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Asymmetries in the transmission of energy price increases and decreases to underlying inflation in the euro area and Spain

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Rationale

Energy prices rose sharply in early 2022 and then began to decline towards the end of the year. Given this situation, it is worth analysing whether an energy price increase raises underlying inflation more than an energy price decrease reduces it.

Takeaways

- Over a one-year horizon, a large hike in energy prices increases underlying inflation by around twice as much as an equivalent decrease reduces it.
- The asymmetry in the response of underlying inflation to changes in energy prices is greater in components that use more energy in their production process.
- Although asymmetry can be identified by analysing historical relationships, there is considerable uncertainty about the validity of such patterns in the current setting, which can be characterised by unprecedentedly large shocks that have driven both energy prices and underlying inflation.

Keywords

Asymmetry, energy prices, inflation.

JEL classification

E31, Q43, C32.

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ASYMMETRIES IN THE TRANSMISSION OF ENERGY PRICE INCREASES AND DECREASES TO UNDERLYING INFLATION IN THE EURO AREA AND SPAIN

Introduction

High energy prices and exceptionally high underlying inflation have marked the recent economic developments in the euro area and in Spain. The outbreak of the war in Ukraine in early 2022 significantly exacerbated the energy price increases under way since 2021, heightening the inflationary pressure that was already present as a result of supply and demand mismatches arising as a result of the pandemic. In particular, inflation's energy component peaked at 44% in March 2022 (see Chart 1). Increases in energy and non-energy commodity prices drove euro area inflation to a record high (10.6%) in October 2022, after which inflation began to ease, supported by falling energy prices. Meanwhile, underlying inflation (which reflects developments in the prices of services and industrial goods excluding energy and food) trended upwards, peaking at 5.7% in March 2023 (see Chart 2). Since then, it has fallen by 1.5 percentage points (pp) in the euro area and by 1.4 pp in Spain, standing at 4.2% in the euro area and at 3.8% in Spain in October. Accordingly, underlying inflation is declining more slowly than headline inflation, consistent with Eurosystem projection exercises. These changes pose the question of whether a series of significant decreases in energy prices reduce underlying inflation to the same extent as a series of increases raises it. The answer depends on whether inflation responds symmetrically to positive and negative energy price shocks.

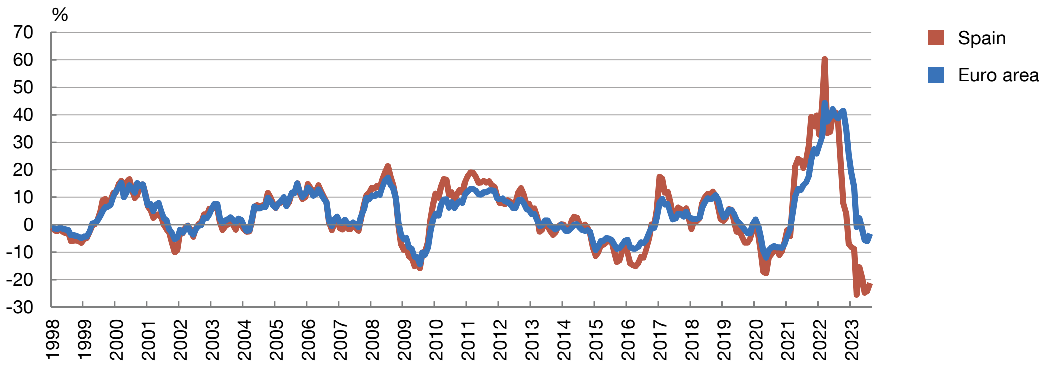
The empirical evidence on whether energy prices have an asymmetrical impact on inflation is inconclusive. On the one hand, Borrallo, Cuadro-Saez, Gras-Miralles and Pérez (2023), Peltzman (2000) and Bacon (1991) find that positive and negative energy price shocks have an asymmetric impact on disaggregated consumer and producer prices in the euro area, United States and United Kingdom, respectively. On the other hand, Gautier, Marx and Vertier (2022) find no asymmetry in the transmission of global oil price shocks (in either direction) to petrol prices in France.

This article presents an econometric model that allows us to test for the existence of asymmetry in the transmission of large positive and negative energy price shocks to underlying inflation. A positive (negative) shock is considered large when the energy price level is above (below) the previous year's maximum (minimum). Accordingly, the model uses both the direction and the size of the shock to determine the response of underlying inflation.

Methodology and data

In order to verify the presence of asymmetries in the transmission of energy price shocks, an econometric non-linear structural vector autoregression (SVAR) model is used, as proposed by Kilian and Vigfusson (2011). SVAR models are useful to capture the dynamic relationships between multiple macroeconomic variables and to understand how unexpected changes in one variable can affect the others. Very briefly, in an SVAR model, the macroeconomic variables depend on historical observations and unexpected disruptions (shocks), such as a rise in energy prices. Furthermore, the

Chart 1
Energy price inflation (not seasonally adjusted)



SOURCE: Eurostat.

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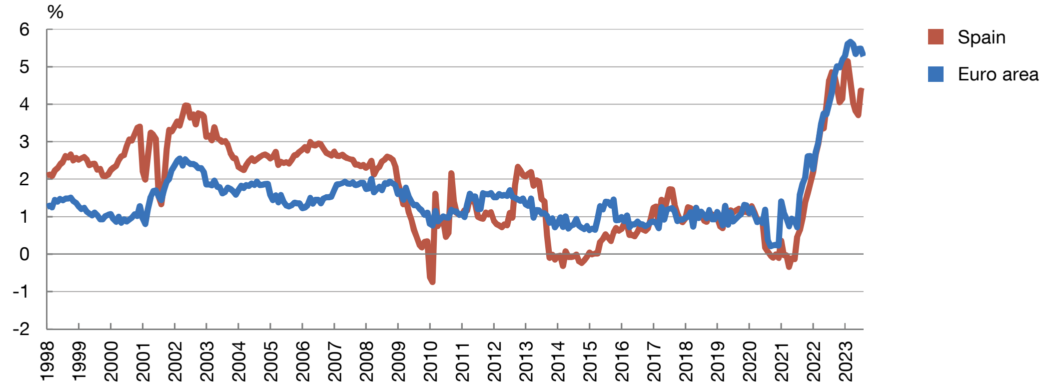
Chart 2
Underlying inflation (not seasonally adjusted)



SOURCE: Eurostat.

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SVAR model used incorporates a series of non-linear terms that make it possible to include potential asymmetries in the transmission of positive and negative shocks depending on their magnitude.

As applied here, the non-linear SVAR model contains two variables: the month-on-month growth rate of the energy price component of the harmonised index of consumer prices (HICP) and that of the underlying indicator (HICP excluding energy and food, or HICPX). Monthly data are used and the sample covers the period from January 1997 to August 2023.[1] Two versions of the model are estimated, one with euro area data and the other with Spanish data.

1 Although only two variables are included in the model, all of the results are robust to the inclusion of an additional variable – the European Commission's Economic Sentiment Indicator for the euro area – to account for the possible impact of economic developments.

The model's asymmetry means that underlying inflation can respond differently when energy prices exceed the maximum of the previous 12 months (local maximum) versus when they fall below their minimum of that same period (local minimum). That is, the asymmetry arises from the relationship between shocks in either direction that are of sufficient magnitude to drive energy prices to their local maximum or local minimum, at which point the transmission of shocks may vary. However, for the purposes of notational simplicity, from now on we discuss the asymmetry between large negative and large positive shocks.

The estimated response of variables to different shocks is identified assuming that energy price inflation does not react contemporaneously to a change in underlying inflation, but that underlying inflation reacts contemporaneously to energy price shocks. Two lagged variables are also included for all the model's variables. Specifically, the non-linear SVAR model can be expressed as follows:

$$\begin{bmatrix} e_t \\ s_t \end{bmatrix} = \begin{bmatrix} \alpha_{0.1} \\ \alpha_{0.2} \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ \beta_{0.21} & 0 \end{bmatrix} \begin{bmatrix} e_t \\ s_t \end{bmatrix} + \beta_1 \begin{bmatrix} e_{t-1} \\ s_{t-1} \end{bmatrix} + \beta_2 \begin{bmatrix} e_{t-2} \\ s_{t-2} \end{bmatrix} + \sum_{i=0}^{2} \begin{bmatrix} 0 \\ \gamma_i \end{bmatrix} e^{+}_{t-i} + \sum_{i=0}^{2} \begin{bmatrix} 0 \\ \phi_i \end{bmatrix} e^{-}_{t-i} + \begin{bmatrix} u_{t,1} \\ u_{t,2} \end{bmatrix}$$

where e_t represents energy price inflation, s_t represents underlying inflation and the terms e^{+}_{t-i} and e^{-}_{t-i} capture the asymmetry by means of the mechanism described previously. This expression shows the relationship between the model's variables and the shocks, accounting for the restrictions imposed to identify their impacts separately. Accordingly, underlying inflation responds contemporaneously to energy price shocks while there is a one-month lag in the response of energy price inflation to underlying inflation shocks.

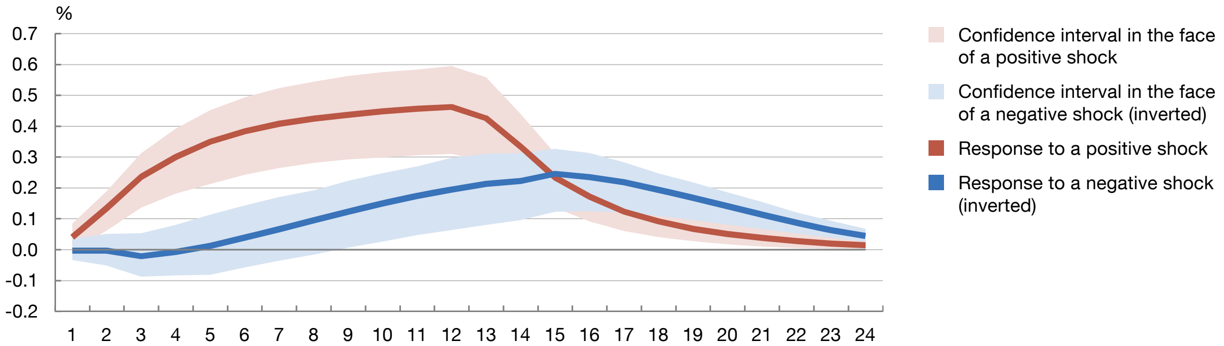
Empirical results

Having estimated the model, we analyse the impact on underlying inflation of increases and decreases in energy price inflation. To calibrate the effect of a large shock on energy prices, we simulate a situation in which there is a large upward shock to inflation's energy component of approximately 6%, as seen when Russia invaded Ukraine.

Chart 3.1 shows the impulse response function (IRF) of euro area year-on-year underlying inflation to a large positive and large negative energy price shock. The response to the negative shock is shown inverted to better compare the magnitude of the response of underlying inflation. As can be seen, underlying inflation responds more markedly to a large rise in energy prices than to a large fall. Furthermore, this difference has a statistical significance of 95% according to the test proposed by Kilian and Vigfusson (2011). At its height (around 12 months after energy price shocks), the inflationary impact of a positive shock is around double that of a negative shock. In both cases, the impact of the shock on inflation is significantly different from zero for around two years. Lastly, it is noteworthy that underlying inflation has a lagged and gradual response to energy price shocks, since it takes time for the energy shock to pass through to non-energy consumer prices.

Chart 3
The response of underlying inflation (y-o-y rate) to an energy price shock

3.a Euro area



3.b Spain

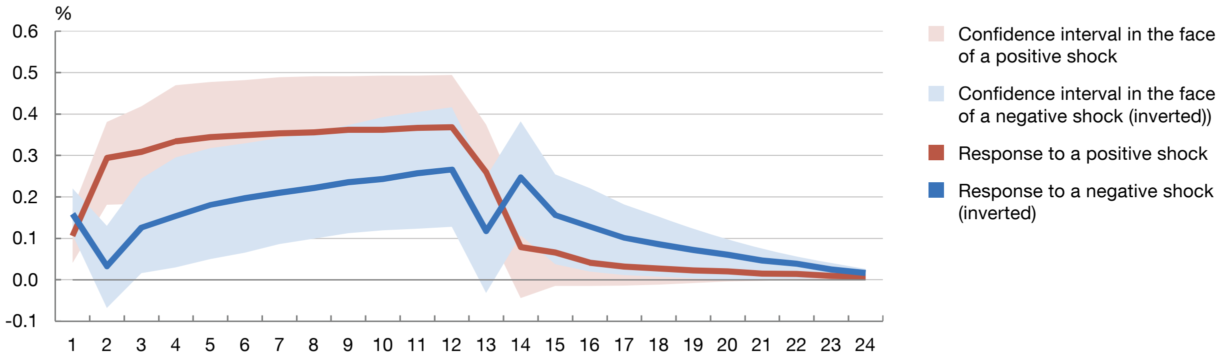


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Chart 3.2 shows, in line with the results for the euro area, how underlying inflation in Spain responds more markedly to a large energy price rise than to a large fall, with the difference having 95% statistical significance. Similarly, the difference is greatest at 12 months, when the impact of the positive shock is twice that of the negative one. However, the magnitude of the underlying inflation responses is greater in Spain than in the euro area,[2] although they do not last as long, given that they are only statistically significantly different from zero in the first year.

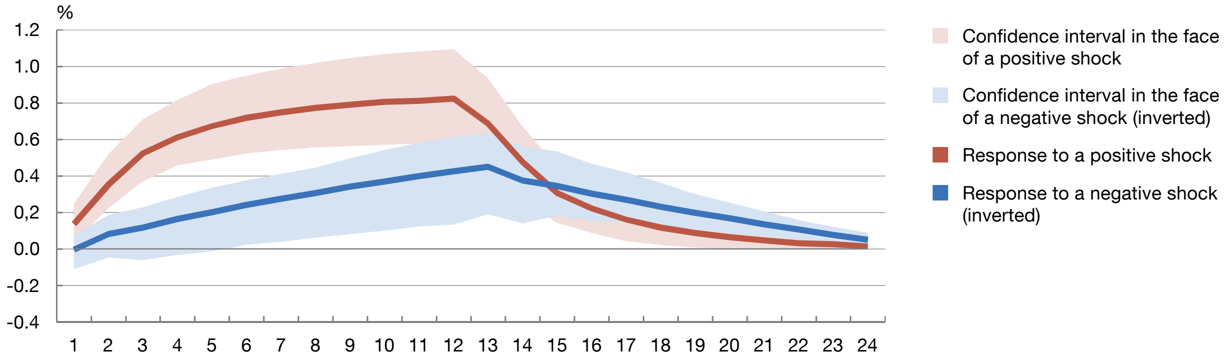
In which inflation components is this asymmetry observed?

The importance of energy and labour inputs in the production process varies considerably across different economic sectors. For example, in furniture and furnishings, energy costs account for a very high percentage of the total, whereas in hospital services, labour costs are very significant.

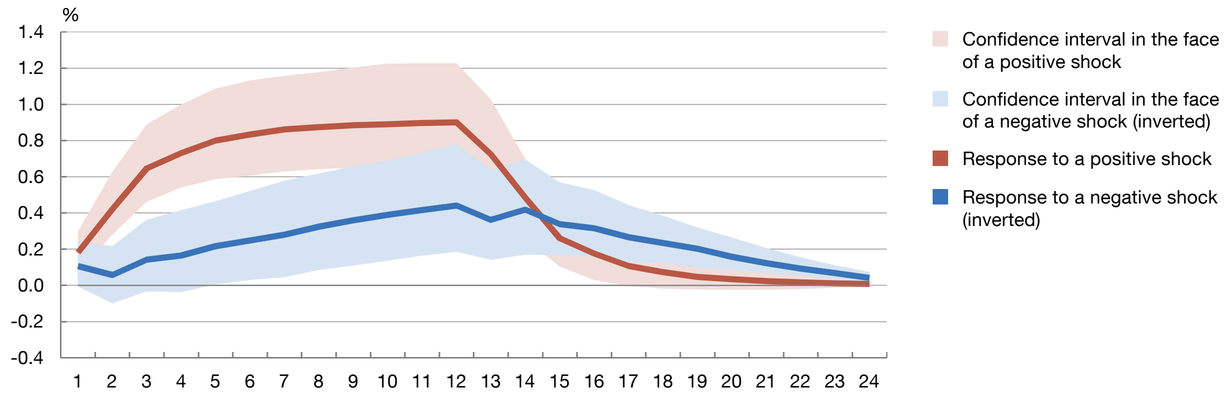
2 See also López-Muñoz, Párraga-Rodríguez and Santabárbara-García (2022) on the transmission of energy price shocks to underlying inflation in the euro area and Spain.

Chart 4
The response of energy-intensive underlying inflation (y-o-y rate) to an energy price shock

4.a Euro area



4.b Spain



SOURCE: Devised by authors.

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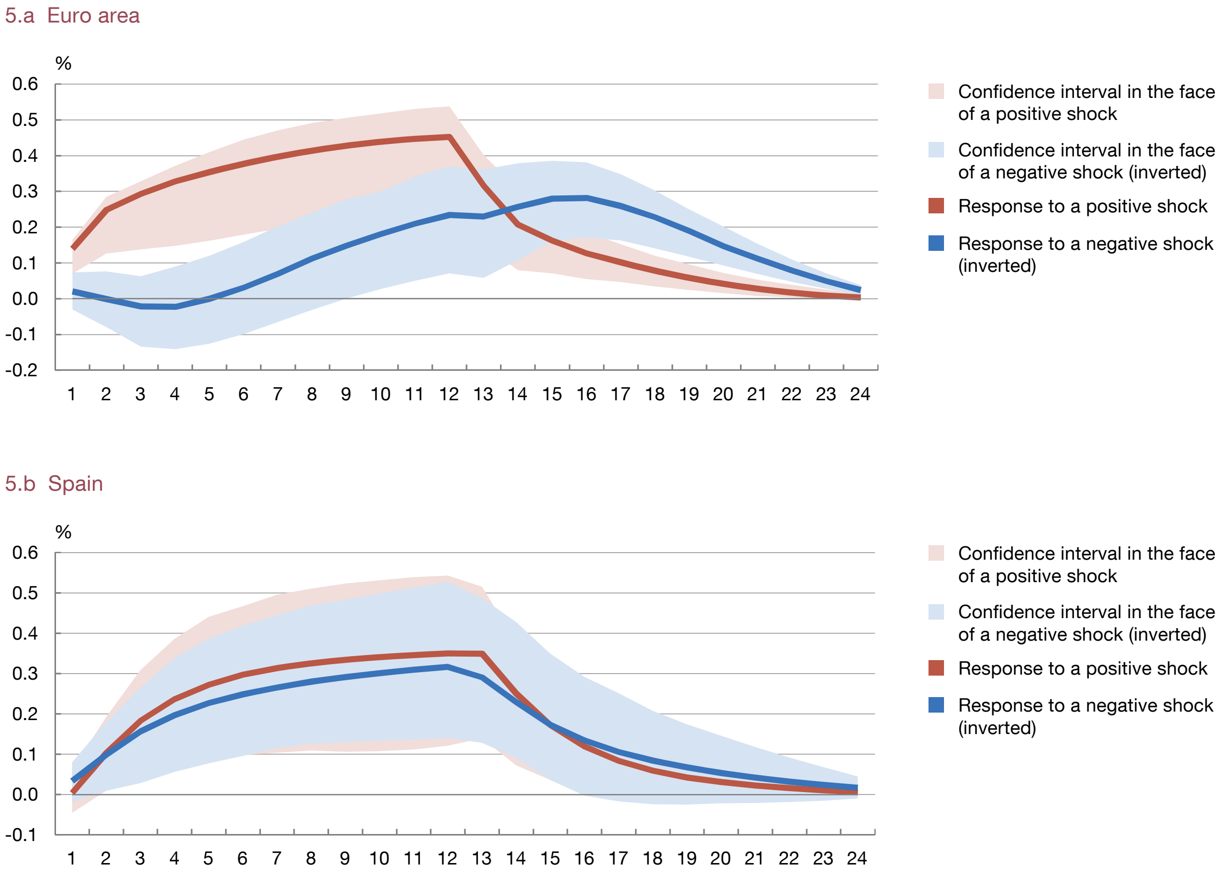
Accordingly, the price of products in the most energy-intensive sectors can be expected to react more strongly to changes in energy prices than the price of products in sectors where wage costs play a more important part.

To identify the underlying inflation items that show the most asymmetric energy price transmission, here we re-estimate the model by breaking down underlying inflation into two aggregates: first, the items most sensitive to changes in energy costs, and second, the items most sensitive to changes in wage costs. Specifically, the energy-intensive underlying inflation aggregate comprises items in economic sectors whose energy costs account for an above-average share of total costs,[3] while the wage-intensive underlying inflation aggregate consists of items in economic

3 The products included in this aggregate are calculated in two stages. First, the input-output tables are used to estimate the share of energy costs as a proportion of total costs in each productive sector at 4-digit CNAE (Spanish National Classification of Economic Activities) level. The CNAE sectors are then matched to the consumption items included in the HICPX at 4-digit COICOP (Classification of Individual Consumption by Purpose) level. Lastly, the consumption items that account for an above-average share of energy costs are included in the aggregate. The correspondence between the CNAE sectors and the COICOP items is an approximation.

Chart 5
The response of wage-intensive underlying inflation (y-o-y rate) to an energy price shock



SOURCE: Devised by authors.

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sectors whose wage costs exceed 40% of total costs.[4] It is important to note that these measures of underlying inflation do not quantify energy price inflation or wage inflation, but rather the inflation of non-energy items whose production process is energy or wage-intensive.

Chart 4 depicts the IRFs of the energy-intensive underlying inflation aggregate in the face of energy shocks, for both the euro area and Spain. In both areas, the results show an inflation response that is very similar in magnitude and significance to that obtained for total underlying inflation.

Lastly, Chart 5 depicts the response of the wage-intensive underlying inflation aggregate for both the euro area and Spain. For the euro area, the results show a greater response to a positive shock, in absolute values, than to a negative shock. However, the magnitude of the response to an increase in energy prices is half that of the response of total underlying inflation, while the

4 The consumption items included in this aggregate are calculated in the same way as the energy-intensive ones, but taking into account the share of labour costs as a proportion of total costs. Specifically, the aggregate includes the consumption items whose wage costs account for more than 40% of total costs. See Lane (2023).

response to a fall in energy prices is approximately zero. For Spain, on the contrary, positive and negative shocks elicit a significant but similar response, which is, in addition, comparable in (absolute) magnitude to the response of total underlying inflation to a negative shock.[5]

Final considerations

This article documents the existence of asymmetries in energy price transmission to underlying inflation. Specifically, the findings show that a significant increase in energy prices pushes up underlying inflation by approximately twice as much as it is reduced by an equivalent decrease in energy prices. However, it is important to note that these findings are drawn from historical patterns that have characterised the relationship between energy price shocks and underlying inflation. There is, therefore, considerable uncertainty about the validity of such patterns in the current setting, which is marked not only by unprecedented large energy price shocks but also by exceptional circumstances affecting inflation and underlying inflation patterns. In consequence, continuous analytical monitoring of this issue is needed over the coming months.

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5 Qualitatively similar results are found for non-energy-intensive underlying inflation.