

European Economics Analyst

UK Inflation—Higher for Longer (Quadri)

- The April inflation print delivered yet another upside surprise on the back of a broad-based re-acceleration in core pressures. In this *Analyst*, we take stock of inflationary pressures across the major inflation components and update our outlook for UK inflation.
- Starting with energy, electricity and gas prices have continued to decline in recent weeks and household energy bills are set to decline by 17% in July. Taken together with the expectation of energy bills remaining broadly flat thereafter (based on latest energy forward curves), energy inflation should decelerate sharply in H2, especially in year-over-year terms.
- Food inflation, on the other hand, remains at record levels and has shown limited signs of slowing so far. Our analysis suggests that this strength in food inflation has largely been due to high input costs being faced by food producers as supply bottlenecks, the conflict in Ukraine, and adverse weather shocks pushed up energy and agricultural commodity prices sharply higher. More recently though, commodity and energy prices have declined, and this has been accompanied by a meaningful decline in food input PPI. Going forward, we therefore expect sequential food inflation to moderate, albeit at a more gradual pace.
- Turning to core inflation, indicators of global supply constraints have eased notably recently and point towards a slowing in core goods inflation going forward. That said, we also find that sequential core goods pressures have historically tended to be very sticky, which suggests that near-term goods inflation may remain elevated for a while. We expect services inflation to stay elevated for longer, however, largely because we remain concerned about wage growth not cooling sufficiently and sustainably over the medium term.
- Taken all together, we revise up our core inflation forecast further, and now expect core inflation at 6.0%yoy (vs 5.6%yoy previously) in December 2023 and at 3.3%yoy (vs 2.9%yoy previously) in December 2024. Taken together with a lower energy price cap forecast but a more gradual decline in food inflation, we keep our end-2023 headline inflation projection unchanged at 4.7%yoy but revise up our end-2024 headline inflation projection to 3.2%yoy (vs 2.7%yoy previously).
- Our analysis reinforces our view that resilient growth, a tight labour market, and persistent inflationary pressures will convince the MPC to deliver significant

Sven Jari Stehn

+44(20)7774-8061 | jari.stehn@gs.com
Goldman Sachs International

Filippo Taddei

+44(20)7774-5458 |
filippo.taddei@gs.com
Goldman Sachs International

Christian Schnittker

+44(20)7774-2269 |
christian.schnittker@gs.com
Goldman Sachs International

Ibrahim Quadri

+44(20)7774-5864 |
ibrahim.quadri@gs.com
Goldman Sachs International

Alexandre Stott

+33(1)4212-1108 |
alexandre.stott@gs.com
Goldman Sachs Bank Europe SE - Paris
Branch

James Moberly

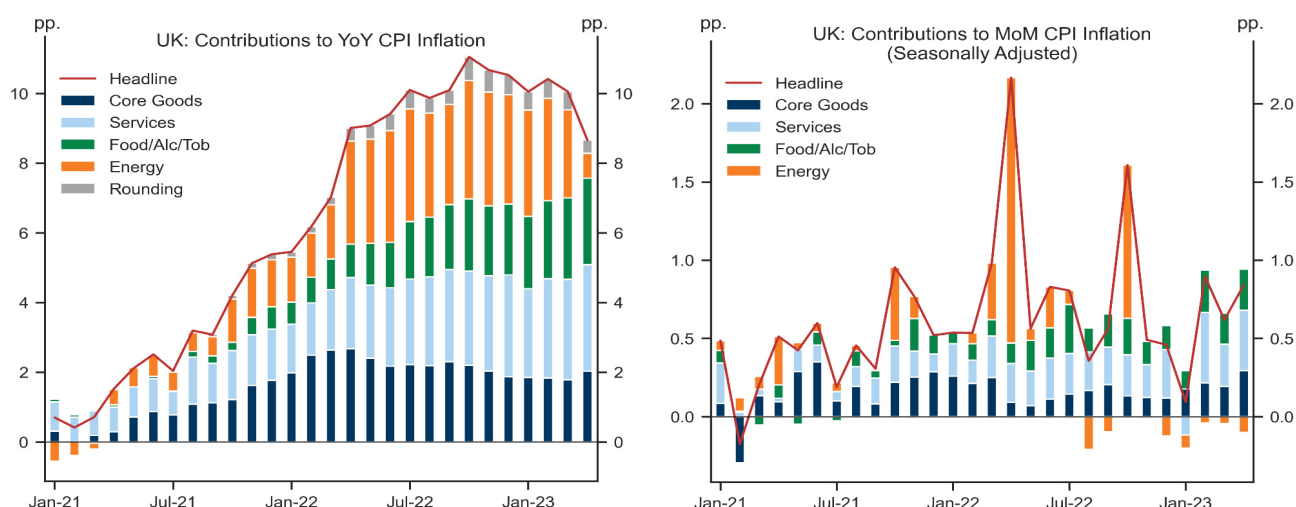
+44(20)7774-9444 |
james.r.moberly@gs.com
Goldman Sachs International

additional tightening. We maintain our forecast of two further 25bp hikes at the upcoming June and August meetings for a terminal policy rate of 5%, but see risks to our terminal rate forecast as skewed to the upside.

UK Inflation—Higher for Longer

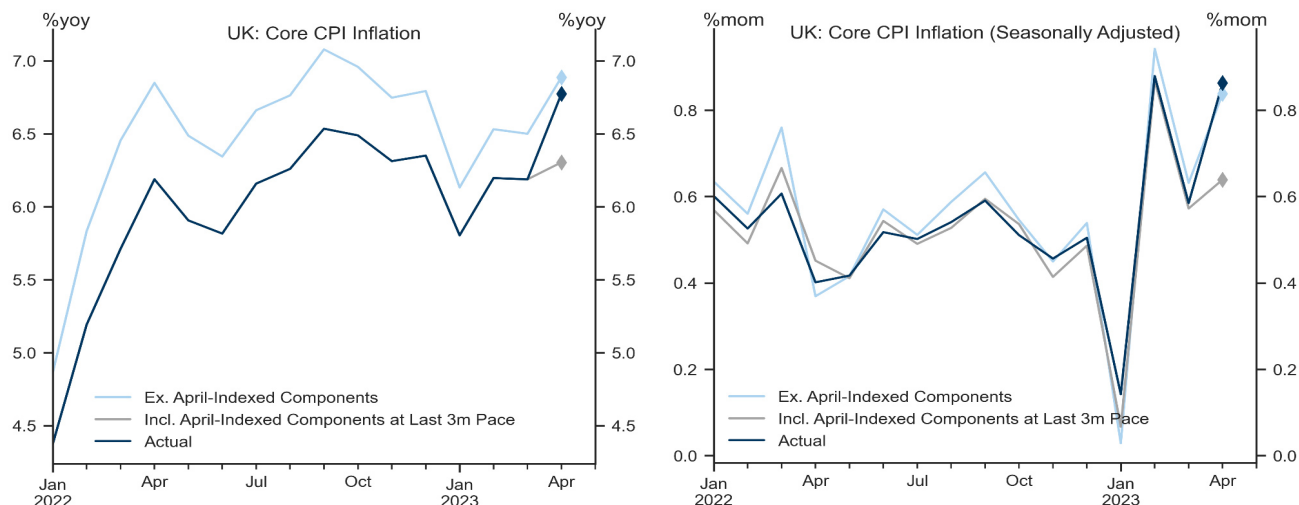
The [April inflation print](#) delivered yet another upside surprise as sequential core pressures re-accelerated sharply. And while headline inflation moderated on the back of falling energy contribution, food inflation—which in both sequential and year-over-year terms has recently been running at its highest level on record—ticked up even further, thereby surprising both consensus and BoE’s projections meaningfully to the upside (Exhibit 1).

Exhibit 1: Sequential Pressures Re-accelerated in April



Source: Goldman Sachs Global Investment Research, Haver Analytics

While part of the increase in the sequential pace last week was accounted for by the so-called April effect, the overall acceleration was far more broad-based. Specifically, April tends to be a month where several household services prices—such as rents and telephone bills—in the UK are reset higher (via inflation indexation). However, as illustrated in Exhibit 2, core inflation excluding such components also increased sharply and overall core inflation would have accelerated even if these April-specific components had increased at the pace observed over the last three months.

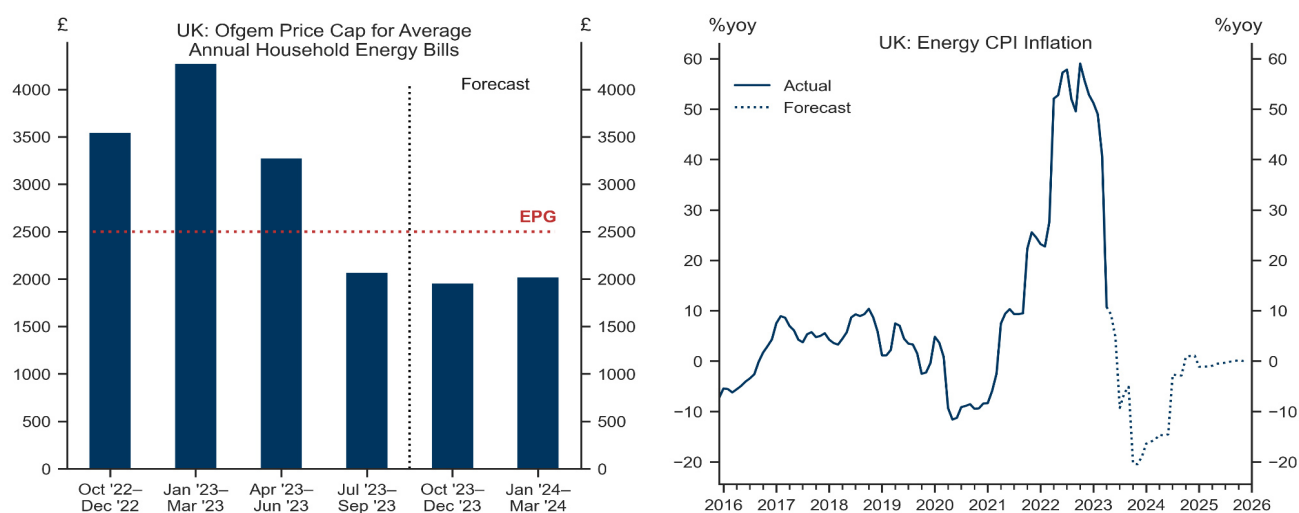
Exhibit 2: The Acceleration in Sequential Pressures Was Broad-Based Across Core Components

Source: Goldman Sachs Global Investment Research, Haver Analytics

In this *Analyst*, we take stock of inflationary pressures across the major inflation components and update our outlook for UK inflation.

Energy Inflation

Energy prices have continued to decline in recent weeks, and the Ofgem recently announced that average household energy bills will be capped at £2,074 (annualized) in Q3, implying a 17% fall in household energy bills in July. Based on the latest energy forward curves, the Ofgem price cap is expected to remain broadly flat thereafter until Q1 next year, which in turn should imply a sharp deceleration in headline inflation in H2, especially in year-over-year terms (Exhibit 3).

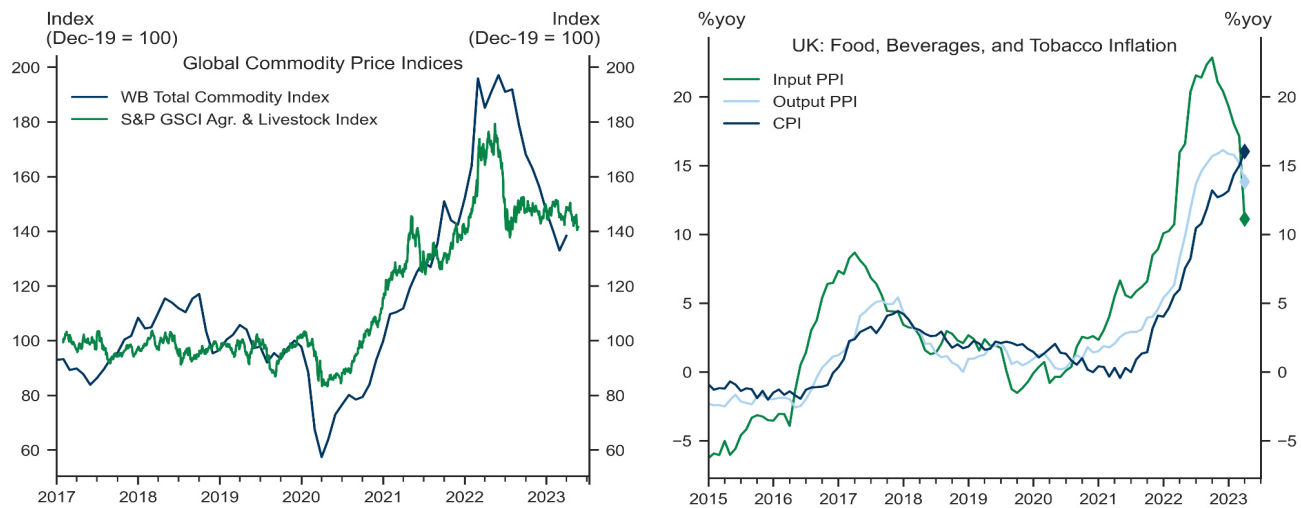
Exhibit 3: Energy Inflation Should Continue to Decelerate Sharply

Source: Goldman Sachs Global Investment Research, Ofgem, Haver Analytics

Food Inflation

Food inflation, on the other hand, remains at record levels and has shown limited signs of slowing so far. The strength in food inflation is largely due to the high input costs being faced by food producers. As illustrated in Exhibit 4, food input PPI increased sharply over the past two years, as supply bottlenecks, the conflict in Ukraine, and adverse weather shocks pushed up energy and agricultural commodity prices sharply higher. More recently, commodity and energy prices have declined, and this has been accompanied by a meaningful moderation in input PPI, suggesting that food CPI inflation should moderate going forward.

Exhibit 4: Food Inflation Remains Remarkably High but Forward-Looking Indicators Point Towards Slowing in the Pipeline



Source: Goldman Sachs Global Investment Research, Haver Analytics, Bloomberg

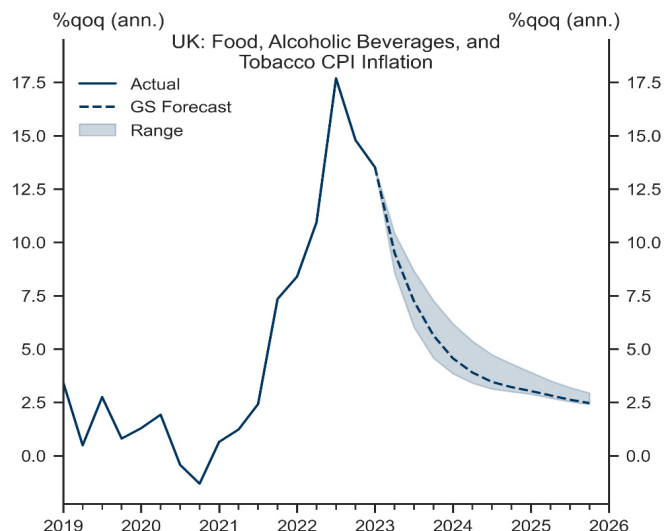
To gauge the outlook for food inflation, we start by regressing sequential food input PPI inflation on its lags, agricultural commodity prices, and the trade-weighted exchange rate. Next, we regress sequential food output PPI and CPI inflation on their respective lags, and on input PPI and output PPI inflation, respectively.

We see three main takeaways from this analysis. First, as expected, global commodity prices and exchange rate movements tend to be important drivers of food inflation. Second, the statistical significance of the lag coefficient suggests that food inflation can be somewhat sticky. Third, sequential food CPI inflation tends to follow sequential food input PPI inflation with a lag of around two quarters (Exhibit 5, left). This is consistent with what was observed in 2017 when input PPI peaked in April 2017, but food CPI continued to increase until its peak in December 2017 (Exhibit 4, right).

Going forward, given the recent moderation in global commodity prices as well as in food input PPI, we expect sequential food CPI inflation to also moderate going forward—albeit at a more gradual pace—from 13.5%qoq (annualized) in Q1 to 6.7%qoq by Q4 (Exhibit 5, right).

Exhibit 5: We Expect Food Inflation to Moderate Going Forward

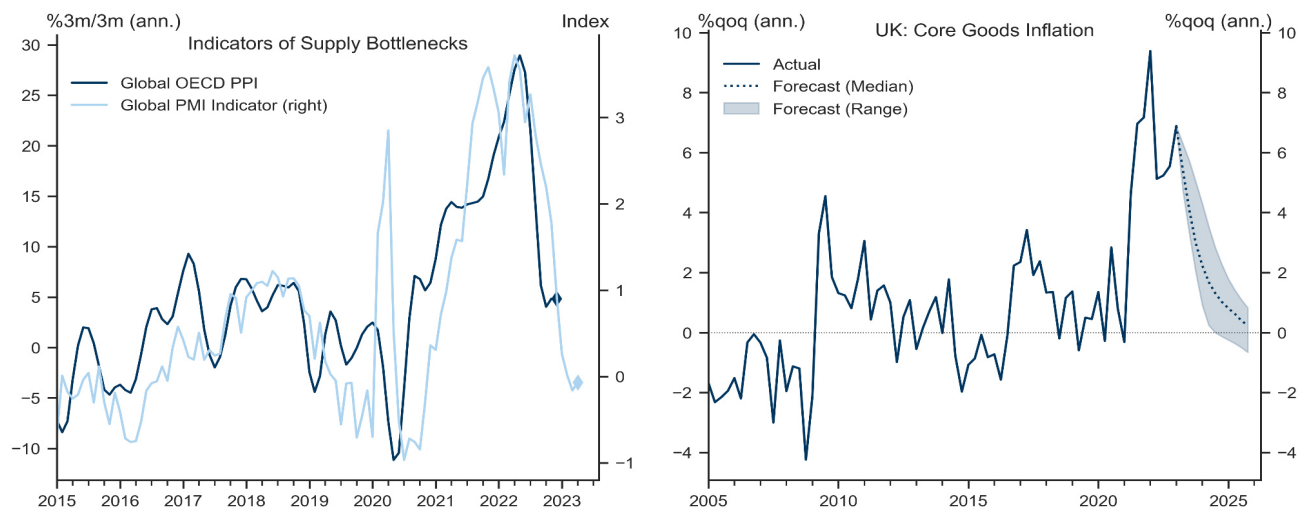
UK: Food Inflation Regressions (%qoq, ann.)			
	Input PPI	Output PPI	CPI
Lag	0.463*** (0.098)	0.224*** (0.076)	0.199*** (0.069)
Commodity Prices	0.121*** (0.019)		
Exchange Rate	-0.193*** (0.038)		
Input PPI		0.528*** (0.052)	
Output PPI			0.666*** (0.048)
Constant	1.167** (0.522)	0.308* (0.169)	0.811*** (0.283)
R-squared	0.582	0.861	0.701
Observations	106	105	107



Source: Goldman Sachs Global Investment Research, Haver Analytics

Core Goods Inflation

Turning to core goods, we recently noted that pandemic and supply bottlenecks have been a significant driver of the strength in core goods inflation over the past year, and that easing supply constraints are likely to weigh down on goods inflation meaningfully going forward. But at the same time, we also found that sequential core goods pressures have historically tended to be very sticky, suggesting that near-term pressures may remain elevated for a while. All told, we expect sequential core goods inflation to slow from 6.9%qoq in Q1 to 3.7%qoq by Q4 (Exhibit 6, right).

Exhibit 6: Near-Term Persistence, Medium-Term Slowing in Core Goods Inflation

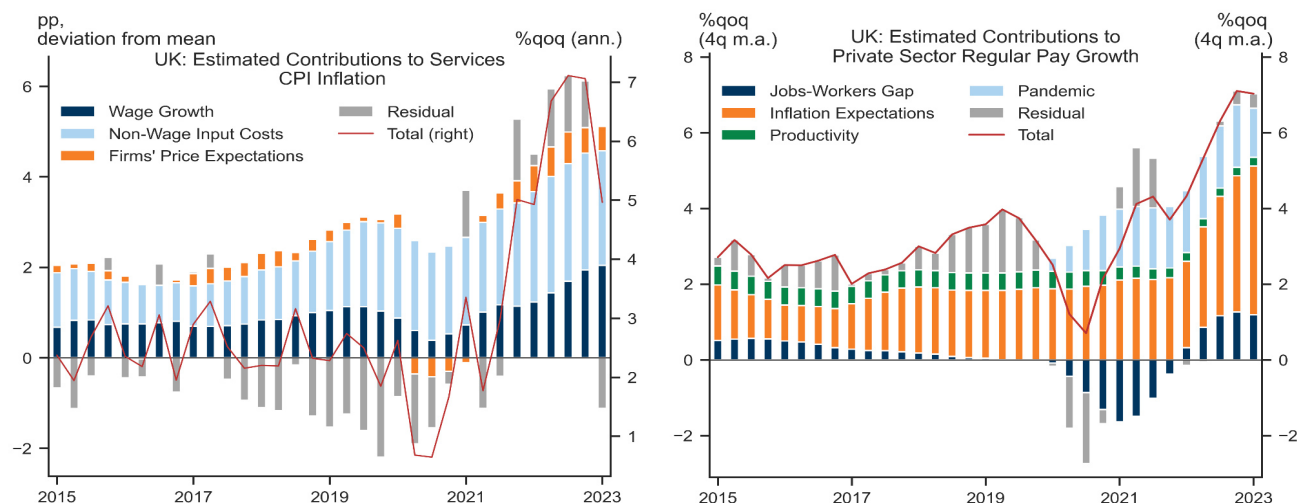
Source: Goldman Sachs Global Investment Research, Haver Analytics

Services Inflation

The outlook for services inflation—which is considered as a proxy for domestic

inflationary pressures—remains concerning, however. In recent research, we had highlighted that the recent strength in services inflation had been driven largely by a mix of remarkably high wage growth and non-wage cost increases (Exhibit 7, left). Such high wage growth has, in turn, been driven by a combination of elevated inflation expectations and a tight labour market (Exhibit 7, right).

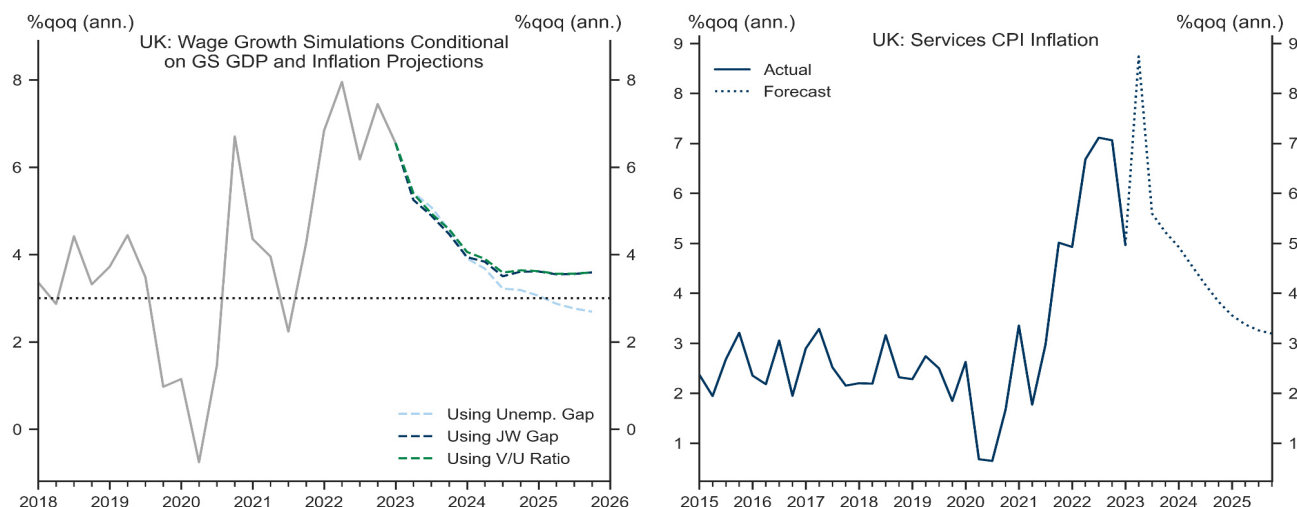
Exhibit 7: Drivers of Services Inflation



Source: Goldman Sachs Global Investment Research

As headline inflation decelerates this year, we would expect inflation expectations and, in turn, wage growth to also moderate. Indeed, our composite measure of long-term inflation expectations has already declined meaningfully from the peak observed late last year and is now tracking at just above its historical average, and wage pressures have eased somewhat as well.

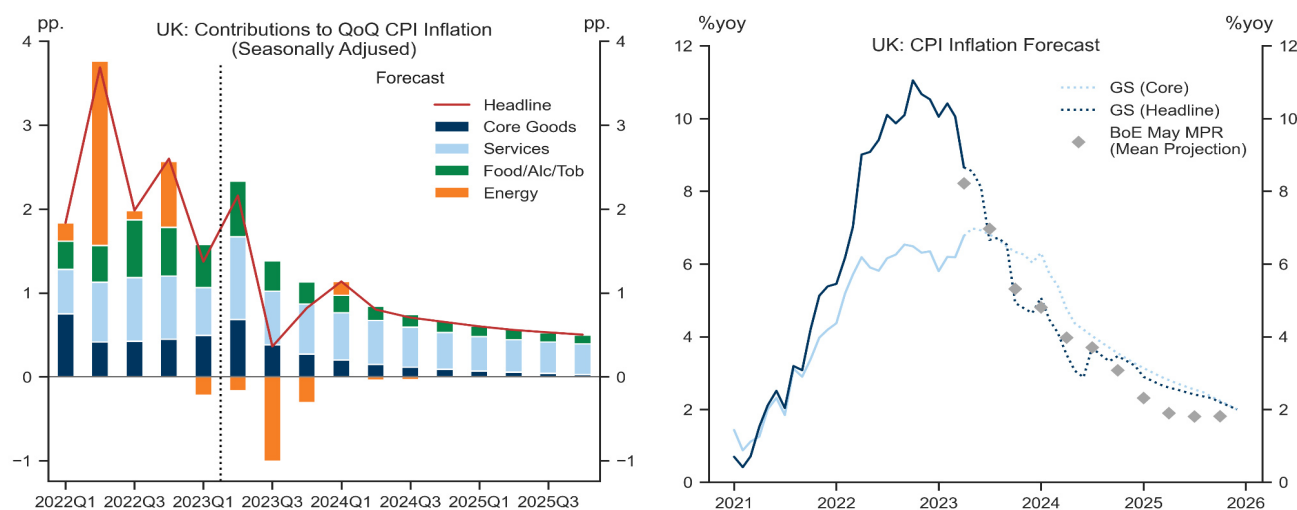
But given the tightness in the labour market, we remain concerned about the risk of wage growth not cooling sufficiently and sustainably over the medium term. Indeed, as we have noted recently, wage Phillips curve estimated using broader slack measures such as the jobs-workers gap and vacancy-unemployed ratio—which have tended to perform better in explaining the recent strength in wage growth—point towards wage growth flattening at around 3½% by end-2025 (Exhibit 8, left). Accordingly, we expect sequential services inflation to remain elevated at 5.2%qoq by Q4, lower than the 7.1%qoq pace observed in 2022Q4 but above the 5.0%qoq pace observed in 2023Q1 (Exhibit 8, right).

Exhibit 8: We Expect Services Inflation to Remain Elevated Through 2023

Source: Goldman Sachs Global Investment Research, Haver Analytics

Pulling It All Together

Taken all together, we revise up our core inflation forecast further, and now expect core inflation at 6.0%yoy (vs 5.6%yoy previously) in December 2023 and at 3.3%yoy (vs 2.9%yoy previously) in December 2024. Taken together with a lower energy price cap forecast but a more gradual decline in food inflation, we keep our end-2023 headline inflation projection unchanged at 4.7%yoy but revise up our end-2024 headline inflation projection to 3.2%yoy (vs 2.7%yoy previously).

Exhibit 9: Persistent Inflationary Pressures

Source: Goldman Sachs Global Investment Research, Haver Analytics, Bank of England

Our analysis reinforces our [view](#) that resilient growth, a tight labour market, and persistent inflationary pressures will convince the MPC to deliver significant additional tightening. We maintain our forecast of two further 25bp hikes at the upcoming June and August meetings for a terminal policy rate of 5%, but see risks to our terminal rate

forecast as skewed to the upside.

Ibrahim Quadri

Disclosure Appendix

Reg AC

We, Sven Jari Stehn, Filippo Taddei, Christian Schnittker, Ibrahim Quadri, Alexandre Stott and James Moberly, hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm's business or client relationships.

Unless otherwise stated, the individuals listed on the cover page of this report are analysts in Goldman Sachs' Global Investment Research division.

Disclosures

Regulatory disclosures

Disclosures required by United States laws and regulations

See company-specific regulatory disclosures above for any of the following disclosures required as to companies referred to in this report: manager or co-manager in a pending transaction; 1% or other ownership; compensation for certain services; types of client relationships; managed/co-managed public offerings in prior periods; directorships; for equity securities, market making and/or specialist role. Goldman Sachs trades or may trade as a principal in debt securities (or in related derivatives) of issuers discussed in this report.

The following are additional required disclosures: **Ownership and material conflicts of interest:** Goldman Sachs policy prohibits its analysts, professionals reporting to analysts and members of their households from owning securities of any company in the analyst's area of coverage.

Analyst compensation: Analysts are paid in part based on the profitability of Goldman Sachs, which includes investment banking revenues. **Analyst as officer or director:** Goldman Sachs policy generally prohibits its analysts, persons reporting to analysts or members of their households from serving as an officer, director or advisor of any company in the analyst's area of coverage. **Non-U.S. Analysts:** Non-U.S. analysts may not be associated persons of Goldman Sachs & Co. LLC and therefore may not be subject to FINRA Rule 2241 or FINRA Rule 2242 restrictions on communications with subject company, public appearances and trading securities held by the analysts.

Additional disclosures required under the laws and regulations of jurisdictions other than the United States

The following disclosures are those required by the jurisdiction indicated, except to the extent already made above pursuant to United States laws and regulations. **Australia:** Goldman Sachs Australia Pty Ltd and its affiliates are not authorised deposit-taking institutions (as that term is defined in the Banking Act 1959 (Cth)) in Australia and do not provide banking services, nor carry on a banking business, in Australia. This research, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act, unless otherwise agreed by Goldman Sachs. In producing research reports, members of Global Investment Research of Goldman Sachs Australia may attend site visits and other meetings hosted by the companies and other entities which are the subject of its research reports. In some instances the costs of such site visits or meetings may be met in part or in whole by the issuers concerned if Goldman Sachs Australia considers it is appropriate and reasonable in the specific circumstances relating to the site visit or meeting. To the extent that the contents of this document contains any financial product advice, it is general advice only and has been prepared by Goldman Sachs without taking into account a client's objectives, financial situation or needs. A client should, before acting on any such advice, consider the appropriateness of the advice having regard to the client's own objectives, financial situation and needs. A copy of certain Goldman Sachs Australia and New Zealand disclosure of interests and a copy of Goldman Sachs' Australian Sell-Side Research Independence Policy Statement are available at: <https://www.goldmansachs.com/disclosures/australia-new-zealand/index.html>. **Brazil:** Disclosure information in relation to CVM Resolution n. 20 is available at <https://www.gs.com/worldwide/brazil/area/gir/index.html>. Where applicable, the Brazil-registered analyst primarily responsible for the content of this research report, as defined in Article 20 of CVM Resolution n. 20, is the first author named at the beginning of this report, unless indicated otherwise at the end of the text. **Canada:** This information is being provided to you for information purposes only and is not, and under no circumstances should be construed as, an advertisement, offering or solicitation by Goldman Sachs & Co. LLC for purchasers of securities in Canada to trade in any Canadian security. Goldman Sachs & Co. LLC is not registered as a dealer in any jurisdiction in Canada under applicable Canadian securities laws and generally is not permitted to trade in Canadian securities and may be prohibited from selling certain securities and products in certain jurisdictions in Canada. If you wish to trade in any Canadian securities or other products in Canada please contact Goldman Sachs Canada Inc., an affiliate of The Goldman Sachs Group Inc., or another registered Canadian dealer. **Hong Kong:** Further information on the securities of covered companies referred to in this research may be obtained on request from Goldman Sachs (Asia) L.L.C. **India:** Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (India) Securities Private Limited, Research Analyst - SEBI Registration Number INH000001493, 951-A, Rational House, Appasaheb Marathe Marg, Prabhadevi, Mumbai 400 025, India, Corporate Identity Number U71414MH2006FTC160634, Phone +91 22 6616 9000, Fax +91 22 6616 9001. Goldman Sachs may beneficially own 1% or more of the securities (as such term is defined in clause 2 (h) the Indian Securities Contracts (Regulation) Act, 1956) of the subject company or companies referred to in this research report. **Japan:** See below. **Korea:** This research, and any access to it, is intended only for "professional investors" within the meaning of the Financial Services and Capital Markets Act, unless otherwise agreed by Goldman Sachs. Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (Asia) L.L.C., Seoul Branch. **New Zealand:** Goldman Sachs New Zealand Limited and its affiliates are neither "registered banks" nor "deposit takers" (as defined in the Reserve Bank of New Zealand Act 1989) in New Zealand. This research, and any access to it, is intended for "wholesale clients" (as defined in the Financial Advisers Act 2008) unless otherwise agreed by Goldman Sachs. A copy of certain Goldman Sachs Australia and New Zealand disclosure of interests is available at: <https://www.goldmansachs.com/disclosures/australia-new-zealand/index.html>. **Russia:** Research reports distributed in the Russian Federation are not advertising as defined in the Russian legislation, but are information and analysis not having product promotion as their main purpose and do not provide appraisal within the meaning of the Russian legislation on appraisal activity. Research reports do not constitute a personalized investment recommendation as defined in Russian laws and regulations, are not addressed to a specific client, and are prepared without analyzing the financial circumstances, investment profiles or risk profiles of clients. Goldman Sachs assumes no responsibility for any investment decisions that may be taken by a client or any other person based on this research report. **Singapore:** Goldman Sachs (Singapore) Pte. (Company Number: 198602165W), which is regulated by the Monetary Authority of Singapore, accepts legal responsibility for this research, and should be contacted with respect to any matters arising from, or in connection with, this research. **Taiwan:** This material is for reference only and must not be reprinted without permission. Investors should carefully consider their own investment risk. Investment results are the responsibility of the individual investor. **United Kingdom:** Persons who would be categorized as retail clients in the United Kingdom, as such term is defined in the rules of the Financial Conduct Authority, should read this research in conjunction with prior Goldman Sachs research on the covered companies referred to herein and should refer to the risk warnings that have been sent to them by Goldman Sachs International. A copy of these risks warnings, and a glossary of certain financial terms used in this report, are available from Goldman Sachs International on request.

European Union and United Kingdom: Disclosure information in relation to Article 6 (2) of the European Commission Delegated Regulation (EU) (2016/958) supplementing Regulation (EU) No 596/2014 of the European Parliament and of the Council (including as that Delegated Regulation is implemented into United Kingdom domestic law and regulation following the United Kingdom's departure from the European Union and the European Economic Area) with regard to regulatory technical standards for the technical arrangements for objective presentation of investment

recommendations or other information recommending or suggesting an investment strategy and for disclosure of particular interests or indications of conflicts of interest is available at <https://www.gs.com/disclosures/europeanpolicy.html> which states the European Policy for Managing Conflicts of Interest in Connection with Investment Research.

Japan: Goldman Sachs Japan Co., Ltd. is a Financial Instrument Dealer registered with the Kanto Financial Bureau under registration number Kinsho 69, and a member of Japan Securities Dealers Association, Financial Futures Association of Japan Type II Financial Instruments Firms Association, The Investment Trusts Association, Japan, and Japan Investment Advisers Association. Sales and purchase of equities are subject to commission pre-determined with clients plus consumption tax. See company-specific disclosures as to any applicable disclosures required by Japanese stock exchanges, the Japanese Securities Dealers Association or the Japanese Securities Finance Company.

Global product; distributing entities

Goldman Sachs Global Investment Research produces and distributes research products for clients of Goldman Sachs on a global basis. Analysts based in Goldman Sachs offices around the world produce research on industries and companies, and research on macroeconomics, currencies, commodities and portfolio strategy. This research is disseminated in Australia by Goldman Sachs Australia Pty Ltd (ABN 21 006 797 897); in Brazil by Goldman Sachs do Brasil Corretora de Títulos e Valores Mobiliários S.A.; Public Communication Channel Goldman Sachs Brasil: 0800 727 5764 and / or contatogoldmanbrasil@gs.com. Available Weekdays (except holidays), from 9am to 6pm. Canal de Comunicação com o Público Goldman Sachs Brasil: 0800 727 5764 e/ou contatogoldmanbrasil@gs.com. Horário de funcionamento: segunda-feira à sexta-feira (exceto feriados), das 9h às 18h; in Canada by Goldman Sachs & Co. LLC; in Hong Kong by Goldman Sachs (Asia) L.L.C.; in India by Goldman Sachs (India) Securities Private Ltd.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs New Zealand Limited; in Russia by OOO Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198602165W); and in the United States of America by Goldman Sachs & Co. LLC. Goldman Sachs International has approved this research in connection with its distribution in the United Kingdom.

Goldman Sachs International ("GSI"), authorised by the Prudential Regulation Authority ("PRA") and regulated by the Financial Conduct Authority ("FCA") and the PRA, has approved this research in connection with its distribution in the United Kingdom.

European Economic Area: GSI, authorised by the PRA and regulated by the FCA and the PRA, disseminates research in the following jurisdictions within the European Economic Area: the Grand Duchy of Luxembourg, Italy, the Kingdom of Belgium, the Kingdom of Denmark, the Kingdom of Norway, the Republic of Finland and the Republic of Ireland; GSI - Succursale de Paris (Paris branch) which is authorised by the French Autorité de contrôle prudentiel et de résolution ("ACPR") and regulated by the Autorité de contrôle prudentiel et de résolution and the Autorité des marchés financiers ("AMF") disseminates research in France; GSI - Sucursal en España (Madrid branch) authorized in Spain by the Comisión Nacional del Mercado de Valores disseminates research in the Kingdom of Spain; GSI - Sweden Bankfilial (Stockholm branch) is authorized by the SFSA as a "third country branch" in accordance with Chapter 4, Section 4 of the Swedish Securities and Market Act (Sw. lag (2007:528) om värdepappersmarknaden) disseminates research in the Kingdom of Sweden; Goldman Sachs Bank Europe SE ("GSBE") is a credit institution incorporated in Germany and, within the Single Supervisory Mechanism, subject to direct prudential supervision by the European Central Bank and in other respects supervised by German Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin) and Deutsche Bundesbank and disseminates research in the Federal Republic of Germany and those jurisdictions within the European Economic Area where GSI is not authorised to disseminate research and additionally, GSBE, Copenhagen Branch filial af GSBE, Tyskland, supervised by the Danish Financial Authority disseminates research in the Kingdom of Denmark; GSBE - Sucursal en España (Madrid branch) subject (to a limited extent) to local supervision by the Bank of Spain disseminates research in the Kingdom of Spain; GSBE - Succursale Italia (Milan branch) to the relevant applicable extent, subject to local supervision by the Bank of Italy (Banca d'Italia) and the Italian Companies and Exchange Commission (Commissione Nazionale per le Società e la Borsa "Consob") disseminates research in Italy; GSBE - Succursale de Paris (Paris branch), supervised by the AMF and by the ACPR disseminates research in France; and GSBE - Sweden Bankfilial (Stockholm branch), to a limited extent, subject to local supervision by the Swedish Financial Supervisory Authority (Finansinspektionen) disseminates research in the Kingdom of Sweden.

General disclosures

This research is for our clients only. Other than disclosures relating to Goldman Sachs, this research is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. The information, opinions, estimates and forecasts contained herein are as of the date hereof and are subject to change without prior notification. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Other than certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgment.

Goldman Sachs conducts a global full-service, integrated investment banking, investment management, and brokerage business. We have investment banking and other business relationships with a substantial percentage of the companies covered by Global Investment Research. Goldman Sachs & Co. LLC, the United States broker dealer, is a member of SIPC (<https://www.sipc.org>).

Our salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients and principal trading desks that reflect opinions that are contrary to the opinions expressed in this research. Our asset management area, principal trading desks and investing businesses may make investment decisions that are inconsistent with the recommendations or views expressed in this research.

We and our affiliates, officers, directors, and employees will from time to time have long or short positions in, act as principal in, and buy or sell, the securities or derivatives, if any, referred to in this research, unless otherwise prohibited by regulation or Goldman Sachs policy.

The views attributed to third party presenters at Goldman Sachs arranged conferences, including individuals from other parts of Goldman Sachs, do not necessarily reflect those of Global Investment Research and are not an official view of Goldman Sachs.

Any third party referenced herein, including any salespeople, traders and other professionals or members of their household, may have positions in the products mentioned that are inconsistent with the views expressed by analysts named in this report.

This research is focused on investment themes across markets, industries and sectors. It does not attempt to distinguish between the prospects or performance of, or provide analysis of, individual companies within any industry or sector we describe.

Any trading recommendation in this research relating to an equity or credit security or securities within an industry or sector is reflective of the investment theme being discussed and is not a recommendation of any such security in isolation.

This research is not an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be illegal. It does not constitute a personal recommendation or take into account the particular investment objectives, financial situations, or needs of individual clients. Clients should consider whether any advice or recommendation in this research is suitable for their particular circumstances and, if appropriate, seek professional advice, including tax advice. The price and value of investments referred to in this research and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

Certain transactions, including those involving futures, options, and other derivatives, give rise to substantial risk and are not suitable for all investors.

Investors should review current options and futures disclosure documents which are available from Goldman Sachs sales representatives or at <https://www.theocc.com/about/publications/character-risks.jsp> and https://www.fiadocumentation.org/fia/regulatory-disclosures_1/fia-uniform-futures-and-options-on-futures-risk-disclosures-booklet-pdf-version-2018. Transaction costs may be significant in option strategies calling for multiple purchase and sales of options such as spreads. Supporting documentation will be supplied upon request.

Differing Levels of Service provided by Global Investment Research: The level and types of services provided to you by Goldman Sachs Global Investment Research may vary as compared to that provided to internal and other external clients of GS, depending on various factors including your individual preferences as to the frequency and manner of receiving communication, your risk profile and investment focus and perspective (e.g., marketwide, sector specific, long term, short term), the size and scope of your overall client relationship with GS, and legal and regulatory constraints. As an example, certain clients may request to receive notifications when research on specific securities is published, and certain clients may request that specific data underlying analysts' fundamental analysis available on our internal client websites be delivered to them electronically through data feeds or otherwise. No change to an analyst's fundamental research views (e.g., ratings, price targets, or material changes to earnings estimates for equity securities), will be communicated to any client prior to inclusion of such information in a research report broadly disseminated through electronic publication to our internal client websites or through other means, as necessary, to all clients who are entitled to receive such reports.

All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client websites. Not all research content is redistributed to our clients or available to third-party aggregators, nor is Goldman Sachs responsible for the redistribution of our research by third party aggregators. For research, models or other data related to one or more securities, markets or asset classes (including related services) that may be available to you, please contact your GS representative or go to <https://research.gs.com>.

Disclosure information is also available at <https://www.gs.com/research/hedge.html> or from Research Compliance, 200 West Street, New York, NY 10282.

© 2023 Goldman Sachs.

No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without the prior written consent of The Goldman Sachs Group, Inc.