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Veronica Guerrieri, Michala Marcussen,
Lucrezia Reichlin and Silvana Tenreyro

THE ART AND SCIENCE OF PATIENCE

RELATIVE PRICES AND INFLATION

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Silvana Tenreyro, CBE, is Professor of Economics at the London School of Economics, Fellow of the British Academy and Fellow of the Econometric Society. She is a former External Member of the Bank of England's Monetary Policy Committee, and former President of the European Economic Association (EEA). Currently, she serves as Director of the CEPR International Finance and Macroeconomics Programme and as member of the External Advisory Group of the IMF. She is the recipient of the 2022 Birgit Grodal Award, the 2021 Yrjo Jahnsson Award, the 2021 Banque de France and Toulouse School of Economics Junior Prize in Monetary Economics and Finance, the 2018 Carl Menger Prize in Monetary Macroeconomics and the Excellence Award in Global Economics Affairs from the Kiel Institute for the World Economy. In 2023 she was made Commander of the British Empire. In the past, Silvana also worked at the Federal Reserve Bank of Boston and served as External Member of the Monetary Policy Committee of the Bank of Mauritius. She was co-Director and Board member of the Review of Economic Studies, Chair of the Women's Committee of the Royal Economics Society, Chair of the EEA's Women in Economics Committee and Director of the Macroeconomics Programme at the International Growth Centre. She was Associate Editor at the *Quarterly Journal of Economics, JEEA*, the *Journal of Monetary Economics, Economica*, and the *Economic Journal* and served as panel member for *Economic Policy*. Her main research interests are macroeconomics – particularly monetary policy – international economics and macro-development. She obtained her MA and PhD in Economics from Harvard University and a BA in Economics from the Universidad Nacional de Tucuman, in Argentina. She holds an Honorary Doctorate from the University of St Gallen.

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Contents

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Foreword

The Geneva Reports on the World Economy are published annually by CEPR and ICMB and have been providing innovative analysis on important topical issues facing the global economy since 1999.

After three decades of low inflation, advanced economies experienced a significant surge due to a unique combination of factors, including the Covid-19 pandemic, supply-chain disruptions, extensive fiscal support packages, and soaring energy and commodity prices due to the Russian invasion of Ukraine. As a result, central banks worldwide swiftly implemented aggressive monetary tightening. Subsequently, as the energy shock subsided and supply issues improved, a disinflationary trend emerged, reflected in headline inflation measures, while core inflation remains above target-consistent levels.

The 26th Geneva Report discusses the euro area and United States economies in this context, examining their recent developments, policy choices, and upcoming challenges.

The research primarily focuses on how various sectors adjust to inflation in response to different shock types, including an analysis of recent fluctuations in energy prices, terms of trade, key activity indicators, and monetary policy responses. The authors outline recent economic trends and examine the historical patterns of price adjustments across sectors, presenting a simplified VAR model to explain the findings and their policy implications.

The findings show that sectoral inflation responses to energy shocks vary significantly in both the euro area and the United States. Conversely, when there is a typical demand shock, such as a change in monetary policy, inflation reactions across sectors tend to be more uniform. The report explains how the euro area is experiencing more persistent inflation from energy shocks compared to the United States due to more significant nominal rigidities, which prevent sectoral relative prices from adjusting in response to an energy shock, and a higher dependence on foreign energy sources, which results in a larger consumption decline and contributes to a slower recovery. The authors argue that accommodating some additional inflation can facilitate the relative price adjustment and efficient resource reallocation across sectors. However, this needs to be balanced against the potential risks of a de-anchoring of inflation expectations.

The report shows that despite the substantial global shock to energy and commodities, inflation reached a lower peak and began to decline earlier than in previous occurrences. It also examines various measures of inflation expectations and finds that they remained firmly anchored, even in the face of these severe shocks.

Overall, the report provides valuable insights into the impact of inflation on the euro area and United States economies, as well as providing cautionary observations on the significant challenges ahead.

This report was produced following the Geneva Conference on the World Economy held in May 2023. CEPR and ICMB are very grateful to the authors and several discussants for their efforts in preparing material for this report, as well as to the conference attendees for their insightful comments. We also thank Laurence Procter for her continued efficient organisation of the Geneva conference series, Antoine Cornevin and Guilherme Suedekum for recording and summarising the discussions, Lapo Bini for research assistance, and to Anil Shamdasani for his excellent handling of its production.

CEPR, which takes no institutional positions on economic policy matters, is delighted to provide a platform for an exchange of views on this important topic.

Tessa Ogden
Chief Executive Officer, CEPR

Ugo Panizza
Director, ICMB

September 2023

Main points

CHAPTER 1

- The large surge in inflation was caused by an exceptional combination of shocks, starting with the Covid-19 pandemic and followed by an extraordinary increase in energy prices, comparable in scale to that seen in the 1970s and 1980s. The supply shocks were highly uneven across sectors.
- Central banks have tightened monetary policy sharply.
- Inflation expectations have remained anchored in the euro area and US economies.
- The energy shock caused a large fall in the terms of trade of the euro area, a net energy importer, and an improvement in those of the US economy, a net exporter.
- The terms-of-trade dynamics are reflected in patterns of demand: euro area consumption and investment fell significantly below pre-pandemic trends, while US consumption and investment quickly overtook pre-pandemic trends. This suggests differences between demand- versus supply-driven inflation.
- A noticeable disinflation process is under way as the energy shock reverted and supply constraints have been easing. Monetary policy should further accentuate this process, with some lag. There is sectoral heterogeneity in the disinflation process.

CHAPTER 2

A historical analysis based on structural VAR estimation shows that:

- The response of inflation and its components to an oil supply shock has a rich dynamic heterogeneity. This is in contrast to the response to monetary policy shocks, which is relatively more uniform.
- The response of inflation to an oil shock in the euro area has typically been more persistent than in the United States.
- Consistent with the VAR results, indicating a lagged response of core inflation to headline, a Granger causality test cannot reject the hypothesis that headline causes core inflation, but not vice versa.
- The main empirical developments are modelled in a stylised New-Keynesian framework, where energy affects some sectors (e.g., manufacturing) directly and others (e.g. services) indirectly through the use of intermediate inputs.

- In response to an energy shock, inflation in energy-intensive sectors responds quickly, while inflation in other sectors responds weakly early on and builds up more gradually.
- Higher degrees of nominal rigidity (as in the euro area) delay the initial response of inflation and reduce its peak, but prolong the deviation from target.
- An open economy dependent on foreign energy, such as the euro area, experiences a larger drop in consumption and a slower recovery than an economy that is self-sufficient, such as the United States.
- Nominal rigidities impair relative price adjustments, generating less reallocation of production across sectors than under flexible prices. Accommodating some additional inflation can facilitate the relative price adjustment and efficient resource reallocation across sectors. Reallocation benefits need to be balanced against the risk of de-anchoring of inflation expectations.

CHAPTER 3

- Putting the current episode in perspective, despite the extraordinary scale of the global shock to energy and other commodities, inflation peaked at a much lower level and started to reverse earlier than in past episodes.
- Analysis of the extent of anchoring of various measures of inflation expectations indicate they remained well anchored, notwithstanding the virulence of the shocks.

CHAPTER 4

- To gauge the extent of tightening implied by the current policy stance, the report discusses different estimates of the equilibrium level of interest rates consistent with price stability, r*. While available estimates for the euro area point to a low r*, estimates for the US economy tend to differ depending on the estimation method. The consensus view amongst market economists, however, suggests a low r*, implying a tight policy stance.
- The gap between model estimates and the consensus view of market economists on the US r* has widened substantially since the pre-pandemic years. This points to a potential role for financial conditions and links to a market debate on the drivers behind narrow credit spreads.
- Bank lending surveys on both sides of the Atlantic point to significant tightening at present. Given the lagged effects of monetary policy, there are clear risks to further tightening.

Introduction

Following more than thirty years of low inflation, in the past three years advanced economies saw a material surge in inflation. Underlying this surge, there was an unprecedented concomitance of factors: the Covid-19 pandemic, with the associated supply chain disruptions and pent-up demand built up during periods of mandated or voluntary social distancing; large fiscal support packages in many countries, particularly in the United States, aimed at limiting output losses during the pandemic; and an extraordinary increase in the prices of energy and other commodities caused by the war in Ukraine. Central banks around the globe have responded with a sharp tightening of monetary policy over a short period of time. As the energy shock unwound and supply constraints eased, a disinflation process has started which is visible in measures of headline inflation, while core measures are still above target-consistent levels.

This report focuses on the experience of the euro area and US economies, taking stock of what has happened and the challenges ahead.

Economists at central banks, academia and markets have argued at length about the extent to which inflation would be transitory and whether inflation was mainly driven by supply or by demand forces. There seemed to be very little agreement, however, on the meaning of 'transitory' (A few months? A couple of years?) or on the desirable length of time over which central banks should return inflation to target following these extraordinary events. To the extent that supply forces play an important role as triggers of inflation, monetary policy faces a difficult trade-off, a situation where the so called 'divine coincidence' – in which price stability and output (gap) stability coincide – does not hold. This has been particularly relevant for the euro area, which, as a net importer of energy, has faced a large negative terms of trade shock and a consequent squeeze in real disposable incomes.

Both in the United States and the euro area, the supply chain disruptions and changes in demand induced by the pandemic and the increase in the prices of energy and other commodities led to large changes in relative prices. This is because, by nature, the triggering shocks were highly uneven, hitting different sectors with variable intensity (for example, an energy price shock hits transportation services more directly than medical services). In addition, different sectors feature different degrees of wage and price rigidities. This combination of uneven shocks and price and wage rigidity, along with the structure of input-output linkages across sectors, led to complex, staggered dynamics of sectoral inflation. This caused a drawn-out response in core inflation, rather than a one-off, sharp adjustment in core price levels. At the time of writing, core inflation in the euro area seems to have plateaued, with a June and July reading at 5.5%, but had peaked in the United States, where core (CPI) inflation was at 6.6% in September 2022 and fell to 4.7% in July.

Part of the debate over elevated core inflation can be split into two broad interpretations. The first is that high core inflation is symptomatic of a de-anchoring of inflation expectations and/or second-round effects involving a profit and wage spiral. The second interpretation sees elevated core inflation as a reflection of relative price adjustments, needed for efficient resource reallocation in response to a shock that hits different sectors with different intensity. This adjustment process would fully unwind just as the triggering shock would, though in the presence of nominal rigidities and input-output linkages, it would take somewhat longer to wane than the underlying shock. While the lagged effects of the tightening of monetary policy already in motion should exert increasing downward pressure on inflation, the first interpretation of elevated core inflation would call for a relatively tighter monetary policy stance, to act against de-anchoring or wage-price inertia. In contrast, in the second case, tightening should be limited, as the relative price adjustment is needed to achieve allocative efficiency and the inflation it generates would dissipate on its own with the end (or reversal) of the underlying inflationary shock.

There are costs and risks with each of these different strategies. The costs of over-tightening are an unnecessarily negative impact on economic activity, along with inefficiencies from relative price distortions, and, equally important in light of central banks' remits, the likely undershooting of the inflation target further in the future. The adverse effects on economic activity are likely to be more consequential in the euro area in particular, since private consumption and investment are still materially below their 2019 trends. At the other end of the argument, the risks of de-anchoring and wage-price spirals stemming from a persistent period of inflation above target must be carefully weighed to avoid a repetition of the inflationary experience of the 1970s.

To contribute to the debate, the main focus of this report is the dynamics of sectoral inflation adjustment in response to different types of shocks. The report starts with a characterisation of the recent rise (and fall) in energy prices and a description of inflation, the terms of trade and some key activity indicators, as well as the monetary policy response, in the euro area and the United States. After setting out the main economic developments in recent years, the report characterises the historical behaviour of sectoral price adjustments. It then proposes a stylised model to rationalise the empirical findings and discusses some policy implications.

The empirical evidence points to a high degree of heterogeneity in sectoral inflation in response to energy shocks both in the euro area and in the United States. The euro area has typically experienced higher persistence of inflation in response to energy shocks than the United States. The analysis also underscores a lower degree of inflation heterogeneity across sectors in response to a standard demand shock (proxied by a monetary policy shock) rather than an energy shock. These features are captured in a stylised two-sector New-Keynesian model with nominal rigidities, where energy directly affects the production of one sector (say, manufacturing) while it affects the other (say, services) only through the use of intermediate goods. This implies that in response to an energy shock, inflation in the energy-intensive sector responds relatively quickly, while inflation

in the other sector is weaker early on but then builds up and produces a second wave of sectoral inflation. Given the uneven structure of the economy, an aggregate demand shock would also generate some heterogeneity in sectoral inflation, but on a much smaller scale than an energy shock that is also uneven in nature. The model can also explain the more persistent inflation response to an energy shock in the euro area relative to the United States. This is because the model generates an inflation response that is initially smaller but more persistent in the presence of a higher degree of nominal rigidities – a more likely feature of the euro area. To capture the different patterns of terms of trade between the euro area and the United States, we also explore an open-economy version of the model and show that an economy that is more dependent on foreign energy, such as that of the euro area, experiences a larger drop in consumption, consistent with the slower recovery of households' consumption in the euro area relative to the United States in the recent period.

The model shows how underlying nominal rigidities prevent sectoral relative prices from adjusting in response to an energy shock, generating less reallocation of production across sectors than in a setting with flexible prices. This implies that when an economy with nominal rigidities is hit by an uneven shock, it may be necessary to tolerate somewhat higher inflation to facilitate the relative price adjustment and the efficient allocation of resources across sectors. This calls for a more accommodative monetary policy stance relative to a setting in which the same level of inflation is generated by an even demand shock with no need for reallocation. The benefits of temporarily higher inflation in response to an uneven shock to allow for relative price adjustments need to be balanced against the potential risks of a de-anchoring of inflation expectations. While the risk of de-anchoring of expectations is outside of the model, we turn to it in the empirical analysis.

As a first step to gauge de-anchoring risks, the report studies the evidence on inflation expectations during the inflation increases and subsequent tightening of the late 1970s and early 1980s, and compares them with the recent period. Arguably, the stability of long-term inflation expectations we have observed in the recent past represents a credibility bonus that central banks can exploit to communicate the rationale for taking a bit longer to return inflation to target, as relative prices adjust and activity recovers.

To assess the extent of tightening implied by the current policy stance, the report discusses different estimates of the equilibrium level of interest rates consistent with price stability, r*. While available estimates for the euro area point to a low r*, estimates for the US economy tend to differ depending on the estimation method. The consensus view amongst market economists, however, suggests a low r*, implying a tight monetary policy stance at present. Moreover, bank lending surveys on both sides of the Atlantic point to significant tightening at present.

The report is organised as follows. Chapter 1 reviews the empirical evidence on euro area and US inflation and real activity in recent years. Chapter 2 documents historical patterns of sectoral price adjustments based on structural vector autoregression (VAR) exercises. To rationalise the empirical observations, it then presents a stylised New Keynesian two-sector model with energy, and carries out various modelling exercises to provide intuition. Chapter 3 puts the current episode of inflation, disinflation and monetary policy tightening into historical perspective. To do so, it provides an empirical analysis of anchoring of expectations over the decades, offering a narrative for their two-way link with inflation and monetary policy over time. Chapter 4 discusses recent estimates of r* based on different methods, along with the consensus view amongst market participants.

CHAPTER 1

The evidence

The past three years have witnessed unprecedented changes in relative prices in the world economy. These relative price changes were triggered by two tail events: first, the Covid-19 pandemic and its aftermath, which caused a significant increase in demand for global goods along with global supply chain disruptions, giving impetus to the early phase of global energy and commodity price increases; and second, the war in Ukraine, which led to an extraordinary step jump in the prices of energy and other commodities. While most countries saw a material surge in inflation, the economic impact of these relative price changes differed across economies. This chapter focuses on the extraordinary shock to energy prices and its economic impact on the euro area and the United States. It then discusses the unwinding of the shock, along with the monetary policy response in both jurisdictions.

1.1 THE INFLATION SHOCK

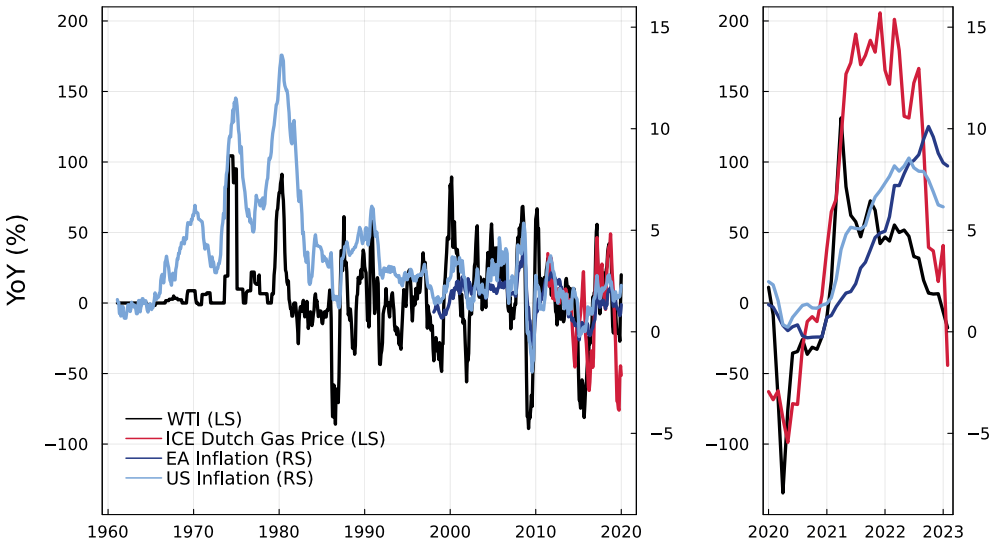
In what follows, we describe first the behaviour and impact of one of the key quantitative drivers of global inflation, energy prices.

Energy prices increased at an unprecedented scale, reaching a peak in the summer of 2022.

Following sharp falls during the early phases of the Covid-19 pandemic, energy prices started increasing in the middle of 2021, largely reflecting the shift in global demand from services towards goods triggered by the pandemic. As the restrictions in gas supply to Europe caused by the war in Ukraine intensified, energy prices saw an extraordinary step-jump. This is illustrated in Figure 1, which plots the year-on- year growth of an index of global crude oil prices (World Texas Intermediate, or WTI) and natural gas prices (the Intercontinental Exchange Dutch gas price), along with annual euro area and US inflation. The left-hand plot shows the time series from 1960 through to 2020, while the right-hand plot shows the series from 2020 to 2023. As the plots make clear, the recent trough-to-peak increases in energy prices are comparable, and indeed larger, than those experienced in the 1970s and 1980s. The figure highlights not only the extraordinary scale of the energy price increases, but also the fast pace at which energy prices picked up.

Increases in energy prices have multiple effects on inflation, which operate at different horizons (Tenreyro, 2022). The first, direct effect is reflected in petrol prices paid by consumers, as well as prices charged on household gas and electricity bills, which immediately translate into higher consumer price inflation.

FIGURE 1 **INFLATION AND ENERGY PRICES: THE EURO AREA AND THE UNITED STATES**



Source: Haver Analytics

There are also indirect supply chain effects through firms' input costs, as the production of many goods and services requires a substantial amount of energy. Even firms for which energy makes up only a small share of their total cost base are likely to increase prices as their intermediate inputs costs may also have increased, owing to rising energy prices. The pass-through of these indirect costs (or 'first-round effects') is a key part of the adjustment in relative prices, and the timing of this pass-through process may vary across sectors and countries.

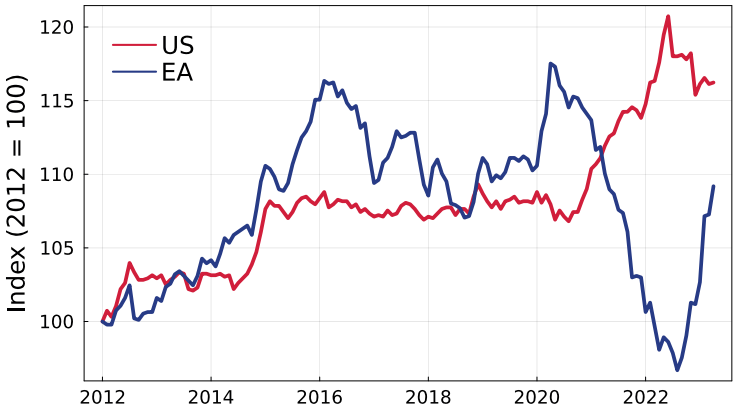
The increase in energy prices can also lead to 'second-round effects'. These refer to a variety of mechanisms that cause inertia from domestic wage and price setting, which, if persistent enough, could push up inflation in the medium term. These are typically a product of various rigidities in real wages, profit margins, and relative wages and prices. Similar channels could arise from increases in inflation expectations beyond the near term. (Near-term inflation expectations naturally increase in response to an energy price increase, consistent with its direct and indirect effects; second-round effects or risks of de-anchoring concern medium- to long-term inflation expectations.)

In addition to these first- (direct or indirect) and second-round effects on domestic wage and price setting, there are also impacts on real incomes and real demand, which can push medium-term inflation in different directions. A critical determinant of this real-income effect is whether the country is a net importer or exporter of energy, which is reflected in the behaviour of the economy's terms of trade.

The euro area experienced a precipitous fall in its terms of trade. In contrast, the United States experienced a sharp increase.

This is illustrated in Figure 2, which shows that in the middle of 2021, a large gap opened up between the two economies' terms of trade (measured as the prices of goods and services exported by an economy relative to the prices of those imported). While the gap has been closing for some time, there is still a significant differential. The terms of trade encapsulate a key point in the debate over monetary policy: for the euro area, the energy shock represented an adverse cost-push shock, while the opposite is true for the United States, as a net energy exporter.

FIGURE 2 **TERMS OF TRADE**



Source: Haver Analytics

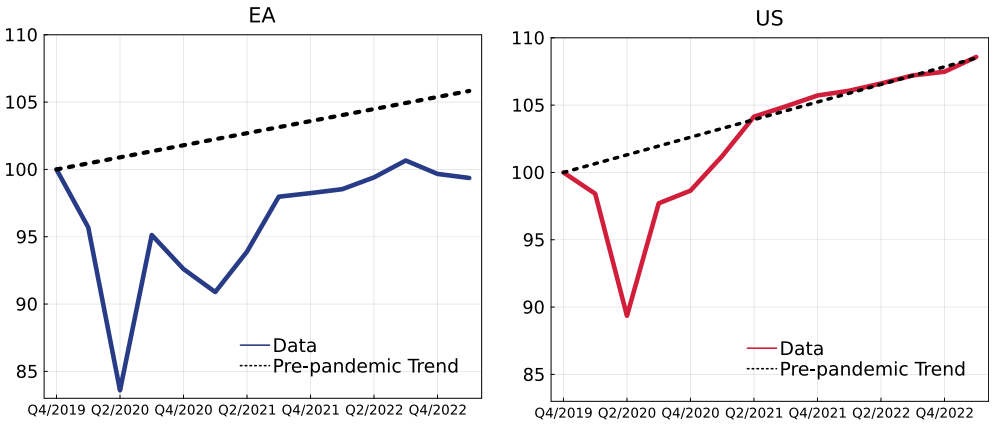
This terms-of-trade pattern most clearly illustrates the absence of a divine coincidence in the euro area economy, as the negative terms-of-trade shock increases near-term inflation while weighing on real incomes, and hence lowers demand and inflation in the medium term.

Reflecting the adverse terms-of-trade shock, activity responded differently in the two economies.

Euro area private-sector demand has fallen well below its pre-Covid trend, whereas US private-sector demand picked up quickly and has been running above its pre-Covid trend.

Starting with private-sector consumption, as illustrated in Figure 3, euro area consumption has been running significantly below its pre-Covid trend. Indeed, consumption only recently returned to its pre-Covid levels. In contrast, US consumption displayed a very quick recovery, reaching pre-Covid level in mid-2021. It started to run at or above its pre-Covid trend by the middle of that year.

FIGURE 3 **PRIVATE CONSUMPTION**

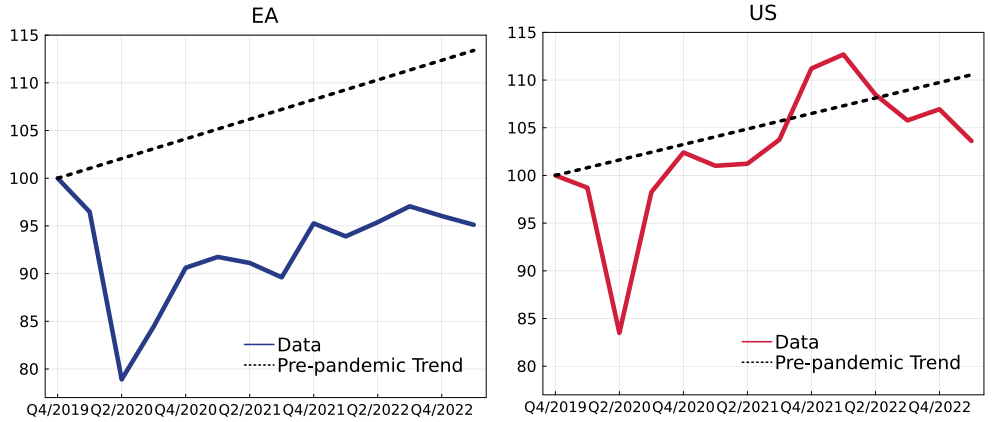


Note: The pre-pandemic linear trend is computed on the sample Q1-2015:Q4-2019.

Source: Haver Analytics.

An even more striking pattern is displayed by private investment. Figure 4 shows that euro area private investment has been running well below its pre-Covid levels (and is materially below pre-Covid trend), whereas US investment overtook its pre-Covid level in 2020 and has been oscillating around its pre-Covid trend.

FIGURE 4 **INVESTMENT**



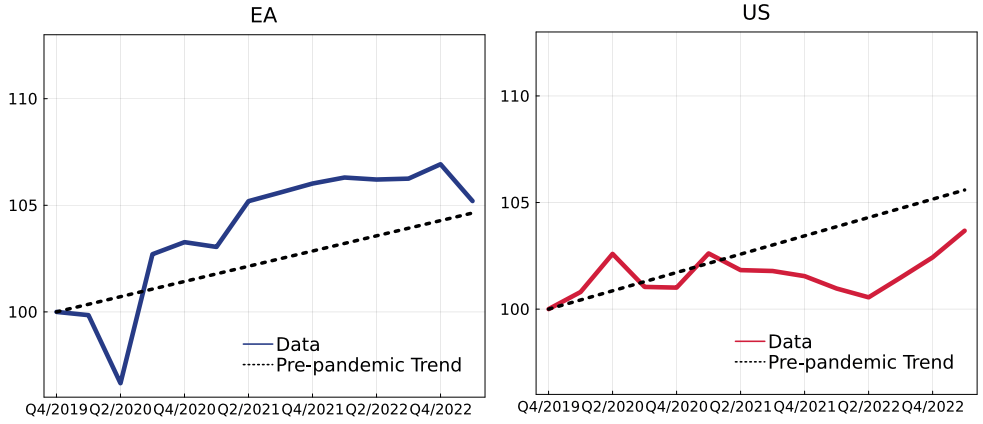
Note: The pre-pandemic linear trend is computed on the sample Q1-2015:Q4-2019.

Source: Haver Analytics.

Government consumption (Figure 5) shows a robust dynamic with respect to the pre-2019 trend for the euro area, but this reflects the relatively flat slope for the pre-2019 period rather than a more supportive fiscal policy than in the United States. If we compare government expenditure (including transfers, which are not shown) between the two jurisdictions, it is clear that the US numbers are way above those of the euro area.

In the Unites States, growth has always been positive, it peaked in the second quarter of 2020 and then steepened again since the second quarter of 2022. In contrast, euro area government expenditure has been decreasing since the end of 2022.[1]

FIGURE 5 **GOVERNMENT CONSUMPTION EXPENDITURE**

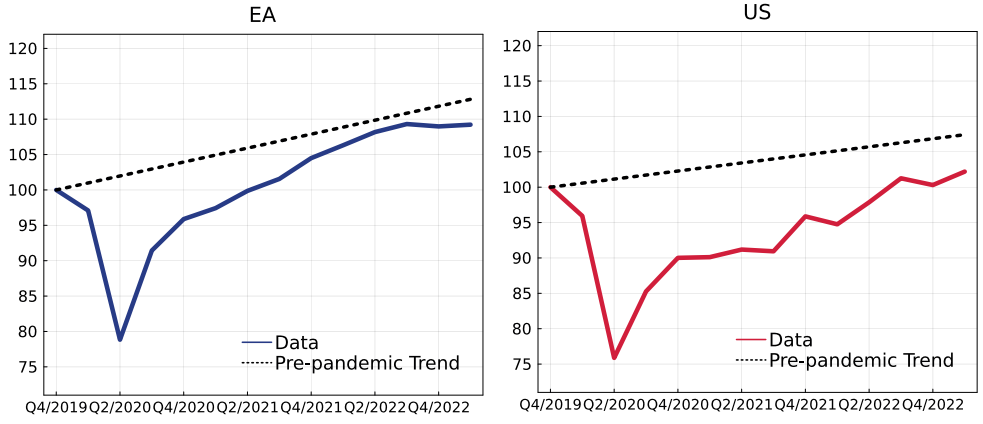


Note: The pre-pandemic linear trend is computed on the sample Q1-2015:Q4-2019.

Source: Haver Analytics.

The behaviour of exports and imports has also been different in the two economies, as illustrated in Figures 6 and 7. In the euro area, both exports and imports remain below pre-pandemic trends, but net exports have been strong given the relative weakness in imports. In the United States, exports recovered to pre-Covid levels in 2022, after a deep fall during the pandemic. Imports have picked up faster, reaching pre-Covid levels in 2020 Q4 and overtaking the pre-Covid trend in 2021, with a net weakening in the balance of trade as imports increased more strongly than exports.

FIGURE 6 **EXPORTS**

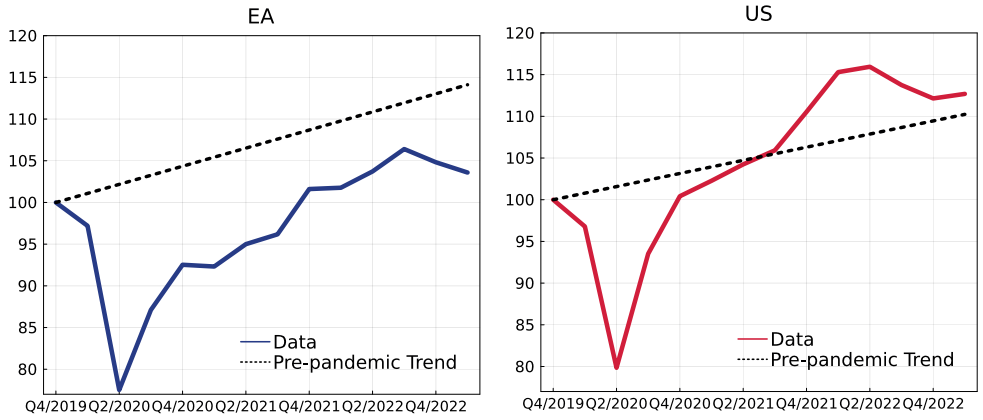


Note: The pre-pandemic linear trend is computed on the sample Q1-2015:Q4-2019.

Source: Haver Analytics.

1 It may be worth noting that much of the pandemic support also came from government credit guarantees and loan moratorium (in both the euro area and the United States).

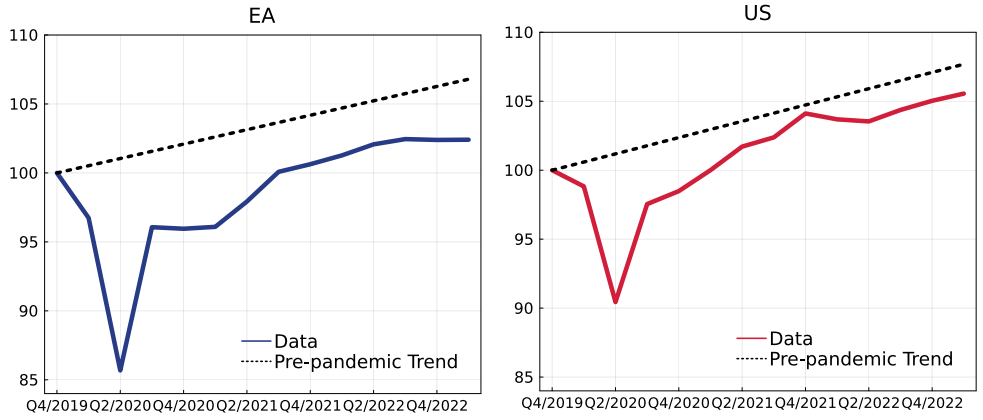
FIGURE 7 **IMPORTS**



Note: The pre-pandemic linear trend is computed on the sample Q1-2015:Q4-2019.
Source: Haver Analytics.

Aggregating over all components, real GDP (Figure 8) has been markedly weaker in the euro area, running consistently below trend. In the United States, instead, real GDP reached its pre-pandemic level by the end of 2020 and got close to its pre-pandemic trend in the middle of 2021, following a parallel trend over the rest of the period.

FIGURE 8 **REAL GDP**



Note: The pre-pandemic linear trend is computed on the sample Q1-2015:Q4-2019.
Source: Haver Analytics.

It is clear from the figures that demand has been significantly stronger in the United States than in the euro area. To be sure, the trends shown in the figures cannot be interpreted as an estimate of potential; however, to argue that demand is a strong driver of inflation, one has to assume that weak GDP dynamics are being driven by a collapse in potential output since the Ukraine war. Although we cannot rule out that possibility without a full analysis of output potential, it seems a priori a hard case to make.

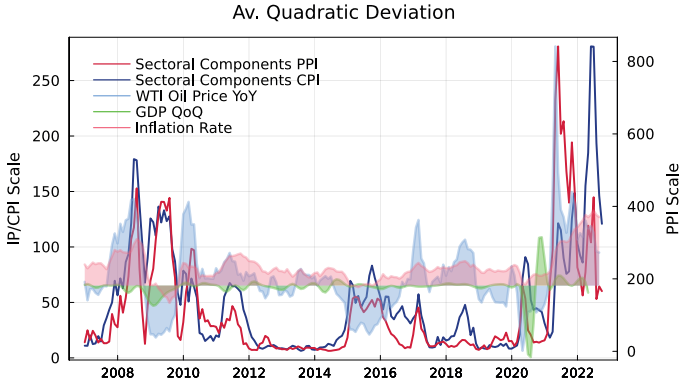
Importantly, aggregate figures of activity and inflation hide significant differences in price dynamics across sectors, to which we turn next.

There has been significant heterogeneity in sectoral inflation.

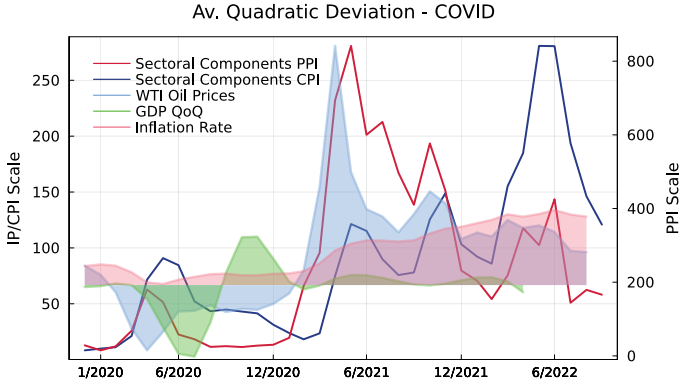
The noticeable sectoral heterogeneity in inflation reflects the uneven nature of the underlying shock, which affected some sectors significantly more than others, and the staggering of relative price adjustments across different sectors. Figure 9 shows indicators of price dispersion for the US economy. Specifically, the red and blue lines are the average quadratic deviation of disaggregated price inflation from headline producer price inflation (PPI) and CPI inflation, respectively. The light blue line is the year-on-year growth rate of WTI oil prices, while the two shaded areas are real GDP growth (quarter-on-quarter) and year-on-year inflation rates. The plot on the right zooms in on the post-2019 period. As is clear in the plots, the quadratic deviation of PPI inflation components increased first, and that dispersion was then subsequently reflected in the dispersion of CPI sectoral components.

FIGURE 9 **SECTORAL INFLATION VARIABILITY**

Average quadratic deviation



Average quadratic deviation – COVID



Source: Haver Analytics

1.2 THE MONETARY POLICY RESPONSE, THE UNWINDING OF THE SHOCK AND DISINFLATION

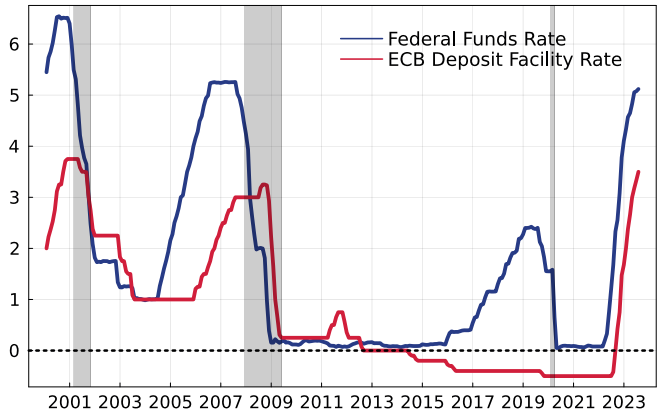
We turn next to the response of monetary policy, the unwinding of the energy shock and other supply constraints and the disinflation process under way.

Monetary policy has tightened rapidly and materially

The pick-up in inflation triggered a fast tightening of monetary policy. Central banks in advanced economies increased policy rates at a rapid pace over 2022 and 2023.

The trajectory of policy rates is illustrated in Figure 10, which shows the ECB deposit facility rate and the Fed Funds rate from 2001 through to the present. Both rates increased sharply in 2022-23. The global synchronisation in tightening, all else equal, could accentuate the dampening effects of higher rates on the real economy and inflation via lending and cost-of-capital channels, while neutralising exchange-rate channels.

FIGURE 10 **POLICY RATES**



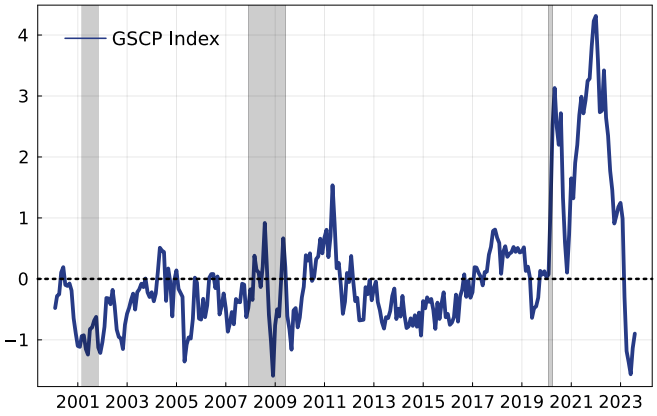
Source: Haver Analytics

Following more than a year of fast and material monetary policy tightening in both the euro area and the US economies, the questions are: Where are we now? And where are we heading to? These questions are particularly relevant as the lagged effects of monetary policy tightening are yet to make their way through the economies.

The energy shock has unwound and other supply constraints have eased.

The prices of energy and other commodities have fallen significantly since their 2022 peaks. As noted earlier, in reference to Figure 2, this has already caused a narrowing in the terms-of-trade gap driven by the shock in energy and other commodities. Moreover, indices of supply constraints have eased materially, with virtually all of them back to their pre-pandemic levels, as illustrated in Figure 11.

FIGURE 11 **GLOBAL SUPPLY CHAIN PRESSURE INDEX**



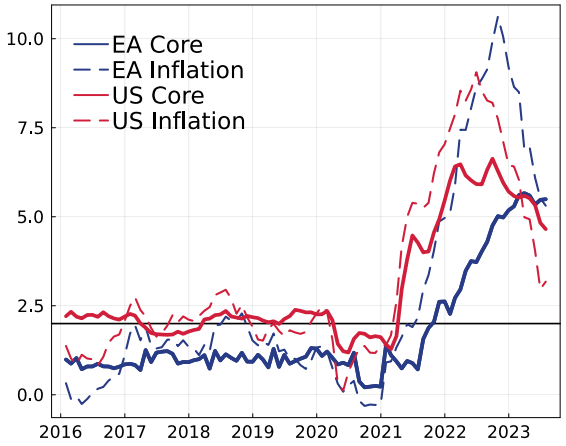
Source: Federal Reserve Bank of New York

We should hence expect many of the developments of the past three years to enter into reverse as the large supply shocks unwind, pushing up on quantities (against the weakening from the monetary policy tightening) and easing inflationary pressures. Of course, the process will not be immediate, and indeed, as discussed earlier, while headline inflation has been declining sharply for several months, core inflation has been stickier.

A disinflation process is under way.

Core and headline inflation picked up quickly above target in the United States and, with a lag, in the euro area. This is illustrated in Figure 12, which shows CPI core inflation as well as headline inflation in both economies. US core inflation responded quickly to the fast recovery following the reopening of economies after the period of mandated or voluntary social distancing during the pandemic. Although core inflation has been falling from its peak in 2022, it is still above target. Similarly, US headline inflation rose and started falling at a faster pace. The figure also shows the delayed response of core inflation in the euro area economy. This reflects in part the euro area's relatively weaker post-pandemic recovery of activity and, arguably, its higher degree of nominal rigidities, which tend to delay the indirect effects of the energy price increases on the costs and prices of other goods and services. Euro area headline inflation shows a steeper rise and a higher peak, as well as a steep fall (so far).

FIGURE 12 **CORE AND HEADLINE INFLATION RATES**

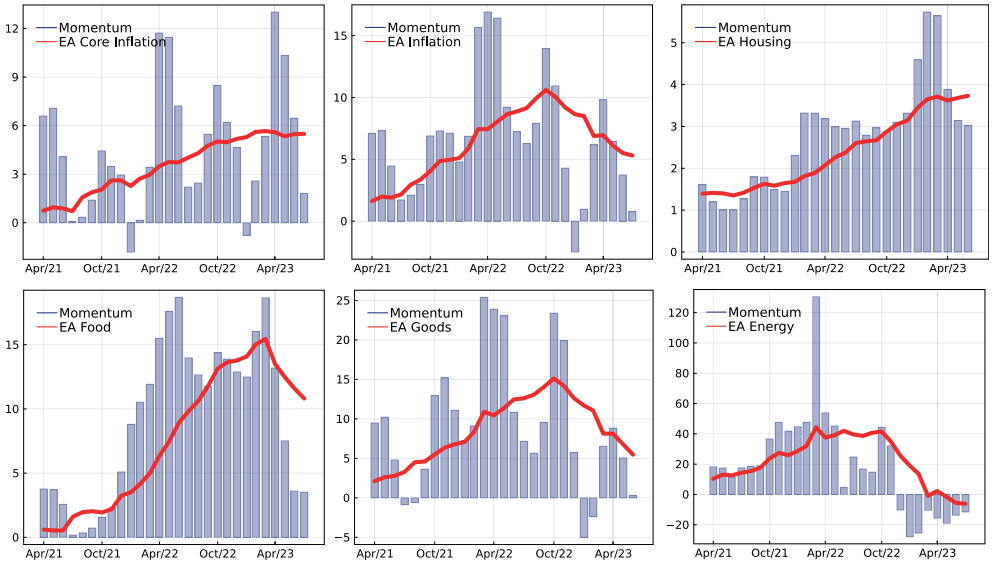


Source: Haver Analytics

There is heterogeneity in the disinflation process.

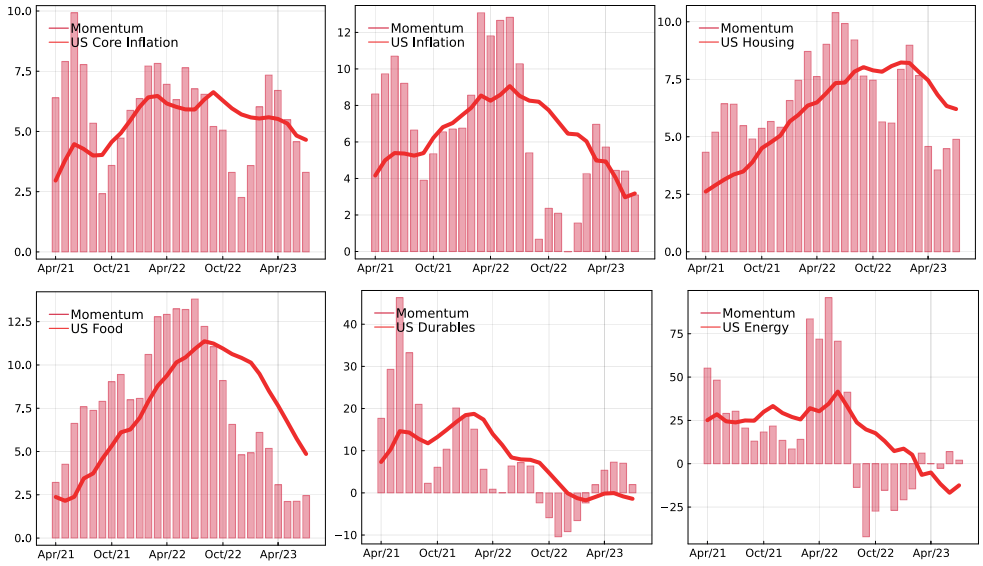
To assess the degree of sectoral heterogeneity in the disinflation process, we report measures of inflation momentum in the various sectors, illustrated in Figures 13 for the euro area and 14 for the US economy. The momentum indicator is constructed as the annualised three-month-on-three-month inflation rate, while the red line is the year-on-year inflation measure.

FIGURE 13 **INFLATION MOMENTUM: EURO AREA**



Source: Haver Analytics

FIGURE 14 **INFLATION MOMENTUM: UNITED STATES**



Source: Haver Analytics

The figures show that momentum of overall inflation has already peaked in both economies, but there are important differences across sectors as well as between the two economies. In the euro area, while energy, goods, food and headline inflation have started a disinflationary process, with momentum having turned negative for a while, the momentum for housing and core has been flat. In the United States, energy, food, durable goods and housing have all reached peaks, with a period of negative momentum in durables and energy. Momentum in core inflation seems to be lagging in both economies, falling at a slower rate. This is largely driven by stickier core services inflation, while core goods inflation is already coming down.

Given the relative stickiness of core inflation, we should also assess the key risks that have underpinned the monetary policy tightening, namely, de-anchoring of inflation expectations or price inertia, additional demand strength stemming from households' savings during the pandemic, and labour market tightness. We discuss these factors in turn.

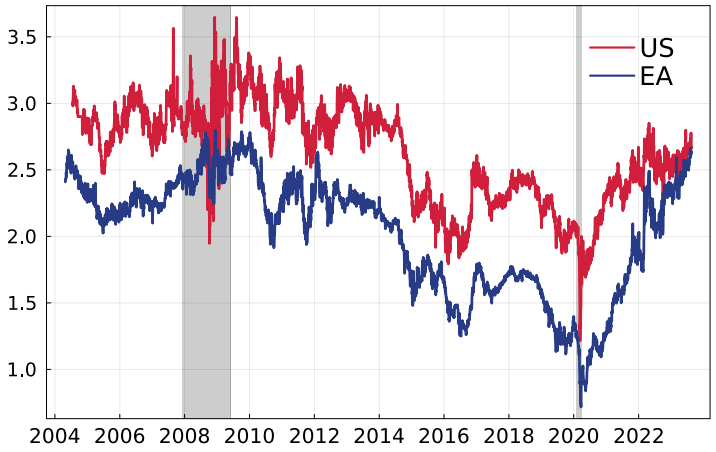
Measures of long-term inflation expectations remain well anchored.

A key concern for policymakers, and a main rationale for tightening, has been the risk of de-anchoring of inflation expectations. Much attention is often paid to financial markets' long-term measures of inflation expectations based on inflation swaps. These measures can, in principle, tell us what financial markets think will happen at a point when shocks have subsided, potentially giving a read on anchoring or, some would argue, credibility. However, these are measures of inflation compensation, not expectations. They are affected by hedging behaviour and risk premia, which might reflect the underlying distribution of shocks hitting the economy, rather than future policy actions or credibility

(Tenreyro, 2023). More fundamentally, if we care about inflation expectations because they can feed back into inflation itself, it is far from clear that financial markets' inflation expectations are the ones that matter, as financial market participants have no role in firms' price-setting or wage negotiations. The shortcomings of simple financial measures of inflation expectations in part explain why the literature has moved to understanding inflation expectations of both firms and households, which are more relevant for pricing decisions and wage negotiations, or to measures that strip out risk premia.[2] Subject to those caveats, financial market measures of inflation expectations in the medium term have remained fairly stable in both the euro area and the United States. Following a sharp fall at the outset of the pandemic, inflation expectations have now returned to target-consistent levels.

This is illustrated in Figure 15, which shows the behaviour of inflation expectations implied by the five-year-to-five-year inflation-linked swaps. Since 2022, these series have been oscillating around 2.5%. For the United States, this is slightly higher than over the period 2015-2021 when inflation was below target, but lower than the average of the 2004-2014 decade. For the euro area, this indicator is back to the level of 2012, after which inflation declined rapidly, and persistently undershot. Overall, financial market-implied measures of inflation expectations appear in line with target-consistent levels.

FIGURE 15 **INFLATION-LINKED FIVE-YEAR, FIVE-YEAR SWAPS**



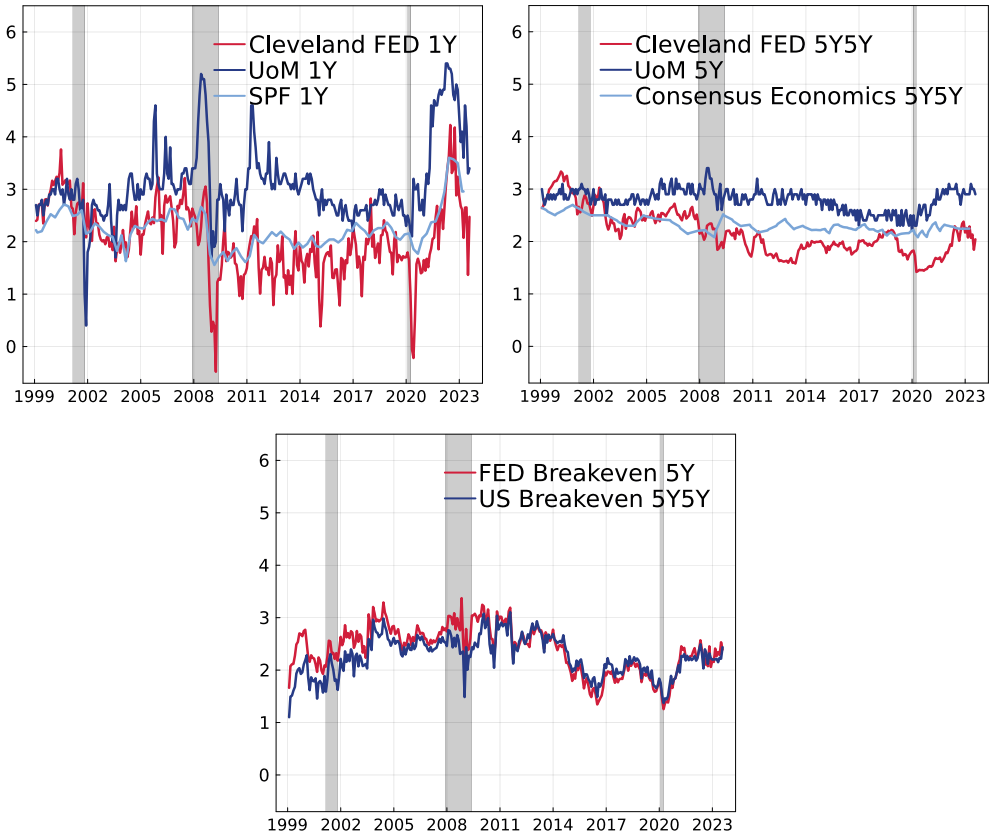
Source: Bloomberg

To address the shortcomings mentioned earlier, Figure 16 reports expectations data for the United States as measured by the Survey of Professional Forecasters (SPF), the University of Michigan (UoM) Consumer Survey, Consensus Economics and the Federal Reserve Bank of Cleveland for one year and five years ahead (which filter out risk premium). The panel on the right also reports measures of break-even inflation. The charts show several

2 For a more comprehensive discussion and summary of the literature, see Tenreyro (2019) and Bandera et al. (2023).

features. First, as is well known, households' inflation expectations are more volatile and on average higher, and more correlated with energy and food than financial market-based measures of expectations. Second, one-year ahead expectations have all turned, reflecting the disinflationary process. Third, long-term expectations are anchored between 2% and 2.5%. The only exception is the UoM survey measure, which has always featured a higher average (even when inflation was at or below target).

FIGURE 16 **MEASURES OF INFLATION EXPECTATIONS**



Source: Consensus Economics and Bloomberg

To the extent that the stability of long-term inflation expectations reflects credibility in the monetary policy framework, the recent experience has been remarkably different from the 1970s and 1980s.

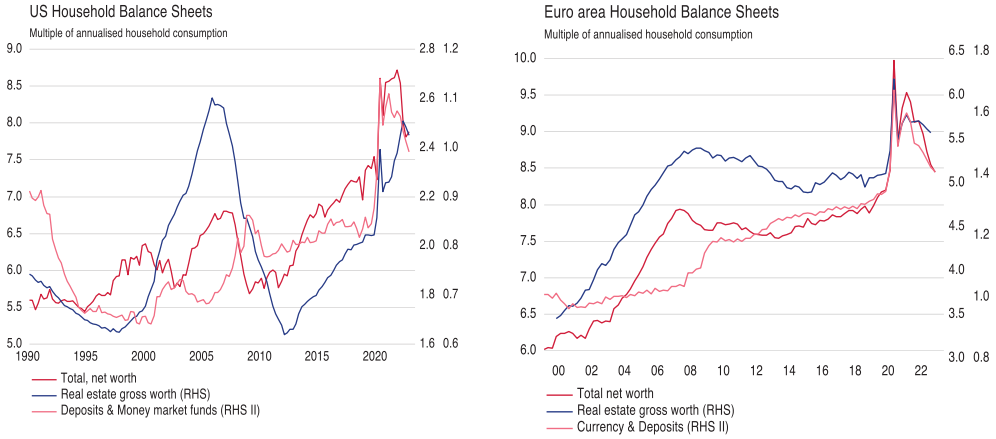
We will discuss this difference in Chapter 3.

We turn now to the question of how much demand pressure should be expected in the future, given households' balance sheets and the state of the labour market in the euro area and the United States. Given space constraints, our analysis is far from exhaustive, aiming to simply highlight some of the key features in the data.

Household savings accumulated during the pandemic have been eroding.

Figure 17 displays euro area and US households' total net worth and its two components: (i) real estate and (ii) deposits plus money market funds, both expressed as a multiple of consumption. In both economies (though particularly in the United States), total net worth over consumption jumped up in the early phase of the pandemic, owing to the negative impact of voluntary or mandated social distancing on aggregate consumption, together with the income support packages put in place by governments. This led to the expectation that demand might be more resilient throughout the energy crisis, as households not only had higher net worth but also stronger liquid buffers (liquid assets are typically thought to lead to a higher marginal propensity to consume than less liquid ones). However, a large part of those gains have now unwound and balances are fast approaching their pre-pandemic levels, suggesting savings may not provide support for consumption for much longer.

FIGURE 17 **HOUSEHOLD BALANCE SHEETS**

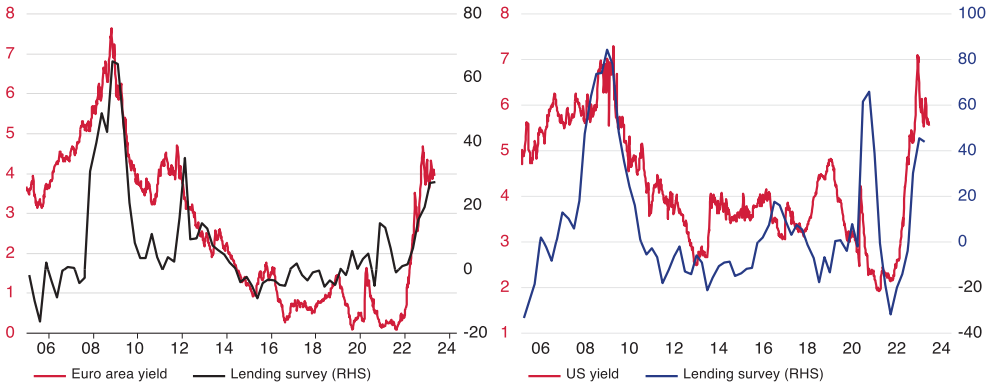


Source: Refinitiv

Financial conditions have tightened materially.

Figure 18 plots BBB corporate yields against summary statistics from lending surveys for the euro area and the United States (a higher value on the lending survey index indicates tighter conditions). All series show a sharp increase, suggesting a material tightening of financial conditions, and while there is some end-of-sample volatility and a hint of a reversal in the euro area, the indices are still remarkably higher than in the period immediately before the pandemic.

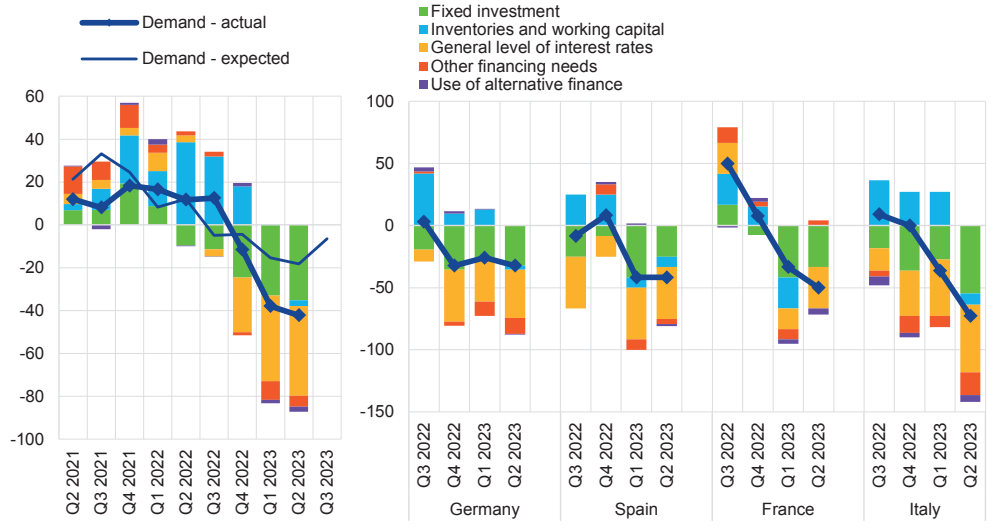
FIGURE 18 **BBB CORPORATE BOND YIELDS AND LENDING SURVEYS: UNITED STATES AND EURO AREA**



Source: Refinitiv

Consistent with the increase in the cost of borrowing, granular data for the euro area show a sharp tightening in the demand from loans, as illustrated in Figure 19, based on the ECB lending survey. For the euro area, this is known to be a leading indicator of a business contraction.

FIGURE 19 **ECB LENDING SURVEY**

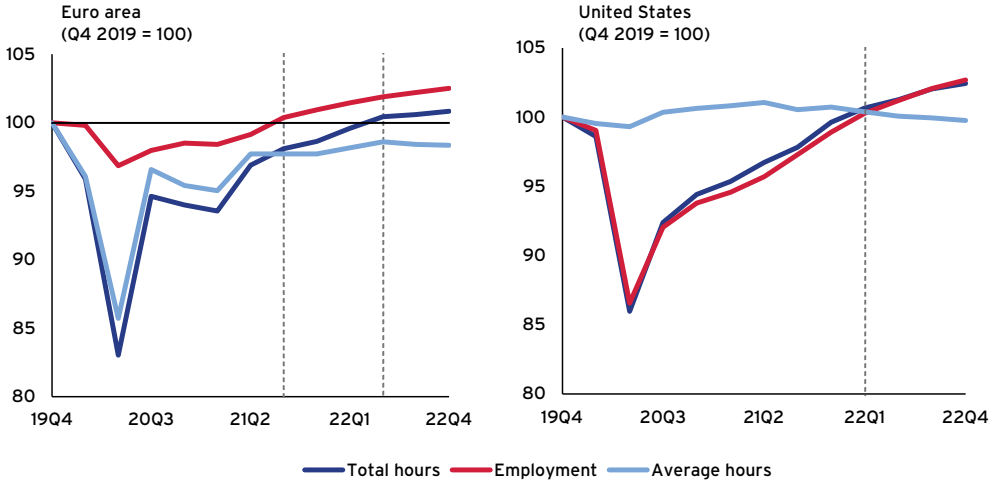


Source: ECB lending survey, second quarter 2023

More ambiguous signs come from the labour market, possibly signalling a difference between the United States and the euro area

A key characteristic of the post-pandemic recovery has been the tightness of labour markets in the euro area and the US economies. This has been captured in various indicators of labour market quantities, including unemployment and vacancies (for an analysis of the US case, see Bernanke and Blanchard, 2023). In the United States, there appears to have been a material shift up in the Beveridge curve, with an increase in the number of vacancies relative to unemployment; a shift in the Beveridge curve is less clear in the euro area. Indeed, the labour markets in the United States and the euro area have behaved quite differently in some dimensions. Although employment has been resilient in both jurisdictions, hours worked displayed a different pattern, showing resilience in the United States but not in the euro area, as illustrated in Figure 20. The figure shows that total hours worked are barely back to the pre-Covid level, with average hours well below their pre-Covid level. Therefore, an explanation of the inflation surge and its persistence based on labour market tightness is not entirely convincing, and indeed appears inconsistent with the experience of the euro area.

FIGURE 20 **EVOLUTION OF HOURS WORKED**



Source: Arce et al. (2023).

CHAPTER 2

The case for patience

A key feature of an energy price shock is that it hits the economy in an uneven fashion, affecting some sectors more directly than others. We think that this uneven nature of the shock is crucial to understand the behaviour of inflation and relative prices.

This chapter starts by providing econometric evidence on the sectoral inflation response to oil supply shocks and monetary policy shocks in the euro area and the United States and on the historical behaviour of core inflation in relation to headline. It then proposes a multi-sector model with energy, which helps explain the empirical patterns. We first explore the effects of an energy price shock in a closed economy, and then we extend the analysis to an open economy and discuss implications for monetary policy.

Although we believe that other types of uneven shocks are behind the recent rise of inflation, including supply chain disruptions following the pandemic, here we focus on energy price shocks because they are relatively easier to identify in the data. However, many channels emphasised in the model would carry through following other shocks with uneven effects across the economy's supply side.

2.1 EMPIRICS

In this section we first report results based on estimated structural VAR to document the sectoral inflation response to oil supply shocks in the United States and the euro area and differences between the response to an oil shock and the response to a monetary shock. We have considered CPI inflation for the United States and HICP for the euro area.

In all specifications, data are monthly and sectoral inflation variables are in year-on-year rate of change. As for real variables, we have considered personal income and personal consumption expenditure also in year-on-year rate of change, industrial production in log levels while unemployment rate and capacity utilization are in levels. The different exercises use different specifications owing to data availability constraints.

Impulse response functions are derived from partial identification of an oil supply shock and a monetary policy shock. Shocks are obtained using high frequency identification methods with external instruments. Box 1 describes the estimation method and the identification of both shocks.

2.1.1 The empirical response of sectoral inflation to oil supply shocks in the US and the euro area

The sample considered is 1997:1 to 2022:12. We report impulse responses to an oil supply shock which has been identified using Känzig's (2021) data as an instrument. Estimation and identification methods are described in Box 1.

Figure 21 reports results for inflation and components for the euro area and Figure 22 does the same for the United States. To interpret the size of the responses, note that the shock is a 1% increase of the WTI price series. As an example, if the value of the impulse response function for inflation at impact is 0.05 (as it is in the US case), this indicates that an 80% oil shock has an impact effect on inflation of 4% relative to the steady state.

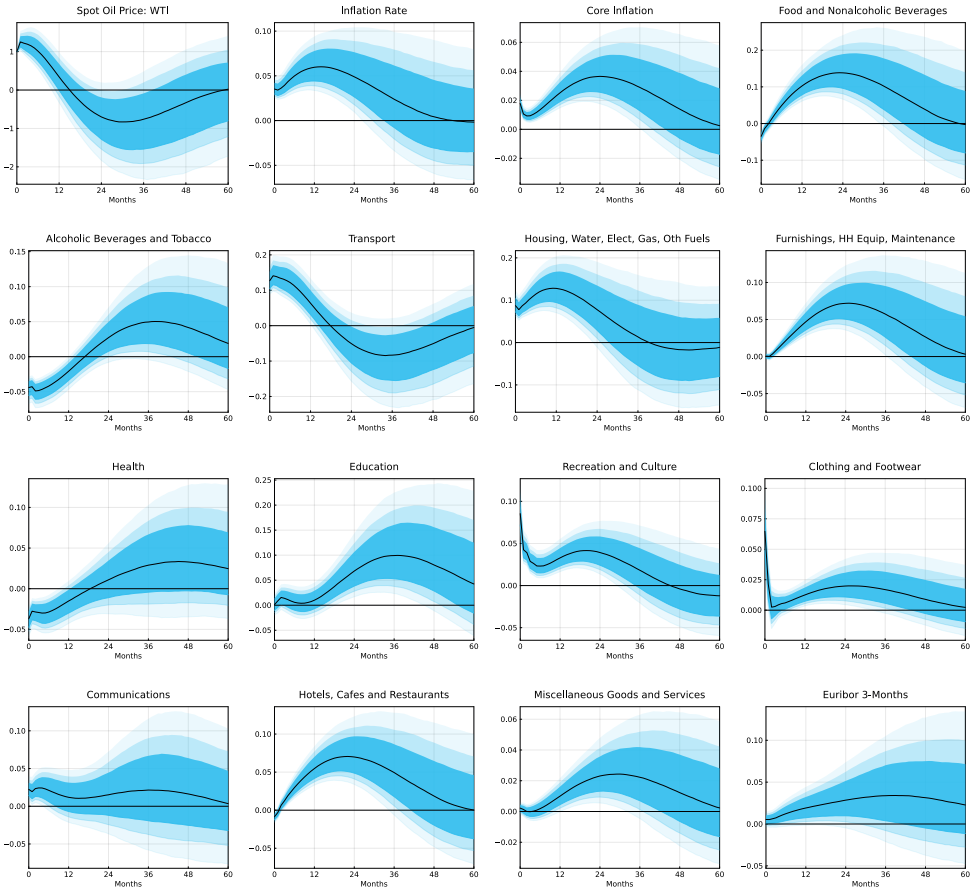
Variable specifications are not identical between the two jurisdictions because of differences in classification. In particular, the US specification includes real variables which are missing in the euro area VAR because of lack of reliable data at the monthly level.

Let us start by commenting on the results for the euro area. Core inflation clearly lags headline and is more persistent. The shock is fully absorbed only after five years, while the effect peaks after two years. If the present inflation episode corresponded to this historical norm and no other shocks were hitting the economy, we would expect that core would peak sometime at the end of 2023. The impact on food is large and slightly lags that on core, while transport has a similar dynamic shape to oil prices. The response of the broad category of housing and utility is less persistent than core but larger in size.

Turning to the United States, we notice a larger impact than in the euro area but less persistence. Core is slightly more persistent than headline but it peaks after a few months, while returning to the steady state only after two years. The fact that core inflation has been decreasing for a few months suggests that other shocks creating persistence might be at work in the present circumstances. Notice also an interesting pattern of dynamic heterogeneity, with food and shelter lagging core inflation.

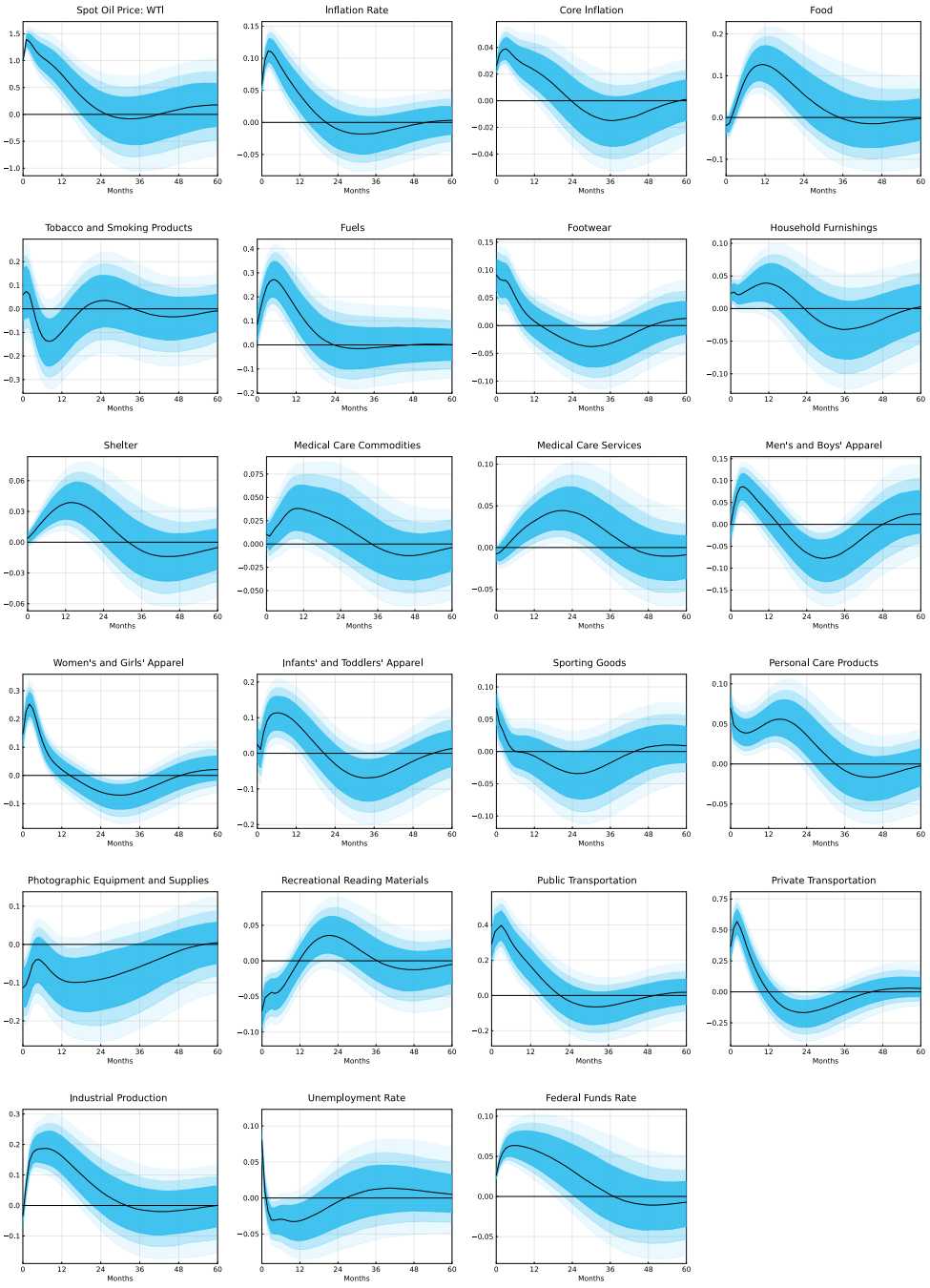
Two features of these results are important for the analysis in next section. First, in both jurisdictions, the response to oil is heterogenous across sectors. Second, the response in the euro area is more persistent than in the United States. The closed economy version of the model we propose in the next section will be able to qualitatively replicate these results.

FIGURE 21 **EURO AREA IMPULSE RESPONSE FUNCTIONS TO AN OIL SUPPLY SHOCK, 1997-2022**



Note: The parameters and the oil supply shock instrument are estimated over the sample 1997:01:01-2022:30:09. The chart reports response to an oil supply shock which increases the WTI price by 1 dollar. Shaded areas are 68%, 80% and 90% coverage ratios.

FIGURE 22 US IMPULSE RESPONSE FUNCTIONS TO AN OIL SUPPLY SHOCK, 1997-2022



Note: The parameters and the oil supply shock instrument are estimated over the sample 1997:01:01-2022:30:09. The chart reports response to an oil supply shock which increases the WTI price by 1 dollar. Shaded areas are 68%, 80% and 90% coverage ratios.

2.1.2 The response of sectoral inflation to oil supply shocks and to monetary policy shocks

We now compare the sectoral inflation response to an oil shock with that to a monetary policy shock. We perform the analysis on US data only since the identification of a monetary policy shock is problematic on euro area data for a long sample.

The monetary policy shock is identified as the unexpected movement in interest rate futures around Federal Open Market Committee (FOMC) dates. To clean the variable from a component that may be determined by market expectations on the future state of the economy, we follow Miranda-Agrippino and Ricco (2021) and consider the part of the monetary policy surprise that is orthogonal to both the central bank's economic projections and to past market surprises. Box 1 explains the procedure. As the Fed's projections we use the Greenbook forecasts which are available until 2015. For this reason, our sample does not include 2016-2022 and spans the 1975-2015 period.

The oil shock is identified as in the previous exercise.

Let us remark, however, that the level of disaggregation for price variables is smaller than in the previous exercise. The reason for this choice has an econometric motivation. The identification of the monetary shock is reliable only on the basis of a roughly balanced panel of price and real variables. For that reason, we are obliged to consider a lower level of disaggregation of price variables.

Figure 23 shows the impulse response functions to a shock that increases the Federal Funds rate by 1%. Note that the size of the responses to the monetary shocks is not comparable with that of the oil shocks. The monetary policy shock is expressed in percentages, while the oil shock is expressed in dollars. For example, reading from the chart, a shock of 1% of the federal fund rate causes a decline of 1.5% of inflation on impact. A shock which increases the oil price by 10 $, causes an increase of inflation of 0.5% on impact and 0.75% after three months.

Let us turn to Figure 24. Qualitatively, we find the same result as in the shorter sample as far as prices are concerned. However, this time the effect of an oil supply shock is clearly negative on real variables. Our interpretation is that this is because this sample includes the 1970s and the 1980s, while in the previous exercise we considered the 1997–2022 period in which the United States became a net oil exporter. This interesting difference is not the focus of our analysis, however.

BOX 1 **VAR ESTIMATION AND SPECIFICATION**

The VAR model is defined as:

$$Y_t = A_0 + A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + u_t \quad (1)$$

In all specifications, the VAR models have been estimated by Bayesian methods using a normal inverse Wishart prior and sum of coefficients prior. The tightness parameter is optimised using Banbura et al. (2010).

The structural shocks ϵ_t are related to the reduced form shocks as follows:

$$\epsilon_t = A_0^{-1} u_t \quad (2)$$

We are interested in identifying an oil shock and a monetary policy shock. Let's label them ϵ_t^o and ϵ_t^m, respectively.

For identification we follow the 'external' instruments approach suggested by developed by Stock (2008), Mertens and Ravn (2013) and Stock and Watson (2018).

This implies selecting an external instrument, z_t, to identify the shock ϵ_t^i where $i = m, o$. The instruments must satisfy two conditions:

- Instrument relevance:

$$\mathbb{E}(\epsilon_t^i . z_t') \neq 0 \quad (3)$$

- Instrument validity (exogeneity):

$$\mathbb{E}(\epsilon_t^i . z_t') = 0 \quad (4)$$

Using a valid instrument gives consistent estimation of a shock. Assuming that the shock of interest is ordered first, estimation of the monetary policy shock is done in three steps:

1. Estimate the VAR model and obtain the residuals ($\hat{u}_t$).

2. In order to obtain elements of the column of the matrix (A_0^{-1}), say a_1, regress $\hat{u}_t$ on z_t.

3. Take the ratio of regression coefficients obtained from step 2 with the coefficient a_{11}.

4. Normalise as $a_{11} = 1$

Under these assumptions, the shock can be identified up to a scale by regressing the instrument on each innovation series.

Choice of instruments

Oil shock

The external instrument for the oil shock is the high-frequency oil shock, identified as in Känzig (2021). We consider the surprise in the futures price for oil on the day on which the Organization of the Petroleum Exporting Countries (OPEC) has a meeting. The relevant time window over which the surprise takes place is between the day of the announcement and the last trading day before the OPEC meeting.

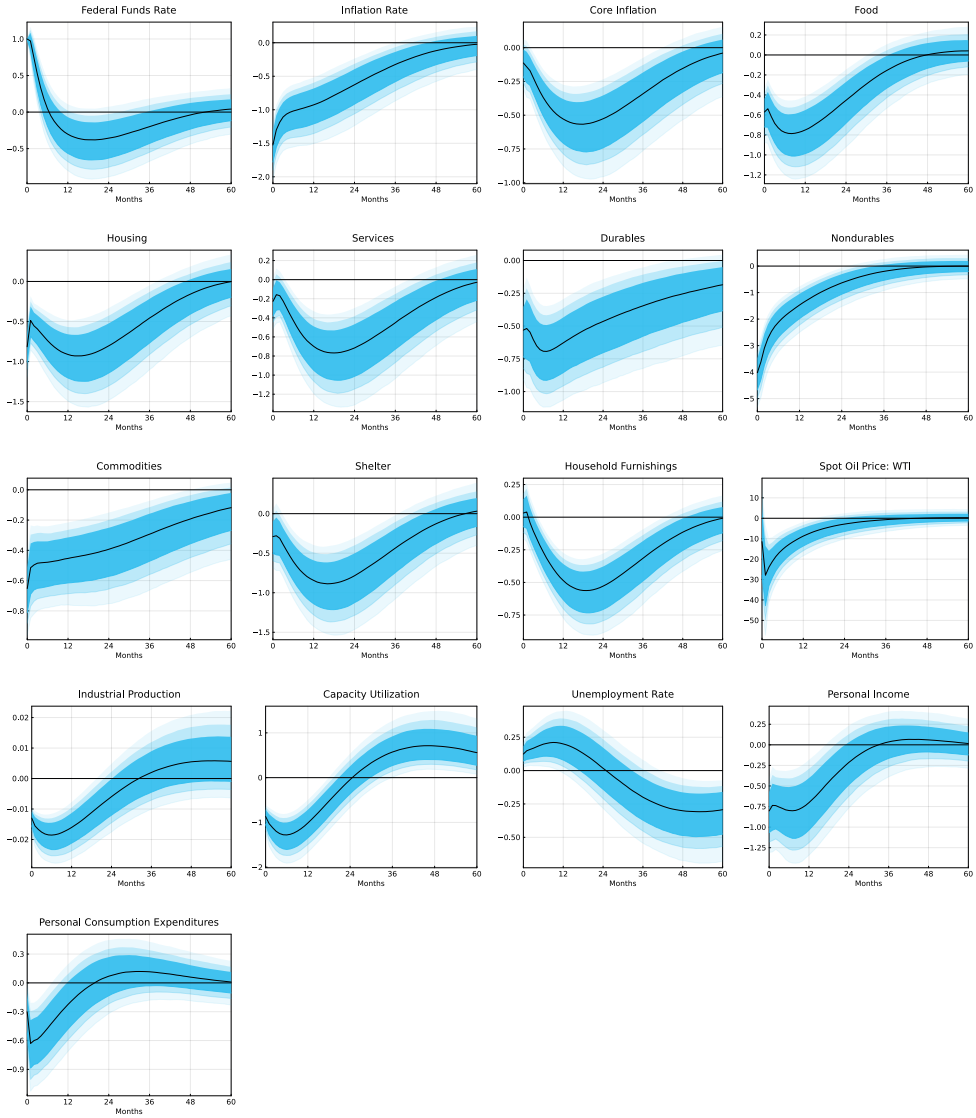
The key assumption is that the news revealed within the window that leads to the surprise in the futures price can be treated as exogenous with respect to the other variables in the VAR.

Monetary policy shock

For monetary policy surprises we follow the convention by using unexpected movements in interest rate futures around FOMC dates.

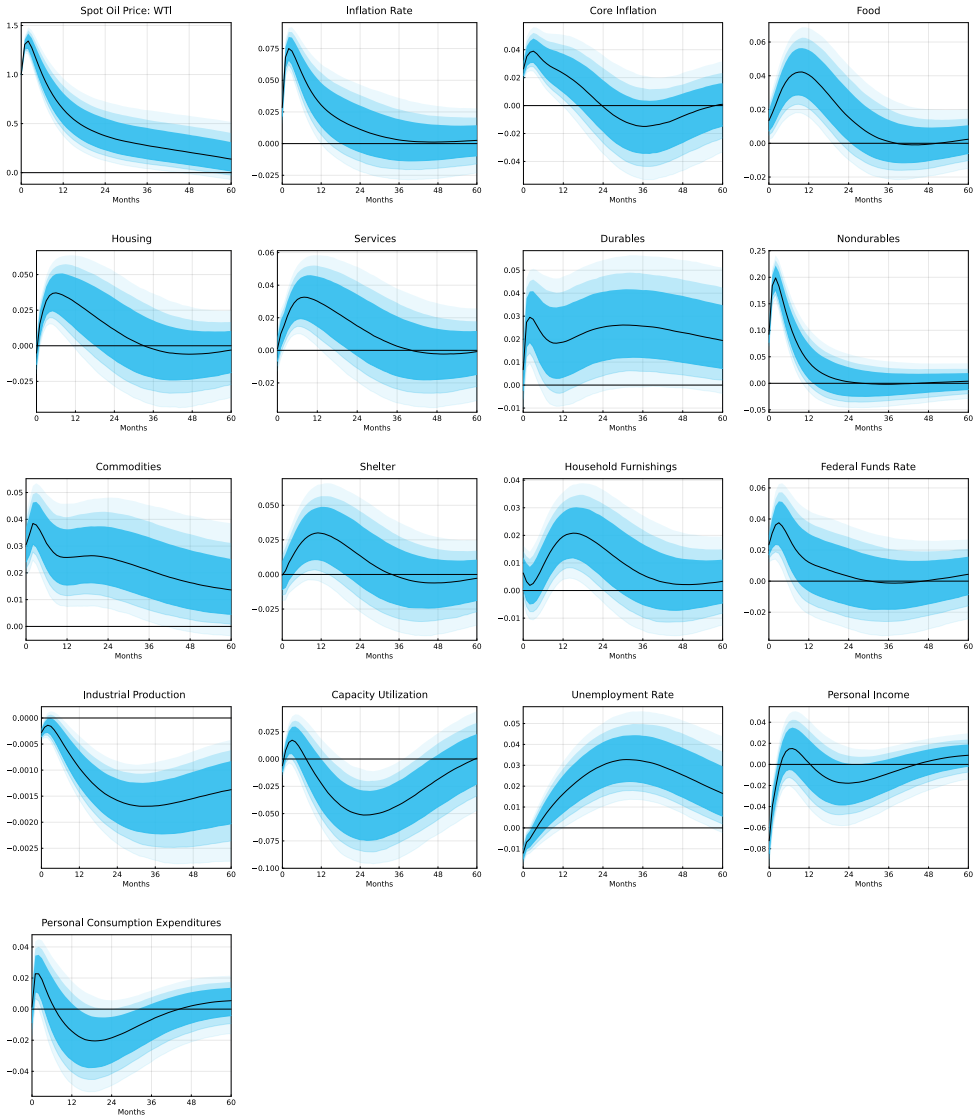
We follow Miranda-Agrippino and Ricco (2021) and consider that part of the monetary policy surprise that is orthogonal to both the central bank's economic projections and to past market surprises. This implies projecting the high-frequency market-based surprises in the fourth federal funds futures around FOMC announcements on Greenbook forecasts and forecast revisions for real output growth, inflation, and the unemployment rate and removing the autoregressive component. The projection controls for the central bank's private information while the removal of the autoregressive component accounts for the slow absorption of information by the agents.

FIGURE 23 **US IMPULSE RESPONSE FUNCTIONS TO A NEGATIVE MONETARY POLICY SHOCK, 1979-2015**



Note: Parameters are estimated over the sample 1979:1:1 - 2015:31:12 while the monetary policy instrument is from 1991:1:1. The charts report the response to a negative monetary policy shock which increases the federal fund rate by 1%. Shaded areas are 68%, 80% and 90% coverage ratios.

FIGURE 24 US IMPULSE RESPONSE FUNCTIONS TO AN OIL SUPPLY SHOCK, 1979-2015

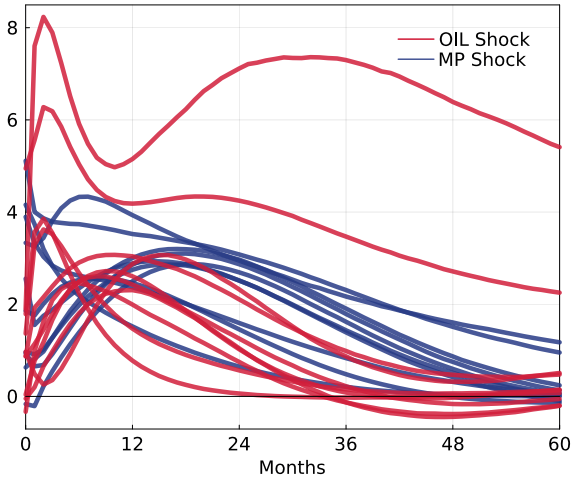


Note: Parameters are estimated over the sample 1979:1:1 - 2015:31:12 while the oil supply shock instrument is from 1991:1:1. The charts report the response to a negative oil supply shock which increases the WTI price by 1 dollar. Shaded areas are 68%, 80% and 90% coverage ratios.

As for the monetary shock, we can detect some heterogeneity in the responses of inflation components (the reason being that a monetary shock has an effect on oil prices) which is, however, less pronounced than in the case of the oil shock.

To better visualise this, we plot the responses to the oil (orange) and monetary (purple) shocks, standardised by their own standard deviations, in the same chart. Standardising this way means we lose any information on the size of the shock, but it helps in comparing the shapes of the responses. In Figure 25, we show responses to a monetary easing shock and to a positive supply shock. The chart highlights the higher degree of dynamic heterogeneity of the responses to the oil shock. This feature will be qualitatively reproduced by the stylised model we present in the next section.

FIGURE 25 **US IMPULSE RESPONSE FUNCTIONS TO AN OIL SUPPLY SHOCK AND MONETARY POLICY SHOCK, 1979-2015**



Note: Impulse response functions are standardised by their own standard deviations.
Source: Own calculations.

2.1.3 Leading-lagging relationship between headline and core inflation in the euro area

In this section, we present a simple Granger causality test derived from a three-variable VAR including headline inflation, core inflation and the unemployment rate for the euro area for the sample 2000-2022. F-tests are reported in Table 1.

The results clearly show that we cannot reject the hypothesis that headline inflation Granger causes core inflation, but that we can reject the hypothesis that core inflation Granger causes headline inflation. This reflects the finding that core inflation is a lagging indicator of headline in the euro area case. The fact that core inflation has not started declining like headline inflation in the euro area may simply be a reflection of this lagged effect.

TABLE 1 **GRANGER CAUSALITY TEST**

	F	df1	df2	p-value	χ^2	df	p-value
Euro area							
Inflation rate ⇐ core inflation	1.59	3	264	0.192	4.77	3	0.189
Core inflation ⇐ inflation rate	6.68	3	264	<0.001	20.05	3	<0.001
United States							
Inflation rate ⇐ core inflation	2.62	3	264	0.051	7.86	3	0.05
Core inflation ⇐ inflation rate	5.55	3	264	<0.001	16.64	3	<0.001

2.2 A STYLISED TWO-SECTOR MODEL WITH ENERGY

The crucial mechanism we want to investigate is how an energy price shock initially hits more directly one sector of the economy, then propagates gradually before dying down, hitting other sectors with different lags. The mechanism of transmission depends on the input-output structure and on the labour market.

To generate the heterogeneity in relative price movements emphasised in the previous chapter, we first of all need a multi-sector model. In the previous chapter, we also contrasted the different responses to the energy shock in the United States and in the euro area. In particular, we emphasised a stark difference in the terms-of-trade responses in the two cases and the fact that household consumption has been much slower to recover in the euro area than in the United States. To capture these facts, it is useful to have a model where the response to an energy price shock depends on how much a country (or macro-region) is dependent on foreign energy imports. We do so by considering an open economy setting and changing the degree of external energy dependence in the initial steady state. Building on Guerrieri et al. (2021), we develop a two-sector open economy model with sticky prices and a scarce factor of production, which we label "oil". Our approach is closely related to the analysis of multi-sector Phillips curves in Aoki (2001), Woodford (2003), and Rubbo (2020).

2.2.1 Relative price response to an oil shock in a closed economy

Let us first explore the transmission of supply shocks to sectoral inflation in a baseline closed economy. To keep the analysis simple, assume that there are only two sectors – say, manufacturing and services. Manufacturing uses labour and oil as factors of production, while services uses labour as a primary factor and manufacturing goods as intermediate inputs. Labour is fully mobile between sectors and nominal wages are flexible. Box 2 describes the ingredients of the closed economy model. The different exposure of the sectors to the energy supply shock, together with the production structure and price stickiness, generates heterogeneity in the inflation responses and relative price adjustments.

BOX 2 **CLOSED ECONOMY MODEL**

The economy features two sectors: sector A, which we label services; and sector B, which we label manufacturing. There is a continuum of infinitely lived households who have standard separable and iso-elastic preferences over consumption C_t and labour effort L_t, where consumption is a constant-elasticity-of-substitution (CES) aggregate of the goods produced in the two sectors. Within each sector $s \in \{A, B\}$ there is a unit mass of firms $i \in [0, 1]$ that produce differentiated varieties Y_{sit} that are combined into the sector output according to a CES aggregator, with elasticity of substitution ε.

All firms in a given sector have the same technology. Namely, firm i producing in sector A has a CES production function with elasticity of substitution ν_B that requires labour, N_{iAt}, and intermediate goods produced in sector B, X_{it}, where X_{it} is itself a CES aggregate of all the varieties produced in sector B.

Each firm i producing in sector B also has a CES production function with elasticity of substitution ν_B, but uses as inputs labour, N_{iBt}, and a scarce good such as oil, Z_{it}. Oil is in fixed supply $\bar{Z}$ and $p_z t$ denotes its price.

Firms in both sectors set prices à la Calvo, that is, each period an independently drawn fraction $1 - \theta_s$ of firms in sector s can reset prices and all other firms must keep their price unchanged. The optimal reset price for a firm in sector $s \in \{A, B\}$ is P^*_{st}, and is the price that maximises the discounted value of profits over all future periods $t + k$ in which the firm has not been able to reset prices, that is,

$$P^*_{st} = \underset{\tilde{P}_{st}}{arg\,max}\; E\left[\sum_{k=0}^{\infty} \Lambda_{t,t+k}\theta_s^k Y_{ist+tk|t}(\tilde{P}_{st} - (1-\tau)MC_{st+k}\right] \tag{5}$$

subject to $Y_{ist+k|t} = Y_{st+k}(\tilde{P}_{st}/P_{st+k})^{-\varepsilon}$, where $\Lambda_{t,t+k}$ is the stochastic discount factor, and τ is the subsidy that the government pays to the firms and is set at the industry level so that the profit-maximising price is equal to the pre-subsidy marginal cost. Note that the marginal cost MC_{st+k} is independent of the firm's output due to the assumption of constant returns to scale.

Following standard derivations, we obtain the following sectoral Phillips curves in log deviation from the steady state

$$\pi_{st} = \rho\pi_{st-1} + \lambda_s(mc_{st} - p_{st}) + (1-\rho)\beta\pi_{st-1}, \tag{6}$$

where the first element on the right-hand side adds an element of inertia (which can be micro-founded, introducing a form of indexation), $\lambda_s \equiv (1-\theta_s)(1-\beta\theta_s)/\theta_s$ represents the degree of price stickiness in the sector, and the marginal costs are

$$mc_{At} = \alpha_A w_t + (1-\alpha_A)p_{Bt} \text{ and } mc_{Bt} = \alpha_B w_t + (1-\alpha_B)p_{Zt},$$

where α_A and $1 - \alpha_A$ are the steady-state shares of labour and of the intermediate input B in the gross output of sector A, while α_B and $1 - \alpha_B$ are the steady-state shares of labour and of the energy input in sector B.

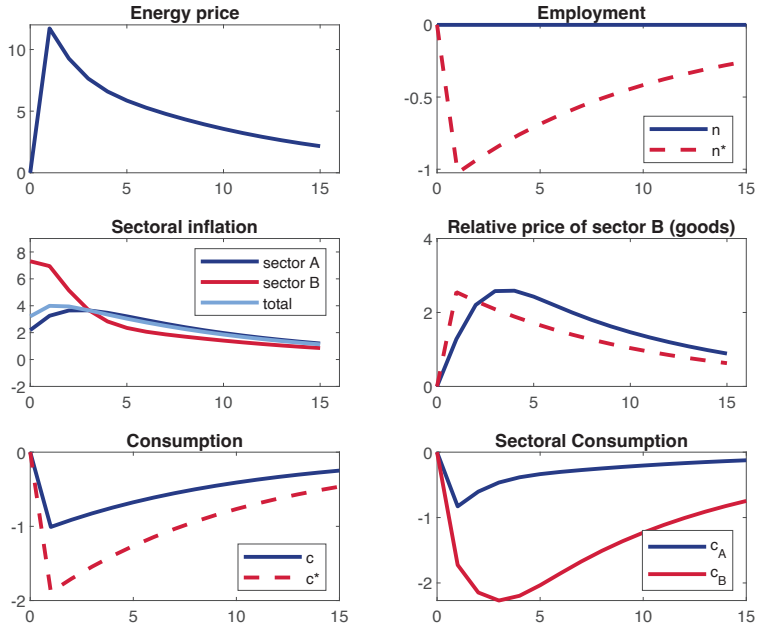
Our main experiment is a transitory negative shock to the supply of oil. The economy's response depends both on the supply shock and on the monetary policy response. In our main example, we consider what happens when monetary policy keeps total employment stable. Table 2 shows the parameters we chose for the baseline calibration.

TABLE 2 **PARAMETERS**

Preferences	$\beta = 0.95$	$\gamma = 0.5$	$\phi = 0.2$	$\rho = 0.05$	$\xi = 1$
Technology	$\eta = 0.7$	$\alpha_A = 0.8$	$\epsilon_A = 1$	$\alpha_B = 0.6$	$\epsilon_B = 0.7$
Stickiness	$\lambda_A = 0.1$	$\lambda_B = 0.2$			

Figure 26 shows how the economy responds to such a shock. The top-left panel shows the increase of the oil price, which responds endogenously to the reduction in oil supply. The top-right panel shows the response of employment (solid blue line) which, by our assumption on monetary policy, is set to zero. For reference, we are also plotting the flexible price response of employment (dashed red line). The fact that the employment response in the flexible price case is negative implies that, under our monetary policy assumption, the central bank is keeping employment above its natural level. Note that this does not mean that monetary policy is easing, as we will discuss in more detail when we look at the consumption response. It just means that monetary policy is not sufficiently contractionary to mimic flexible-price employment.

FIGURE 26 **CLOSED ECONOMY RESPONSE TO AN OIL SHOCK**



The middle-left panel is the crucial one. It shows how inflation responds differently in the two sectors and that this simple model can replicate, albeit in a stylised way, the observation from the empirical analysis above: the sector which uses oil directly (sector B, in red) shows a fast response; the response of inflation in the other sector (sector A, in blue) – which uses oil only indirectly through the intermediate goods – is weaker early on, but then builds up and produces a second wave of inflation. The differential responses

produced by the model echo the impulse responses in Figures 24 and 21, which show that sectors that use oil more directly experience faster and deeper responses. The yellow line plots total inflation and shows that the underlying heterogeneous responses in sectoral inflation rates translate into an overall more persistent response of total inflation.

To understand this two-wave response, it is useful to briefly discuss the sectoral Phillips curves. The model features two sectoral Phillips curves, which capture the effects of optimal, staggered price setting. The fundamental force that drives inflation in both sectors is the distance between nominal marginal costs in the sector and the current price level in that sector. Marginal costs in sector *B* are immediately affected by oil prices, which causes inflation in that sector to immediately pick up. However, due to stickiness, the nominal price of *B* increases only gradually. As the price level in sector *B* increases, it increases nominal marginal costs in the service sector *A*, given that good *B* is used as an intermediate input in sector *A*. This implies that the price response of services is delayed, hence generating a persistent effect on overall inflation. The specific degree of delay in the service sector relative to the goods sector clearly also depends on the degree of price stickiness.

Note that the input-output structure is not the only channel of transmission across sectors. Another important transmission occurs through the labour market, via the adjustment in nominal wages. In the current version of the model, wages are fully flexible and this adjustment takes place quickly: as nominal prices in sector *B* pick up, the overall CPI increases; this leads workers to ask for higher nominal wages to make up for the lost purchasing power. In turn, this increases marginal costs and hence the inflation rates in both sectors. Note that recent work on wage-price spirals by Lorenzoni and Werning (2023) also emphasises a multi-wave interpretation of inflation, focusing on the delayed response of nominal wage inflation. In the open-economy version of the model, we will also consider an extension of the model with sticky wages that not only will produce additional persistence in the inflation response, but will also increase the delay between the responses of the two sectors.

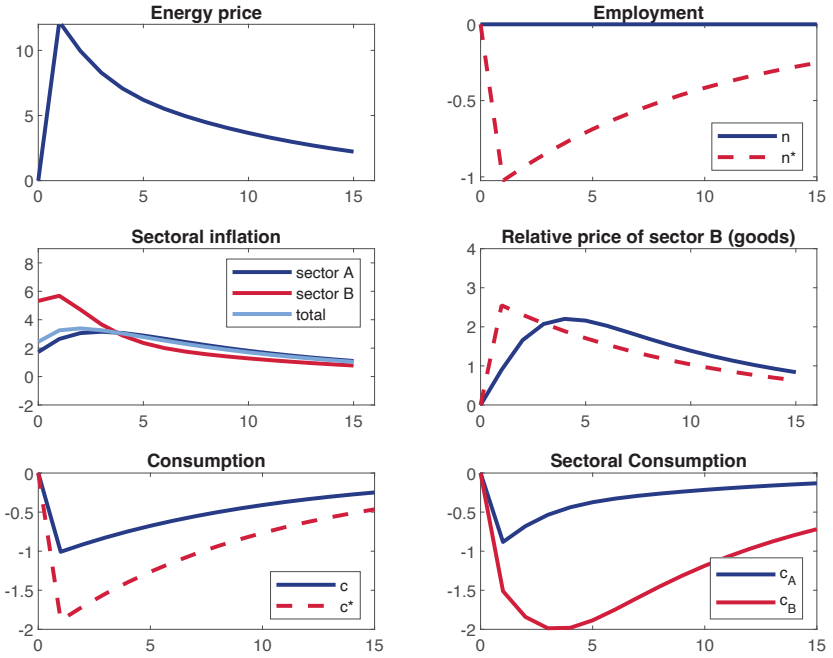
Going back to Figure 26, the blue solid line in the middle-right panel shows the behaviour of the relative price of manufacturing goods (sector B). The dashed red line in the same panel shows the response of the same relative price in an economy with flexible prices. The figure shows that price stickiness generates delay in the relative price adjustment.

The bottom panels show what happens to household consumption. The bottom-left panel compares total consumption (blue solid lines) to its flexible-price level (red dashed lines) and shows that consumption drops less in the presence of sticky prices. This is simply a reflection of the fact that the central bank is keeping employment above its natural level. Note that the consumption path is increasing after the shock, which, from the consumer Euler equation, implies that the real interest rate is temporarily higher. This justifies our previous claim that the central bank's response in this simulation is contractionary.

Finally, the bottom-right panel shows how households shift consumption between the two goods in response to the shock. The figure shows that consumption in both sectors declines, but it does so more in manufacturing (the sector directly affected by the shock) in response to the increase in that sector's relative price.

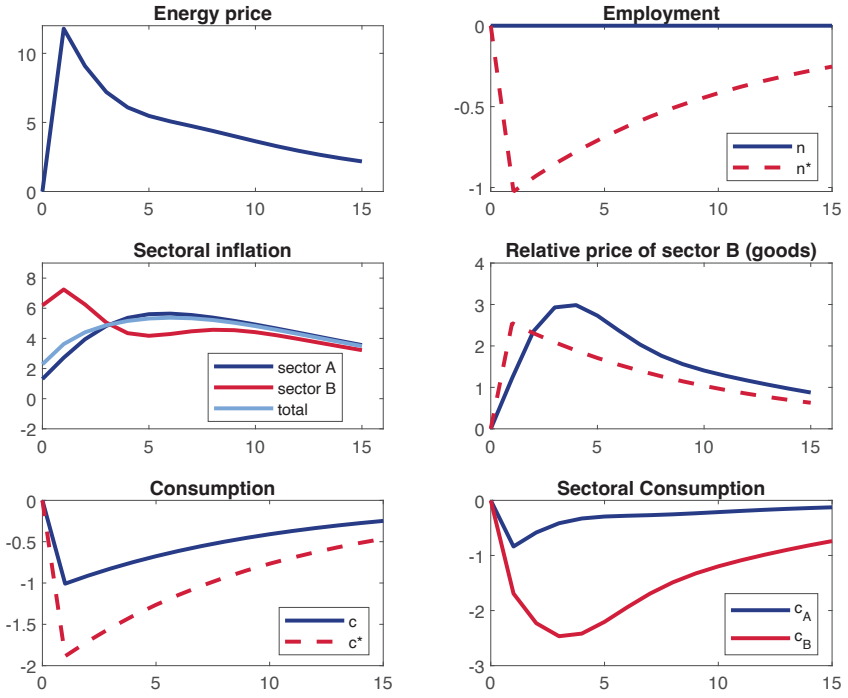
To sum up, the persistent effect of inflation is the effect of the uneven impact of oil prices in the two sectors combined with price stickiness. This implies that the degree of price stickiness in the economy and the degree of substitutability between the two goods and between different factors of production are key parameters of the model that affect inflation dynamics. In particular, given that there is a large literature emphasising the fact that the euro area exhibits more price stickiness than the United States, we now explore the effect of the same oil shock in an economy where prices are more sticky. Figure 27 shows the response of a closed economy to the same contraction in oil supply as in Figure 26 when the prices in sector B are more sticky. The figure shows that, in this case, the shock generates a smaller response in overall inflation, and especially, in inflation in sector B, but larger persistence as the hump in total inflation is delayed relative to the benchmark. The model's implications are consistent with the VAR analysis in the previous chapter. In particular, Figures 22 and 21 show that in response to the same energy shock, the euro area experienced smaller but more persistent inflation.

FIGURE 27 **ECONOMY WITH HIGHER DEGREE OF PRICE STICKINESS**



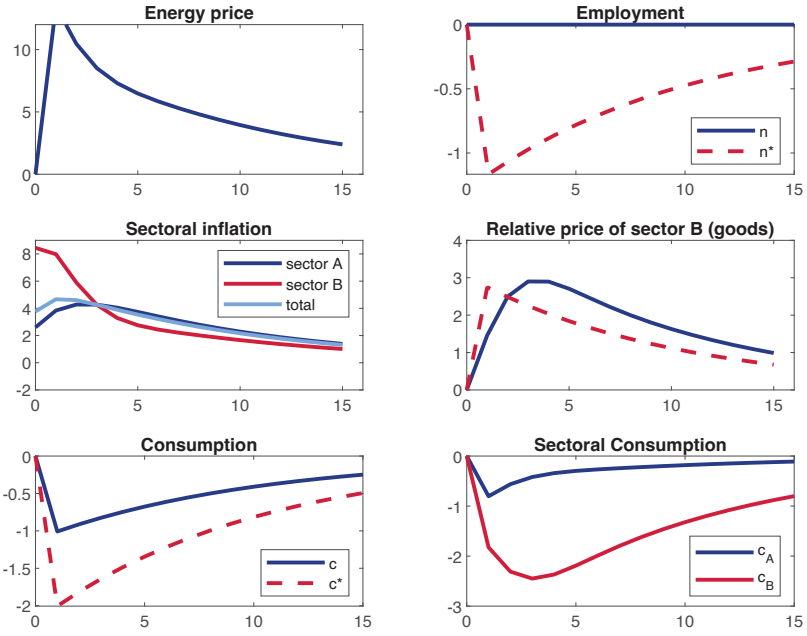
In the model, we also introduce inertia in inflation dynamics driven by a form of indexation. Naturally the degree of persistence of inflation also crucially depends on how strong this force is. Figure 28 shows the response of an economy where the degree of inertia is larger than the baseline economy and shows that this increases both the level and the persistence of inflation.

FIGURE 28 **ECONOMY WITH SMALLER DEGREE OF INDEXATION**



Another interesting area of comparative statics relates to the elasticity of substitution between labour and oil in sector B. Figure 29 shows that when labour is a better substitute for oil, then an oil shock would have smaller effects on inflation because the economy will respond by using more labour in sector B. However, this implies that the relative price in sector B will increase less than would happen in the flexible price economy, generating a larger drop in consumption.

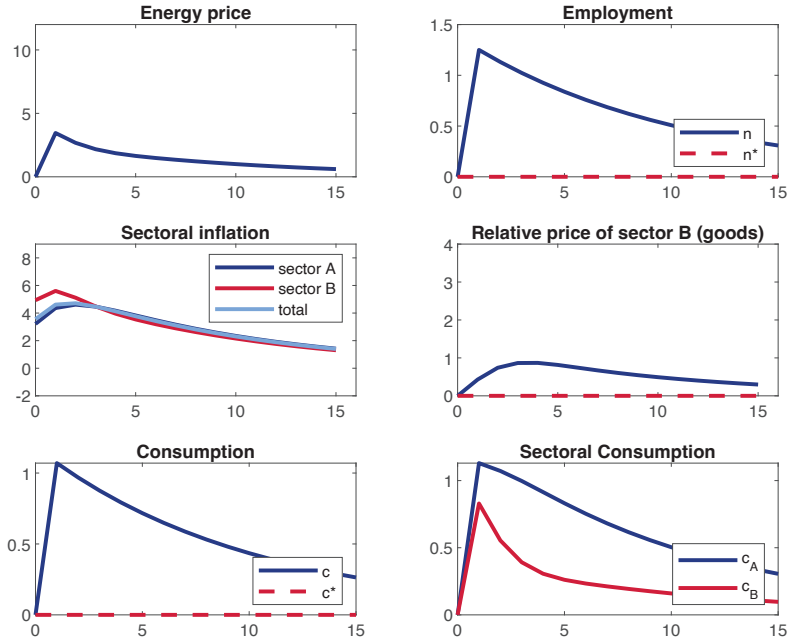
FIGURE 29 **ECONOMY WITH LOWER ELASTICITY OF SUBSTITUTION BETWEEN LABOUR AND OIL**



2.2.2 Monetary policy implications

In thinking about monetary policy, a first natural question is whether total and sectoral inflation in this economy would respond differently to an even shock, such as a monetary policy shock. Figure 30 shows the response of the economy to an aggregate demand shock – that is, an increase in aggregate consumption – that generates the same increase in total inflation on impact. The figure shows that an aggregate demand shock generates much less heterogeneity in sectoral inflation than an oil price shock, as the demand pressure affects the market for all goods. It is interesting to note that there is still some degree of heterogeneity, which is due to the fact that oil prices increase slightly in response to the aggregate shock, so the same effects of an oil shock apply but on a smaller scale. This is consistent with the VAR analysis in the precious chapter, which shows that for both the euro area and the United States there is a smaller degree of sectoral heterogeneity in response to a monetary shock than in response to an energy price shock. Note that in the model, the response of the economy to a monetary policy shock is identical to the response to any other aggregate demand shock that hits all sectors in the same way.

FIGURE 30 **CLOSED ECONOMY RESPONSE TO AN AGGREGATE DEMAND SHOCK**

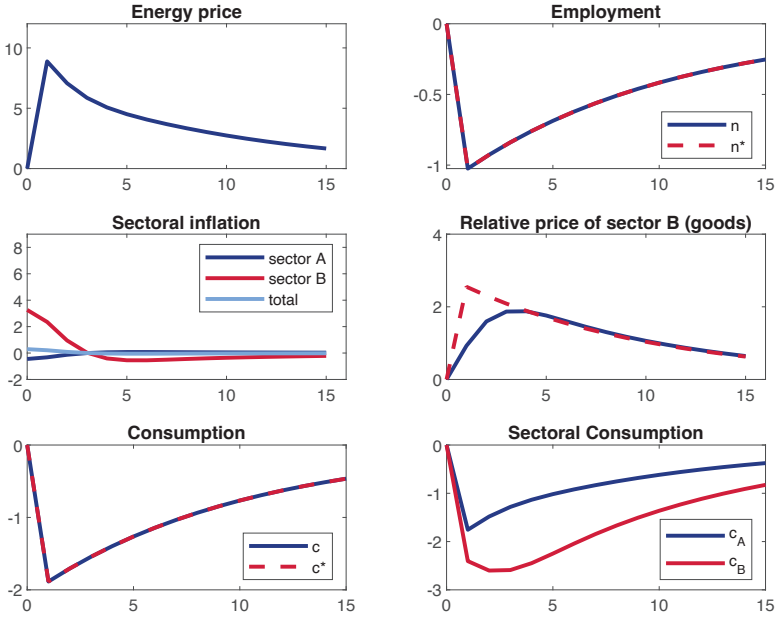


Given that the model, although stylised, is able to replicate some salient features of the data, we can now use it to explore some policy implications. In particular, the previous exercises have emphasised that relative price movements are efficient in response to an uneven shock, but not in response to a shock that hits all the sectors in the same way. A natural question arises: should the monetary policy stance be different in response to a shock that has more heterogeneous effects on sectoral inflation or not? To address this issue, Figure 31 shows the response of the economy to the same oil shock as in Figure 26, but assuming that in each period after the shock employment is set equal to the employment level in the flexible price version of the model. This case can be thought of as an economy where the central bank follows a tight monetary policy with a pure stabilisation objective.

In comparing Figure 26 and Figure 31, we can see that while the tight monetary policy helps in reducing inflation to zero, it cannot replicate the relative price movement of the flexible-price economy. In fact, the relative price of good B increases much less than in the flexible-price economy and with more delay, generating distortions in the allocation of resources, and hence lower consumption. In particular, in response to the oil shock it is efficient to reallocate labour from sector B, which uses oil directly, to sector A, which uses oil only through intermediate goods. The figure shows that this is the case, as consumption of good B declines more than consumption of good A. However, in the flexible-price economy, there would be a larger reallocation of resources thanks to the larger and faster increase in the relative price of good B. Hence, a tight monetary policy, by containing inflationary pressures, reduces the relative price adjustments that are necessary to obtain

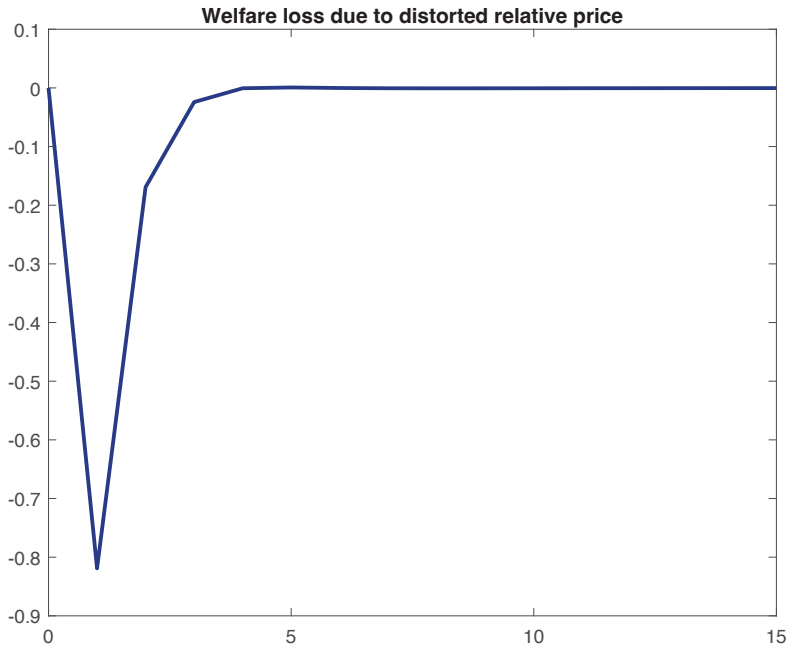
the right allocation, hence reducing welfare. In the log-linearised model, consumption drops as in the flexible-price counterpart because the Hulten theorem applies. However, the distortions in relative price adjustment have sizeable second-order effects that reduce consumption and welfare in the full non-linear model. Figure 32 shows the loss in welfare due to the distortion in relative price changes between the two sectors (assuming that all firms in each sector set the same average price to abstract from further welfare losses coming from dispersion within each sector).

FIGURE 31 **CLOSED ECONOMY RESPONSE TO AN OIL SHOCK WITH TIGHT MONETARY**



To sum up, Figure 31 shows that although a tight monetary policy is successful in reducing aggregate inflation, it generates distortions in the relative price movement across sectors. These inefficient relative price movements do not show up in lower consumption in the log-linearised model, but have sizeable second-order effects in the full model, as is shown in Figure 32. Figure 26 shows that keeping employment constant would be too expansionary, generating a drop in consumption smaller than the natural level and high inflation at the same time. An analysis of optimal monetary policy is beyond the scope of this report, but these exercises suggest that the optimal policy would probably be somewhere in the middle. Overall, the main take away is that when we conduct monetary policy to fight inflation, we should be cautious and keep in mind that accepting a degree of short-term inflation may be a necessary cost to allow for relative price movements that help obtain a better allocation of resources.

FIGURE 32 **CLOSED ECONOMY RESPONSE TO AN AGGREGATE DEMAND SHOCK**



A small open economy and terms of trade

The war in Ukraine has contributed greatly to the substantial rise of energy prices in Europe. This was due in particular to the fact that Russia was one of the main suppliers of natural gas, which is used in many European countries. In order to think about such a shock, we need to extend our model to consider an open economy that may be a net importer of energy. For ease of exposition, we discuss the impact of an oil price rise, although the model could easily be used to analyse a rise in the price of natural gas or other commodities.

In Box 3, we describe the extended version of the model in which we assume that the economy is open and the energy price shock is an increase in the foreign oil price. In particular, we focus on a small open economy and, for simplicity, we make the extreme assumption of financial autarky. We assume that the economy imports oil from abroad (on top of a fixed domestic supply) in exchange for exporting manufacturing goods. This version of the model is better suited to thinking about euro area economies, where oil (and natural gas) is mostly imported, while the closed version of the model is better suited to think about the United States, which mostly uses domestic oil. Contrasting the open and closed versions of the economy helps us reconcile both the different pattern of terms of trade and the different recovery path of households consumption in the euro area versus the United States.

BOX 3 **OPEN ECONOMY EXTENSION**

We now extend the model to a small open economy. We assume that on top of the domestic fixed supply of oil $\bar{Z}$, there is a fully elastic supply of oil abroad that is traded at an exogenous price P^*_{Zt} in exchange for good B. The price of domestic oil then is going to be

$$P_{Zt} = S_t P^*_{Zt},$$

where S_t is the exchange rate. To keep the model simple, we make the stark assumption that the economy is in financial autarky. Given that oil is traded in exchange of goods produced in sector B, the balance of payment requires

$$P_{Bt} C^*_{Bt} = S_t P^*_{Zt} (Z_t - \bar{Z}_t).$$

The world demand for good B depends on the relative price of that good and on exchange rate.

In particular,

$$C^*_{Bt} = C^*_B\left(\frac{P_{Bt}/S_t}{P^*_t}\right).$$

To sum up, the market clearing conditions for the two goods show that good A is only consumed domestically, while good B is consumed domestically and abroad and is also used as intermediate input, that is,

$$Y_{At} = C_{At} \text{ and } Y_{Bt} = C_{Bt} + C^*_{Bt} + X_t,$$

where X_t is the total demand for intermediate inputs.

Figure 33 shows the response of a small open economy to an oil shock, when keeping the employment level constant. In particular, to make it comparable to the shock to the closed economy represented in Figure 26, we increase the foreign oil price so as to obtain the same increase in the domestic oil price as that generated by the reduction in domestic oil supply in the closed economy. The figure shows that the responses of total and sectoral inflation are qualitatively similar, although in the open economy both total and sectoral inflation move slightly more. The more pronounced difference between the two economies is in the response of household consumption. In the open economy, the drop in total consumption is much more pronounced than in the closed economy. This is due to the fact that in the open economy, the drop in foreign oil prices acts as a negative income shock, while in the closed economy the revenues of the oil sectors go back to the representative household. A different way of looking at the same issue is that the terms of trade of an energy-importing country deteriorate, so the country is poorer overall. This is consistent with Figure 2 in Chapter 1, which shows that the terms of trade in Europe have deteriorated, unlike in the United States, while the household consumption dynamics in Europe have been weaker.

FIGURE 33 **SMALL OPEN ECONOMY RESPONSE TO AN OIL SHOCK**

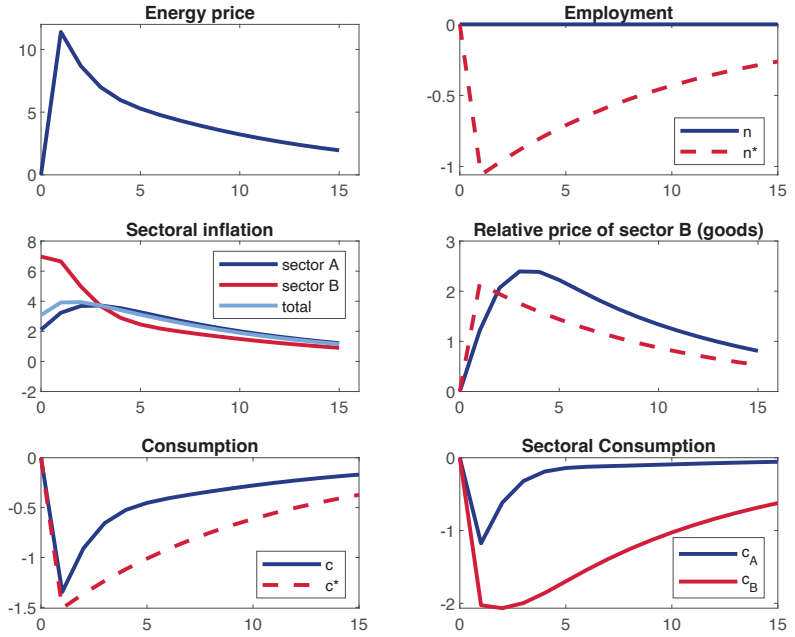


FIGURE 34 **SMALL OPEN ECONOMY RESPONSE TO AN OIL SHOCK WITH TIGHT MONETARY POLICY**

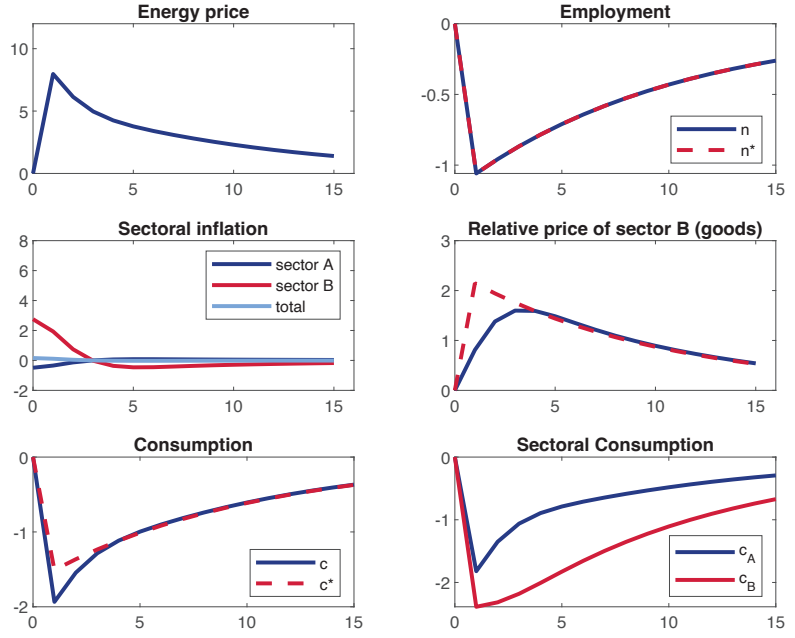


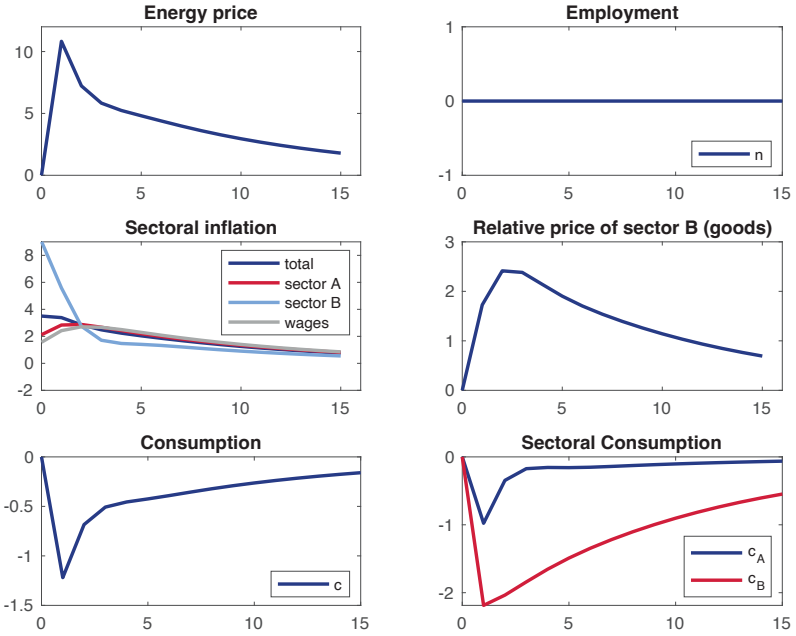
Figure 34 shows the response of an open economy to the same foreign price shock, when employment behaves as in the flexible price economy. The figure shows that as in the closed economy, a tight monetary policy that aims at keeping employment at the natural level is able to keep inflation at zero, but generates too little movement in relative prices and hence an inefficient allocation of resources that generates a drop in total consumption below the flexible price counterpart. As in the closed economy case, the relative price of good B increases in response to the increase in oil price, but not enough relative to the flexible price counterpart, so there is not enough reallocation of labour to sector A on impact in response to the shock. However, in the open economy, consumption drops even more than in the closed economy because of the exchange rate effect. In particular, because of the deterioration of the terms of trade, the economy has to export more manufacturing goods, depressing domestic consumption even further.

The model can be extended along different dimensions. We now explore a version of the model with sticky wages. Introducing sticky wages is formally analogous to introducing a third sector that produces labour services, so in that sense the effect is a transmission from sector B to the labour sector, and finally to sector A.

Figure 35 shows the response of an open economy with sticky prices and wages to the same oil shock considered in Figure 33, when keeping the employment level constant. We keep all the parameters the same, except that now there is a new parameter, λ_w, that controls the degree of wage stickiness, and we choose λ_A and λ_B, which control the degree of stickiness in price setting in sectors A and B, so that the level of headline inflation is the same as in the case of flexible wages. In that case, we have to assume a high degree of price stickiness in sectors A and B to obtain a plausible degree of transmission from energy prices to headline inflation. With the introduction of sticky wages, we can make more realistic assumptions on λ_A and λ_B.

The figure shows that, once we recalibrate the degree of price stickiness to obtain the same headline inflation, the model with sticky wages behaves similarly to the model with flexible wages. The notable difference is that the response of wages is now more realistic: wages increase in response to the shock and then start to revert back, whereas in the model with flexible wages they were decreasing. The figure also shows that prices in the two sectors increase more in response to the shock, but this is just a result of the more reasonable stickiness parameters in the two sectors.

FIGURE 35 **SMALL OPEN ECONOMY RESPONSE TO AN OIL SHOCK WITH STICKY WAGES**

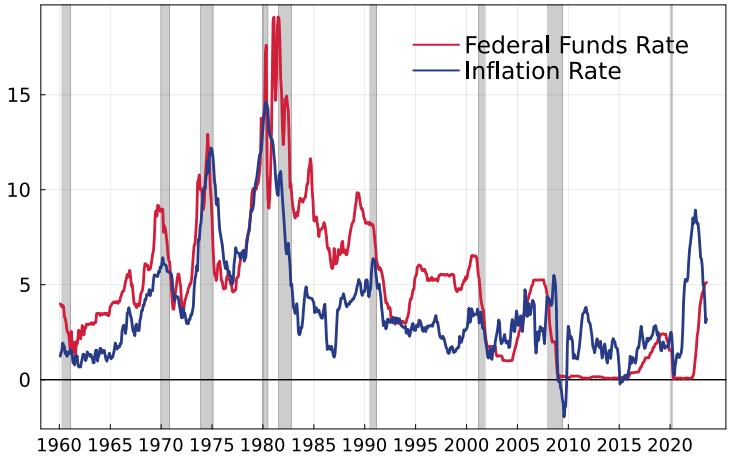


CHAPTER 3

Inflation, disinflation and monetary tightening in historical perspective: The US case

This chapter puts the current surge in inflation and monetary policy tightening in perspective. We focus on the United States to establish a historical benchmark, given the ease of data comparability over time. Figure 36 displays the Federal Funds rate and the inflation rate in the United States since 1960. It shows the steep disinflation of the 1980s, two decades of inflation below the Federal Funds rate (a situation only observed very recently) and, finally, an inflation rate that remained between 3% and 4% until the second half of the 1990s.

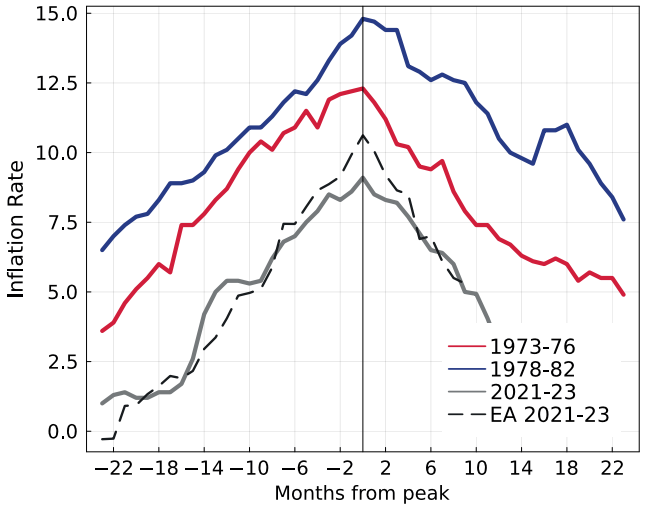
FIGURE 36 **FEDERAL FUNDS RATE AND INFLATION RATE, 1960-2023**



Source: Haver Analytics

Figure 37 shows that, although as observed in Chapter 1, the recent energy shock has been much larger than in the 1970s or 1980s, euro area and US inflation have been reversing much more quickly than US inflation did in those episodes.

FIGURE 37 **INFLATIONARY AND DISINFLATIONARY EPISODES**



Source: Haver Analytics

We also observe that the peaks reached by headline inflation in both the United States and the euro area were at lower levels than the peak experienced in the United States the 1970s and early 1980s. This is not surprising since, in the latter episode, the oil shock hit after a prolonged period of expansionary fiscal and monetary policy that had started in the mid-1960s.

The historical account of those years shows that the response to the supply shock related to OPEC I was chaotic. Monetary and fiscal policy oscillated between easing and tightening in a stop-and-go fashion (Blinder, 2021; Bernanke, 2022). The conceptual framework on which that response was based underplayed the importance of price stability and the commitment to a clear and credible target. Neither the Federal Reserve nor US Congress considered inflation to be a primary target. Indeed, the Federal Reserve Act establishing the dual mandate was only passed in 1977.

OPEC-II struck when inflation was already relatively high, having been driven by expansionary fiscal and monetary policy, and preceded by a steady increase in food price inflation since 1976. From October 1976 to April 1980, inflation rose from 5.4% to 14.6%.

When Paul Volcker was appointed Chair, the Federal Reserve had arguably lost credibility in its ability or willingness to control inflation. However, the political will was maturing, as was demonstrated by the fact that, in 1977, Congress established the dual mandate with the Federal Reserve Act.

Volcker's first attempt to tame inflation was soon reverted after a short recession materialised, which was also partly explained by credit controls implemented by the Carter administration. According to Alan Blinder's reconstruction, the post-recession increase in inflation coincided with credit controls being dismantled. At that point (September 1980), Volcker went for a sharp tightening.

For our discussion, it is interesting to note that, at the time, the Federal Reserve acted with a delay and, by the time action was taken, the oil shock had subsided. At that point, the resurgent inflation was driven by demand: monetary policy tightened in response to an overheated economy in which the inflation anchor had been lost. Goodfriend and King (2005) argue that the "incredible disinflation" that followed and the cost in terms of unemployment was the result of lost credibility. Once that credibility was established, Volcker could enjoy a "credibility bonus".

In what follows, we analyse three related issues. The first is the evolution of the degree of anchoring of inflation expectations over time, as a proxy for the Federal Reserve's credibility.[3] The second is the extent to which the level of the real interest rate reflects the degree of monetary tightening over time. The third is lessons from the costs of disinflation from Volcker's period.

3.1 ASSESSING INFLATION ANCHORING

Building on the Congressional Budget Office's framework for inflation expectations, we set inflation expectations as a function of past inflation and the central bank's inflation target (equation 7) as follows:

$$\text{Expected Inflation}_t = \sum_{i=1}^{p} \gamma_i \, \text{PCE inflation}_{t-i} + \lambda \, \text{Inflation Target} + \varepsilon_t \tag{7}$$

$$\text{Where: } \sum_{i=1}^{p} \gamma_i + \lambda = 1; \; \lambda \geq 0; \; \sum_{i=1}^{p} \gamma_i \geq 0 \tag{8}$$

In this model, if inflation were to be determined solely by past inflation (i.e., λ with a value of zero), inflation expectations would behave in an 'accelerationist' way – that is, a 1% increase in past inflation, given lags, would result in a 1% increase in inflation. If, conversely, inflation expectations were guided solely by the central bank's inflation target, then these would be 100% anchored (i.e., λ with a value of one).

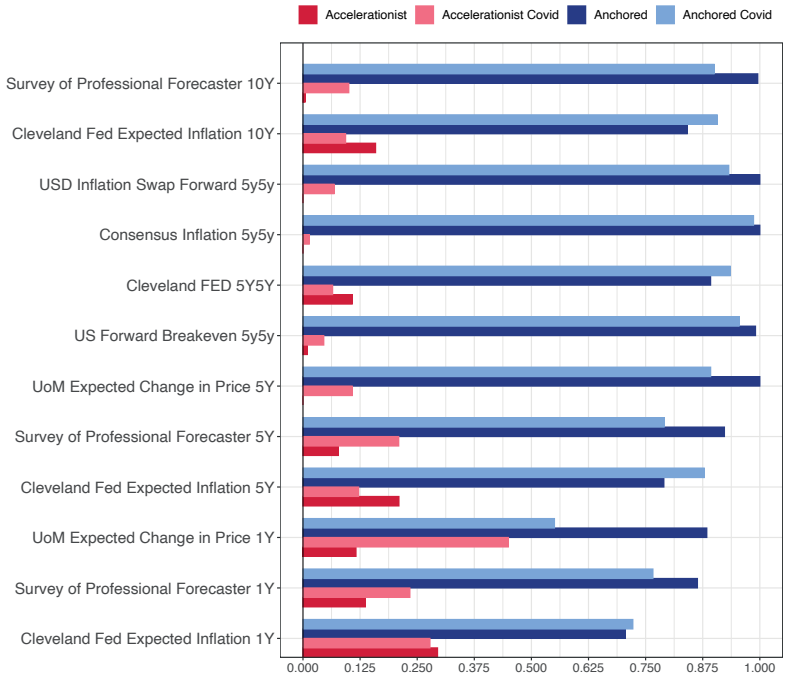
To fit the model, we use several measures of inflation expectations for the US: the University of Michigan Survey of Consumers; the Survey of Professional Forecasters; the Consensus Economics survey of professional economists; the Reserve Bank of Cleveland's

3 See Tenreyro (2023) for a somewhat different take on credibility.

inflation expectations (which are model derived) (Haubrich et al., 2011), market inflation break-evens and inflation swaps. These are the same measures we plotted in Figure 16 in Chapter 1, and the caveats discussed then also apply here.

In the analysis, we look at the behaviour of the anchored term over both the near-term (one year) and the medium-term (five-year, five-year) horizon.[4] Our analysis starts in 1996. Setting a value for the inflation target is quite straightforward from 2012 onwards, when the Federal Reserve adopted an explicit 2% inflation target. From 2007 onwards, we can use the economic projections from the Board of Governors and the Presidents of the Federal Reserve Banks published since then, which also confirm a target close to 2%. As for the previous period, we follow Milani (2020), who shows that over the course of the late-1990s it became understood that the Federal Reserve had an unannounced inflation target of somewhere around the 2% mark. We draw on a gradient descent algorithm to estimate the model in equation 7 and further require the values hereof to be null or positive. Further details on the parameter estimates and their statistical properties are given in the appendix. We first estimate the equations for the various inflation surveys over the period 2000 to 2019, and then test with the more recent period starting in 2020 until the present, which we refer to as the "Covid" period in the figures. Results are reported in Figure 38.

FIGURE 38 **INFLATION EXPECTATIONS DECOMPOSITION**



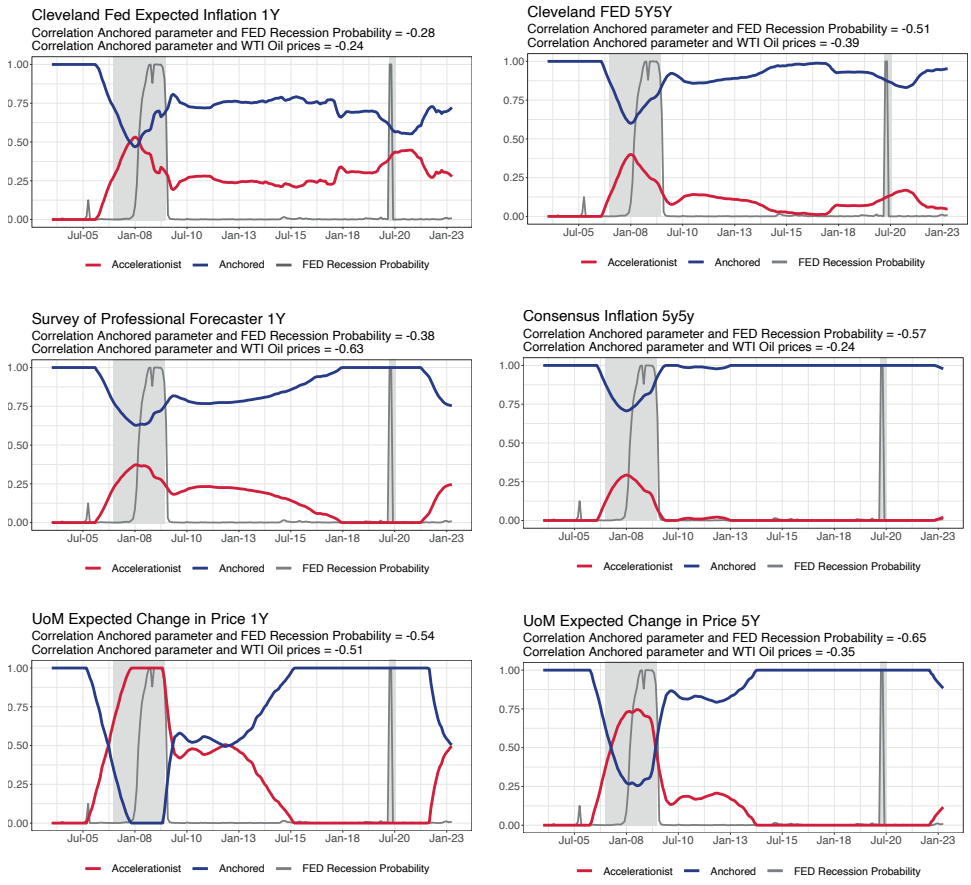
Source: Consensus Economics and Bloomberg

4 Note that throughout the analysis, we use five-year, five-year and six- to ten-year interchangeably.

We observe a slight decline in the anchored term across most of the survey measures between the pre-Covid period of 2000-2019 and the Covid period 2020-2023. The exception is the one-year-ahead University of Michigan consumer-based survey, which sees a more notable decline.

To understand the behaviour of the anchor term over time, we next estimate the equations over a seven-year rolling window. Results are illustrated in Figure 39 (on the vertical axis we have the parameter values). They show that the anchored term is not constant, but changes in parameters are small for the five-year, five-year expectation of the Federal Reserve Bank of Cleveland and Consensus Economics (the anchored term is never below 75%), confirming the well-known fact that short-term expectations are volatile and so are consumer expectations in general.

FIGURE 39 **ROLLING WINDOW ESTIMATION**



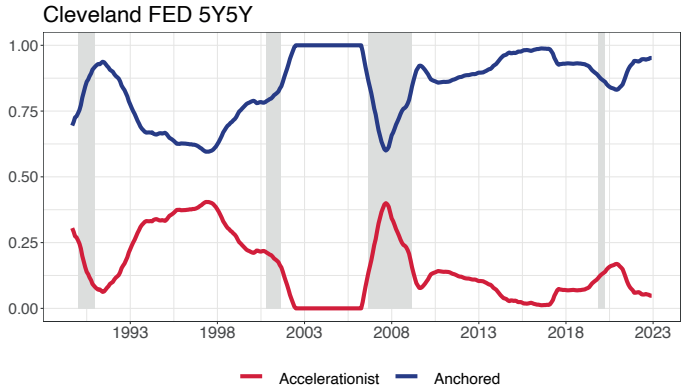
The figure also reports the correlation between the anchor term and Federal Reserve recession probabilities and oil prices. The anchored term is negatively correlated with the Federal Reserve recession probability: as the probability of recession increases, the accelerationist term goes up while the anchored term declines.

However, the average correlation is driven mostly by the Global Financial Crisis episode; over the Covid period, it is virtually zero. The finding that recessions are a risk to the anchored component of inflation expectations suggests that the occurrence of a deep recession may erode the credibility premium. This risk seems to have been greater during the Global Financial Crisis than it is today.

The correlation between the anchored term with oil prices is smaller. It increased in 2008 when oil prices surged and it spiked again, though very briefly, in the early phase of the pandemic, when oil prices fell. This suggests that the anchored component may be temporarily affected by oil prices, but that volatility unwinds quickly as the shock dissipates.

As a final exercise, we perform a similar rolling-window exercise using the Federal Reserve Bank of Cleveland five-year, five-year data since 1982. In an admittedly somewhat arbitrary way, we set the target from 1982 to 1996 at 4% and keep the 2% target since then. Figure 40 shows that the anchored term before the new millennium was much lower even if the model includes a higher inflation target. This also suggests that the Federal Reserve enjoys a higher credibility premium today than in the past.

FIGURE 40 **ROLLING WINDOW ESTIMATION, 1982:2023**



Source: Bloomberg

To summarise, while the recent inflation period has seen a slight decline in the anchored term, the modest magnitude suggests that central banks enjoy a credibility premium, which was not the case in the early 1980s.

3.2 MONETARY POLICY STANCE

To put the current monetary policy stance in historical perspective, we construct a heat map of the extent of tightening using a number of indicators (Table 3). More precisely, we consider the effective Federal Funds rate, the real effective Federal Funds rate gap with respect to Laubach and Williams' (2003) estimates of the natural rate, the 10-year Treasury yield, the US 30-year mortgage rate, Moody's US Corporate Baa spread, Moody's US Corporate Aaa spread, and the Chicago Fed National Financial Conditions Index (NFCI) non-financial leverage sub-index.

In the table, a row corresponds to a tightening monetary policy cycle as classified in Kwan and Liu (2023). The first column reports the duration of the cycle in months and the following columns the various indicators divided into total change and average change per month. Total change indicates the latest value compared to the start of the tightening cycle, the monthly averages are thus this change divided by the duration of the tightening cycle. For the present cycle, we count the months to date. Intensity of colour signals, correspondingly, the intensity of tightening in the "total change" metric and the "speed of tightening" in the change per month metric.

The most striking result in Table 3 is that the change in the gap between the Federal Funds rate and the estimate of the natural rate is largest in the current tightening. All the yield and credit spread metrics have also seen substantial increases, although their interpretation is less clear. It is only the recent movement of non-financial leverage index that has been small in historical comparison, indicating a relatively low degree of financial stress. In terms of speed, the table shows that the current tightening has been faster than most other episodes.

To conclude, Volcker's Federal Reserve had a looser stance both because r was higher at the time and the inflation average was higher, possibly owing to a different implicit inflation target. Moreover, Volcker's Federal Reserve did not have a credibility bonus, as gauged by the anchoring measures.

TABLE 3 **SELECTED INDICATORS OF DEGREE OF MONETARY TIGHTENING**

Start	End	Duration in months	Fed funds target rate		Fed fund target rate (CPI 12M) - r* (LW)		10Y US Treasury Yield		US 30Y Mortgage Yield		Moody's Baa US Corporate Yield		Moody's Aaa US Corporate Yield		Chicago Fed NFCI Leverage Subindex	
			Total change in basis points	Average change per month	Total change in basis points	Average change per month	Total change in basis points	Average change per month	Total change in basis points	Average change per month	Total change in basis points	Average change per month	Total change in basis points	Average change per month	Total change, actual	Average change per month
Dec-65	Nov-66	11					47	4			111	10	67	6		
Dec-68	Aug-69	8					0	0			63	8	52	6		
Apr-71	Aug-71	4	25	6	96	24	20	5	36	9	31	8	34	9	0.03	0.01
Feb-72	Sep-73	19	550	29	201	11	86	5	126	7	40	2	36	2	1.23	0.06
Mar-74	Jul-74	4	-75	-19	-192	-48	48	12	69	17	86	22	71	18	-0.21	-0.05
Apr-77	Apr-80	37	562	15	-60	-2	331	9	732	20	512	14	400	11	2.04	0.06
Feb-81	Jun-81	4	-50	-13	72	18	43	11	173	43	43	11	40	10	0.16	0.04
Jul-83	Aug-84	13	212	16	83	6	101	8	159	12	124	10	72	6	0.87	0.07
Mar-88	Mar-89	12	300	25	208	17	73	6	91	8	10	1	42	4	-0.13	-0.01
Feb-94	Apr-95	14	275	20	246	18	93	7	141	10	84	6	95	7	0.72	0.05
May-99	Jul-00	14	175	13	48	3	41	3	129	9	63	5	72	5	0.25	0.02
Apr-04	Jul-06	27	425	16	396	15	47	2	126	5	30	1	12	0	1.80	0.07
Dec-16	Feb-19	26	175	7	205	8	27	1	38	1	11	0	-27	-1	0.21	0.01
Jan-22		20	525	26	890	44	218	11	360	18	215	11	173	9	0.67	0.03

Source: Refinitiv and Bloomberg, latest data available August 2023

3.3 COSTS OF DISINFLATION

The consequence of Volcker's disinflation was not only a prolonged recession, but also serious financial tensions. The year 1984 saw the crisis of a large bank, Continental Illinois, which, after having faced a run on deposits, was bailed out. The savings and loans industry was the other victim. As interest rates rose, depositors withdrew funds to seek higher returns. The demand for mortgages declined, as a consequence of the tightening, and the cap on interest on savings and loans deposits was lifted in an attempt to halt the flight of depositors. This led to many savings and loans becoming insolvent. Since deposits were insured, losses were passed on to taxpayers. What happened is lucidly summarised in a quote from Volcker as reported by Alan Blinder, who says that when he asked Volcker how he thought monetary policy worked to crush inflation, Volcker responded: "by causing bankruptcies" (Blinder, 2021, p. 106).

It is still too early to draw comparisons with the effects of the current monetary policy tightening – given the long lags in monetary policy transmission, the economy has not yet seen the full effects of the current tightening. Over time, the tightening should push down on aggregate demand, lowering inflationary pressures along with activity. The effect of monetary policy will be acting against the background of unwinding supply shocks, which will push up on activity and relieve inflationary pressures. The outcome from these two forces – slowing demand and expanding supply – are ambiguous for activity, but should be disinflationary, all else equal.

CHAPTER 4

Where are we heading to? The market view

In the first three chapters, the report has presented arguments that call for patience in fighting inflation in the face of uneven supply shocks. We have shown empirically that the pattern of winding and unwinding of temporary supply shocks takes time to propagate across sectors. We have also argued that efficiency considerations require flexibility in relative prices for a speedy adjustment to the shock and its unwinding; in the presence of downward nominal rigidities, this calls for temporarily higher inflation.

If we consider the extraordinary size of the supply shock the economy has had to absorb and the fact that monetary policy operates with a material lag, these observations suggest that the benefits of more tightening will be small when compared to the risks. This is particularly true for the euro area, which, as discussed, was hit by a large negative terms-of-trade shock that is now reversing.

An important question in assessing the policy stance is of course what level of real interest rate is consistent with price stability (the so-called natural rate, or r*).

The natural rate comprises a complete term structure, with short-run r* capturing current cyclical economic conditions and longer-run r* capturing more secular trends.

In this final chapter, we discuss the evidence on r*, reflected in the consensus view of market economists, as well as in estimates of r* obtained from both empirical and structural models. We focus primarily on the United States, given data availability, and then turn to estimates of r* for the euro area.

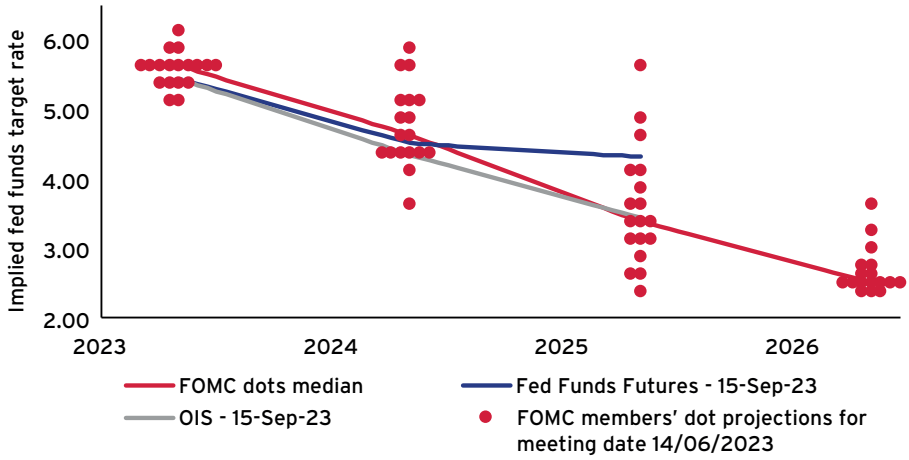
4.1. R* ESTIMATES FOR THE UNITED STATES AT DIFFERENT HORIZONS

We start our discussion with the 'dot plots' for the Federal Funds rate and contrast them with various r* estimates, drawn from commonly referenced models and the consensus of market participants.

Figure 41 reports the views of the FOMC on the nominal level of the mid-point of the projected appropriate target ranges for the Federal Funds rate at different horizons, including the longer term, for which the current shocks should have fully unwound. At the June 2023 FOMC meeting, the median projection indicated a federal fund rate at 5.6% by the end of 2023, 4.6% by the end of 2024, 3.4% at the end of 2025 and 2.5% in the longer run. Looking at the individual dots, however, we note a wide dispersion

of views. The mid-point of the fed funds target range stood at 5.38% following the 26 July 2023 meeting. Recently, market pricing around the Federal Reserve dots has been remarkably volatile, reflecting sharp shifts in market perceptions of recession risks and high sensitivity to individual data releases.

FIGURE 41 **FOMC PROJECTIONS FOR THE FEDERAL FUNDS RATE**

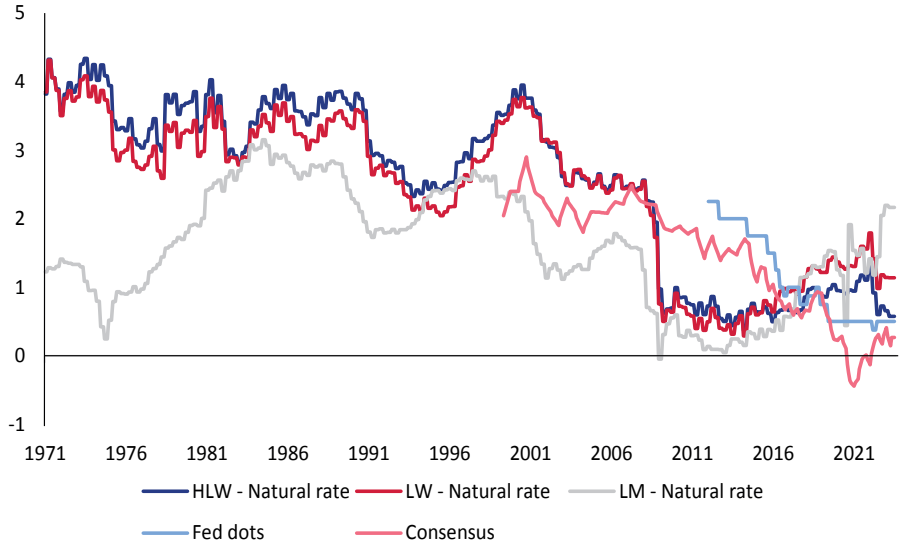


Source: Bloomberg. Market values on 4 August 2023

While the dots out to 2025 offer a view on the interest rate path set by monetary policy, the longer- run dot offers a view on the level of interest rates that would prevail once the current shocks have fully unwound. This can thus be considered as a proxy for the nominal equilibrium rate consistent with price stability. To set this in real terms, we subtract the longer-run FOMC projection for personal consumption expenditures (PCE) inflation, which yields a median estimate for r* of 0.5% within a range of 0.4% to 1.6%. Back in December 2019, just before the pandemic struck, the median stood at 0.5% within a range of 0.0% to 1.3%, suggesting a slight increase but still well below the level of 2.25% implied by the first release of the Federal Reserve dots back in 2012.

Figure 42 shows various estimates for the longer-run r*. We report the consensus of market economists' (6- to 10-year horizon) view, which, with a median of 0.35%, is at the lower end of estimates, together with estimates derived by structural time-series models that are popular in policy analysis. Consensus data are survey-based and can be interpreted as the perception of market economists in real time. The time-series models, on the other hand, use minimal identification restrictions to extract trends and cycles from the data, modelled as orthogonal components. The figure shows that the range of the latest estimates from these models is quite wide: 1.14% with the model developed by Laubach and Williams (2003) (LW), 0.58% with the model of Holston et al. (2023) (HLW) and 2.16% with the Lubik and Matthes (2023) (LM) model.

FIGURE 42 **US R* ESTIMATES**



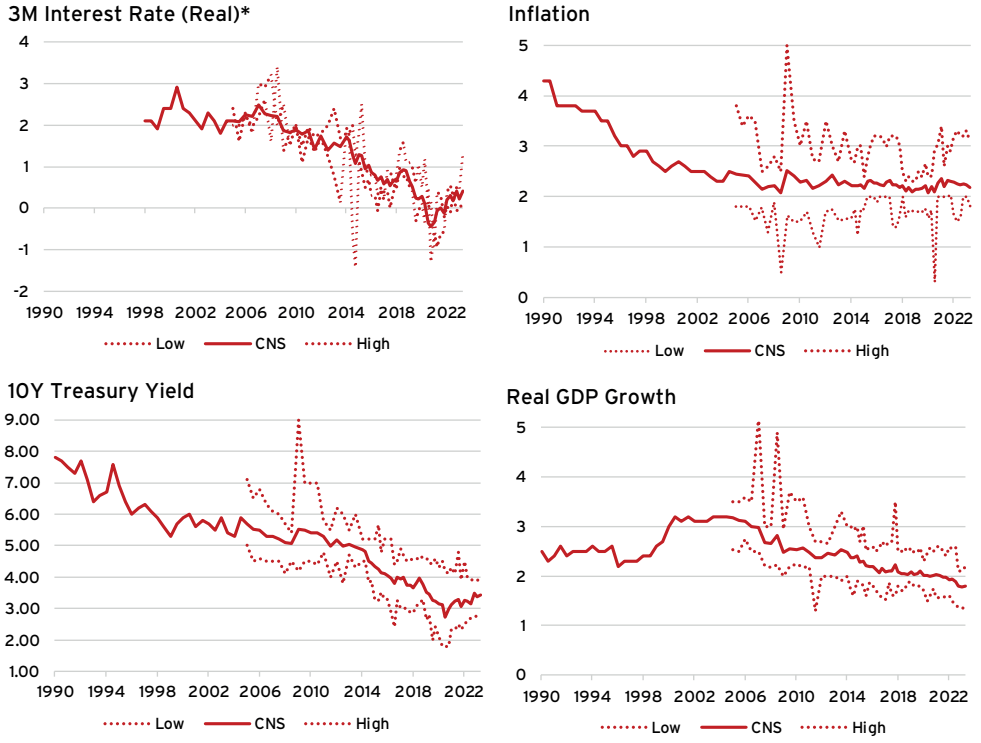
Source: Bloomberg.

The estimates from the LW and HLW models are based on revisions of the original specifications to account for time-varying volatility and a persistent Covid supply shock. This adjustment led to an upward revision in r* for the period just before the pandemic, which, all else being equal, implies that monetary policy in the pre-pandemic period was more accommodative than estimates at that time suggested. Note, however, that the estimates are now slightly lower than their pre-pandemic levels, with the latest readings down by 30 basis points and 46 basis points, respectively, since 4Q19. Consensus, on the other hand, shows a recent very slight increase, while the LM measure is very volatile at the end of the sample.

Overall, from these estimates it is hard to get a consistent view of the level, or even the direction, of r*. However, with the exception of LM, they all point to the conclusion that policy in the United States is presently restrictive.

Zooming in on the longer-term consensus of market economists (6- to 10-year) in Figure 43, we can make a few additional observations. First, we note that inflation expectations remain well anchored, as discussed in previous chapters. Second, we observe that estimates of trend GDP growth have slightly declined in recent years. Third, the three-month real interest rate over the 6- to 10-year horizon, which we use above as a proxy for the consensus view of market participants on r*, declined over the pandemic period, and much more sharply than what would be implied by the consensus view on trend GDP growth. It has since returned to the levels that prevailed just prior to the pandemic period, and much more sharply than what would be implied by the consensus view on trend GDP growth. It has since returned to the levels that prevailed just prior to the pandemic.

FIGURE 43 **US LONG-TERM CONSENSUS (6-10 YEARS)**



Source: Consensus Economics.

The wide range of estimates illustrates the considerable uncertainty that surrounds r*, both in the present context and historically. Moreover, while estimates generally trended down from the early 2000s to the late 2010s, recent developments have shown diverging movements. The VAR and more structural model-based estimates of r* do not lend themselves to a clear-cut conclusion at this stage. The consensus of market economists, however, seems in line with a view of no structural change affecting r*.

A different perspective is offered by a recent blog from researchers at the Federal Reserve Bank of New York, based on updates of a DSGE model and a structural time-series model developed in Del Negro et al. 2017) (see Baker et al., 2023). They distinguish between a short-run measure of r*, which is relevant for gauging how restrictive or expansionary current policy is, and a longer-run measure, which is relevant when assessing terminal rates. The short-run measure is very volatile and moves with cyclical factors, being low during recessions and high when the economy is booming. The long-run measure, on the other hand, is smoother and corresponds more closely to the estimates from the time-series model and the ones reported in Figure 42, as well as the measure published by authors themselves. Their time-series model suggests that r* fell by just over 10 basis points between 4Q19 to 2Q23, while the short-run DGSE estimate indicates an increase of 50 basis points and implies a short-run value for r* of 2.2% in 4Q23, easing to 1.8%

in 4Q24, 1.5% in 4Q25 and 1.3% in 4Q26. The associated nominal values are 5.9% in 4Q23, 4.3% in 4Q24, 3.7% in 4Q25 and 3.4% in 4Q26. Comparing these estimates to the current mid-point of 5.38% for the Fed Funds target range would suggest that further policy tightening might be required for the United States.

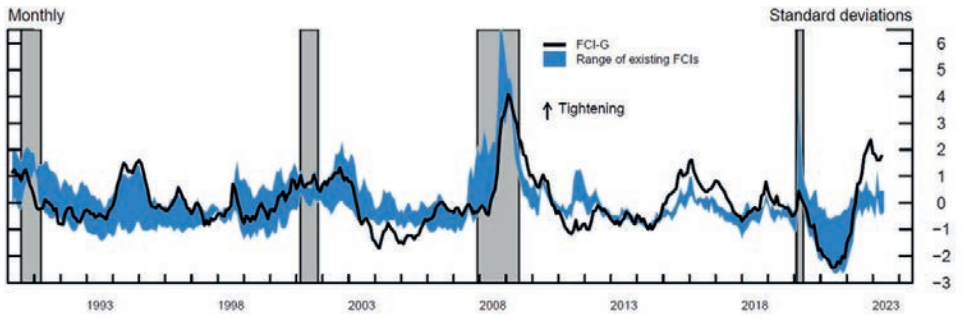
As discussed in the Baker et al. (2023), what the model characterises as 'financial shocks' are a key driver of these trends. More precisely, these reflect the behaviour of corporate credit spreads, which have remained surprisingly narrow, despite the rapid Federal Reserve rate hikes and the recent banking turmoil.

Indeed, credit spreads have remained surprisingly low, notwithstanding a significant tightening of bank lending conditions (see Chapter 1). Obviously, this interpretation is very much model-driven. Indeed, credit spreads have remained surprisingly low, notwithstanding a significant tightening of bank lending conditions (see Chapter 1). One interpretation is that the narrow credit spreads, picked up by the model's 'financial shock', reflect the low risk of business failures. Business failures have been exceptionally low during the pandemic, in sharp contrast to previous recessions, owing largely to exceptional fiscal support. More recently, however, there has been an uptick in business failures. If this trend is confirmed, as fiscal support wanes, a deterioration of credit spreads is likely to follow.

A new measure of financial conditions constructed by Ajello et al. (2023) at the Federal Reserve bank of New York can shed some further light on this point. The authors propose a broad financial conditions index relative to future economic growth (FCI-G), shown in Figure 44.

The most recent reading of the FCI-G suggests that financial conditions are exerting a drag of around 0.75 percentage points on GDP over the coming year. As illustrated in Figure 44, a comparison of the FCI-G with other popular indicators of financial conditions show a more significant tightening. The multipliers applied to estimate the FCI-G are derived from the FRB/US model and show that the present financial conditions are exerting a tightening effect, above levels seen after the global financial crisis. Combined with signs that inflation and growth are both slowing, this would argue for prudence in further tightening.

FIGURE 44 **US LONG-TERM CONSENSUS (6-10 YEARS)**

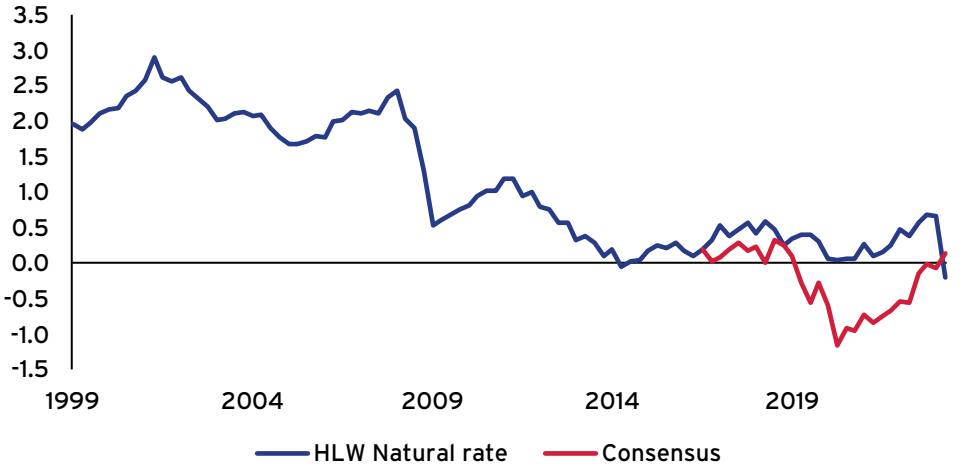


Source: Ajello et al. (2023).

4.2 ESTIMATES OF R* IN THE EURO AREA

Turning to the euro area, estimates of r* are less widely available and the ECB does not produce a dot plot. Figure 45 shows the HLW estimate of longer-run r* for the euro area plotted against our proxy of the consensus view of market participants (three-month interest rates six to ten years ahead).

FIGURE 45 **EURO AREA R* ESTIMATES**

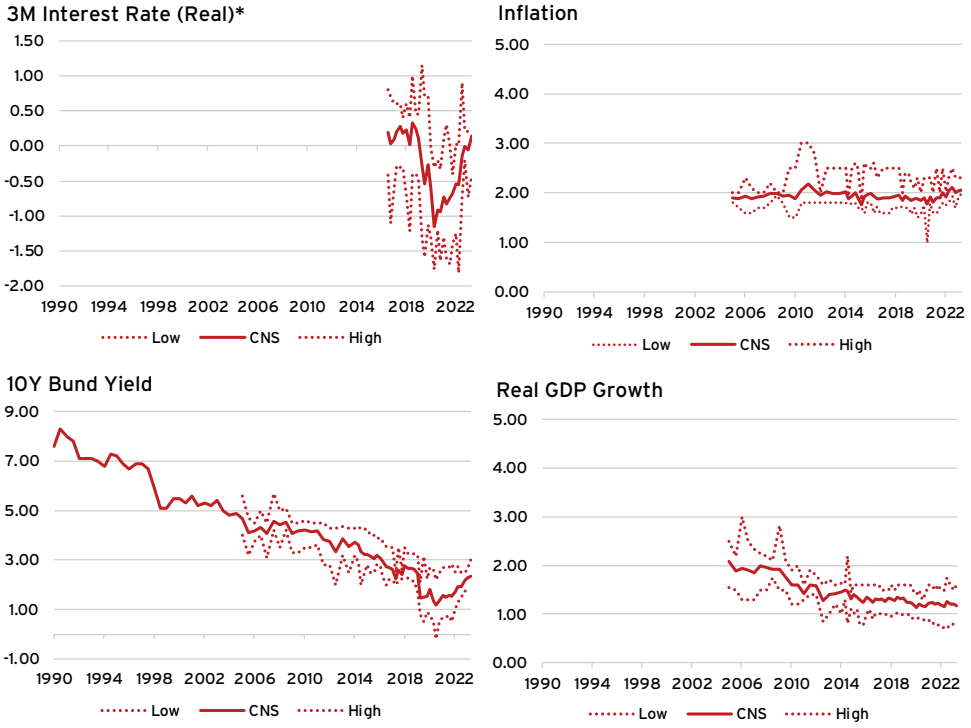


Source: Consensus Economics and Bloomberg.

The gap between the two measures is striking. The updated estimates from the HLW model that account for the pandemic effects saw a significant upward adjustment. While we observe an increase in both measures from their pandemic lows, there is little to suggest a major structural shift.

As was the case for the United States, a quick look at the longer-term market economists' consensus data, illustrated in Figure 46, suggests that inflation expectations have remained well anchored, while there seem to be a fairly stable outlook on potential growth trend. Given that euro area financial conditions have mirrored those of the United States, with tight credit spreads and robust equity markets, alternative r* estimates that attribute a greater role to financial conditions might show somewhat higher estimates for the euro area.

FIGURE 46 **EURO AREA LONG-TERM CONSENSUS (6-10 YEARS)**



Source: Consensus Economics.

However, looking at the leading indicators of the euro area credit cycle, including various indices from the banks' lending survey and credit growth, all seem to point to a significant tightening. As was the case for the United States, euro area indicators point to risks from further monetary policy tightening.

To sum up, the analysis in this chapter has shown that since the pandemic there has been increased dispersion of r* estimates. The consensus view of market economists, however, points to a low value of r*, which implies that the stance of monetary policy in both the United States and the euro area is currently very tight. This raises the question of why the US economy has been so resilient. One answer is fiscal support, which may itself have contributed to accommodative financial conditions (e.g., narrowing credit spreads and reducing business failures). However, fiscal support is now unwinding.

Another explanation is that inflation is driven down by the easing in supply restrictions while the real economy has not felt the full effect of monetary policy tightening owing to lags in transmission. Both explanations argue for prudence in further monetary policy tightening, not least given that leading indicators point to a slowdown on both sides of the Atlantic, particularly in the euro area.[5]

5 An explanation solely based on financial resilience is hard to reconcile with differences between the United States and the euro area, given that euro area indicators are pointing to increased recession risks.

Discussions

INFLATION AND MONETARY POLICY AFTER VOLCKER (CHAPTERS 1 AND 2)

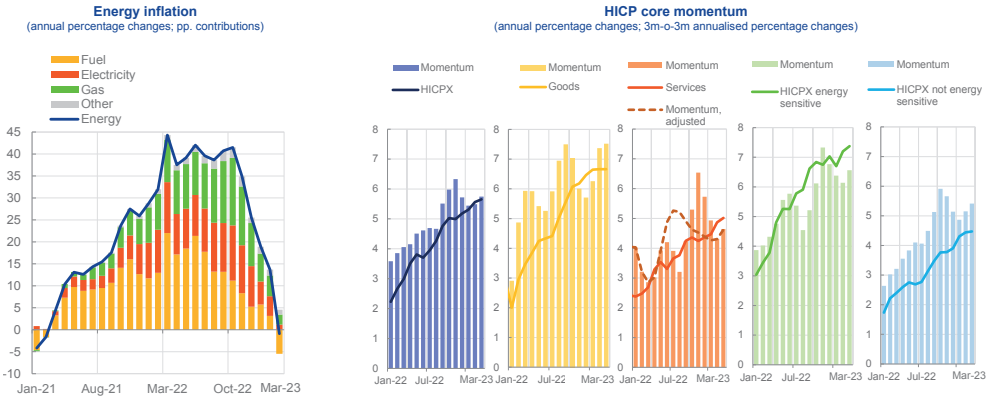
Chaired by Nathan Sussman, Geneva Graduate Institute

Frank Smets, *European Central Bank*

I am pleased to participate in this year's discussion of the Geneva Report on inflation, which I found to be insightful. Please note that the views expressed here are my own and do not necessarily represent those of the ECB or its Governing Council.

The authors of the report take a clear stance on what the main drivers of inflation in the euro area are. Primarily, they emphasise the role of relative price shocks, particularly the energy price shock, and its propagation to core inflation through supply chain linkages. This emphasis is well taken. As depicted in the left panel of Figure 1, the euro area has recently experienced very high energy price inflation of 40–45%. However, this is primarily a shock to the level of energy prices, as by now, energy price inflation is back to its initial state. In the right panel, you see the progression of core inflation in the euro area, which is still increasing. The contribution of energy price inflation to core inflation is illustrated in the last two graphs in the right panel of Figure 1, which decompose core inflation into energy-sensitive goods and services and those that do not rely much on energy. Inflation in energy-sensitive sectors has increased significantly more than in the non-energy sensitive sectors and continues to rise, despite some indicators of a plateauing momentum. This decomposition underscores the importance of the cascading of the energy price shock to other sectors through the input/output structure of the economy.

FIGURE 1 **ENERGY PRICES AND INFLATION**

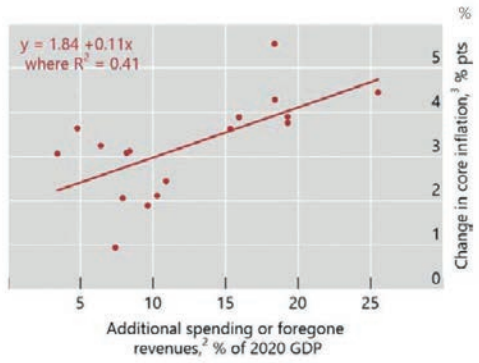


Sources: Eurostat, ECB calculations

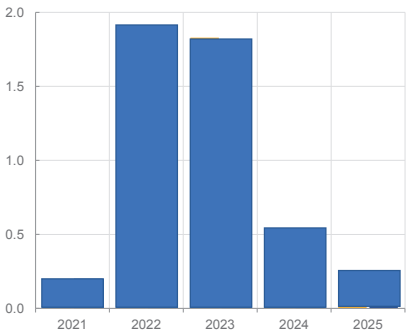
However, there are also other elements at play that are not discussed extensively in the report. One such factor is fiscal policy in conjunction with pandemic-induced supply chain bottlenecks. The left panel of Figure 2 shows a clear positive correlation between changes in public spending across advanced economies and the changes in core inflation. The primarily demand-driven impact of fiscal policy on inflation may have different implications for the persistence of inflation and the appropriate monetary policy stance.

FIGURE 2 **THE ROLE OF FISCAL POLICY IN DRIVING CORE INFLATION**

Fiscal policy support pushed up core inflation …



…. and continues to be substantial in the euro area (as percentage of GDP).



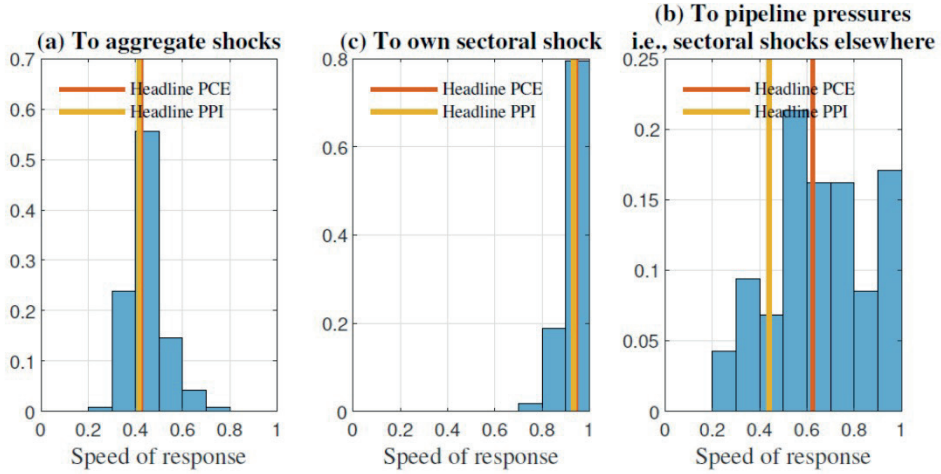
Source: Carstens (2023), ECB.

The right panel presents some Eurosystem estimates of the fiscal stimulus in response to the energy crisis and the cost-of-living crisis in the euro area. It reveals that the fiscal stimulus, which was around 2% in 2022, did not see a significant reduction this year. This persistently high stimulus is a concern to the extent that it will contribute to the pick-up in inflation in 2024 and thereby complicate the central bank's task of restoring inflation to 2%. Notably, this stimulus is nearly double what we saw during the global financial crisis, marking it as a significant economic impulse.

I appreciate the vector autoregression (VAR) evidence presented in the report, which shows convincingly the persistent and often delayed effects of relative price shocks on the various components of headline inflation as well as the more delayed response in the euro area versus the US. To show the importance of those shocks for inflation, a VAR decomposition showing how much current core inflation is driven by energy price shocks would be useful. This would provide an indication of whether we also need to be concerned about other aspects. The VAR model could also be used to predict the peak in core inflation and its potential decline. One variable that I found lacking in the analysis is wages. Given the concern about price-wage spirals, it would be beneficial to also evaluate the historical contribution of relative price shocks to wages.

The VAR analysis is informative and highlights the danger of underestimating the cascading effects of sectoral shocks and the resulting persistence. In my own research (Smets and Tielens, 2023), my co-author and I provide a complementary analysis using a structural dynamic stochastic general equilibrium (DSGE) model with a comprehensive input-output structure, sectoral heterogeneity, and price stickiness to decompose US sectoral and aggregate inflation series into three components. The first component is driven by aggregate shocks, the second by the sector-specific shocks, and the third by pipeline pressures (i.e., the effect of other sector shocks through the supply chains and the input-output structure). Once we segregate these components, we can better understand their contribution to the persistence of aggregate inflation. The left panel of Figure 3 indicates, as is already known, that aggregate shocks have persistent effects on inflation.

FIGURE 3 **PIPELINE PRESSURES AND INFLATION DYNAMICS**



Source: Smets and Tielsen (2023).

In contrast, own sector-specific shocks, such as the current energy one, primarily induce a short-term, non-persistent effect on inflation that usually dissipates within one quarter, as shown in the centre panel. Finally, the right panel describes the persistence in sectoral prices arising from pipeline pressures coming from other sectors. The aggregate inflation persistence coming from pipeline pressures is very similar to that coming from aggregate shocks, but the distribution across sectors is significantly wider and relates to a sector's position in the input-output structure, the stickiness of input sector prices, and the elasticity of substitution. If there is considerable substitution between your inputs, a shock in one sector may be less impactful as you substitute for another sector. This heterogeneity is consistent with the larger cross-sectoral variation the authors find in response to an energy shock relative to an aggregate demand shock such as to monetary policy.

Finally, the authors propose two broad interpretations of high core inflation. First, it could be a reflection of a natural relative price adjustment needed for efficient resource reallocation in response to shocks hitting different sectors with varying intensity. This interpretation suggests that a degree of inflation is beneficial and will naturally fade as the shock unwinds, requiring less policy tightening. The second interpretation posits that the uptick in core inflation is symptomatic of the de-anchoring of inflation expectations or second-round effects involving a wage–profit spiral. Under this interpretation, inflation will likely be more persistent and may not automatically revert to target, necessitating tighter monetary and fiscal policy. The authors lean towards the first, more dovish interpretation, arguing that economic activity, particularly in the euro area, has not yet fully recovered, that medium-term inflation expectations appear to be still anchored, and that wage dynamics, while catching up, do not seem entirely out of line. While I am sympathetic to this view, it is important to be aware of the risk of nonlinearities and multiple equilibria. In a recent paper, Borio et al. (2023) suggest that the risk of transitioning to a higher, more persistent inflation regime increases the longer inflation remains elevated. Particularly in an interconnected economy where various sectors and wage-price setters are linked, there is a coordination issue. If market actors begin to anticipate higher inflation, this could trigger a swift change.

Ultimately, what is crucial is the behaviour of inflation expectations, as they will determine whether there is a high risk of transitioning into a more inflationary regime. While the authors highlight that medium-term inflation expectations still seem anchored, especially for the euro area, it is important to consider what really informs price and wage setting now. It is not so much about where inflation will be five years from now, but rather what inflation will look like next year or in the next two years. These shorter-term expectations remain somewhat elevated, though they are coming down quite rapidly. This aligns with the authors' narrative, but monitoring these indicators will be crucial moving forward.

Oscar Arce, *European Central Bank*

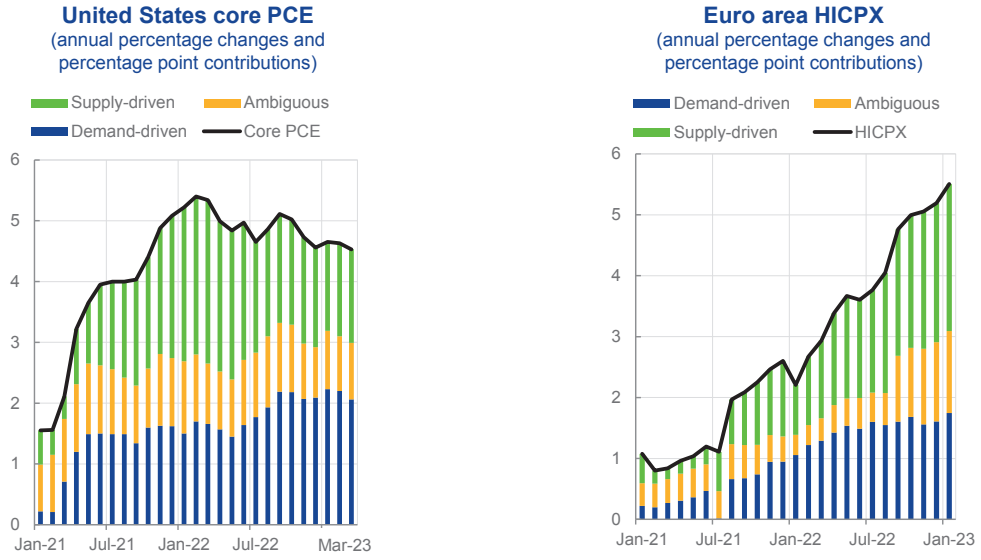
I am grateful to the organisers for inviting me to discuss this fascinating report. It is thought-provoking and filled with robust analysis, which I genuinely enjoyed reading. In terms of the narrative, I concur with the presented stance. The explanation for the inflation surge is clearly and neatly outlined in the report, particularly emphasising the differences between the euro area and the United States, and the significant asymmetric impact of the terms of trade shock. This understanding is key for interpreting the scenarios on both sides of the Atlantic. However, as time progresses, I perceive these differences are gradually blurring, a point I intend to elaborate on later.

In considering the implications for monetary policy, had I seen your latest version and your slides, I might have titled my slides "Can we afford to be patient?". Theoretically, there are compelling arguments for a degree of patience. The analytical foundation for this position is robust. However, in practice, given the complexity of the factors involved, I argue that as policymakers, we cannot afford to be overly patient in adjusting our monetary policy. The report suggests that we should not be surprised by some inflation as the shock should

trigger a sectoral reallocation process. Furthermore, it proposes that we could afford a bit more patience because central bankers have amassed considerable credibility, especially seen in the stability of medium-term inflation expectations. However, I would argue that while this accumulated credibility has been crucial to controlling inflation, it is not sufficient. More importantly, this credibility is not a static asset; we must continually invest in it. Despite the sharp increase in inflation in the euro area, similar to the United States, medium-term inflation expectations remain remarkably stable at around 2%, regardless of whether you measure them through surveys or market financial indicators. This stability, even amid significant positive surprises in inflation, is a crucial element to highlight in the euro area's recent experience. I believe an essential ingredient behind this stability has been the rapid and strong response of our monetary policy. In nine months, we have increased interest rates by 375 basis points. Without this relatively forceful monetary policy response, inflation expectations might not have remained anchored. While this response is beneficial, it is by no means a guarantee that patience will be sufficient to bring inflation down.

Another point where perhaps I diverge from the report's tone is the relative emphasis on supply versus demand shocks in the euro area. In Figure 2, I have displayed the composition of demand and supply drivers of inflation in the United States (left panel) and the euro area (right panel), following Shapiro (2022). There are distinct differences. In the United States, demand factors played a robust role early in 2021, while in the euro area, inflation is primarily driven by supply. However, there is a significant and growing contribution from demand factors in the euro area.

FIGURE 1 **DEMAND AND SUPPLY DRIVERS OF INFLATION**



Sources: Haver Analytics, Eurostat, Shapiro (2022), ECB staff calculations

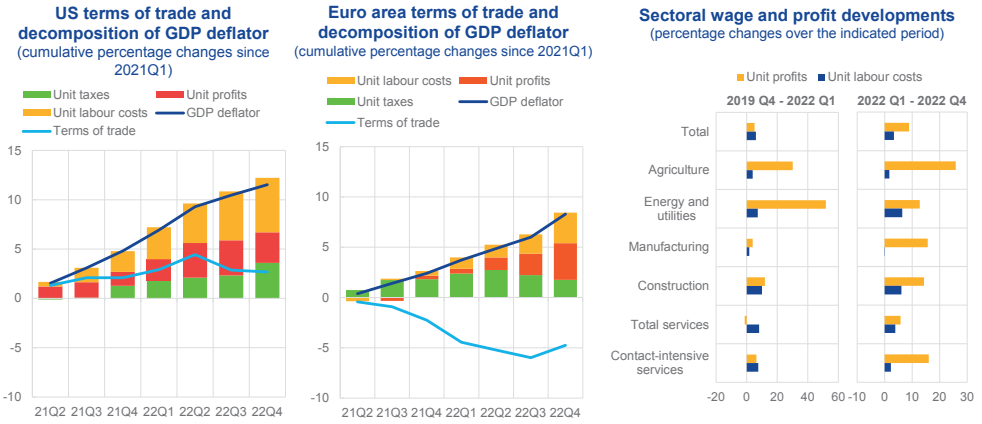
Initially, the acceleration in inflation was due to supply shocks, but as time progresses, demand is gaining momentum. We need to be mindful that although this negative supply shock initially dampens demand, mainly via reduced real incomes, as wages and profits adjust over time, it may push up aggregate nominal demand beyond a level consistent with medium-term price stability. This is tied to wages and labour market dynamics, as well as to profit margins, as Frank Smets mentioned.

Labour market tightness in the euro area is at a historical high, whether we are looking at the job vacancy rate or the unemployment rate. In March, we learned that the unemployment rate was 6.5%, the lowest in euro area history. The European Commission's indicators on labour shortages are also at record highs. Despite a strong labour supply recovery from pre-COVID levels (much faster than in the US), labour demand remains strong, causing wages to rise. This wage acceleration in the euro area, indicated by all measures of recent negotiated wage evolution, is a point of concern for us.

Let us discuss profits now. Wages are rising robustly, but these are negotiated wages based on new collective agreements, so the impact on the overall agreement stock is felt more gradually. Profits, however, are moving very quickly. Recently, particularly in the second half of last year, unit profits contributed more to domestic price pressure acceleration in the euro area than unit labour costs did, as measured by the GDP deflator (see the centre panel of Figure 2). This contrasts with the United States, where the profit margin pickup, while present, has not been as significant (see the left panel of Figure 2). This could be a reaction to imbalances in certain sectors – for instance, supply constraints due to bottlenecks while demand for services was recovering strongly following the economy reopening. Moreover, an atmosphere of high inflation, which to a large extent was triggered by an economy-wide common factor (i.e., energy) is facilitating significant price increases in many sectors (see the right panel of Figure 2). Therefore, along with recent wage acceleration, we are also somewhat concerned about this profit acceleration, which should ideally moderate down the road.

Of course, we are not perceiving a fully-fledged wage–price spiral in the euro area. However, there is an evolution of both wages and prices that is creating an element of upward pressure. This factor is also taken into account by policymakers when setting monetary policy. I found the comparison between the current episode and the 1970s in the report very interesting. While the focus was on the United States, similar results can be instructive for the euro area. There are clear differences between the two periods. In the 1970s, there was a fully-fledged wage–price spiral with a rapid and significant increase in unit labour costs. Currently, unit labour costs have increased but in a more modest way, and profits are contributing to domestic price pressures, though on a significantly lower scale than in the 1970s.

FIGURE 2 **SECTORAL SUPPLY-DEMAND IMBALANCES ARE FUELING UNIT PROFITS**



Sources: Haver Analytics, Eurostat, Shapiro (2022), ECB staff calculations.

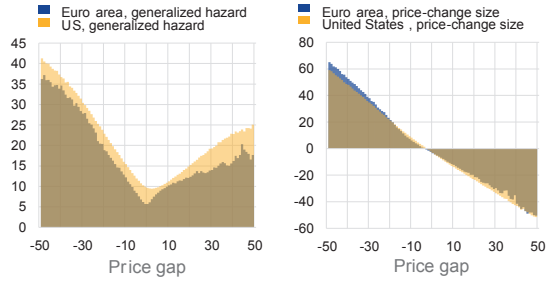
I also found the econometric exercise on Granger causality between headline and core inflation quite intriguing. While many of you are probably familiar with the ECB's reaction function that emphasises underlying inflation dynamics, the results of the exercise show that headline inflation Granger causes core inflation, but not vice versa. Based on these findings, the conclusion is that we may need to wait until headline inflation decreases, which is already happening, and observe its impact on core inflation. It is important to note that core inflation is likely still influenced by past energy price increases. Also, depending on the econometric specification, one may find that after the recent inflation surge, core inflation has some predictive power for headline inflation in the euro area, especially after controlling for energy costs.

In the report, the authors also mention the level of price rigidity in the euro area, which is considered higher than in the United States. However, recent research challenges this conclusion. Using PRISMA data, Karadi et al. (forthcoming) find that price determination is best characterised as state-contingent rather than time-contingent (see the left panel of Figure 3). This implies that pricing may be contingent on specific circumstances rather than fixed over time. Additionally, for the sample of supermarket data, it appears that the level of rigidity in the United States and the euro area nowadays is quite similar, challenging the previous asymmetry (see the right panel of Figure 3). This has implications for monetary policy analysis.

In conclusion, while some level of patience may be warranted, we cannot afford to be overly patient in the current circumstances.

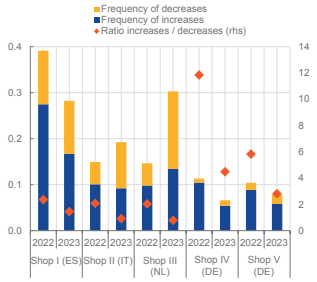
FIGURE 3 **STATE-DEPENDENT PRICE ADJUSTMENTS**

Price-age hazard and the size of non-zero price changes as a function of the price gap in supermarket scanner data



Monthly frequency of price adjustment in European online supermarkets

(share of increases and decreases, April 2022 and April 2023)



Sources: Karadi et al. (forthcoming), ECB staff calculations.

Floor discussion

Lucrezia Reichlin (London Business School) followed up on several comments from the discussants. She disagreed with the notion that real wages were picking up, stating that they had actually declined. She expressed concerns about the weakness in consumption and investment, suggesting that these indicators do not support the argument for a prevailing demand-driven narrative. She also acknowledged the pent-up demand resulting from the COVID-19 pandemic, but cautioned against attributing the current economic situation solely to a decline in potential output. She emphasised the signs of weaknesses building up and highlighted the potential for a substantial decline in economic activity. Additionally, she raised the point that monetary policy usually acts with a lag and that terms of trade shocks could have a negative impact on real income, particularly affecting the weakest sectors of society. Moving on to fiscal policy, Reichlin emphasised that fiscal policy has multiple objectives beyond inflation control and highlighted the supportive role of fiscal policy in 2021 and 2022 in preventing a larger hit to GDP. However, she expressed uncertainty about the future trajectory of fiscal policy, noting the potential for a slow consolidation and questioning the extent of support for aggregate demand. Regarding expectations, she commented on the credibility bonus enjoyed by central banks, as inflation expectations have remained remarkably stable even when central bank responses were perceived as delayed. She cautioned against relying solely on short-term inflation expectations, as they are strongly correlated with headline inflation and oil prices. She highlighted the importance of central bank credibility, independence, and communication in shaping inflation expectations. Reichlin acknowledged the possibility of a switch to a high inflation expectation regime if high inflation persists, but expressed reservations about cross-country studies as a basis for understanding inflation dynamics.

Stefan Gerlach (EFG Bank) questioned whether core inflation data are contaminated by second-round effects and whether there should be a measure of core inflation that is not affected by these effects. He pondered the possibility of having two measures of core inflation. Gerlach also directed a question to Oscar Arce regarding wages. He noted that wage increases tend to be higher when people change jobs, and he inquired about the extent to which the current pickup in wages is due to labour reallocation versus persistent demand for labour.

Charles Goodhart (LSE) followed-up on the example of the comparison with 1970s and highlighted the differing outcomes of countries such as Germany and Switzerland compared to the UK and Italy. He questioned why this example was not mentioned in the report and emphasised the need to nuance the discussion around energy shocks, specifically highlighting the larger magnitude of the oil shock in the 1970s compared to the current situation. He also referenced the work of Benigno and Eggertsson (2023) on the surge of inflation in the 2020s and the return of a nonlinear Phillips curve, suggesting that there is a body of opinion supporting this view.

Lucrezia Reichlin addressed Gerlach's question on core inflation, mentioning her own econometric measure of 'clean core' inflation that is orthogonal to oil. She acknowledged the difference between this statistical measure and the core inflation used by central banks. Regarding Goodhart's comments on the 1970s, Reichlin highlighted the differences in the policy context, notably in credibility, during that period, contrasting it with the current environment. She emphasised the need for more economic history work to distinguish between the two episodes. She also acknowledged the puzzle of labour market tightness and real wages not increasing and expressed septicism about the nonlinear Phillips curve.

Oscar Arce (European Central Bank) briefly responded to Stefan Gerlach's question on wages, noting that wage dynamics have been driven by job-switchers in the United States, and to a lesser extent in the euro area. He acknowledged the acceleration of wages for job-switchers in the euro area until very recently, but with some signs of deceleration. Arce also addressed the issue of clean measures of core inflation, referring to the persistent and common component of inflation indicator (PCCI) for the euro area that controls for the indirect effects of energy costs, which has proven to be a strong predictor of headline inflation.

Nathan Sussman (Geneva Graduate Institute) referred to a recent paper of Autor et al. (2023) which suggests that most of the wage increases are occurring at the lower end of the labour market as a response to the layoffs and disappearance of service jobs during the pandemic. He mentioned that this phenomenon could be seen as both inflationary and potentially positive from another perspective.

Charles Wyplosz (Geneva Graduate Institute) expressed concern about using VAR models to explain recent events, given the unprecedented nature of the pandemic and its effects on the economy. He questioned the usefulness of extracting meaningful information from data that coincide with such extraordinary and unprecedented events.

Gianluca Benigno (University of Lausanne) made a suggestion to strengthen the hypothesis, recommending that the report also consider global supply chain pressures as a factor influencing inflation (Benigno et al., 2022). He also suggested distinguishing between the neutral stance of policy and the extent of tightening, as well as considering the implications of exchange rate fluctuations.

Lucrezia Reichlin responded to the comments. She clarified the approach used in the VAR analysis, explaining that it is an experimental exercise based on available data and past patterns of shocks and their effects. She acknowledged the need for caution and the possibility that the current situation may be different. Regarding global supply chain constraints, she agreed that more evidence should be included in the second version of the report. Reichlin also addressed the distinction between neutrality and tightening in monetary policy, and the role of the exchange rate mechanism, which is discussed in the model of the report. She emphasised the need to be cautious when considering financial effects and financial stability risks associated with tightening monetary policy.

Luigi Federico Signorini (Banca d'Italia) raised a potential pitfall in the analysis of profits and their role in the inflationary process, highlighting the reliance on profit shares as a measure that may be influenced by changes in intermediate costs relative to labour costs. He suggested that differences between the United States and Europe in the role of energy prices could explain disparities in profit shares, and announced a forthcoming discussion paper on the subject by Bank of Italy researchers.

Vitor Gaspar (International Monetary Fund) suggested considering financial effects and financial frictions, noting the possibility of financial instability risks associated with tightening monetary policy.

Nathan Sussman added a comment regarding the policy mix, referring to the work of Bruno and Sachs (1985) on stagflation. He suggested that fiscal policy should support real adjustments in the economy while monetary policy should focus on anchoring inflation expectations.

THE VIEW FROM THE MARKETS (CHAPTER 4)

Chaired by Nathan Sussman, Geneva Graduate Institute

Silvia Ardagna, *Barclays*

Thank you for inviting me to discuss this very interesting report. In my comments today, I would like to complement Michala's presentation by providing additional data on the euro area and the United Kingdom. Specifically, I will focus on selected risk and inflation expectations indicators to offer insights into the tightening conditions and the outlook for inflation in these regions.

Figures 1 and 2 display heat maps comparing, respectively, the tightening cycles in the euro area and the United Kingdom. While the timing of the cycles may vary, it is evident that both regions have experienced significant tightening. In the euro area, even Germany's conservative central bank has witnessed one of the tightest cycles in history. Similarly, the United Kingdom has seen a substantial cumulative change in the policy rate. It is important to note that the observed tightening in real terms may appear less significant due to high spot inflation driven by energy and base effects. However, considering inflation expectations, which are expected to moderate in the coming months, the cumulative tightening becomes more apparent.

FIGURE 1 **EURO AREA TIGHTENING CYCLE HEAT MAP**

			Duration	Policy rate		Real Policy rate - LW natural rate (EA)		2-year rate		10-year rate		Germany corporate bond rate / EA Composite	
				Cumulative	Per month	Cumulative	Per month	Cumulative	Per month	Cumulative	Per month	Cumulative	Per month
	Oct-1972	Jun-1973	9	4.00	0.44	1.50	0.17	2.84	0.32	1.77	0.20	2.50	0.28
	Mar-1979	Jun-1980	16	4.50	0.28	1.39	0.09	2.41	0.15	0.61	0.04	1.90	0.12
	Jun-1984	Jul-1984	2	0.50	0.25	1.22	0.61	0.20	0.10	-0.04	-0.02	0.00	0.00
Germany	Jul-1988	Nov-1989	17	3.50	0.21	1.74	0.10	2.81	0.17	0.46	0.03	1.00	0.06
	Feb-1991	Feb-1991	1	0.50	0.50	0.33	0.33	-0.36	-0.36	-0.30	-0.30	-0.20	-0.20
	Aug-1991	Jan-1992	6	1.50	0.25	-0.10	-0.02	-0.59	-0.10	-0.91	-0.15	-0.10	-0.02
	Jul-1992	Aug-1992	2	0.75	0.38	1.98	0.99	0.09	0.04	-0.05	-0.02	0.20	0.10
	Nov-1999	Oct-2000	12	2.25	0.19	0.89	0.07	1.10	0.09	-0.06	0.00	1.17	0.10
	Dec-2005	Jun-2007	19	2.00	0.11	1.99	0.10	1.72	0.09	1.13	0.06	1.47	0.08
Euro area	Jul-2008	Jul-2008	1	0.25	0.25	0.30	0.30	-0.11	-0.11	0.01	0.01	0.12	0.12
	Apr-2011	Jul-2011	4	0.50	0.13	0.62	0.15	1.33	0.33	0.11	0.03	0.26	0.07
	Jul-2022	Mar-2023	10	3.50	0.35	5.45	0.54	1.95	0.19	0.76	0.08		
	Mar-2023	Jul-2023	13	4.25	0.33	7.08	0.54						

Source: Bloomberg, Barclays Research

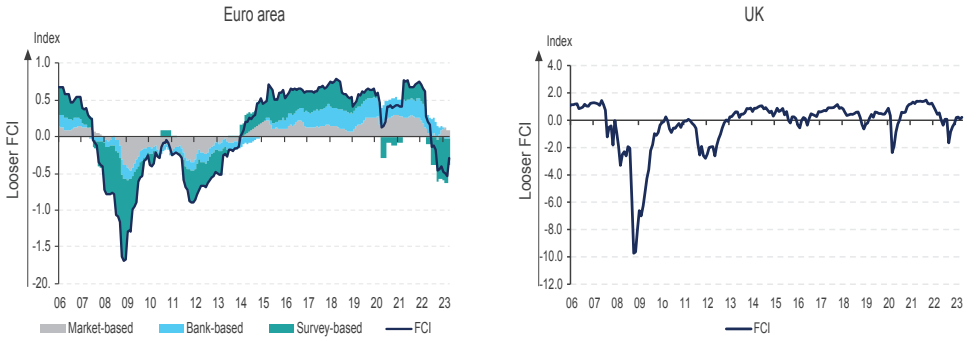
FIGURE 2 **UK TIGHTENING CYCLE HEAT MAP**

		Duration	Policy rate		Real Policy rate - LW natural rate (UK)		3m-year rate		10-year rate		20-year rate	
Start	End		Cumulative	Per month	Cumulative	Per month	Cumulative	Per month	Cumulative	Per month	Cumulative	Per month
Jun-1972	Jan-1973	8	3.91	0.49	2.27	0.28			1.03	0.13	-0.14	-0.02
Jul-1973	Dec-1973	6	5.31	0.89	4.11	0.69			2.25	0.38	1.41	0.24
May-1975	Nov-1975	7	1.97	0.28	-1.68	-0.24			0.33	0.05	-1.59	-0.23
Apr-1976	Nov-1976	8	5.87	0.73	12.36	1.54	6.12	0.76	1.29	0.16	1.37	0.17
Dec-1977	Dec-1977	1	1.73	1.73	2.62	2.62	1.46	1.46	-0.24	-0.24	-1.18	-1.18
Apr-1978	Feb-1979	11	7.13	0.65	6.43	0.58	6.47	0.59	2.06	0.19	0.41	0.04
Jun-1979	Dec-1979	7	5.00	0.71	-1.98	-0.28	5.00	0.71	2.74	0.39		
Aug-1981	Nov-1981	4	2.73	0.68	1.64	0.41	1.29	0.32	0.03	0.01		
Dec-1982	Feb-1983	3	1.74	0.58	2.68	0.89	1.95	0.65	0.68	0.23		
May-1984	Jul-1984	3	2.60	0.87	3.14	1.05	2.76	0.92	1.15	0.38		
Jan-1985	Feb-1985	2	4.38	2.19	3.54	1.77	4.03	2.02	0.54	0.27		
Jan-1986	Feb-1986	2	1.00	0.50	1.43	0.72	0.92	0.46	-0.04	-0.02		
Oct-1986	Nov-1986	2	1.00	0.50	0.27	0.14	1.06	0.53	0.85	0.43	0.48	0.24
Aug-1987	Sep-1987	2	1.00	0.50	1.24	0.62	0.95	0.47	0.78	0.39	0.50	0.25
Feb-1988	Feb-1988	1	0.50	0.50	0.51	0.51	0.33	0.33	-0.23	-0.23	-0.17	-0.17
Jun-1988	Dec-1988	7	5.25	0.75	2.44	0.35	5.11	0.73	0.35	0.05	-0.39	-0.06
May-1989	Nov-1989	7	2.00	0.29	2.43	0.35	1.97	0.28	0.31	0.04	0.46	0.07
Sep-1994	Mar-1995	7	1.50	0.21	0.31	0.04	1.15	0.16	-0.09	-0.01	0.00	0.00
Oct-1996	Nov-1996	2	0.25	0.13	0.01	0.00	0.52	0.26	-0.30	-0.15	-0.46	-0.23
May-1997	Dec-1997	8	1.31	0.16	1.08	0.13	1.27	0.16	-1.36	-0.17	-1.56	-0.20
Jun-1998	Jul-1998	2	0.25	0.13	0.70	0.35	0.32	0.16	-0.08	-0.04	-0.22	-0.11
Sep-1999	Mar-2000	7	1.00	0.14	1.71	0.24	0.97	0.14	-0.11	-0.02	-0.28	-0.04
Nov-2003	Sep-2004	11	1.25	0.11	1.82	0.17	1.14	0.10	-0.02	0.00	-0.17	-0.02
Aug-2006	Aug-2007	13	1.25	0.10	1.78	0.14	1.68	0.13	0.46	0.04	0.28	0.02
Nov-2017	Dec-2017	2	0.25	0.13	0.27	0.14	0.14	0.07	-0.12	-0.06	-0.14	-0.07
Aug-2018	Sep-2018	2	0.25	0.13	0.37	0.18	0.05	0.03	0.13	0.07	0.16	0.08
Dec-2021	Mar-2023	16	3.98	0.25	-0.95	-0.06	4.19	0.26	2.56	0.16	2.84	0.18
Dec-2021	Jun-2023	19	4.65	0.24	6.59	0.35						

Source: Bloomberg, Barclays Research

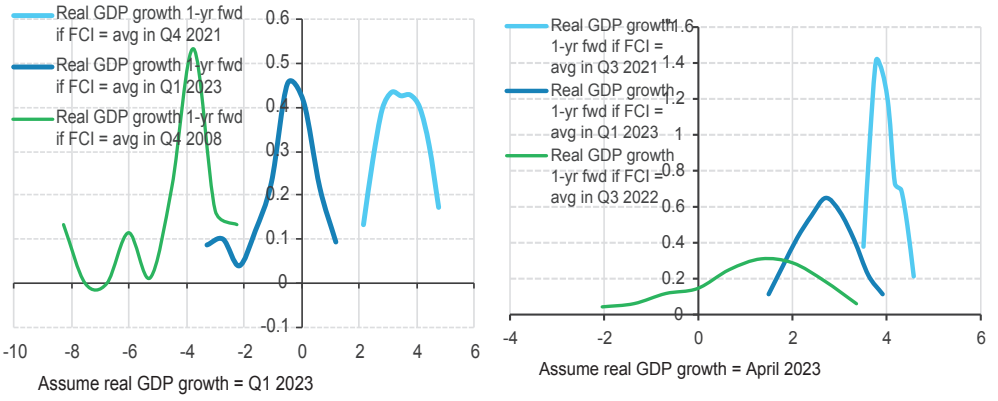
Moving on to financial conditions, indicators reveal considerable tightening in both the euro area and the United Kingdom. In the euro area, several financial condition indices, including market-based indicators and the bank lending survey, suggest a tightness comparable to that seen in 2012 (see Figure 3). Bank lending survey data, in particular, contribute significantly to this tightening. It is widely acknowledged that financial conditions have a strong link to economic growth, and I would like to highlight this connection using a simple approach. By applying a quantile regression model to forward growth predictions based on current growth and financial conditions, we can simulate growth distributions under different financial condition scenarios. These simulations illustrate the increased risk of recession associated with tighter financial conditions (see Figure 4).

FIGURE 3 **FINANCIAL CONDITIONS INDICES: A SIZABLE TIGHTENING**



Source: Bloomberg, Barclays Research

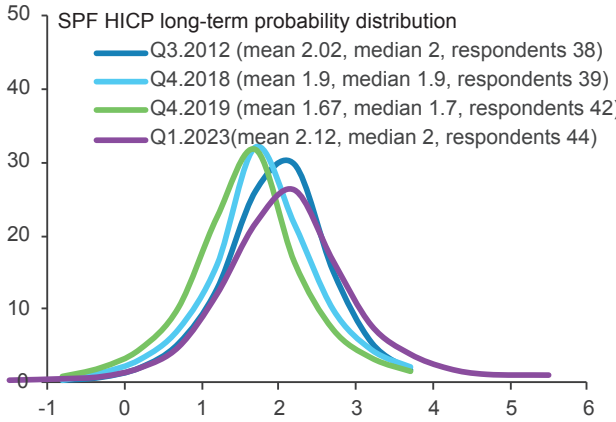
FIGURE 4 **GROWTH AT RISK UNDER DIFFERENT FINANCIAL CONDITIONS SCENARIOS**



Source: European Central Bank, Bank of England, Barclays Research

Shifting our focus to inflation expectations, I would like to present insights from the survey of professional forecasters conducted by the ECB. Examining the distribution of long-term inflation expectations, we find that, despite some mass in the right tail indicating higher inflation expectations from a few respondents, the overall distribution remains well-anchored (see Figure 5). This suggests that long-term inflation expectations are still firmly grounded. Similar patterns can be observed in the UK, where the market's inflation predictions have exhibited comparable characteristics.

FIGURE 5 **EURO AREA SURVEY OF PROFESSIONAL FORECASTERS' LONG-TERM INFLATION EXPECTATIONS**

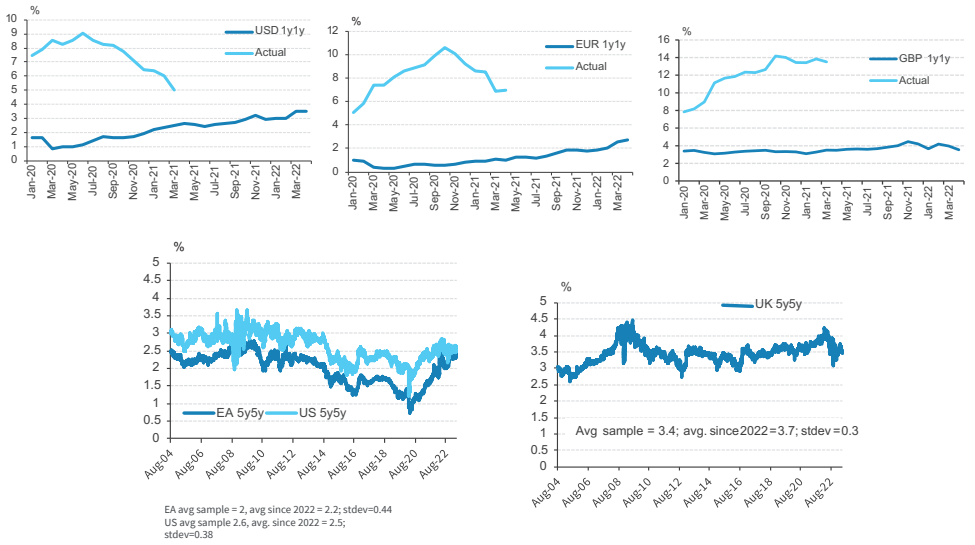


Source: European Central Bank, Barclays Research

Lastly, I would like to touch upon inflation swaps. While various factors influence these swaps, they serve as market indicators for inflation expectations. Comparing actual inflation terms with market pricing from a year ago, we observe significant deviations. However, when looking at the five-year, five-year inflation swap, a widely used metric, the volatility surrounding the values has remained relatively stable. This supports the notion that central bank credibility remains intact.

In conclusion, I concur with the main message of the chapter. There is a notable degree of tightening in the pipeline for the euro area and the United Kingdom. Long-term inflation expectations, as observed through survey data and market pricing, appear to remain anchored. However, it is essential to interpret these measures cautiously, as they may also reflect global inflation trends rather than specific regional considerations. Additionally, market-based measures, such as inflation swaps, can be influenced by various factors, including trade strategies and pricing differentials.

FIGURE 6 **THE INFLATION SWAP MARKET DID NOT PRICE THE SURGE IN INFLATION**



Source: Bloomberg, Barclays Research

Gertjan Vlieghe, *Element Capital*

I am honoured to be invited to this conference and to have the opportunity to discuss this very interesting report. The report raises pertinent questions about the extent of tightening, inflation expectations, and inflation risk premia. The authors provide a comprehensive analysis by examining a broad range of tightening measures, financial conditions indices, yield curve slopes, and bank lending surveys, as well as various price pressure indicators. Their conclusion, which I agree with, is that these measures indicate tightening financial conditions and easing price pressures. However, I would like to offer a slightly different perspective on a few aspects.

To begin, when assessing the degree of monetary policy tightening, I prefer to start with simpler approaches rather than delving into an extensive array of indicators, which, while informative, may not capture the essence of the matter. Real interest rates, in my view, are at the heart of assessing tightening. Specifically, I would like to focus on market measures of real interest rates, derived from nominal swaps and inflation swaps. While these measures are not perfect, they do possess internal consistency as they reflect the views of market participants on both nominal rate expectations and inflation expectations. Figure 1 displays the two-year real rates for the US and the euro area. As of a few days ago, the US two-year real rate stood at approximately 1.6%, signifying an increase of around 190 basis points from the pre-pandemic level of just below zero and a rise of roughly 460 basis points from the pandemic-induced low of minus 3%. The euro area two-year real rate was

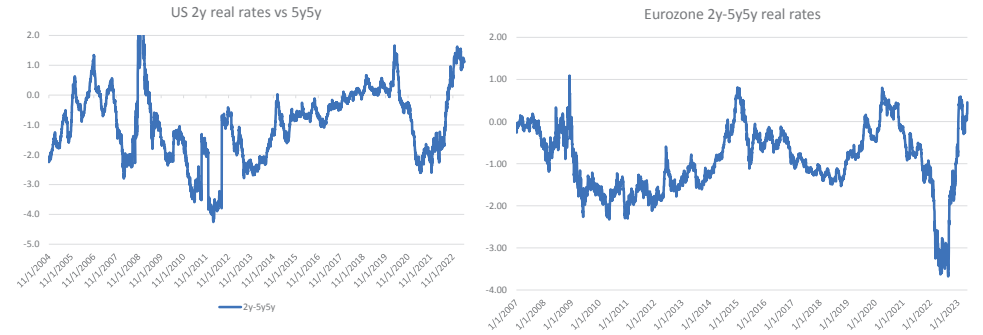
approximately 0.7%, demonstrating a comparable increase of around 220 basis points from the pre-pandemic level of minus 1.5% and a surge of roughly 470 basis points from the pandemic-induced low of minus 4%. Thus, both regions have experienced substantial real tightening.

FIGURE 1 **MARKET MEASURES OF REAL INTEREST RATES**

Source: Bloomberg, Element Capital calculations

While these measures lack an extensive historical perspective, it is worth considering that the market perceives a significant decline in the neutral rate over a longer time horizon. Consequently, a more precise measure of the tightness of monetary policy entails comparing current real interest rates to the market's medium-term view, which serves as an approximation of the market's perception of the neutral rate. Figure 2 provides this perspective, illustrating the difference between the two-year real rates and the five-year, five-year real rates. In the United States, this yields a restrictive monetary policy of approximately 110 basis points, approaching previous cyclical highs over a relatively short sample period dating back to the mid-2000s. Notably, the market's view aligns with the Federal Open Market Committee's announcement and the consensus forecast. Similarly, the euro area reveals a slightly less restrictive monetary policy of around 50 basis points, approaching previous cyclical highs. It is noteworthy that the market's view of the neutral rate in the euro area is only marginally lower than in the United States, contrary to popular belief.

FIGURE 2 **MARKET MEASURES OF REAL INTEREST RATES RELATIVE TO NEUTRAL**



Source: Bloomberg, Element Capital calculations

Highlighting the significance of real interest rates is crucial since they represent the fundamental building block in modern economic models. However, it is essential to challenge the flawed arguments that nominal policy rates below the rate of inflation necessarily implies loose policy. Such reasoning is misleading and confuses ex-ante and ex-post real interest rates. Moreover, it is disheartening to witness prominent figures continuously referring to Taylor rules in a manner that encourages this flawed thinking. Taylor rules, often formulated as the nominal rate minus the current rate of inflation, fail to account for forward-looking inflation expectations. Hence, I urge for a more nuanced understanding that acknowledges the important point made in the report: good policy demands a delicate balancing act between the risks of doing too little and doing too much.

Turning to inflation expectations and inflation risk premia, I agree with the report's assertion that inflation expectations in financial markets remain well anchored. The evidence presented is convincing and reflects positively on the effectiveness of central bank frameworks, communications, and actions thus far. However, I propose that inferences about risk premia should be confined to broad and persistent trends, rather than focusing on high-frequency variations observed in the chart. It is important to differentiate between inflation risk and inflation risk premia, as well as real rate risk and real term premia. Risk is about uncertain future outturns, while risk premium is about covariance with consumption. The measures presented in Figure 47 of the report somewhat mix risk and risk premia, warranting caution in drawing definitive conclusions. For instance, during the late 1990s, when inflation was persistently low due to globalisation-induced disinflation, inflation term premia were negative and real term premia were remarkably high, according to the estimates presented in the report. These large estimates should give us pause for thought, suggesting that our approach may require adjustment. If true inflation expectations held by financial market participants are lower than the consensus inflation forecasts, our estimates of inflation risk premia will be biased downwards and estimates of real term premia will be biased upwards. Turning to recent market dynamics, with rapidly rising nominal rates and resilient economies, there is a reasonable probability that the neutral rate perceived by market participants may be slightly higher than previously anticipated, leading to an upward bias in measured real term premia in the report. Consequently, we need to carefully evaluate consensus measures of inflation expectations and interest rate expectations, as they may not fully reflect market expectations. It is important to distinguish between risk and premia and consider the broader context when analysing term premia and their correlations with other relevant factors.

In conclusion, real rates have undergone significant increases, offering a reliable measure of tightening. Therefore, it would be prudent to prioritise their assessment before exploring a wide range of indicators related to tightening, increased recession risk, and reduced price pressures. Moreover, it is crucial to acknowledge that the existence of recession risk or declining price pressures during a tightening cycle does not provide definitive evidence of good or bad policy. Typically, tightening occurs in response to rising

price pressures, and it is only after the completion of the tightening cycle that we observe a subsequent decline in price pressures. It is wrong to imply that tightening until price pressures normalise, or a recession occurs, indicates effective policy, and Chapter 4 of the report should make that clearer. Rather, policymakers must strike a balance between the risk of doing too little and doing too much, utilising models and judgement to guide their decisions. Market expectations, as demonstrated by well-anchored inflation expectations, play a vital role in this process. While further exploration of inflation expectations and risk premia is intriguing, caution should be exercised in drawing strong conclusions from high frequency variations. In particular, we must be mindful of distinguishing between risk and premia and consider the broader trends and contexts in which they emerge.

Floor discussion

Amlan Roy (Global Macro Demographics and London School of Economics) referred to the Fed's use of the Index of Common Inflation Expectations based on 21 indicators, which the author could explore in the report. Additionally, he proposed extending the VAR analysis to incorporate a Bayesian VAR with priors on inflation expectations for forecasting purposes. Lastly, Amlan Roy suggested that more work is needed in understanding r*, notably in considering factors like globalisation and demographics and in looking at the whole moment generating function of R.

Angel Ubide (Citadel) pointed out that there is a possibility that short-term r* rates may have experienced a transitory yet persistent increase during the tightening cycle, which contrasts with the assumption made in the report that r* has remained unchanged. If this alternative scenario were true, it would suggest a lesser degree of tightening. He suggested re-estimating the r* measure to account for post-COVID periods. Second, he questioned the asymmetry in the approach of focusing on spot inflation, noting that policymakers often wait to tighten until they see signs of inflation, but the same approach is not always applied in reverse. He acknowledged the challenges of forecasting inflation amidst numerous shocks, where the noise outweighs the signal. He recommended that the report could benefit from further discussion on this issue.

Charles Wyplosz questioned the absence of discussion on quantitative easing (QE) or quantitative tightening (QT) in the report, emphasising the importance of understanding their effects on inflation.

Nathan Sussman suggested looking directly at the Treasury Inflation-Protected Securities (TIPS) market and utilising information from it to infer risk premia.

Michala Marcussen (Société Générale) responded by stating that some indicators in the report are derived from the TIPS market, but cautioned that there are challenges associated with inflation tools in the market due to liquidity and trading particularities. She emphasised the use of a wide range of indicators to compensate for the absence of a single perfect indicator. She also acknowledged the suggestion to explore broader inflation

expectations indicators from the Fed and emphasised the report's intention to keep it simple and transparent. Marcussen acknowledged the ongoing research on R* and agreed that more work is needed. She also mentioned the challenges of forecasting inflation with numerous shocks and the need for a discussion on symmetry and confidence.

Lucrezia Reichlin acknowledged that any estimates of R* are subject to uncertainty and emphasised the report's aim of incorporating different metrics to provide a comprehensive analysis. She also mentioned that the language used in the report could be made more precise regarding the type of tightening being discussed. Regarding QE, she noted that it was the principal instrument at the lower bound but emphasied that short-term interest rates are now the principal instrument for tightening.

A STYLISED MODEL OF INFLATION (CHAPTER 3)

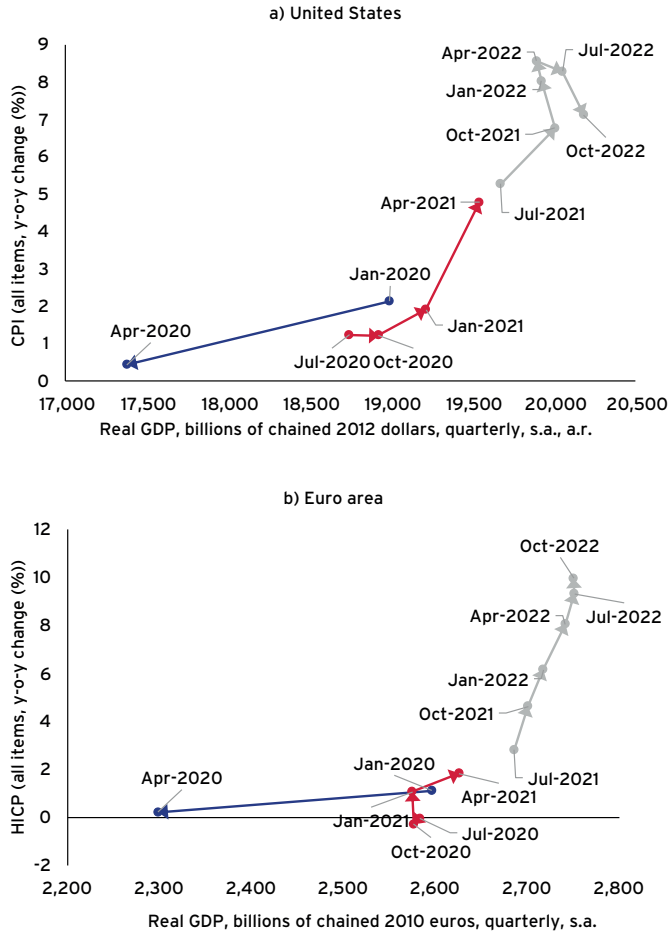
Chaired by Signe Krogstrup, Danmarks Nationalbank

Giancarlo Corsetti, *European University Institute*
This is a very interesting and provocative report on current inflation dynamics. In my discussion, I will provide context regarding inflation crises and economic modelling, and how the model presented in the report fits into the current discussions. Then, I will discuss the model itself. Finally, I will have three comments: the first on relative prices and markups; the second on distribution, aggregate demand, and welfare (consumption); and the third on distribution conflicts. These three issues complicate the analysis, although they do not necessarily go against the core message of the report.

On inflation crises and economic modelling, my comments draw on the fifth Future of Banking report (Corsetti et al., 2023) , which argues that to understand the inflation crisis in the post-pandemic period, we need to look at it through three perspectives, namely, aggregate, sector (granular), and international.

The aggregate perspective can be captured by using Phillips curves. The red arrows in Figure 1 (the United States on the left, the euro area on the right panel) represent the pandemic period, the blue arrows represent the reopening period, and the green arrows are non-linear effects during the post-pandemic period. The non-linearity is arguably due to significant stimulus jointly delivered by fiscal and monetary policies that is still very much present at the aggregate level.

FIGURE 1 **AGGREGATE PERSPECTIVE: A PHILLIPS CURVE**



Source: Corsetti et al. (2023)

The sector perspective calls attention to the large shift from demand for services to demand for goods in the first phase of the pandemic. One could tell a story that the demand for tradable goods accumulated across countries and created a global driver of inflation – goods are tradable, hence their price dynamic tends to align across borders. In addition, goods production is relatively intensive in energy and commodities. Hence, sector excess demand translated into commodity inflation that, in turn, was experienced by the other sectors (services) as a cost-push shock. This was then exacerbated by the energy crisis prompted by the war in Ukraine. The labour market was initially tight in the goods sector, slack in the service sector. A key development was the passage from sectoral heterogenous to overall aggregate labour market tightness over time, driven by a lasting strong aggregate stimulus.

Of course, there are some important caveats regarding this strong demand. The heterogeneity in demand/tightness across sectors and markets has been quite persistent, as a by-product of pandemic-induced behaviour and policies. The labour market is far from homogenous. Second, experience suggests that a tight labour market can quickly deteriorate when recessionary impulses kick in.

The international perspective emphasises the energy crisis and the divide that this created across regions, especially Europe versus the United States. When we look at the terms of trade of these two regions, they diverged during the crisis, partly explained by energy prices and partly by the strengthening of the US dollar.

The model in the report somehow combines these three perspectives. It starts from the international perspective, and then articulates a sector perspective, to draw conclusion about aggregate demand policies.

In a nutshell, the model consists of upstream and downstream sectors. The upstream sector produces manufacturing goods using labour and oil. These goods are priced based on wages, oil prices and a markup. The downstream sector produces services using manufacturing goods and labour. Downstream services prices are based on goods prices, wages and a markup.The model is closed by observing that the prices of goods and services drive wages. Goods prices are directly impacted by oil prices. Services prices are indirectly – and more gradually – affected by oil prices through increases in goods prices and wages. How energy shocks drive prices and wages in the economy depend on differences in the degree of stickiness of prices across sectors, indexation and substitutability between oil and labour, which can be used to map out differences between the United States and the euro area.

Moving on to my three comments, the first being on relative prices and markups, I would suggest that an important topic of discussion in the chapter is the response of sectoral markups following the energy shock. Perhaps the authors could elaborate on it. As a model suggestion, the structure of the model resembles Corsetti et al. (2010), where we study how prices and markups move when upstream and downstream firms are integrated through real links in a two-layer network structure and both have sticky prices (i.e., there are multiple layers of price rigidities). We have some interesting results that I think are worth discussing here. First, suppose prices are flexible. We show that upstream firms *reduce* markups when their marginal costs increase. The reason is that, whenever upstream firms change their prices, the prices downstream also change, but by a lower fraction. But the higher the upstream price goes, the greater its weight in the downstream price becomes, and hence the more a rise in prices crowds out the final demand. In jargon, the price elasticity of the demand for the upstream firms is decreasing in the price they charge. In terms of the model of the report, if all prices were flexible, an increase in energy prices would be in part compensated by a downward adjustment of markups in the goods sector.

Now introduce price rigidities, assuming that firms only reset prices randomly (Calvo), and abstract from the input-output real links for the moment. Here the markup moves in the opposite direction: upstream firms that can reset their prices raise their markups when their marginal costs increase. The reason is that (because of sticky prices) a large fraction of downstream firms will not adjust their prices. The upstream firms are therefore less worried about the effect of their pricing decision on final demand. They actually take advantage of price stickiness downstream to eat up some of the markups of downstream firms. In terms of the model in the report, this means that, with price stickiness, not only is the pass through of energy shocks into inflation (obviously) slower, but also the energy shock may create a strong divergence in sectoral prices along the adjustment path.

The second comment is on distribution, aggregate demand, and welfare (consumption). Price movements create income and substitution effects. In a country that imports oil, an increase in oil prices means that the value of its output falls – i.e., there is an adverse terms of trade effect that reduces real incomes. We know from the open-economy literature that when (i) there is not enough financial insurance in the economy, and (ii) oil and manufacturing goods are complements in production, terms of trade movements can be significant – generating sizeable losses in real income. In the case of heterogenous agents, those who do not participate in the financial market are impacted particularly hard by this income effect, which further complicates the trade-off between unemployment and inflation faced by central banks.

My third and last comment is on distribution conflicts. A traditional argument, recently revamped by Lorenzoni and Werning (2023), is that disagreement/conflict on long-run relative prices and wages may aggravate inflation–employment trade-offs for central banks and result in persistent inflation. This wage–price scenario is obviously a risk that weighs against the call for patience in the report. However, it would be also interesting to explore how, in a 'disagreement/conflict' scenario, fiscal policy could end up playing a role in redistribution, with implications also for deficits and thus the macro stance. There is an inherent tension between the two: redistribution may reduce the conflict hence the pressure on inflation; deficit financing may instead create inflationary pressures.

In conclusion, the report builds a case for patience. My comments have tried to address some missing elements in the model, but they do not go against the core message of the report. I understand that a key objection to the message of 'patience' in the report is that central bankers should have been paying more attention to labour market tightness, and that we cannot count on fiscal policy for taming inflation. My reactions to those objections would be that labour market tightness may come down quite fast, and that countries not be able to (and arguably should not) keep fiscal policy loose for much longer.

Argia Sbordone, *Federal Reserve Bank of New York*

Many thanks to the organisers for inviting me to discuss this intriguing report. Before I start my discussion, I should say that my comments are my own thoughts and do not represent the views of either the Federal Reserve Bank of New York or the Federal Reserve System.

The report's empirical analysis discussed in the morning shows rich dynamic heterogeneity in inflation across countries and across sectors. The report presents two alternative explanations for inflation persistence and its different sectoral incidence, explores two sets of policy recommendations and puts them forth for discussion. The first alternative argues in favour of pure persistence and second-round effects. Under this interpretation, policymakers should be worried because in this scenario when prices increase, wage increases follow and then inflation expectations increase. The second explanation of inflation persistence sees it instead as a natural effect of adjustments in relative prices, a necessary process after the economy is hit by uneven shocks.

To sort these explanations, the report presents a model that is simple but has all the key ingredients to characterise heterogeneity in inflation. I will first recap the key results of the chapter and then offer a few comments – some of them echoing remarks already made during the day – on the extent to which the report could be the whole 'story' of the post-pandemic inflation. Finally, I will present some insights from complementary analysis of sectoral inflation done with colleagues at the Federal Bank of New York.

A structural model that seeks to interpret the uneven and persistent post-pandemic inflation seen both in Europe and the United States needs to incorporate a number of features. It needs a sectoral dimension to generate heterogeneity in the responses to shocks, and it needs appropriate inertia to support persistence – the inertia being either in the form of nominal rigidities or in some ad hoc adaptive adjustment. The more general questions then concern whether movements in relative prices can generate aggregate inflation, what the transmission channels are, what determines persistence, and lastly, how monetary policy affects transmission and persistence.

For a brief recap, the model has two sectors, only one of which uses oil as a direct input. The model delivers two sectoral Phillips curves, where sectoral inflation depends on sectoral real marginal costs. Nominal marginal costs depend on production costs, and prices may adjust at different speeds in the two sectors. An oil shock has an uneven impact – hitting first the sector using oil and only later the other sector. Monetary policy plays a key role in the transmission of the oil shock to the two sectors. In the baseline results, a monetary policy that does not let unemployment fall to a level that is consistent with the flex-price equilibrium results in more persistent inflation. By contrast, a tighter monetary policy controls inflation faster.

A few key factors drive persistence in the model. The first is the degree of substitutability between factors of production: the less substitutable the factors are in the sector hit by the shock, the more prices in the sector increase. The second is the degree of price stickiness (although it is not clear to me how stickiness is represented in the model). Third is the degree of indexation. The report presents cases of less or more inertia, and everything goes according to intuition: more inertia slows down the adjustment and generates higher persistence. Fourth is the degree of substitutability between goods in consumption. Finally, there is the extent of policy accommodation: with tighter monetary policy, employment falls to the level of the flex-price equilibrium and inflation is rapidly controlled, but at the cost of a fall in aggregate consumption (clearly not the outcome preferred by the authors). To sum up, a policy that targets zero output gap may be too expansionary.

I very much like the simplicity of the model, but I should note a few elements that are either missing altogether or are underdiscussed. To start with, labour supply is not easily reallocated and, particularly in the United States, has in fact been in decline. A phenomenon labelled the 'Great Resignation' reflects how difficult it has been to bring workers back to work. Also related to labour supply, the pandemic has brought some changes in consumer preferences as well as elements of deglobalisation. Considering the role of inflation expectations, both short- and long-run, could further enrich the model.

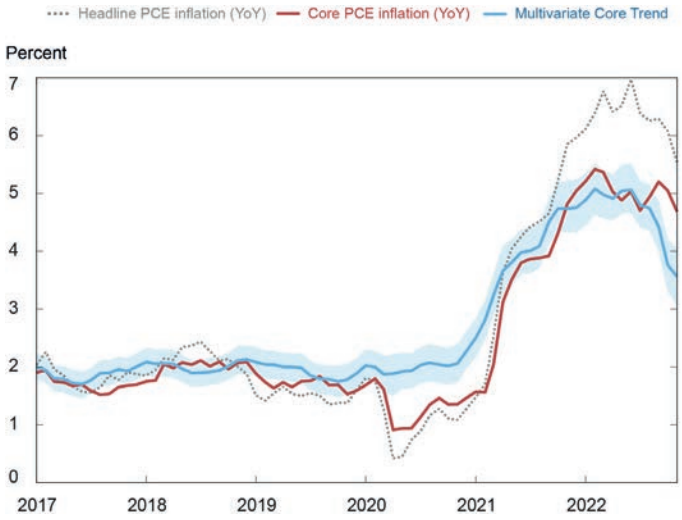
One more quibble is with the role assigned by the report to demand and supply in determining inflation persistence. The oil shock is treated in the model as a supply shock that directly affects production costs and generates overall inflation persistence. However, the oil shock may also generate compositional shifts in the demand, which could be an important element in explaining inflation persistence. Recent work by Di Giovanni et al. (2022) shows that one half and one third of observed inflation in the euro area and in the United States, respectively, is explained by sectoral shortages, with the remaining part explained by demand.

On substitutability between labour and oil, I would like to point out that an increase in the disutility of work may impair this substitutability, and possibly generate increase in persistence. Again, the work by Di Giovanni et al. (2022) shows that when you have multiple shocks, such as a disutility of work shock in addition to an oil shock, their effects compound, making inflation higher and more persistent.

Finally, I would like to mention, related to this report, the empirical analysis of inflation persistence at sectoral level done with colleagues at the New York Fed. In Almuzara et al. (2023), we look at the 17 main sectors in the Personal Consumption Expenditure (PCE) price index to disentangle persistent and transitory components in inflation. We model the persistent component of each sectoral inflation as the sum of a common trend across all sectors and sector-specific trends. We then construct a measure that we call

multivariate core trend (MCT) inflation, which is a share-weighted aggregation of the persistent components of the core sectors. As you can see in Figure 1, this measure was stable during 2020, increased earlier than the standard core measure in 2021, and is now declining after peaking in mid-2022.

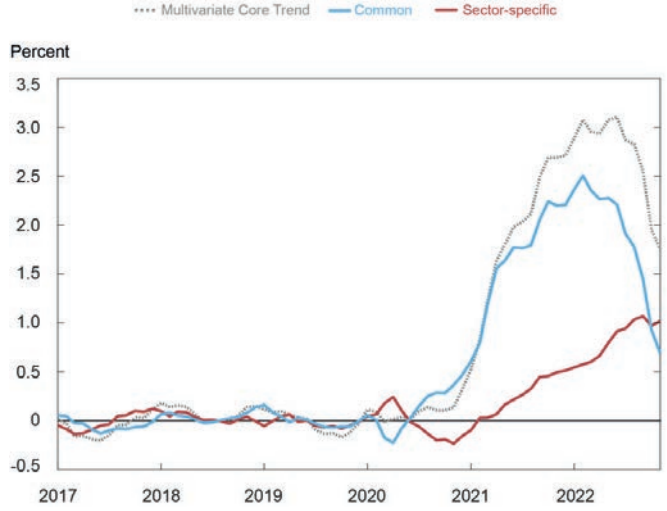
FIGURE 1 **PCE AND MULTIVARIATE CORE TREND INFLATION**



Note: Shaded area is a 68% probability band.
Source: Almuzara et al. (2023)

Furthermore, decomposing the increase in trend relative to the pre-pandemic average into the contribution of the common and the sector-specific components, as reported in Figure 2, shows that spikes and moderation are mainly broad-based.

FIGURE 2 **INFLATION TREND DECOMPOSITION: COMMON VERSUS SECTOR-SPECIFIC**



Source: Almuzara et al. (2023)

Even more telling is the trend in the three main sectors on which the inflation debate has focused in the United States: core goods and core services excluding housing have contributed in a similar way to the pick-up and then the decline of inflation persistence, while housing inflation is largely idiosyncratic and has until recently been a main source of persistence.

To conclude, this is a very good and interesting model: it contains the core elements of the post-pandemic inflation and can still be enriched in a few dimensions.

Veronica Guerrieri, *Chicago Booth*
Thanks to Giancarlo Corsetti and Argia Sbordone; these were all great comments. To Giancarlo Corsetti, I think it is very interesting to look at the marketing implications, and we are going to look back at Corsetti et al. (2010) and think more about that. If we have heterogeneous agents, we can think about income effects already in a closed economy, and this could generate amplification through the income impact on consumption. Also, fiscal policy is a very interesting point to think about. Currently, the model abstracts from the cost of the loss in output and consumption that comes from the tightening, as well as from the cost of keeping inflation low. But these costs feed back into fiscal policy, which impacts inflation, too.

Argia Sbordone emphasised very interesting possible extensions of the model. She correctly pointed out that labour is not fully mobile. I have already worked on labour reallocation in Guerrieri et al. (2021), and I think we should introduce a discussion about it in our report. Relative price movements are even more important when costs associated with labour reallocation are considered in the model. If there are costs of labour reallocation, we want to try to induce the right reallocation as fast as possible, because other frictions in the labour market slow down reallocation anyways. The comments on how substitutability between oil and labour may be impaired, and how it would amplify the effects, are all very relevant.

It is important to mention that we do not claim that our model explains the whole story of what is happening with inflation. There are certainly other shocks that influence inflation dynamics. However, what we would like to emphasise in the report is that supply shocks that hit sectors differently were particularly large and predominant in recent years. These shocks generated a need for price movements. We are not saying we need to be expansionary; we are just emphasising the cost of slowing down the relocation across sectors, which is needed in the economy.

Lastly, it was very interesting to look at the decomposition of common and sector-specific factors affecting inflation persistence – and we should look more carefully into Almuzara et al. (2023). On the other hand, in Guerrieri et al. (forthcoming), we show that supply shocks also generate endogenously demand effects, especially in the presence of incomplete markets. The model we present in this report does not incorporate these elements, but it would be interesting to expand it in that direction.

Further thoughts

Signe Krogstrup, *Danmarks Nationalbank*

This is a very interesting and timely report. We are coming out of a long period of below-target inflation and interest rates that have been hovering around the effective lower bound.

For the last three years, we have been hit by a series of shocks that have jointly led to high inflation. This is the first time that we have high inflation across the United States and Europe since the 1980s. Since then, the structures of our economies have changed. There is hence a lot to learn about inflation dynamics and the required monetary policy responses. We are learning all this in real time. For this reason, there is a high premium on any type of analysis of the most recent data, as well as on modelling the dynamics. This report is an important contribution, and I enjoyed reading it. It makes specifically sense to focus on multisector modelling and look at the transmission through relative prices.

From a central bank point of view, how should monetary policy respond given what we have learned from this report? I have three remarks relating to this.

First, the report makes a case that supply shocks are driving inflation, and if you accept that premise, the report is very useful. But as a policymaker you need to factor in all the other shocks that are obviously also affecting the economy, and which differ significantly across the United States and Europe. For instance, we have talked about fiscal policy, which has played a big role and has been used very differently across the United States and Europe. This raises the question of fiscal-monetary coordination, and this issue is not a distraction. For instance, we have a peg in Denmark, and consequently our central bank advises the government on fiscal policy with a view to business cycle management. We have been recommending tight fiscal policy.

Energy price shocks also differ significantly across the United States and Europe. The oil price is very important in the United States, but I think we should be careful to say that it is exogenous, and that it is a shock. In fact, much of oil price developments we have seen over the last few years have been demand driven. In Europe, we have experienced a gas price shock, which was arguably a supply shock.

Wage setting – and what is going on in labour markets – is also an important factor. There are different reasons across countries for tightness in labour markets, but there is indeed tightness in largely all countries. In Denmark, we are expecting wage growth rates to go up significantly this and next years, and that is going to keep core inflation up.

Second, the report makes clear how monetary policy is also risk management. We are in a situation where there is significant uncertainty and there are risks on both sides. If supply shocks are transitory and inflation expectations are well anchored, then we risk overtightening. That is very much the assessment of the report, and it argues that we need to be patient. However, there is also a risk that inflation expectations de-anchor, that we are too patient.

I very much agree that data currently suggest that inflation expectations are anchored. However, measures of expectations are imperfect. We should be careful to rely on them uncritically.

The interesting question is not *whether* inflation expectations are anchored, but *why* they are anchored. It is surprising how inflation expectations have been anchored throughout this period. What could make them de-anchor? If we were to accept that inflation expectations are anchored, and consequently we tighten less, will we be able to see when expectations de-anchor? Will we be able to respond accordingly well in advance? Those are some of the concerns of central banks that we need to discuss.

Third, as the point was made this morning, if we tighten until inflation comes back to target, it is already too much. But it was also suggested this morning that we have to wait until we see the 'whites of the eyes' of inflation. If we are tightening too much now, when do we know when to stop? Do we need to see the white of the eyes? Or do we trust our analysis and our models, which in fact did not help us much in the last few years? It would be interesting to discuss whether the model and analysis presented in the report are able to give us any insight into these questions. Along the same lines, if we are tightening too much, will we be able to respond in advance or to respond early enough to undo and prevent the worst outcome of an overtightening? That would certainly depend on monetary policy slack, and on what stance we are in.

Lucrezia Reichlin, *London Business School*
Thank you very much for these very thoughtful remarks. I agree that supply shocks are not the only story. It is a story, but a story that has been overlooked – and the idea of the report is to emphasise that story. Many papers that analyse inflation make a sharp distinction between supply and demand forces. But as Veronica Guerrieri explained previously, when there are complementarities and heterogeneity across sectors, it becomes very difficult to separate these forces. Therefore, more than the separation between supply and demand, we should try to understand the complementarities and the amplification mechanisms. We have already underlined some mechanisms in the paper, but our discussants also highlighted other interesting ones. I think those are important suggestions to where the analytical work in central banking should go.

Is oil exogeneous? Of course it is not. But, as we discussed in the morning, our VAR analysis is an experiment using oil shocks based on supply surprises, which are identified from OPEC announcement using high-frequency data. This is the best effort you can make to identify an exogenous shock. We are not saying that this is the whole story about oil, but we are saying that if we could identify an exogenous oil shock, this is the kind of heterogeneity and lead-lag relationship that you would see.

On wages, the comment about Denmark is very interesting, and everybody worries about second-round effects. If we look at the data in the United States and in Europe, we have a stronger wage second round effect in the United States than in Europe, but still more persistence in Europe compared to the United States. In a way, wages cannot be the whole story, otherwise, if they were the main driver, then we should have observed the opposite.

On anchoring of inflation expectations, and why they are so anchored, the truth is that we know very little about inflation expectations formation. Again, a very important area for future research.

Lastly, on the question about when we know that is time to stop tightening, we are trying to find metrics to understand how big is the reallocation effect that the model emphasises. Ideally, we could have a kind of a real-time metric that we could use for policy. So far, we have a simple model that illustrates a mechanism – but the point is well taken.

Veronica Guerrieri, *Chicago Booth*
Just a quick comment on wage growth, although not emphasised in the presentation, wages play a role in the transmission mechanism of inflation in the model through marginal costs. When oil prices hit one sector, then wages increase as well, and this increase is transmitted to the other sector with some lags, and so forth. We have fully flexible wages in the model; therefore, this force is very small. It is clearly important to think about wage-price spirals, and they are relevant. We could easily add a third sector that produces work and strengthen the persistence of inflation even more. However, I agree that the more relevant story is around anchoring of inflation expectations, and on that, Lucrezia Reichlin has already commented.

FLOOR DISCUSSION (ALL CHAPTERS)

Alexander Swoboda (Geneva Graduate institute) concurred with Signe Krogstrup's remarks on the importance of knowing why expectations are anchored. However, he raised the question of what really matters – inflation expectations or the realisation of those expectations. Also, to what extent can realisations influence the way expectations are formed? Swoboda also commented on the relevance for modelling of who is forming those inflation expectations and for what purpose. Lastly, he briefly touched on how adaptive expectations can be rational or irrational depending on circumstances and the importance of distributional considerations, since individuals possibly behave differently depending on their credit constraints, including with regards to wage bargaining.

Jeronimo Zettelmeyer (Bruegel) mentioned that there is presumably evidence of de-anchoring in past episodes. The question is then whether past evidence can provide insight on what de-anchoring looks like – a sharp switch or a slow gradual process? In his view, if we observe a slow gradual process, it makes more sense to stop tightening and if we see some de-anchoring, resume tightening.

Lucrezia Reichlin stressed that although in the 1980s and 1990s inflation expectations were likely more volatile, since the 2000s they have been very well anchored – and if anything, they moved with the probability of recession. Indeed, it is not possible to completely exclude the possibility that at some point de-anchoring will happen, but the authors did not see that happening it in the data. With regards to whether we could expect gradual or sharp de-anchoring, she argued that more work must be done. On one hand, there is evidence of a gradual anchoring of expectation in the post-Volcker years. On the other hand, there are also high inflationary episodes, particularly in emerging market economies, in which expectations are sharply adjusted.

Angel Ubide suggested looking at the de-anchoring of inflation expectations during 2015 to 2019 using five-year, five-year breakeven, both in the United States and in the euro area, and discuss whether there was an urgency at the time to correct de-anchoring, and how that episode relates to what we are seeing now. He also echoed Alexander Swoboda's remarks about what inflation expectations really are – for many, it is a very abstract concept, and what economic agents are really concerned about is pricing expectations of companies, especially for the one year ahead.

Michala Marcussen added to the de-anchoring discussion, reminding the audience that inflation targeting is a rather new phenomenon. Therefore, what had we de-anchored from in the past? She also emphasised the importance of paying attention at the inflation term premia, which now are not moving. If suddenly there are significant shifts in inflation term premia, that should be a warning sign of de-anchoring.

Marcussen also picked up on Signe Krogstrup's remarks about when should we undo tightening monetary policy. She suggested that financial condition risks determine the feasibility of monetary actions. If we have a classic credit tightening, which may lead to some banks facing liquidity issues, the central bank can always step in and provide liquidity support. Thus, in this case, it is manageable to correct overtightening. However, when those liquidity issues become solvency ones, then it could be already too late. Therefore, balancing inflation, output and financial risks is extremely important.

Thomas Harr (Dansmark Nationalbank) inquired whether it is really possible to see in the data that the energy shocks create inflation persistence. He illustrated his point by arguing that data on the euro area and on Denmark show that the indirect effects of energy are about to fade. He underscored that his question was not about second-round

effects such wages, but rather about indirect effects. Moreover, he also commented about the difference in timing of when the energy shock hit the United States and the euro area – in practical terms, it might not be that in the euro area there is more inflation persistence, but just that the shock hit it later.

Lorenzo Codogno (London School of Economics) weighed in on the discussion, arguing that supply shocks are not equal. Even within energy supply shocks, gas and oil shocks are not comparable because their substitution effect is very different – which means they impact sectors in different way. Also, he suggested that the magnitude of the effect might allow for different monetary responses. If the magnitude of the shock is negligible, monetary policy would not be changed, but if sizable, probably yes.

Lucrezia Reichlin argued that the VAR analysis provides evidence of inflation persistence in response to identified oil shocks – a persistence that is stronger than the persistence generated by monetary shocks. In fact, even when oil shocks fade, persistence lives on, which can also be seen in the data. With regards to differences between oil and gas shocks, although it is true that they are not the same thing, the authors needed identified shocks to run their empirical analysis. They take the identified oil shocks as a proxy for shocks that could generate an uneven response across sectors.

Veronica Guerrieri explained that the use of OPEC announcements as surprise shocks in their empirical analysis ensures that the difference in the inflation persistence seen in their impulse responses are not due to the difference in timing of when energy shocks hit the United States and the euro area.

Jeronimo Zettelmeyer provided further insight, suggesting that even if increases in energy prices were endogenous to US dynamics, such as expansionary fiscal policy or higher demand for manufactured goods, that should not change the analysis from the perspective of Europe.

Thomas Harr alluded to the discussions in the morning on how a monetary policy shock seems to be more homogenous compared to an energy shock. However, he reminded the audience that this time monetary tightening has been very synchronised, which is maybe creating a more direct link between energy and monetary policy.

Lucrezia Reichlin explained that there are still differences in the inflation dynamics depending on the origin of the shocks. The authors observed some heterogeneity in the impulse responses when shocks were originated by monetary policy, which could be credited to the fact that oil prices also respond to monetary policies, but clearly oil shocks generate more heterogeneity in the impulse responses.

Olivier Garnier (Bank of France) raised the question of whether adding consumption of energy by households could produce even greater inflation persistence because of second-round effects through wages.

Veronica Guerrieri explained that although in the current version of the model households do not consume energy, which could indeed produce higher inflation persistence – and is certainly an extension that should also be considered – the nominal wage channel is able to generate the amplification effects necessary to mimic the persistence seen in the data.

Oscar Arce encouraged work on extending the model to accommodate wage rigidities. He suggested emphasising more the asymmetry between rigidity of goods prices and rigidity of wages, particularly in the euro area. Arce stressed how wages in Europe are relatively rigid. Collective agreements typically last for a number of years, whereas profit margins can move very quickly. He also argued that a constant markup amid a large terms-of-trade cost-push shock could well be compatible with rising unit profits, fuelling in turn domestic price pressures, as evidenced in the euro area over the last few quarters.

Veronica Guerrieri agreed that wage rigidities are important and currently missing from the model, and that the authors could incorporate those rigidities in an extension. She stressed that the model was initially kept simple to purposedly highlight relative price adjustments.

Anthony Smouha (Atlanticomnium) echoed concerns about the model not incorporating wage dynamics. He inquired about the role of trade unions in pushing up prices and potentially generating a wage-price spiral.

Lucrezia Reichlin responded to the concern about wage-price spiral, arguing that although nominal wages may pick up, real wages remain really down.

Lorenzo Codogno urged the authors to discuss trade-offs and policy implications in the report. If the impact on the economy is heterogenous, and consequently affects relative price adjustments and the reallocation of resources within the economy, a more cautionary approach to monetary policy would be preferable. However, delaying tightening might have a cost in terms of long-term inflation. He urged the authors to discuss these trade-offs and policy implications in the report.

Binqi Liu (Nekton Capital) commented on differences between fiscal stimulus and inflation in China in comparison with what has been seen in the United States and in Europe. Despite large expansionary fiscal policies across all economies, China has not been facing significant inflationary pressures.

Michala Marcussen argued that although this was not the focus of the report, she sees a few important differences between China on one side and the United States and Europe on the other. First, the buffers during the pandemic were different. If we take a simple measure such as excess deposits, in China, these are mainly reallocation of savings from other types of assets. They are not excess deposits in the same way as we see them in the United States and in Europe, which are directly fuelling consumption. Second, China did not experience a pandemic housing boom, in contrast to its Western counterparts. In

fact, housing prices fell over the same period. Third, China was not doing the same type of credit accommodation over most of the pandemic. There are differences between the United States and Europe, but the two are more comparable. China is a very different story in terms of drivers.

Catherina Rho (European Commission) built on Signe Krogstrup's comments regarding coordination between fiscal and monetary policy, which is particularly relevant for the European Union, as expansionary fiscal policy for the post-pandemic recovery has not yet ended and there are – and will be more – efforts towards the green transition. She suggested that these could be an interesting topic for a follow-up report.

Michala Marcussen agreed with Catherina Rho's point about the need to look further into fiscal dynamics. She raised the question of whether we are now going to go through a period of debt deleveraging, or a new cycle of more fiscal expansion.

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Appendix

TABLE A1 **VARIABLES**

Series	Source Name	Source	Transf.	Rel. Importance (If Applicable)
United States				
Federal Funds Rate	Federal Funds Rate	FRED	Level	-
Spot Oil Price: WTI	Spot Oil Price: West Texas Intermediate	Haver Analytics	Level	-
Inflation Rate	CPI-U: All Items	Haver Analytics	YoY(%)	100
Core Inflation	CPI-U: All Items Less Food and Energy	Haver Analytics	YoY(%)	80.801
Food	CPI-U: Food at Home	Haver Analytics	YoY(%)	13.613
Tobacco and Smoking Products	CPI-U: Tobacco and Smoking Products	Haver Analytics	YoY(%)	0.608
Fuels	CPI-U: Fuels and Utilities	Haver Analytics	YoY(%)	4.38
Footwear	CPI-U: Footwear	Haver Analytics	YoY(%)	0.604
Household Furnishings	CPI-U: Household Furnishings and Operations	Haver Analytics	YoY(%)	4.682
Shelter	CPI-U: Shelter	Haver Analytics	YoY(%)	33.316
Medical Care Commodities	CPI-U: Medical Care Commodities	Haver Analytics	YoY(%)	1.508
Medical Care Services	CPI-U: Medical Care Services	Haver Analytics	YoY(%)	7.289
Men's and Boys' Apparel	CPI-U: Men's and Boys' Apparel	Haver Analytics	YoY(%)	0.666
Women's and Girls' Apparel	CPI-U: Women's and Girls' Apparel	Haver Analytics	YoY(%)	1.075
Photographic Equipment and Supplies	CPI-U: Photographic Equipment and Supplies	Haver Analytics	YoY(%)	0.071
Recreational Reading Materials	CPI-U: Recreational Reading Materials	Haver Analytics	YoY(%)	0.120
Public Transportation	CPI-U:Public Transportation	Haver Analytics	YoY(%)	1.105
Private Transportation	CPI-U: Private Transportation	Haver Analytics	YoY(%)	14.055
Housing	CPI-U: Housing	Haver Analytics	YoY(%)	42.385
Services	CPI-U: Services	Haver Analytics	YoY(%)	62.261
Durables	CPI-U: Durables	Haver Analytics	YoY(%)	10.942
Nondurables	CPI-U: Nondurables	Haver Analytics	YoY(%)	26.397
Commodities	CPI-U: Commodities	Haver Analytics	YoY(%)	37.339
Industrial Production	Industrial Production Index	Haver Analytics	$\log_*100$	-
Capacity Utilization	Capacity Utilization: Industry	Haver Analytics	(%)	-
Unemployment rate	Civilian Unemployment Rate: 16 yr +	Haver Analytics	(%)	-
Personal Income	U.S.: Personal Income	Haver Analytics	YoY(%)	-
Personal Consumption Expenditure	Personal Consumption Expenditure	FRED	YoY(%)	-
Euro area				
Euribor 3-month	Euribor 3-month - Historical close, average	ECB	Level	-

Series	Source Name	Source	Transf.	Rel. Importance (If Applicable)
Spot Oil Price: WTI	Spot Oil Price: West Texas Intermediate	Haver Analytics	Level	-
Inflation Rate	EA11-20: HICP: Monetary Union	Haver Analytics	YoY(%)	100
Core Inflation	EA11-20: HICP: Total ex Energy/Food/ Alcohol/Tobacco	Haver Analytics	YoY(%)	69.790
Food and Nonalcoholic Beverages	EA11-20: HICP: Food and Nonalcoholic Beverages	Haver Analytics	YoY(%)	16.100
Alcoholic Beverages and Tobacco	EA11-20: HICP: Alcoholic Beverages and Tobacco	Haver Analytics	YoY(%)	3.800
Transport	EA11-20: HICP: Transport	Haver Analytics	YoY(%)	15.000
Housing, Water, Elect, Gas, Oth Fuels	EA11-20: HICP: Housing, Water, Elect, Gas, Oth Fuels	Haver Analytics	YoY(%)	15.200
Furnishings, HH Equip, Maintenance	EA11-20: HICP: Furnishings, HH Equip/ Maintenance	Haver Analytics	YoY(%)	6.800
Health	EA11-20: HICP: Health	Haver Analytics	YoY(%)	4.900
Education	EA11-20: HICP: Education	Haver Analytics	YoY(%)	1.000
Recreation and Culture	EA11-20: HICP: Recreation and Culture	Haver Analytics	YoY(%)	8.900
Clothing and Footwear	EA11-20: HICP: Clothing and Footwear	Haver Analytics	YoY(%)	5.200
Communications	EA11-20: HICP: Communications	Haver Analytics	YoY(%)	2.700
Hotels Cafe and Restaurant	EA11-20: HICP: Hotels, Cafes and Restaurants	Haver Analytics	YoY(%)	10.500
Miscellaneous Goods and Services	EA11-20: HICP: Miscellaneous Goods and Services	Haver Analytics	YoY(%)	9.900