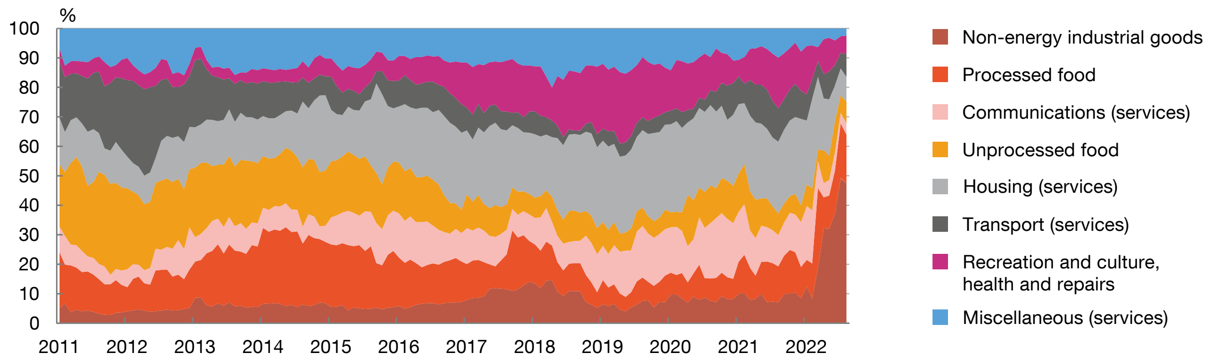
11 See Diebold and Yilmaz (2009). The procedure is called generalised forecast error variance decomposition, which is robust to the order in which each model variable is assumed to affect the others.

Chart 2
Influence of the energy component on the other components

2.a Aggregate effect of energy on the other components



2.b Normalised contribution of each component



SOURCES: Eurostat and Banco de España.

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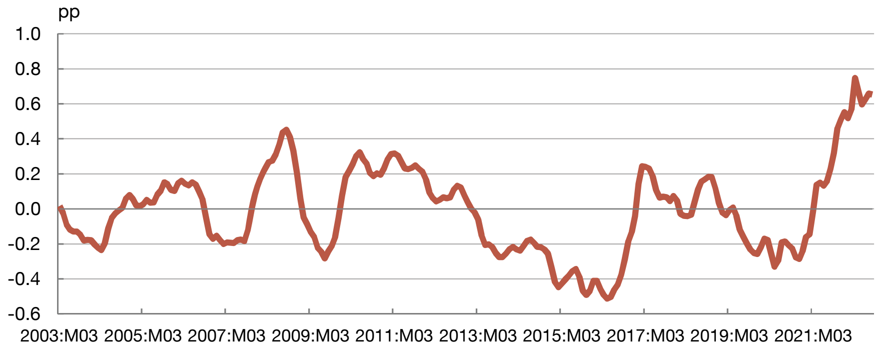
Chart 2.a depicts the time profile of this contribution, expressed in percentage points (pp). According to these findings, the effect of energy usually explains between 5% and just over 6% of the variance in the other components taken as a whole. However, with the substantial increase since mid-2021 – which has intensified in 2022 – the proportion of the variance explained by energy has stood above 7%, exceeding the sample's prior peak (corresponding to a negative shock: the fall of over 75% in the oil price between mid-2014 and early 2016). Naturally, there is also no reason why the changes in the contribution of energy price surprises to the variance in the prices of the other goods and services should be distributed evenly across the other eight components. Chart 2.b depicts the time profile of the distribution of the impact of energy prices across the other categories. In the most recent period, there has, above all, been a considerable increase in the influence of the variance in energy prices on the variance in the prices of non-energy industrial goods.

The second methodological approach seeks to analyse how the price of energy influences underlying inflation, using a less detailed breakdown but taking other macroeconomic factors

Chart 3
Contribution of energy prices to underlying inflation



SOURCE: Banco de España.

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into account. Although based on the same analytical tool (i.e. a VAR model), the specification of the model has two key differences with respect to the previous example. First, in place of the HICP broken down into nine categories, it includes the HICP energy index and the underlying HICP (in this case, the indicator excluding energy and food). Second, with a view to ensuring that other determinants are factored in, the model also incorporates several macroeconomic factors that tend to shape inflation developments. These additional variables (which, much like the price variables, are available monthly) are the month-on-month percentage change in a variable that proxies economic activity[12] and measures of economic policy uncertainty and agents' confidence.[13] Here, the sample used in the estimation of the model comprises the period running from April 2002 to August 2022. Once the VAR model has been estimated, a historical decomposition is performed and the contribution made by each component to changes in underlying inflation is calculated.[14] Chart 3 shows the 12-month moving sum of the historical contribution of energy to underlying inflation.[15] The results suggest that the contribution of energy prices to the rate of underlying inflation was non-existent in March 2021, and grew swiftly thereafter, reaching 0.6 pp in August 2022, a figure notably higher than the previous historical peak reached in September 2008.

These two exercises illustrate, from different perspectives, the effect of the recent rise in energy prices on the other components. However, neither analysis is able to pinpoint the relevant

12 Monthly GDP is obtained via the Denton method, using a factor calculated based on a wide range of indicators.

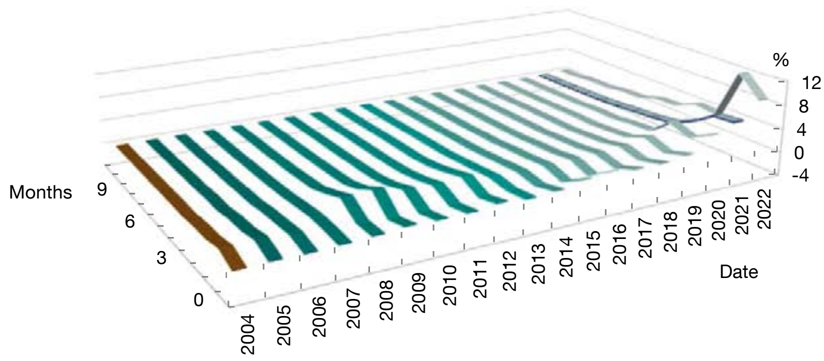
13 The way the uncertainty and confidence measures are constructed is described, respectively, in Ghirelli, Gil, Pérez and Urtasun (2019) and Aguilar, Ghirelli, Pacce and Urtasun (2021). Changes in levels of uncertainty are associated with the scale of the variability around a particular expected growth in activity, while fluctuations in confidence may lead to changes in the expected growth itself.

14 This type of modelling calls for assumptions to be made regarding the order in which the innovations in each of the variables influence the others (what is technically known as a Cholesky decomposition). The order established is from the most exogenous variable to the most endogenous: HICP energy index, uncertainty, confidence, GDP and underlying HICP.

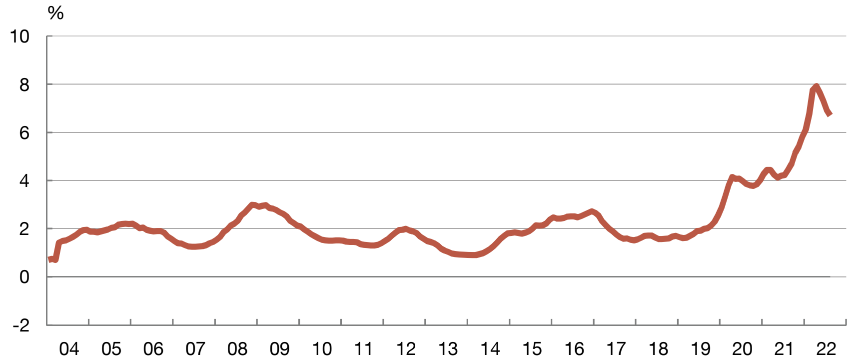
15 The previous exercise sought to measure the extent to which the different components of inflation were connected. The aim of this exercise is to quantify how much energy influences the behaviour of underlying inflation, once other determinants have also been controlled for.

Chart 4
Changes in the response of underlying inflation to energy

4.a Response of underlying inflation to innovation in energy



4.b Standard deviation of the energy component



SOURCE: Banco de España.

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proportions of this increase that can be explained by the greater sensitivity of the other HICP components to changes in energy prices or by the larger scale of the energy price shocks. Needless to say, these options are not mutually exclusive.

The third exercise seeks to determine which of these two channels (larger shocks or greater degree of pass-through) is more important. To this end, a VAR model with time-variant parameters is estimated, including three variables expressed in month-on-month rates: the HICP energy index, the HICP non-energy index and a proxy for economic activity.[16] The sample used to estimate the model comprises the period running from April 2004 to August 2022.

16 The time-variant parameters include both the auto-regressive coefficients and the covariances associated with the residuals, which provide, respectively, information on the scale of the effect in the event of a shock of a given size and information on the size of any surprises. Specifically, it is assumed that all of the parameters follow a random walk. Meanwhile, the VAR model with changing parameters is estimated using Bayesian methods, in line with the procedure proposed in Primiceri (2005). Lastly, the structural surprises are obtained using a Cholesky decomposition.

Chart 4.a shows the impact of an unexpected 1% increase in the price of energy consumer goods on non-energy inflation at different points in time. On the surface area represented in this chart, one of the horizontal axes is the date corresponding to each impulse response function, and the other is the delay in months to which each effect refers, while the vertical axis is the estimated size of the effect. The estimates indicate that the response of underlying inflation to a given increase in energy prices has grown recently and has become longer-lasting.

Nonetheless, an analysis of the results of the model also reveals that the larger impact of changes in energy prices is due not only to the greater degree of pass-through of a shock of normalised size, but also to the larger scale of the shocks observed. Specifically, the last year and a half has seen a notable rise in the volatility of energy prices, which has quadrupled with respect to the pre-pandemic period (see Chart 4.b). Thus, this last analysis reveals that both factors have played a key role in this episode: the recent energy price shocks have been large in scale and the extent to which they have been passed through to the other consumer prices has increased.

Conclusions, limitations of the exercise and possible future extensions

The exercises performed suggest that, compared with the pre-pandemic period, the extent to which variations in energy prices have passed through to the non-energy prices in the consumption basket appears to have increased. As a result, persistent inflationary pressures have been observed, with potentially adverse consequences for economic activity, particularly if agents incorporate these developments into their medium-term inflation expectations and, by extension, into price and wage-setting processes. In the case of the Spanish economy, the available evidence suggests that, despite the recent increase, the pass-through of the costs of energy (and other commodities) to the selling prices of goods and services, and the impact of inflation on wage demands, are, for the time being, limited.[17] Nonetheless, the sizeable impact (by historical standards) of energy price rises on other prices points to the existence of future risks.

These findings could in part be explained by the fact that the past two years have seen very powerful shocks (such as the gradual reopening of economies following the most stringent phases of lockdown, production chain bottlenecks, and the fallout from the Russian invasion of Ukraine) which have coincided with the rising cost of energy and non-energy commodities. This suggests that the energy price-related effects may be capturing some of the impact of these other shocks in the exercises performed. The widespread cost inflation at the initial stages of the production chain, as a result of the simultaneous rise in the prices of many commodities, may have multiplied the apparent effect of inflation on subsequent phases of the production process, triggering a more extensive spread of the price rises across the different categories of goods and services.

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17 This assertion regarding the modest scale of these two transmission processes is based, respectively, on Fernández and Izquierdo (2022) and Izquierdo (2022).

Nonetheless, it is possible that the very sharp rise in energy costs may have led firms to adjust their prices more often than is usual in the face of smaller shocks, where the incentives to adjust prices are less compelling.

This research could be expanded in the future to distinguish between the implications of fluctuations in the prices of oil and of gas for the prices of non-energy goods and services. In other historical episodes, sharp swings in the cost of energy were prompted by the price of oil. This time round, however, the price increases have spread to natural gas.[18] Both fuel (produced from oil) and gas and electricity (the price of which hinges significantly on gas) form part of the household consumption basket. Moreover, oil, gas and electricity all have their part to play, in widely varying amounts and proportions, in the production processes for other goods and services. Although the exercises performed probably capture the overall effects of rising oil and gas prices satisfactorily, it would be interesting, in the current circumstances, to attempt to break down this impact between the two primary sources of energy considered.

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18 See López, Párraga and Santabárbara (2022) for an assessment of the effects of rising gas prices on other consumer prices.

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