Analysis

What factors have influenced the dynamics of euro area prices and wages?

Monetary policy | 03 May 2024 | Lauri Vilmi, Sami Oinonen

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Euro area inflation in 2021 and 2022 was driven upwards particularly by the rise in energy and food prices and by the various supply chain disruptions. The rise in prices in that period has been fuelling wage increases since the start of 2023. Continuing labour shortages have also boosted wage pressures. Inflation expectations increased in 2022 due to the persistence of high inflation. However, the European Central Bank's (ECB) measures for tightening monetary policy have enabled inflation expectations to be anchored at around 2%. The anchoring of expectations and the moderation of energy and food inflation are contributing to reducing the rate of inflation. The tight labour market and the rise in wages to compensate for higher prices are nevertheless still keeping inflation above the 2% target. The results presented in this paper are based on a dynamic model of inflation that focuses on the euro area's inflation and wage dynamics of recent years.



Since mid-2021, euro area inflation has been exceptionally high and above the ECB's target of 2%. A similar period of high inflation also occurred in the United States, but the US surge in inflation happened earlier than in the euro area. The high inflation has been explained by various supply and demand side factors.[1] Firstly, the COVID-19 pandemic increased disruptions in global supply chains. Then, as a result of Russia's war in Ukraine, the prices of energy and other raw materials rose sharply. The rise in agricultural input prices and the higher price of energy as a result of the war also caused a surge in food prices.[2] On the demand side, prices were pushed up by the growth in consumption, boosted by the strong fiscal and monetary stimulus, and by the strong fluctuations in the structure of demand, shifting from the demand of goods to the demand for services. This has been accompanied by a marked increase in public consumption. The growth in aggregate demand tightened the labour market. Even though the size of the labour force has increased strongly since the beginning of 2022 as a result of growth in immigration and the higher labour force participation rate[3], the supply of labour has been constrained by the reduction in the number of hours worked per employee[4] and by population ageing[5].

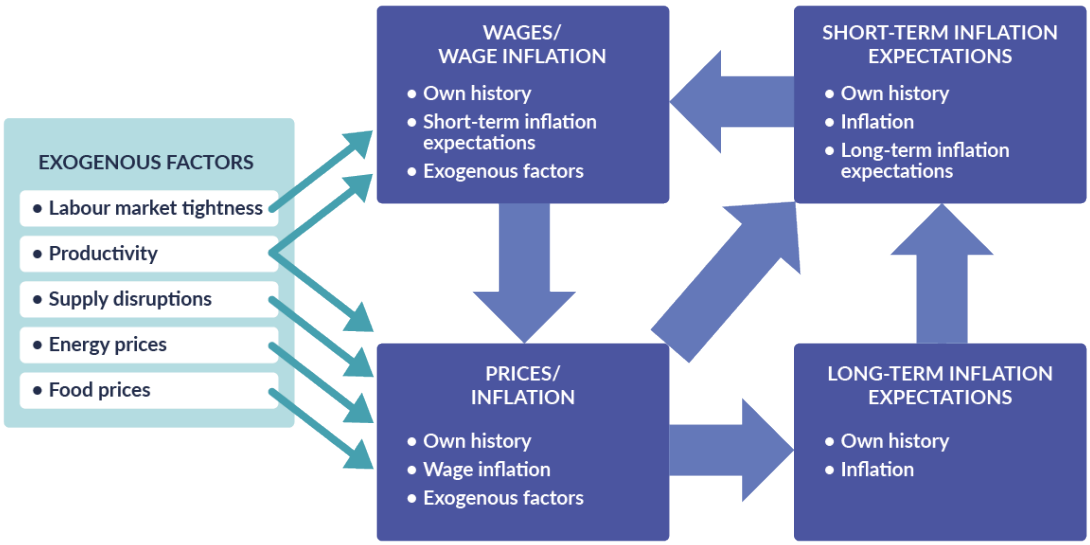
We examined inflation dynamics in the euro area using a simple model of wages and prices that is based on Blanchard and Bernanke's (2023)[6] price dynamics model of the United States[7]. The model allows us to analyse the effects of labour market tightness, energy and food price movements and supply disruptions on inflation and wage developments in the euro area. The model is a relatively simple representation of the economy and is not based directly on microeconomic theory. Some of the results may thus be sensitive to the assumptions made.

Chart 1 illustrates the variables of the Bernanke-Blanchard model and their dynamics. The model

consists of four endogenous variables: wage growth (w_t), quarterly inflation (Π_t) and short-term ($\Pi_t^{E,S}$) and long-term inflation expectations ($\Pi_t^{E,S}$) (blue boxes). In addition, the price variables are affected by various exogenous factors (turquoise box). These are changes in energy (Π_t^{e}) and food (Π_t^{f}) prices, labour market tightness (v_t) supply disruptions (x_t) and productivity trend growth (A_t^{trend}). The arrows show the interdependence between the variables.[8]

Chart 1.

Description of the model used



Source: Bank of Finland.

Companies and employees negotiate wages, taking into consideration the tightness of the labour market and (short-term) inflation expectations. In the model, wages are predetermined, which means that they do not respond immediately to new shocks in the economy. The wage equation resembles wage setting in a New Keynesian model in the sense that expectations have an effect on current wages, but contrary to the basic New Keynesian model, wages are affected by inflation expectations and not expectations regarding future wages.

Companies, in turn, when setting prices for their products, take into account their wage costs and other production costs. So, in the model by Blanchard and Bernanke (2023), inflation expectations do not have a direct effect on price setting; instead, prices are determined in a backward-looking manner and inflation expectations are reflected in prices only indirectly via the wage equation.

Short-term inflation expectations are affected by previous expectations, actual inflation in the previous quarters and long-term inflation expectations. These variables are in turn affected by their lags and by actual inflation. If the central bank's inflation target is credible, long-term expectations should be anchored close to 2%. If expectations increase above that level, this would cause the model to show a persistent rise in inflation above the target.

Supply shocks triggered a surge in inflation

The group of equations can be estimated as a SVAR (structural vector autoregression) model in which the endogenous variables are wages, prices and short and long-term inflation expectations, and the exogenous variables are labour market tightness, food and energy price inflation and an indicator of supply disruptions. The SVAR model allows us to see not only the direct effects of shocks but also their indirect effects via the other variables in the model. This allows us to examine the effects of the various factors on euro area inflation in recent years.

The variables in the equations of the estimated model for the euro area were selected on the basis of data availability, in line with the study by Blanchard and Bernanke. The equation estimates are for the year 2000 onwards. The model's price variables are the seasonally adjusted price indices for the euro area's HICP and energy and food prices, and the wage variable is the indicator of negotiated wages calculated by the ECB for the euro area (in Blanchard and Bernanke: *the labour cost indicator*), which, due to its smaller volatility, is a better measure than actual wages (compensation per employee or per hour worked) for describing and analysing euro area wage dynamics. As a measure of short-term inflation expectations we use the expectations one year ahead available from the ECB's Survey of Professional Forecasters[9] (SPF), and correspondingly, as a measure of long-term expectations, the SPF's expectations five years ahead (in Blanchard and Bernanke: *the one-year and ten-year inflation expectations measured by the inflation expectation series of the Federal Reserve Bank of Cleveland*). As an indicator of labour market tightness, we use the 'shortage of labour force as a factor limiting production' indicator derived from the European Commission's business survey (in Blanchard and Bernanke: *vacancy-to-unemployment rate*, v/u), and as a measure of supply chain disruptions we use the 'Global Supply Chain Pressure Index (GSCPI)' of the Federal Reserve Bank of New York (in Blanchard and Bernanke: *an index of supply chain problems based on Google searches*). Productivity growth is measured as the eight-quarter moving average of labour productivity per hours worked.

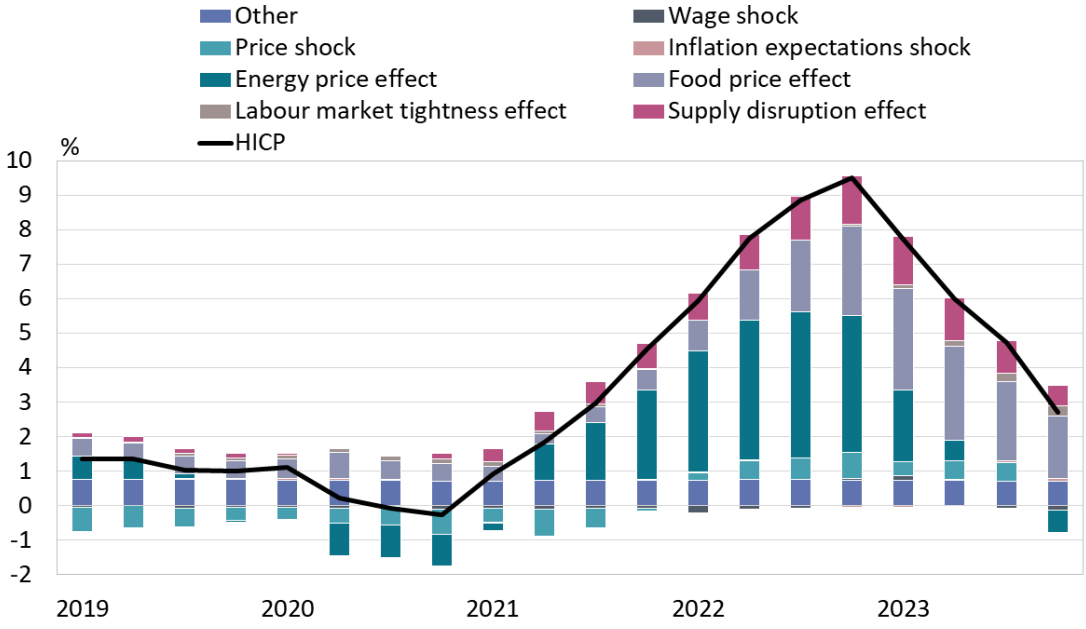
The same model has recently been applied by Arce et al. (2024) for examining euro area inflation dynamics. The group of variables used by them is largely the same as the one we have used in estimating the results presented in this article, with a couple of exceptions. For the modelling of short-term inflation expectations, Arce et al. (2024) use the Consensus Forecast for expected

inflation[10] one year ahead. The labour market tightness measure is the vacancy-to-unemployment rate (v/u). Their estimations include the catch-up term applied in the Bernanke-Blanchard model as well, which describes the wage compensation resulting from the inflation surprise (see footnote 7).

Charts 2 and 3 show the effects of exogenous factors on euro area inflation and wage dynamics and the inflationary impact of shocks to endogenous variables. The effect of productivity growth is included in the term 'other'. Euro area inflation in early 2021 was affected largely by the surge in energy and food prices and the increase in supply disruptions (Chart 2). Energy price shocks, in particular, explain much of the surge in inflation in 2021 and 2022. The drop in energy prices also contributed significantly to the lower rate of inflation in 2023. The surge in prices was also driven by other inflationary shocks that can be explained by the strong growth in demand. These factors that initially spurred inflation faded in 2023, and the effect of energy prices on inflation even turned negative. Inflation has nevertheless remained above the ECB's target, driven especially by persistently high food inflation and the tight labour market.

Chart 2.

Energy and food prices as well as supply disruptions triggered a surge in euro area inflation



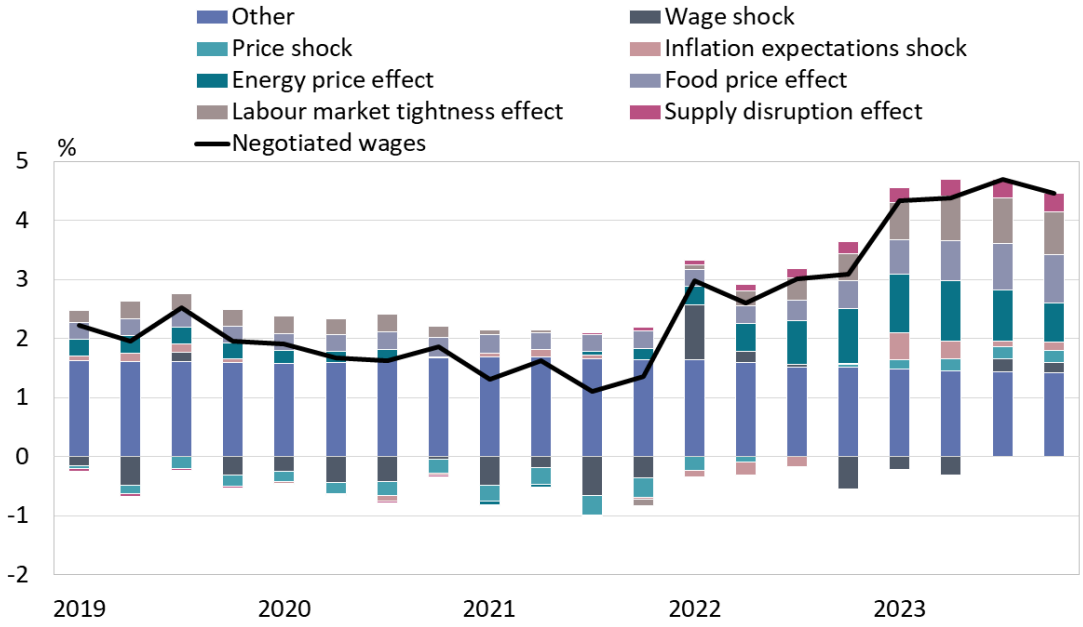
Source: Bank of Finland calculations.
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The impact of the increasingly tight labour market on wage growth has been stronger than the impact of inflation (Chart 3). It is estimated that around 0.7 percentage points of the increase in

negotiated wages in the last quarter of 2023 was attributable to the tightness of the labour market. The faster growth in wages is otherwise explained mainly by the higher wage demands of employees resulting from the rise in commodity price inflation, which was driven by rising energy and food prices and supply disruptions. These factors appear to be having a prolonged upward effect on wages in the euro area. The conclusion then is that the increased wage growth seems to have largely been a reaction to the high inflation rate rather than being associated with wage shocks linked to future inflation expectations or strong growth in labour demand.[11] Over the course of 2023, wages were also pushed up slightly by a rise in inflation expectations, but this impact on wage growth is estimated to have been moderate and limited to around 0.1–0.2 percentage points.

Chart 3.

Wage growth in the euro area has mainly been a reaction to consumer price inflation



Source: Bank of Finland calculations.
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The research results concerning euro area inflation and wage growth correspond closely to those of other similar studies. A structural model recently introduced by Bernanke and Blanchard has been used to estimate the recent dynamics of prices and wages in a range of countries. In their paper, Bernanke and Blanchard (2024)[12] sum up the final results of their recent studies regarding the United States, the United Kingdom, the euro area and Japan as well as the results of as yet unpublished research concerning Canada, France, Germany, Belgium, the Netherlands, Spain and

Italy. Bernanke and Blanchard note that although there are differences across countries, the main conclusion is that the rise in inflation in all the countries examined was primarily caused by direct shocks to prices (energy, food and supply disruptions), while the tight labour market has had only a relatively minor impact on inflation. The recent slowing of inflation has to a large extent been a result of the decline in energy prices, whereas food prices have remained high. However, the prolonged tightness of the labour market is beginning to be reflected in inflation and, if the tightness persists, this may lead to permanently higher inflation.

The calculations for the euro area in Arce et al. (2024)[13] yielded very similar results to those presented in this article. Arce et al. also note that the pass-through of wages to euro area price inflation has weakened during the pandemic. Bernanke and Blanchard (2024) in turn state that the results for the eleven studies completed thus far show that the impact of energy prices and supply shocks appears to have been strongest in the euro area, while the impact of food prices has been strongest in Japan, followed by the euro area.

The marked role of supply shocks as a driver of inflation in the United States is also noted by Blanchard and Bernanke (2023). In the US, wage growth seems to have remained moderate for now, but Blanchard and Bernanke also point to the risks associated with wage inflation, especially if it persists. The same risks are evident in the euro area. Haskel et al. (2023)[14] estimate that price and wage inflation are more rigid in the United Kingdom than in the United States, but inflation expectations in the UK have remained more moderate than anticipated in the model outcomes, in contrast with the euro area. Nakamura et al. (2024)[15] note that supply shocks were also a key inflation driver in Japan and that the results were largely similar to those for the United States, which they consider somewhat surprising, given the differences between Japan and the US in labour market structure and firms' price and wage-setting behaviour. The impact of labour market tightness on inflation has been very small in Japan.

Protracted inflation threatened to push inflation expectations too high

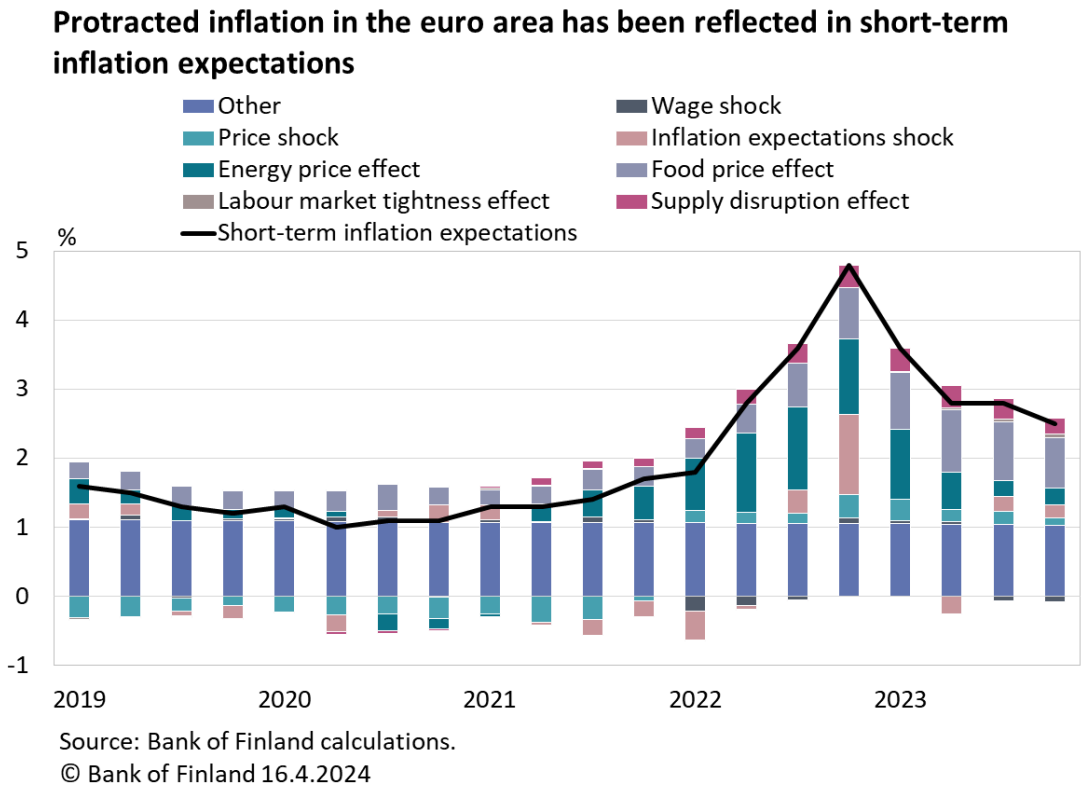
In the model framework, the variables with the strongest effect on the inflation outlook over the medium-term are the formation and development of inflation expectations. Rising energy prices have a so-called first-round effect on inflation, meaning that an increase is directly reflected in the inflation rate. These types of individual, one-off shocks will normally only affect inflation for a short period of time, and their effects will gradually fade away.

The model also includes a feedback loop between inflation and inflation expectations. This means that a shock affecting inflation (or wages) will also be reflected in inflation expectations and wages

and will ultimately cascade back to inflation, causing a so-called second-round effect. This can cause a de-anchoring of inflation expectations from the central bank's inflation target. In the Bernanke-Blanchard model, inflation expectations are considered well-anchored when the actual inflation rate does not have a significant impact on expectations (see Chart 1, in which there should be no feedback from the price/inflation box to inflation expectations). In fact, Blanchard and Bernanke (2023) state that without shocks or changes in exogenous variables, price inflation and wage growth are ultimately determined on the basis of long-term inflation expectations, and if the expectations are well-anchored, inflation will rise only temporarily. However, if the long-term inflation expectations become de-anchored from the central bank's inflation target, this may lead to changes in inflation that are more permanent and durable.[16] Changes in inflation expectations, especially long-term expectations, have long-lasting effects on inflation and wages in the model, although the pass-through rate is slow. The credibility of the monetary policy inflation target plays an important role in determining inflation expectations, especially long-term expectations. These expectations can be managed through monetary policy measures.

The strong increase in energy and food prices and, to a lesser extent, supply disruptions, pushed up short-term inflation expectations, especially in 2022 and 2023 (Chart 4). Shocks inevitably carry some indirect effects, which are reflected in inflation after a slight delay. The assumed lengthy duration of the shocks may also have affected the price assumptions for the immediate future. As the period of high inflation persisted, inflation expectations in the latter part of 2022 became subject to an increasing number of independent shocks, which cannot be explained by the normal transmission of price pressures to inflation expectations. This can, at least to some extent, be interpreted as a sign that the anchor for inflation expectations is weakening. This was preceded by a lengthy period of high inflation, which had begun to pass through to inflation expectations.

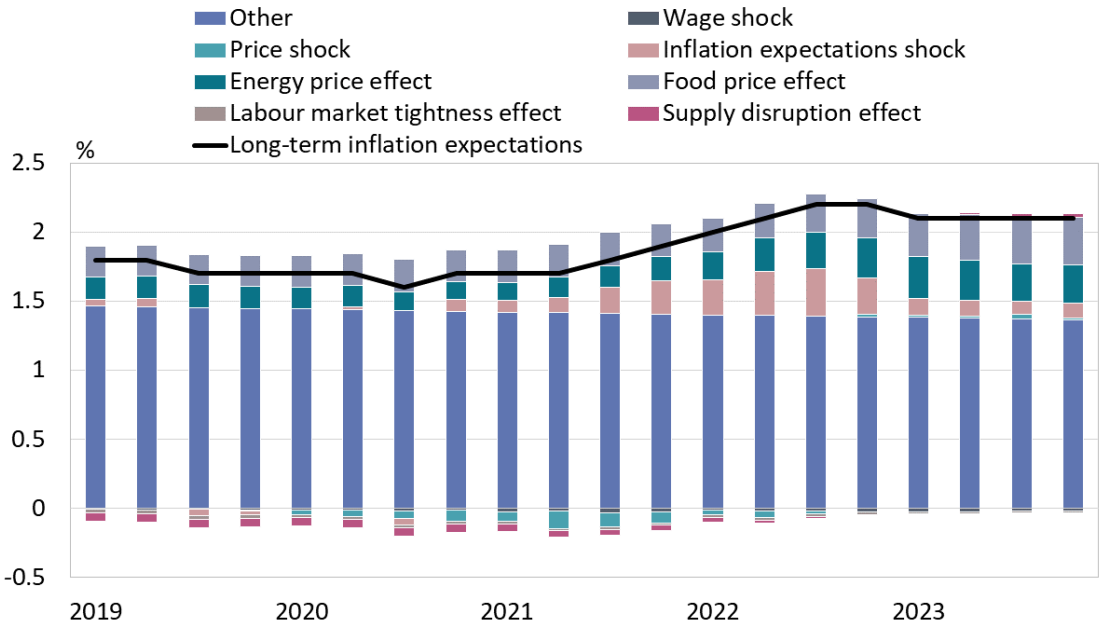
Chart 4.



The protracted high inflation also passed through to long-term inflation expectations (Chart 5), which increased at a slightly higher rate in 2022 than projected by the model. This too may indicate a slight weakening in the anchor for long-term inflation expectations. However, in 2023, through determined tightening of monetary policy and commitment to its inflation target, the ECB managed to moderate the pressures on inflation expectations.[17] Inflation expectations have returned closer to 2% in 2023 and 2024.

Chart 5.

Long-term inflation expectations in the euro area have returned to close to 2%



Source: Bank of Finland calculations.
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Inflation is declining towards the target

The surge in inflation in the euro area peaked in October 2022. Since then, the inflation rate has slowed almost as rapidly as it rose. The slowing has largely been caused by the same factors that led to the increase, but in reverse (Chart 2). On the supply side, energy prices have fallen considerably from their peak levels, and their impact on inflation in recent quarters has even been negative. As a result of the falling energy prices, food price pressures have also gradually decreased, slowing the rise in food prices. Moreover, the post-pandemic supply chain disruptions have diminished, and the situation has gradually returned to normal. On the demand side, inflation has been curbed both by the gradual phasing out of support measures related to the pandemic and the energy crisis, and by the tightening of monetary policy. As a result, consumer demand has decreased, consequently reducing the imbalance between supply and demand.

Inflation expectations are of key importance when it comes to the future path of inflation. Expectations are reflected in the current inflation rate through wage formation and firms' price-setting. According to the model framework presented in this article, an increase in inflation expectations would lead to rising wages via the wage equation and, correspondingly, to a gradual rise in inflation via the price equation. If economic agents expect inflation to increase in the future,

this will be reflected in higher wage demands and higher prices. It is therefore of paramount importance that these expectations remain well-anchored to the central bank's inflation target.

The COVID-19 pandemic and the energy crisis caused inflation expectations to rise. This was notably reflected as a clear and temporary increase in short-term inflation expectations, driven, in particular, by the rise in energy prices (Chart 4). More worrying from the perspective of the inflation target and price stability, however, was the gradual, though less pronounced, rise in long-term expectations during 2022 (Chart 5), which increased the risk of inflation expectations becoming de-anchored.

The ECB nevertheless managed to curb the rise in inflation expectations through determined and consistent tightening of monetary policy. Short-term inflation expectations began to decline in the second half of 2023 and have returned to around 2%. The gradually accelerating rise in long-term inflation expectations lost momentum in 2023 and expectations have since returned close to 2%. Furthermore, the shocks to inflation expectations have been minor in recent quarters, which supports the return of the inflation rate to the central bank's target. As a result, inflationary pressures appear to be easing and inflation is returning to its target.

Conclusion

Our analysis using the inflation model originally developed by Blanchard and Bernanke (2023) shows that the drivers of price dynamics in the euro area have been similar to those in the United States and other countries. The analysis shows that factors affecting commodity markets and with a direct effect on prices, particularly those related to global supply, had a pronounced role as an explanatory factor for high inflation. These changes in the commodity markets have been further passed through to wage growth. By contrast, labour market tightness has so far had only a minor impact on inflation in the euro area. At the same time, the tightening of the labour market has fuelled wage inflation somewhat.

The rise in inflation in 2022 passed through to short-term inflation expectations and, to some extent, long-term inflation expectations as well. This increased the risks of a situation where high inflation persists above the central bank's inflation target. Inflation expectations have recently stabilised close to 2%, in part owing to the support of a highly responsive monetary policy. The normalisation of inflation expectations and the reaction of wages to the rise in inflation supports the view that inflation will soon return to a level close to 2%.

However, in interpreting the model outcomes, it is worth noting that the results are subject to the usual amount of uncertainty associated with modelling, both in terms of the model specification and in terms of the selection of variables used. Nevertheless, the model framework provides an

informed and intuitive, relatively simple description of price and wage developments and the factors affecting them, and serves as a useful additional tool for economists to examine and interpret inflation dynamics.

Notes

1. De Santis, R.A. and Stoevsky, G. (2023), 'The role of supply and demand in the post-pandemic recovery in the euro area', ECB Economic Bulletin, 4/2023. ↑
2. Rezessy, A. and Maravalli, G. (2024), 'What's behind the spike in food inflation – recent developments, drivers and outlook in the euro area', Quarterly Report on the Euro Area (QREA), Vol. 22, No. 4 (2023). ↑
3. Consolo, A., da Silva, A.D., Martinez Hernández, C. and Weißler, M. (2023), 'The euro area labour force: recent developments and drivers', ECB Economic Bulletin, Issue 6/2023. ↑
4. Obstbaum, M., Oinonen, S., Pönkä, H., Vanhala, J. and Vilmi, L. (2023), 'Transmission of recent shocks in a labour-DSGE model with wage rigidity', BoF Economics Review, 1/2023. Also: Astinova, D., Duval, R.A., Hansen, N-J.H., Park, B., Shibata, I. and Toscani, F.G. (2024), 'Dissecting the Decline in Average Hours Worked in Europe', IMF Working Paper, 12 January 2024. ↑
5. Arce, O., Consolo, A., da Silva, A.D. and Mohr, M. (2023), 'More jobs but fewer working hours', The ECB Blog, 7 June 2023. ↑
6. Blanchard, O. and Bernanke, B.S. (2023), 'What caused the US pandemic-era inflation?', NBER Working Paper, 31417. This paper uses less generous lags for the variables than the original study by Blanchard and Bernanke (2023), in which four quarterly lags are used for all the variables, with the exception of trend productivity growth. For the euro area, a less generous lag structure generates very similar results to a model with a more generous lag structure. ↑
7. In the original model by Blanchard and Bernanke, the wage equation also includes a catch-up term, which measures the difference between actual inflation and inflation expectations in the corresponding period a year earlier, i.e. the actual inflation surprise. As both expectations and inflation are already included in the model as independent variables, the term has been excluded from this specification because the effect of the catch-up is already accounted for via these variables. The exclusion of the term amplifies, in historical decompositions, the wage impact of endogenous shocks affecting various prices, but does not change the general conclusions derived from the results. ↑
8. The equations can be presented as follows: ↑
9. The ECB has conducted and published the SPF since 1999. The survey is conducted quarterly with a panel that is composed of around 75 professional forecasters, of which about two thirds represent the financial sector and the rest represent non-financial institutions and research institutes. The average number of participants ranges between 40 and 50. In the SPF questionnaire, forecasters are asked to provide their inflation expectations for the current calendar year as well as the next one and the one after that, and an estimate for the longer term (4–5 years). Participants are also asked to provide their ↑

'rolling horizon' forecast for 12 and 24 months ahead from the release of the latest available data (at the time of the survey).

10. Consensus Forecast produces a monthly survey of financial sector professionals and economic institutions in which the respondents are asked to provide their view on, among other things, inflation in the current year and the next calendar year. The number of respondents is around 30. ↑
11. Euro area wages have been measured using negotiated wages. However, wage drift has also increased, which has not been taken into account in the model. It is possible that the higher labour demand or increased wage pressures could be reflected in wage drift, beyond the estimates presented here. ↑
12. Bernanke, B. and Blanchard, O. (2024), Analysing the Inflation Burst in Eleven Economies. In English, B., Forbes, K. and Ubide, Á. (eds), Monetary Policy Responses to the Post-Pandemic Inflation. CEPR Press. ↑
13. Arce, Ó., Ciccarelli, M., Kornprobst, A. and Montes-Galdón, G. (2024), 'What caused the euro area post-pandemic inflation? An application of Bernanke and Blanchard (2023)', ECB Occasional Paper Series, No. 343. ↑
14. Haskel, J., Martin, J. and Brandt, L. (2023), Recent UK inflation: an application of the Bernanke-Blanchard model, Bank of England Working Paper. ↑
15. Nakamura, K., Nakano, S., Osada, M. and Yamamoto, H. (2024), 'What Caused the Pandemic-Era Inflation?: Application of the Bernanke-Blanchard Model to Japan', Bank of Japan Working Paper Series, No.24-E-1. ↑
16. Inflation expectations and their formation have been analysed in a recent analysis article published in the Bank of Finland Bulletin: Lehmus, M., Oinonen, S. and Vilmi, L. (2023), 'Monetary policy measures have strengthened the anchoring of inflation expectations', 3 October 2023 (https://www.bofbulletin.fi/en/2023/4/monetary-policy-measures-have-strengthened-the-anchoring-of-inflation-expectations/). ↑
17. Read more about the tightening of monetary policy in Laine, O.-M., Nelimarkka, J. and Vilmi, L. (2023), 'The tightening of monetary policy has curbed price inflation', Bank of Finland Bulletin analysis article, 22 November 2023 (in Finnish) (https://www.eurojatalous.fi/fi/2023/artikkelit/rahapolitiikan-kiristaminen-on-hillinnyt-hintojen-nousua/). ↑

Keywords

euro area, inflation, inflation expectations, prices, wages