

Monthly Trend Inflation Measurement at Sectoral Level

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Disclaimer: The views expressed are those of the authors and do not necessarily reflect the views of the Bank of England or its Committees.

The Inflation Surge of 2021

- Was it persistent or transitory?

“Central banks have always faced the problem of distinguishing transitory inflation spikes from more troublesome developments, and it is sometimes difficult to do so with confidence in real time” – Jerome Powell, Fed, August 2021

- Were the drivers sector-specific or broad-based?

“One of the most striking economic features of the pandemic has been the impact between and within sectors” – Dave Ramsden, BoE, August 2024

Why the Debate Still Matters Today

- **Pandemic revealed sector linkages** - *understanding their inflation dynamics can help central bankers make informed judgments.*
- **Geopolitical frictions and trade policy shifts** - *may influence whether inflationary pressures are persistent or transitory*

WSJ wsj.com

Fed Officials Flagged Risks of 'More Persistent' Inflation From Tariffs

April 9, 2025 — Federal Reserve officials highlighted the risks of longer-lasting inflationary pressures from tariffs ...

This Paper

- We estimate trend inflation using aggregated and disaggregated sectoral CPI data.
- This allows us to examine the recent inflation surge:
 1. How persistent was the recent surge in inflation?
 2. Was it **broad-based** or **sector-specific**?

This Paper

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 2. Was it **broad-based or sector-specific?**
- Prior work focuses on quarterly trend estimates: Stock and Watson 2007, 2016; Chan et al. 2013; Li and Koopman 2021; Eo et al. 2023, among others
⇒ Our focus is on **monthly** trend inflation.
- Another strand uses disaggregated data Duarte and Rua (2007); Birmingham and D'Agostino (2011); Ibarra (2012); Barkan et al. (2023) but, with limited focus on the UK Forbes et al. (2018); Joseph et al. (2024)
⇒ We add to this literature by estimating **UK sectoral** trend inflation.

Methodological Framework and Key Results

We build on Stock and Watson's (2007, 2016, 2019) Unobserved Components Stochastic Volatility and Outliers (UCSVO) model to study inflation dynamics.

- **Incorporate monthly** seasonality, outliers, and volatility
- **Use UK sectoral** CPI data in a multivariate UCSVO framework

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Key Results:

1. The UK inflation surge was mainly due to a rise in the **persistent component**.
2. This rise was explained more by **broad-based macroeconomic forces** than by sector-specific factors.

Presentation Roadmap

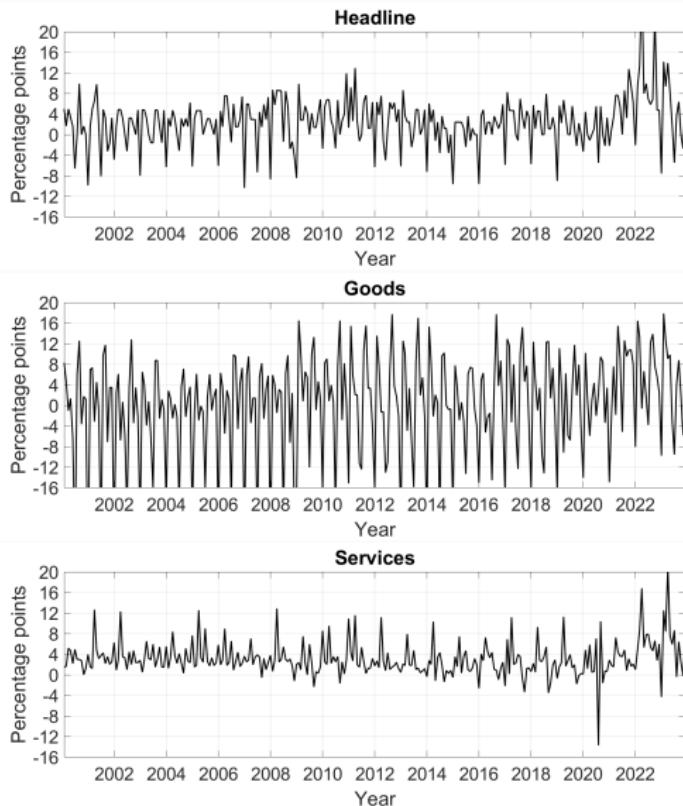
1. **UK CPI data by sector**
2. **UCSVO Model**
 - Persistent and Transitory Components of Aggregate Inflation
 - Sectoral Inflation Dynamics
3. **Multivariate UCSVO**
 - Incorporating Sectoral Dynamics into Trend Inflation
4. **Some Insights into Model Evaluation**
5. **Conclusion**

UK CPI data by sector

Data

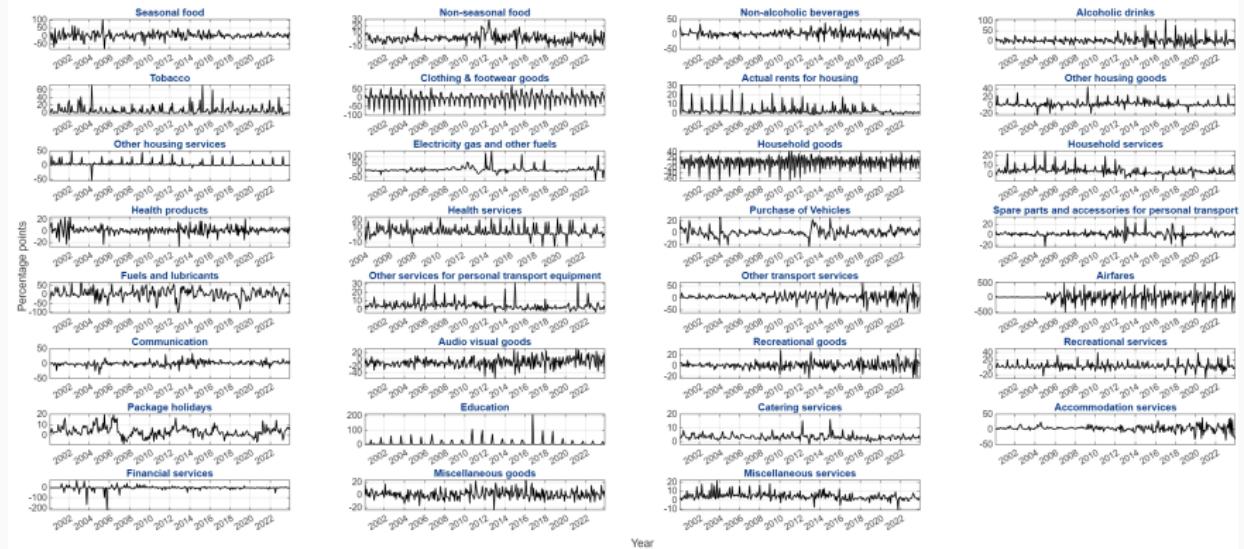
- UK Consumer Price Index (CPI) data from the Office of National Statistics
 - **85 disaggregated CPI sectors**, aggregated into **31 sectors** using CPI expenditure weights [Table](#)
 - **16 Goods sectors** (e.g., food, beverages)
 - **15 Services sectors** (e.g., rent, transport)
- Inflation is measured monthly at an annualised rate over the period January 2000 to December 2023.

UK Inflation Aggregates



→ Goods inflation shows the highest volatility, followed by Headline and Services.

Inflation Dynamics Across 31 UK CPI Sectors



- Volatility (std. dev.) ranges from 3.6 to 40.6 percentage points

UCSVO Model

- Persistent and Transitory Components of Aggregate Inflation
 - Sectoral Inflation Dynamics
-

Unobserved Components

The model decomposes inflation into three unobserved components:

$$\pi_t = \underbrace{\tau_t}_{\text{trend}} + \underbrace{s_t}_{\text{seasonal}} + \underbrace{\varepsilon_t}_{\text{transitory}} \quad (1)$$

- We follow Stock and Watson (2016), Forbes et al. (2018) and use term 'trend' to capture persistent component of inflation.

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The components are separately identified as they follow distinct stochastic processes:

$$\tau_t = \tau_{t-1} + \eta_{\tau,t} \quad (2)$$

$$s_t = s_{12} - \dots - s_1 + \eta_{s,t} \quad (3)$$

$$\varepsilon_t = \eta_{\varepsilon,t} \quad (4)$$

Stochastic Volatility and Outliers

Shocks η_t follow stochastic volatility process:

$$\eta_t = \sigma_t e_t, \quad e_t \sim \text{i.i.d. } \mathcal{N}(0, 1)$$

$$(1 - L) \ln(\sigma_t^2) = \nu_t, \quad \nu_t \sim \text{i.i.d. } \mathcal{N}(0, \sigma_\nu^2)$$

- $e_{\tau,t}, e_{s,t}, e_{\varepsilon,t} \sim$ standard normal shocks and $\sigma_{\tau,t}^2, \sigma_{s,t}^2, \sigma_{\varepsilon,t}^2$ follow log-random walks

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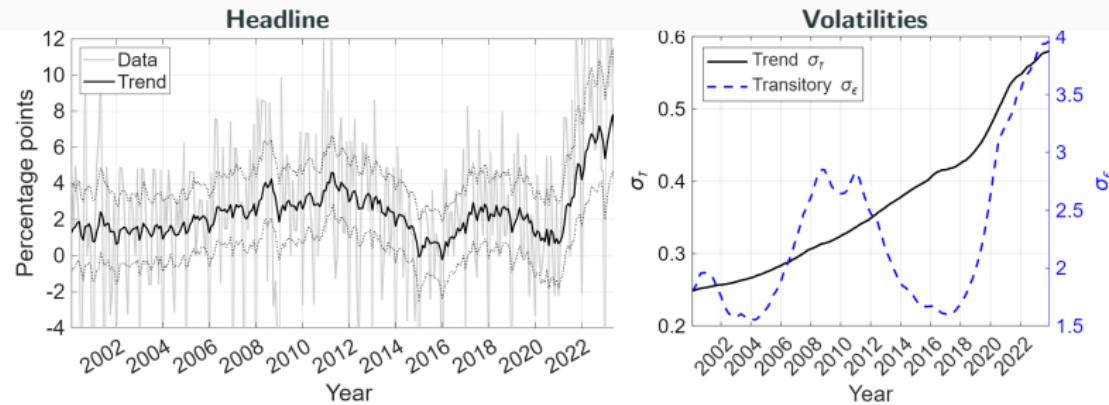
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Outliers are incorporated via multiplicative random factors o_t :

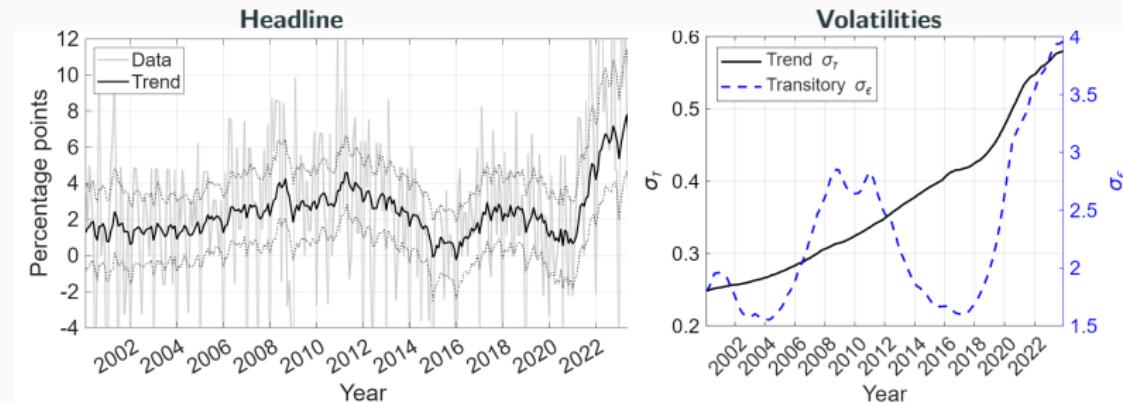
$$\eta_{\varepsilon,t} = o_t \sigma_{\varepsilon,t} e_{\varepsilon,t} \quad \text{where} \quad o_t \sim \text{i.i.d. } \mathcal{N}(0, 1)$$

$$o_t = \begin{cases} 1 & \text{with probability } 1 - p \\ \mathcal{U}[2, 10] & \text{with probability } p \end{cases}$$

Persistent Component of Inflation



Persistent Component of Inflation



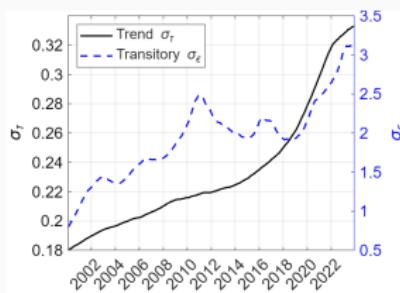
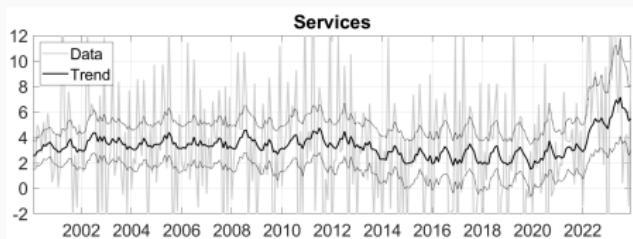
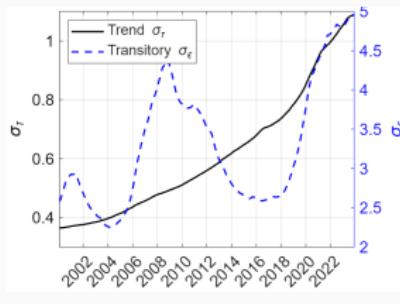
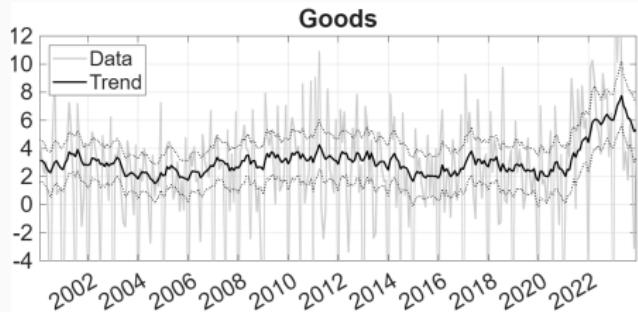
- **Trend inflation** hovered around 2% pre-2021, then **rose sharply**.
- **Volatility of trend shocks** increased, raising uncertainty and risk of prolonged inflationary pressures.

Thus, post-pandemic inflation in the UK was increasingly driven by the **persistent component**

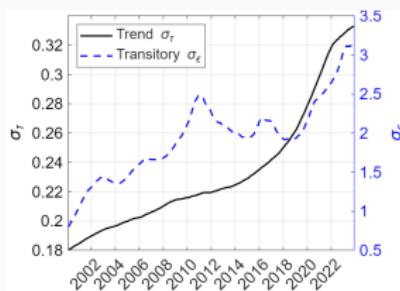
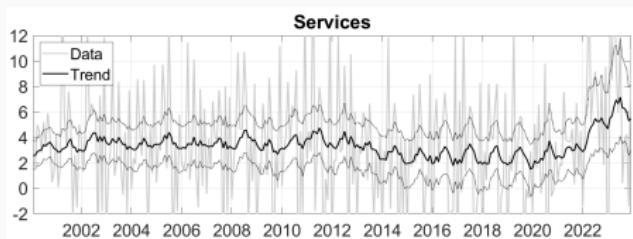
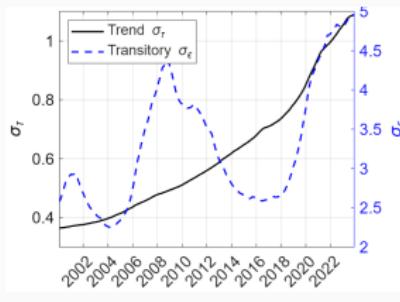
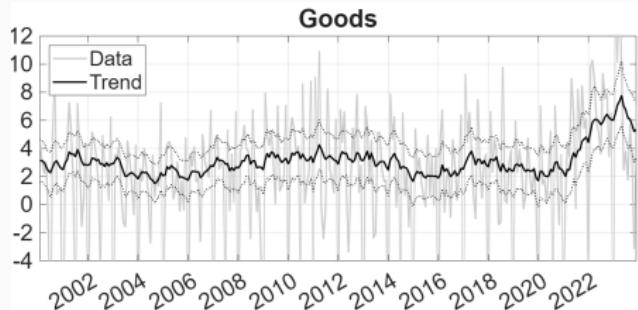
Seasonality

Outliers

Headline Trend Driven by Goods and Services, but Differently



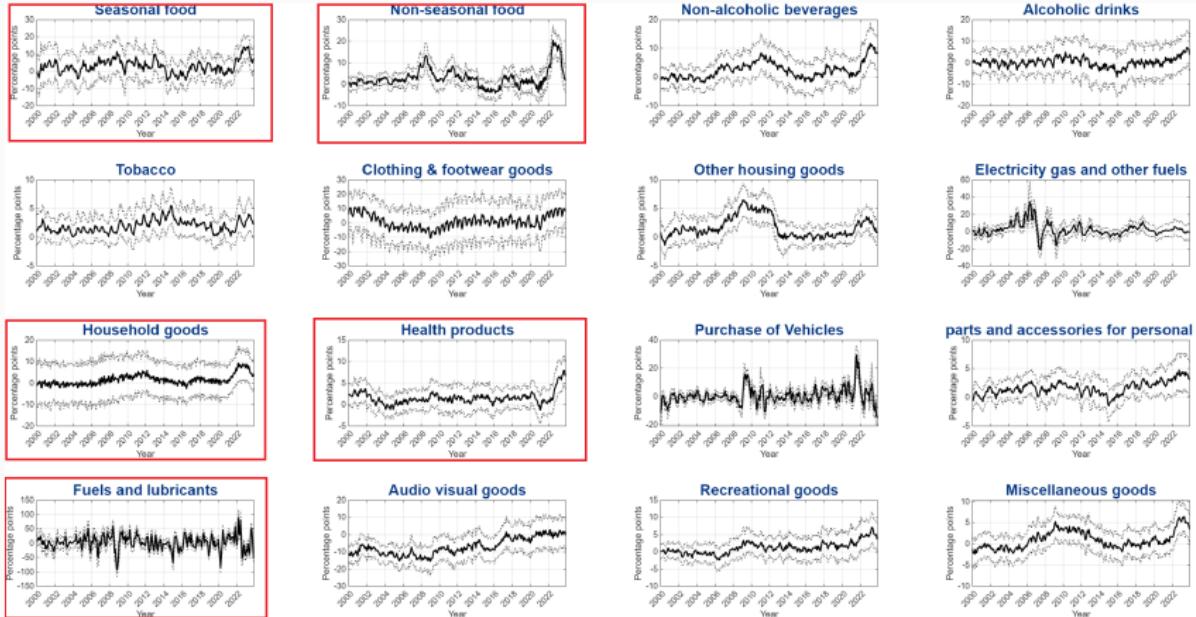
Headline Trend Driven by Goods and Services, but Differently



- **Goods trend** rose sharply in 2022, while **services** increased more gradually, indicating underlying momentum.
- **Trend volatility** in goods is approximately three times higher than in services.

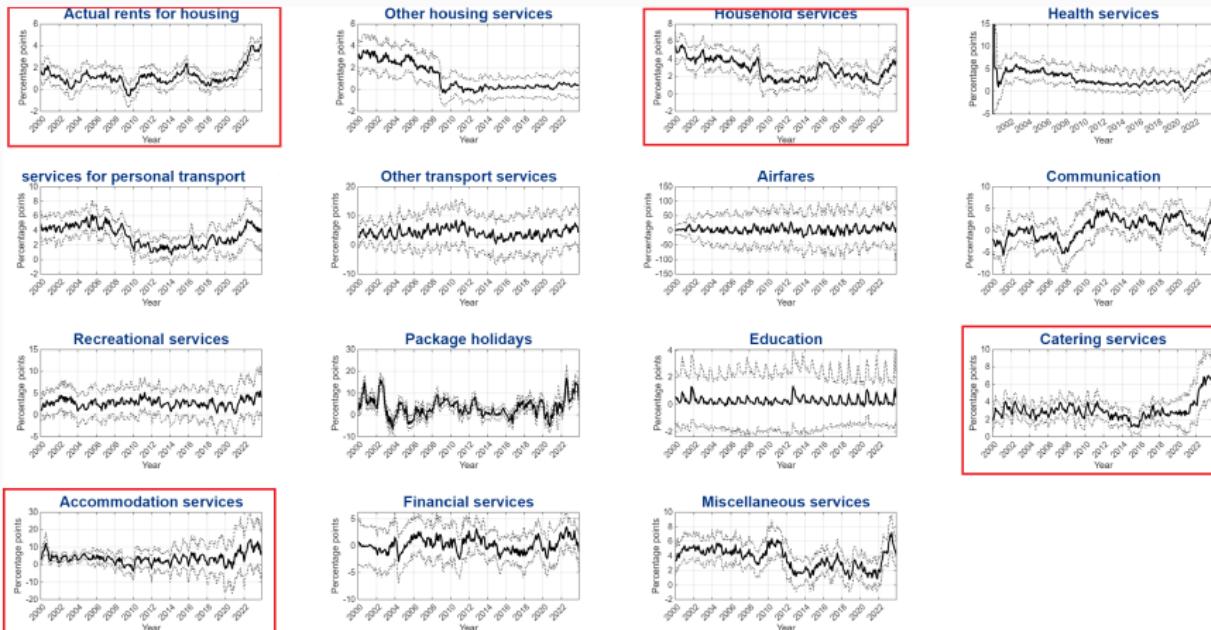
Sectoral Trend Inflation

Sectoral Goods Trend Inflation



- Rising trend inflation in goods during the pandemic - particularly in food, household items, health products, and fuels. seasonality

Sectoral Services Trend Inflation



- Rising trend inflation in services during the pandemic - particularly in rents, catering, accommodation services.

seasonality

Multivariate UCSVO

→ Incorporating Sectoral Dynamics into Trend Inflation

Multivariate UCSVO

- Extends the UCSVO model by incorporating a common latent trend and sector-specific components.

Inflation for each sector i :

$$\pi_{i,t} = \underbrace{\alpha_{i,\tau}\tau_{c,t} + \alpha_{i,s}s_{c,t} + \alpha_{i,\varepsilon}\varepsilon_{c,t}}_{\text{common, broad-based}} + \underbrace{\tau_{i,t} + s_{i,t} + \varepsilon_{i,t}}_{\text{unique, sector-specific}} \quad (5)$$

Multivariate UCSVO

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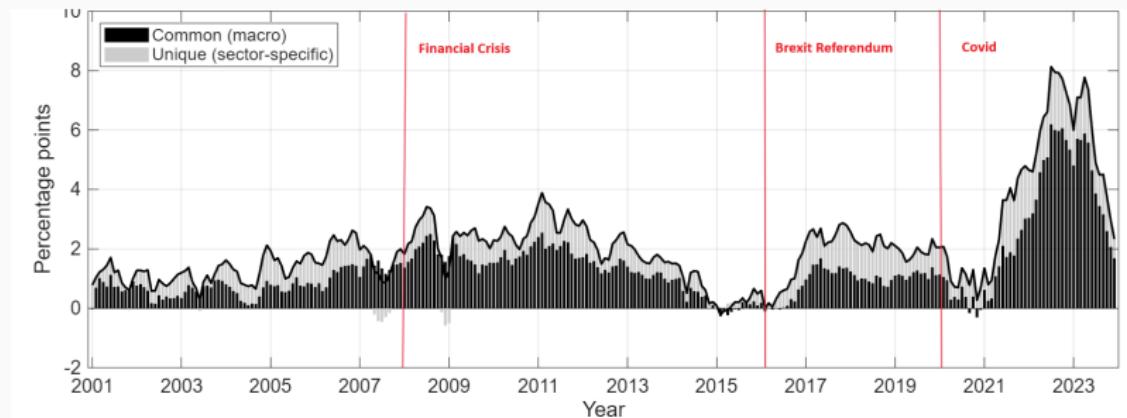
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Aggregate Trend Inflation:

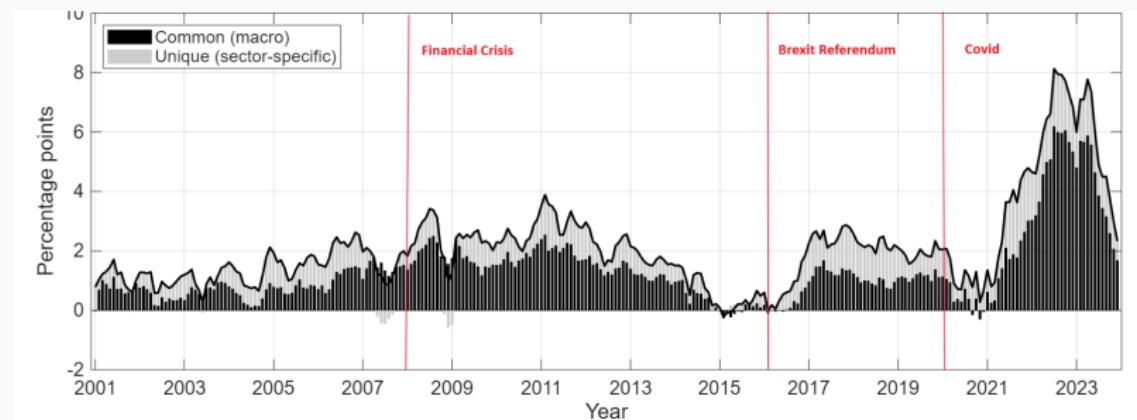
$$\tau_t = \sum_{i=1}^n w_{i,t} (\alpha_{i,\tau} \tau_{c,t} + \tau_{i,t}) \quad (6)$$

where $w_{i,t}$ denotes CPI weight of sector i ; the terms $\tau_{c,t}, s_{c,t}, \varepsilon_{c,t}$ are common components; and $\tau_{i,t}, s_{i,t}, \varepsilon_{i,t}$ are sector-specific components.

Persistent Component of Inflation: Macro vs Sectoral Drivers



Persistent Component of Inflation: Macro vs Sectoral Drivers



1. **2008 Financial Crisis:** Trend increase was primarily driven by common macroeconomic forces.
2. **2016 Brexit Referendum:** Driven by a combination of common and sector-specific shocks.
3. **2020 Covid:** Supply chain disruptions and energy shocks led to a broad-based rise in trend inflation. By early 2023, both components declined.

How did Pandemic Shocks affect Goods and Services Trends?



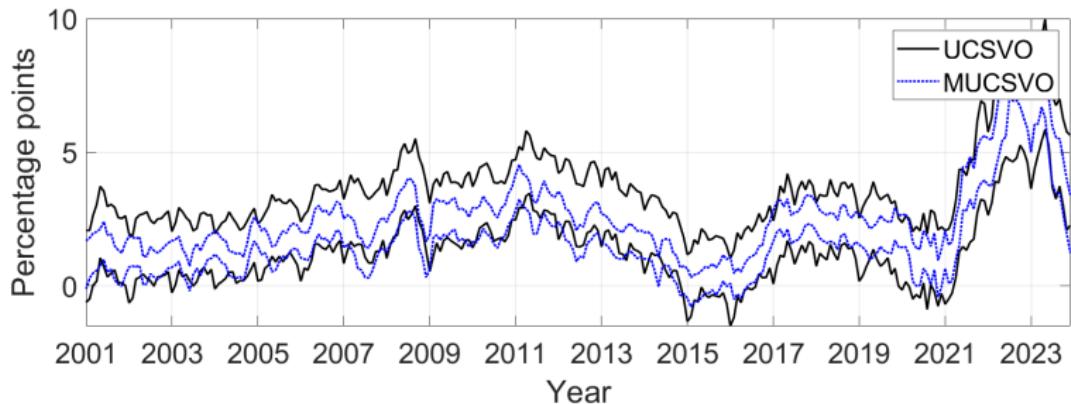
How did Pandemic Shocks affect Goods and Services Trends?



*For central banks, a key responsibility is responding to macro shocks — those affecting the **common component***

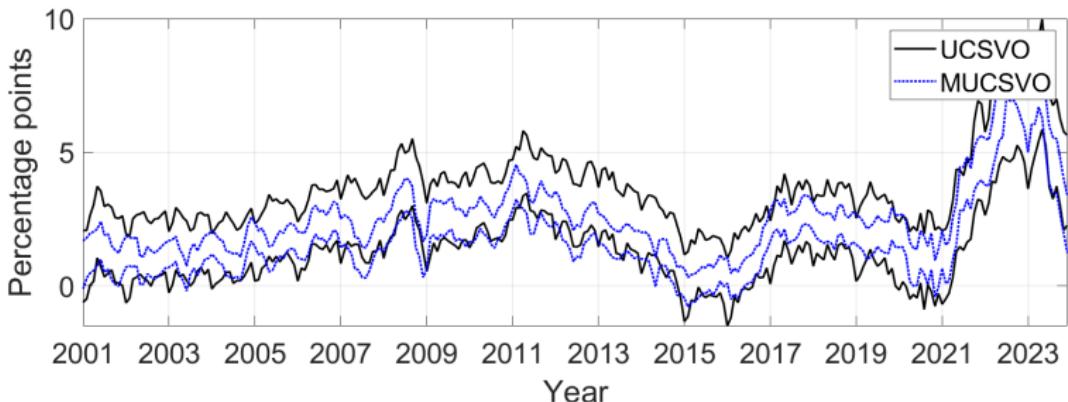
Some Insights into Model Evaluation

Credible Intervals of Trend Estimates



The lines show 68% posterior credible intervals for trend inflation.

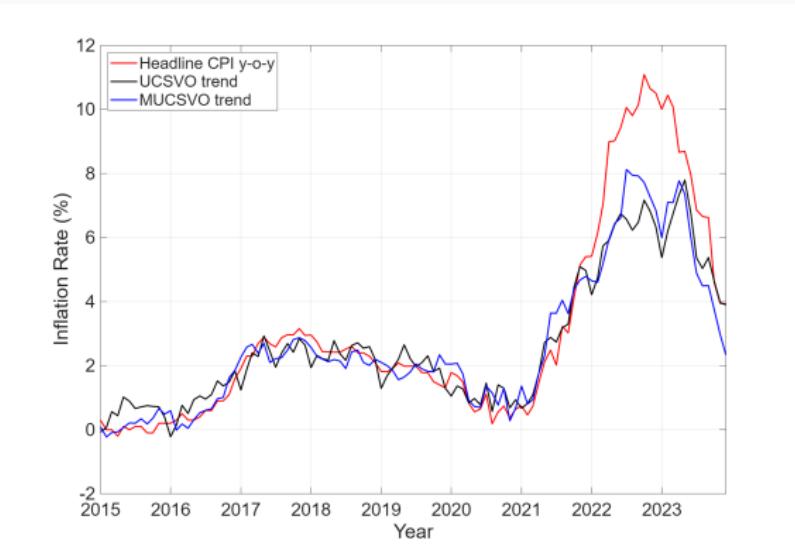
Credible Intervals of Trend Estimates



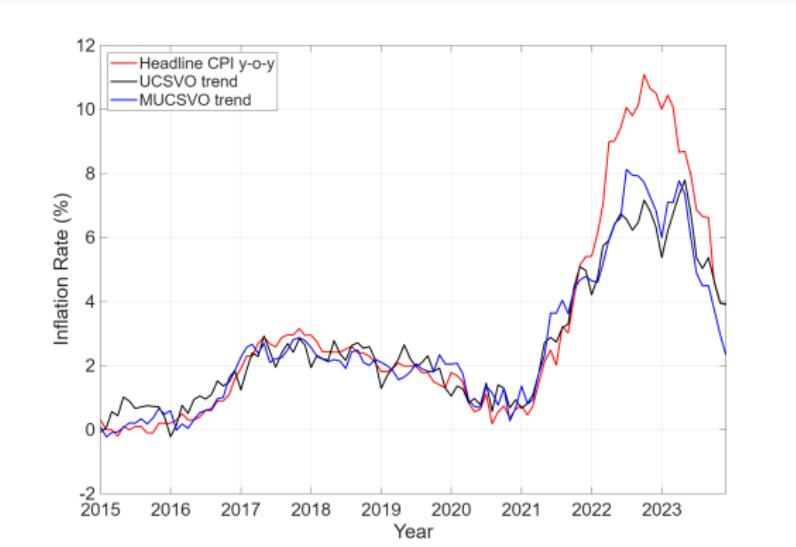
The lines show 68% posterior credible intervals for trend inflation.

- **MUCSVO credible intervals** are 50% narrower than UCSVO.
- **Stock and Watson (2016)** find that **multivariate UCSVO** intervals are 35% (US) and 40% (Euro Area) narrower than univariate model estimates. UCSVO bottom-up

Would the Models have Picked Up the 2021 Inflation Surge?



Would the Models have Picked Up the 2021 Inflation Surge?



- Both **UCSVO** and **MUCSVO** capture the turning point in early 2021.
- Neither model **fully captures** the 2022 inflation peak, though **MUCSVO** provides a closer approximation.
- In 2023, both models **track the subsequent decline** reasonably well.

Conclusion

Conclusion

- We estimate **monthly trend inflation** for UK aggregates and sectors.
- The 2021 inflation surge in the UK was **driven by the persistent component** of inflation.
- **Broad-based macro factors** explain the rise in the persistent component.
- **Sectors** have distinct trend dynamics relevant for policymakers.
- Multivariate UCSVO improves the accuracy of trend estimates.

Thank you!

Sectors classified as Goods and Services

[Back to Data](#)

Goods	Services
Seasonal food	Actual rents for housing
Non-seasonal food	Other housing services
Non-alcoholic beverages	Household services
Alcoholic drinks	Health services
Tobacco	Other services for personal transport equipment
Clothing & footwear goods	Other transport services
Other housing goods	Airfares
Electricity, gas and other fuels	Communication
Household goods	Recreational services
Health products	Package holidays
Purchase of vehicles	Education
Spare parts and accessories for transport	Catering services
Fuels and lubricants	Accommodation services
Audio visual goods	Financial services
Recreational goods	Miscellaneous services
Miscellaneous goods	

Evolution of CPI Sectoral Weights

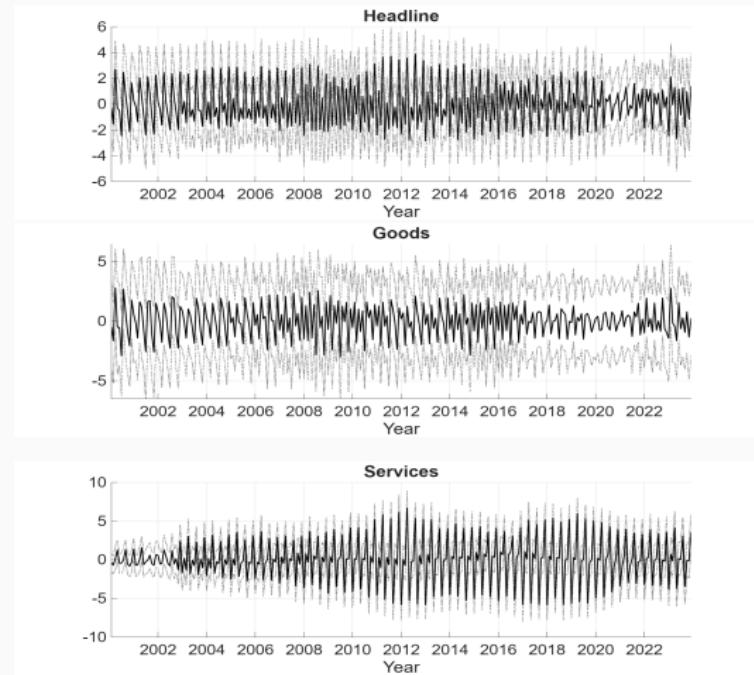
Weights and Dynamics



- CPI sectoral weights (assigned by ONS) evolve slowly over time
- Sharp movements in aggregate inflation are typically driven by price dynamics, not shifts in expenditure weights

Seasonality

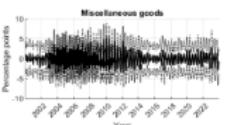
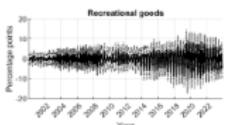
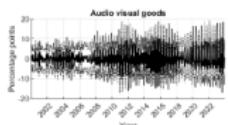
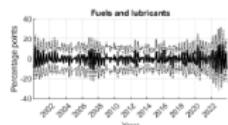
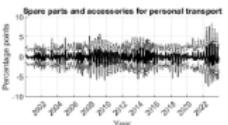
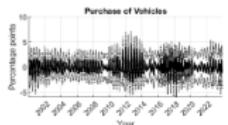
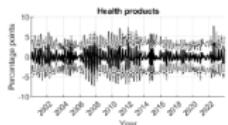
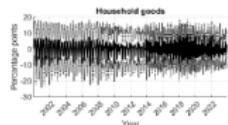
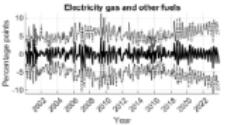
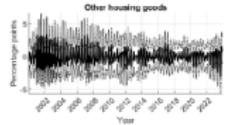
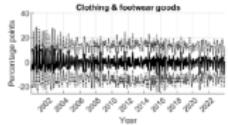
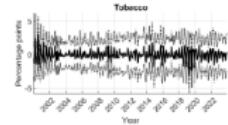
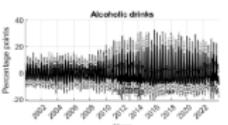
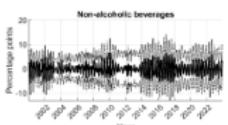
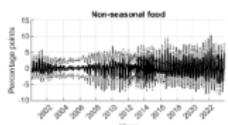
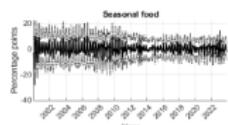
Trend headline



Goods seasonals display a similar pattern and magnitude with headline inflation, while services show more seasonal variation.

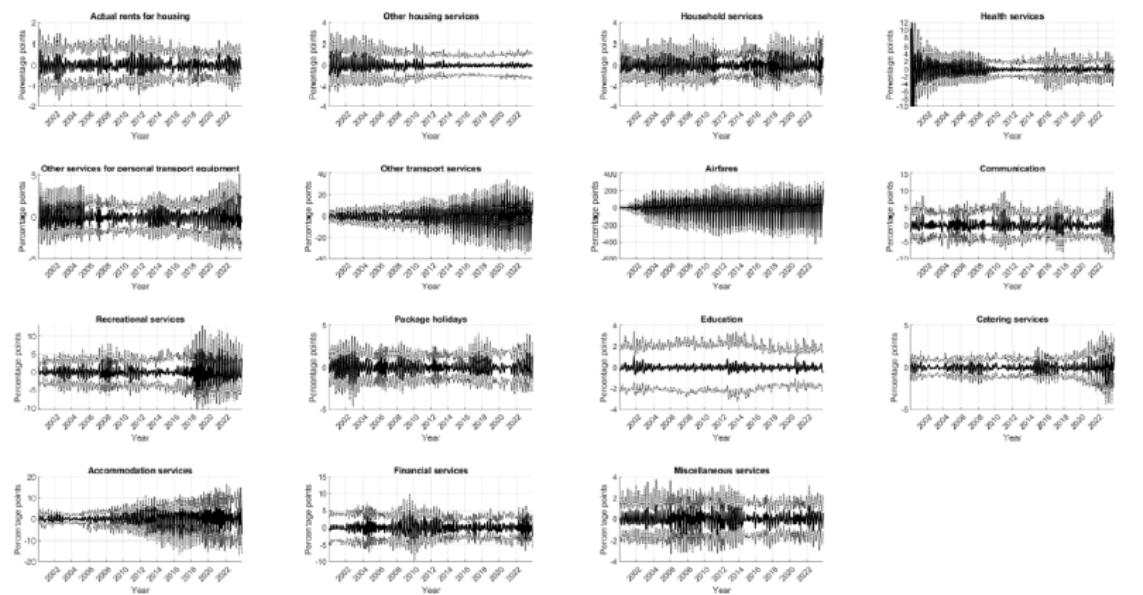
Estimated Seasonal Component from UCSVO - Goods

Sectoral Goods



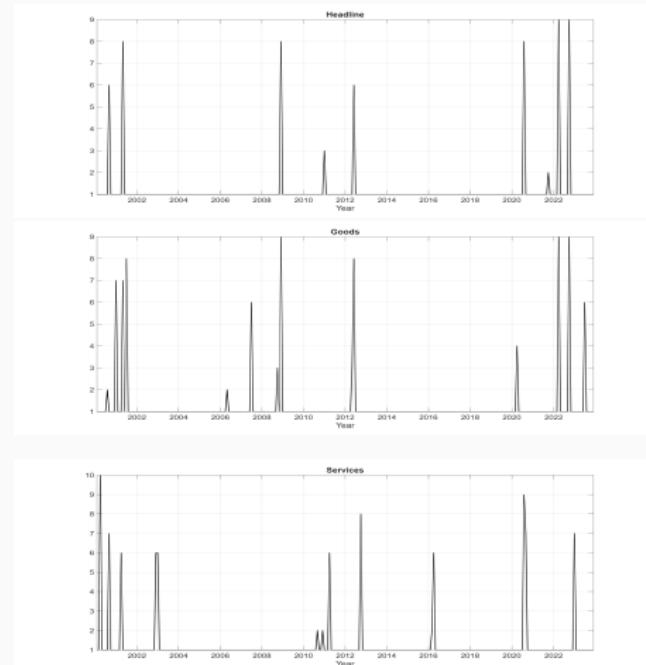
Estimated Seasonal Component from UCSVO - Services

Sectoral Services



Outliers

Trend headline

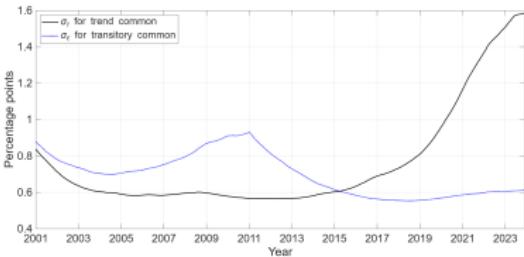


While the specific months in which outliers occur differ, they cluster around mid-2000s, global financial crisis and recent inflationary surge.

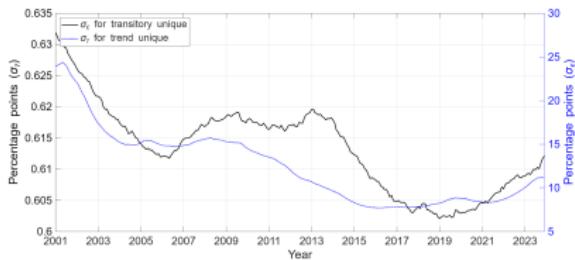
Stochastic Volatilities: Macro vs Sectoral

Multi trend

Estimated volatilities for common



Estimated volatilities for unique

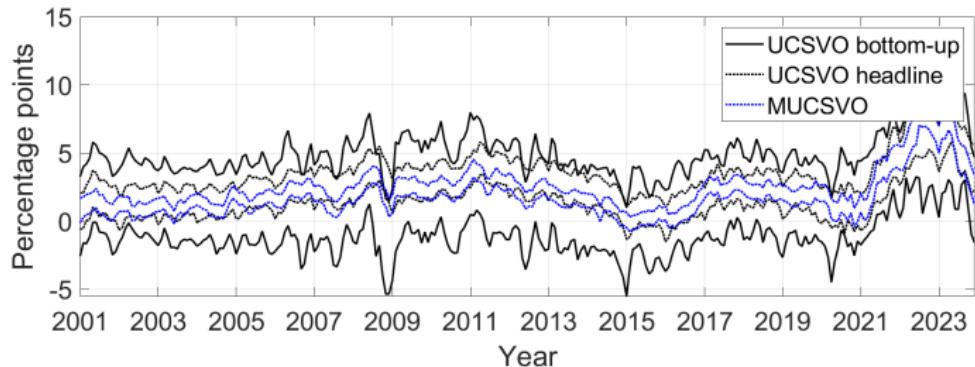


- Common macro forces became more volatile; more co-movement across sectors
- Sector-specific volatility declined pre-Covid, but picked up during pandemic

Rise in both common trend and its volatility points to a macro-driven rise in trend inflation.

Credible intervals of trend estimates

Credible intervals



MUCSVO bands are 80% narrower than UCSVO bottom-up, and 50% narrower than UCSVO headline.

Forecast Performance Comparison

Trend accuracy

Trend Inflation Forecasts Across Horizons

	Full sample			Pre-Covid			Post-Covid		
	1m	3m	6m	1m	3m	6m	1m	3m	6m
Headline	0.40	0.79	1.32	0.14	0.28	0.47	0.52	1.01	1.70
Goods	0.60	1.15	1.96	0.24	0.48	0.90	0.76	1.46	2.48
Services	0.33	0.50	0.72	0.19	0.24	0.31	0.41	0.63	0.92
Health goods	0.64	1.03	1.68	0.30	0.36	0.41	0.80	1.32	2.19
Package holidays	0.52	1.15	2.03	0.31	0.77	1.49	0.63	1.37	2.35

- We focus on trend inflation estimation, but accurate trends improve forecast performance.
- Out-of-sample forecast using UCSVO model for 2016–2023.
- Forecast accuracy declines with horizon.
- RMSE is lower in the pre-Covid period.
- RMSE for goods is higher than for services.

Would the Models have Picked Up the Recent Rise in Inflation?

- CPI excl. petrol & utilities

