# The Global Inflation Shocks

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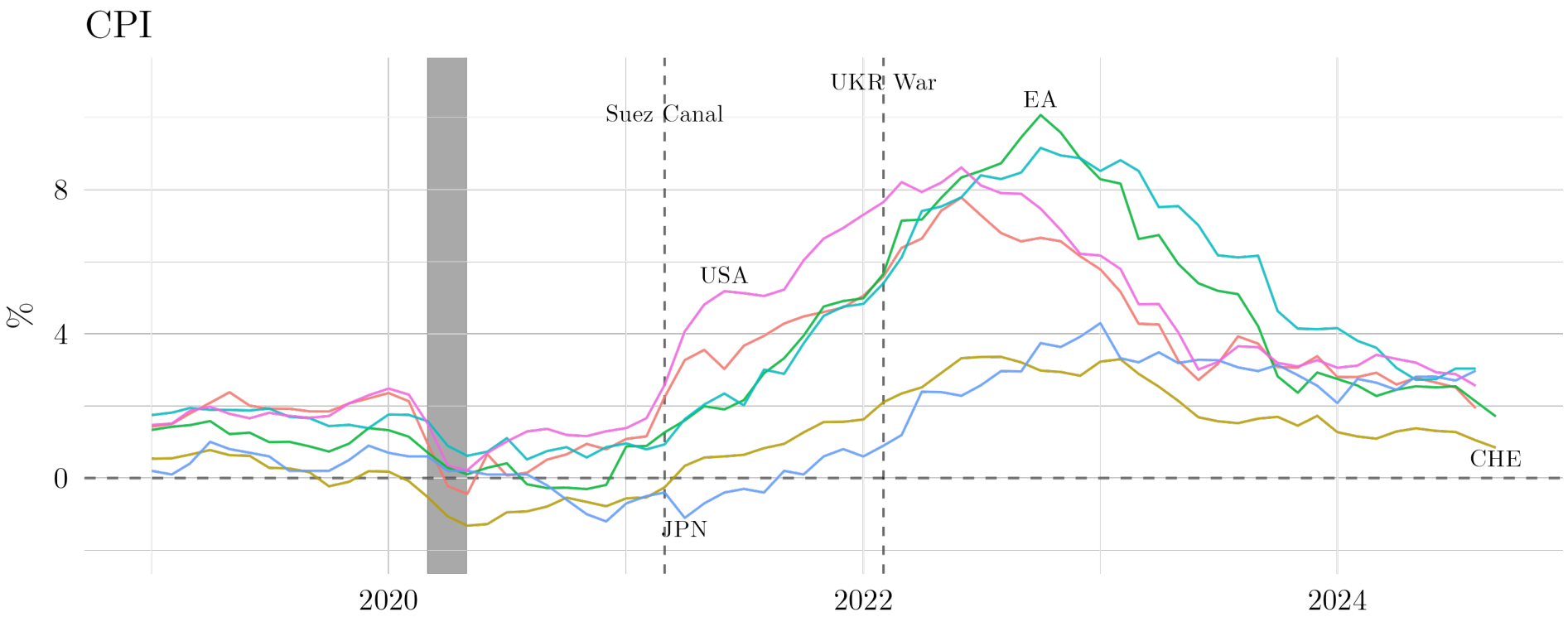
November 18, 2024

# Introduction

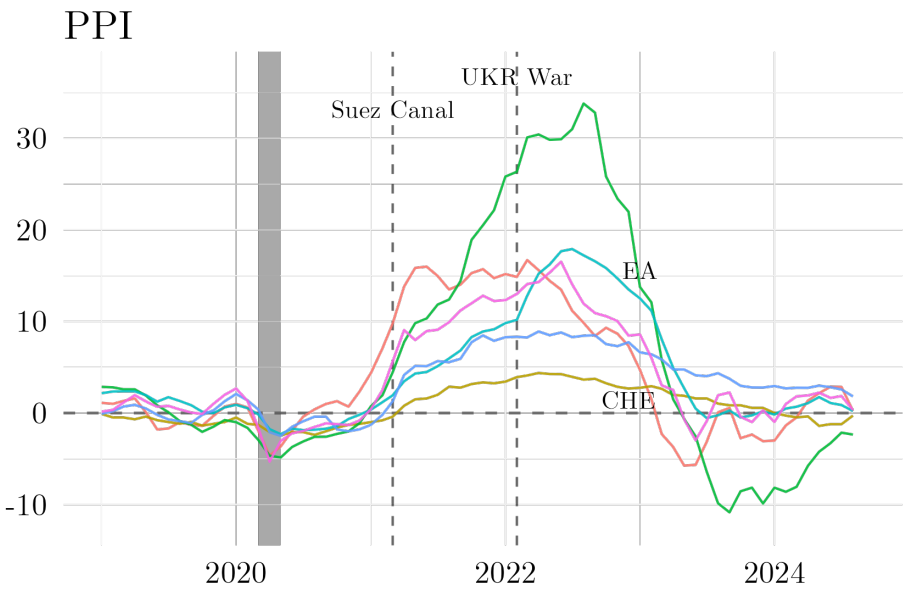
- Key Question: What role do global shocks play in the recent surge in inflation?
- Motivation:
  - Post-pandemic inflation spike;
  - Importance of distinguishing between global supply and demand factors;
  - Behavior of different measures of inflation (Headline, Core, Goods, Service, Producer, Import)
  - Designing effective policy responses
- Background:
  - "The GSCPI: A New Barometer of Global Supply Chain Pressure (May 2022)", FRBNY staff report 1017 (Benigno et al.)
  - "The Global Supply Side of Inflationary Pressures", by Akinci et al., Liberty Street Blog (January 2022)
  - "New Barometer of Global Supply Chain Pressures", by Benigno et al., Liberty Street Blog (January 2022)

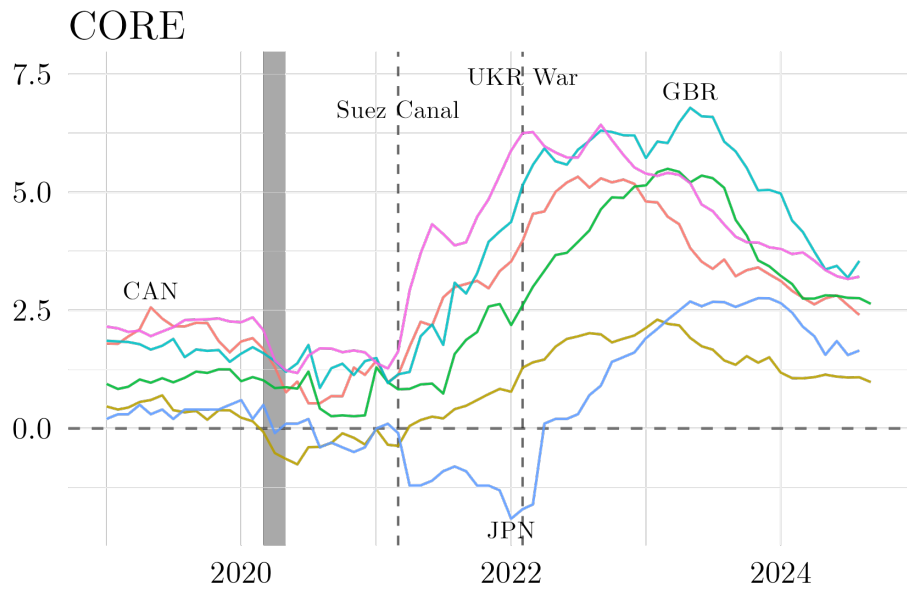
# Evolution of Different Measures of Inflation: CPI




- Comovements among countries are quite pronounced.

# Evolution of Different Measures of Inflation: Core and PPI




- The pattern of different measures of inflation differs among countries.
- Still differences relative to the pre-pandemic period.

# This research: What is the Role Global Shocks?

What is the Role of Global Shocks?

- Types of Inflation:
  - Consumer Price Index (CPI): broad-based increases
  - Producer Price Index (PPI): more volatile and responsive
  - Core Inflation (excluding food and energy): persistent but slower rise.
- Examine the behavior of these measures of inflation through the lens of global shocks: Global Supply Chain Pressure Index (NYFRB), Global Demand Pressure (NYFRB), Oil Supply Shocks (NYFRB)

# How do we conduct our analysis?

How do we conduct our analysis?

- Starting point: Global Shocks (identified)
- Local Projection Method (Jorda, 2005) applied at different levels for each measure of inflation:
  - Individual Country;
  - Principal Component;
  - Panel Analysis;
- Impulse Responses and Historical Decomposition.

# Results

Our Preliminary Results:

- Strong role of Global Factors in driving different measures of inflation (both in pre and post-pandemic samples) with PPI >CPI>Core.
- Impulse Response analysis shows the persistent response to GSCPI shock (whole sample);
- Historical Decomposition: our global factors track first principal component well in the pre-pandemic sample. Accounting for individual country inflation shows differences in terms of relative importance of our shocks during pandemic.

# GSCPI: quick background

- **Idea behind GSCPI:**
  - Construct a parsimonious indicator that provides a bird's-eye perspective of developments at the supply level of the global supply chain.

- **Construction Steps:**
  - Collect various indicators (global transportation, sub-components PMIs (delivery times, backlogs, Purchase Stocks)
  - Geographical Coverage: U.S., Euro-area, UK, Japan, Taiwan, South Korea and China
  - Isolate the supply component:
    - Regress supply chain components of PMIs on corresponding PMI "New Order" data.
    - Regress global transportation costs on GDP-weighted "New Orders" and "Quantities Purchased" from national PMIs.
  - Use residuals to run a principal component analysis (PCA) to extract a common global component: **GSCPI**.

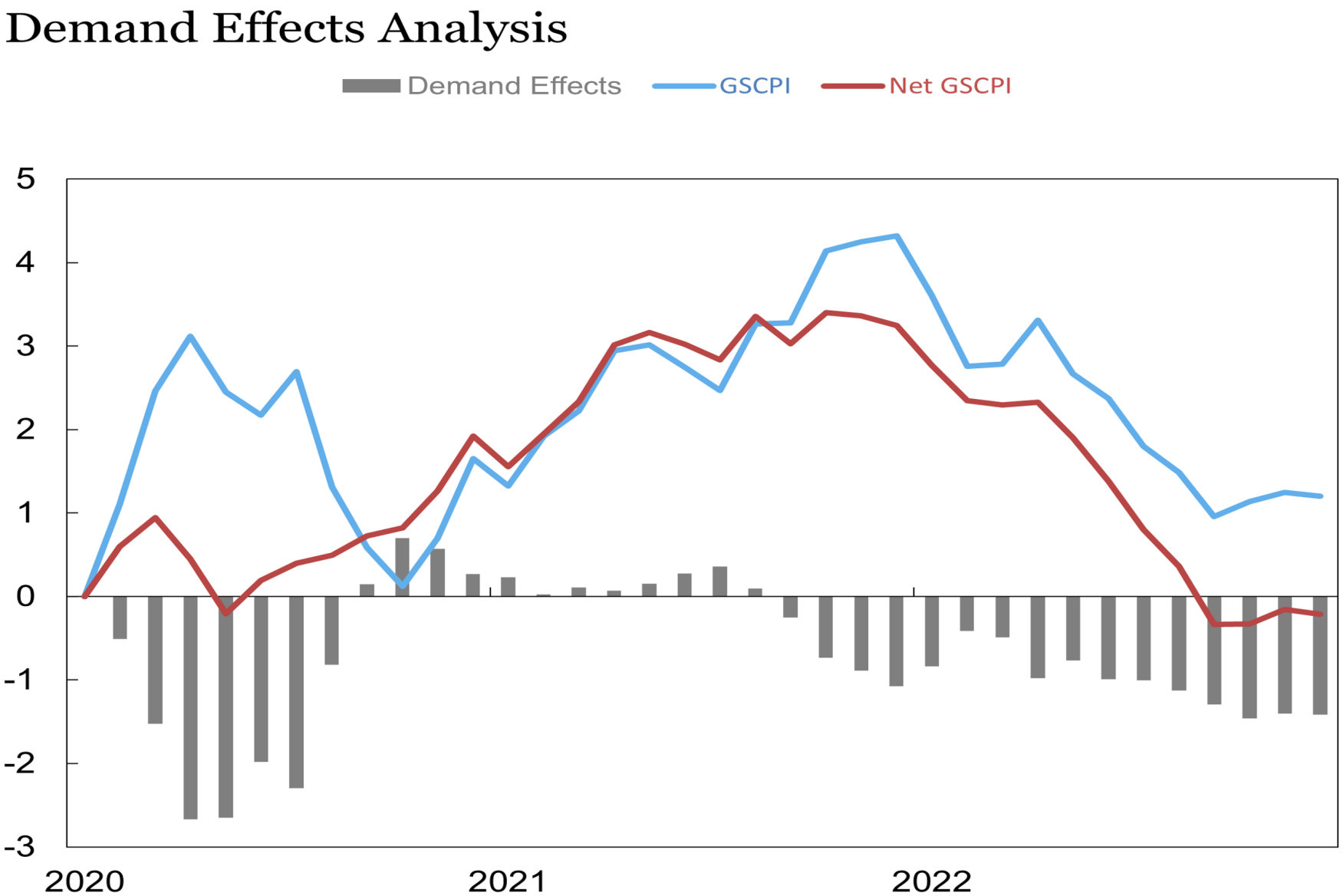
# Net GSCPI and Global Demand Pressure

How do we extract Global Demand Pressure?

- **Construct Net GSCPI**
  - Use the same series as GSCPI but we do not isolate the supply component;
  - Use standardized series to extract principal components that proxy net pressures at the global supply chain level.

- **Construction Global Demand Pressure**
  - Compute the difference between the GSCPI and Net GSCPI by initializing the indexes at zero at a given point in time to compare them over time.
  - Difference is global demand pressure.

# Illustration Net GSCPI

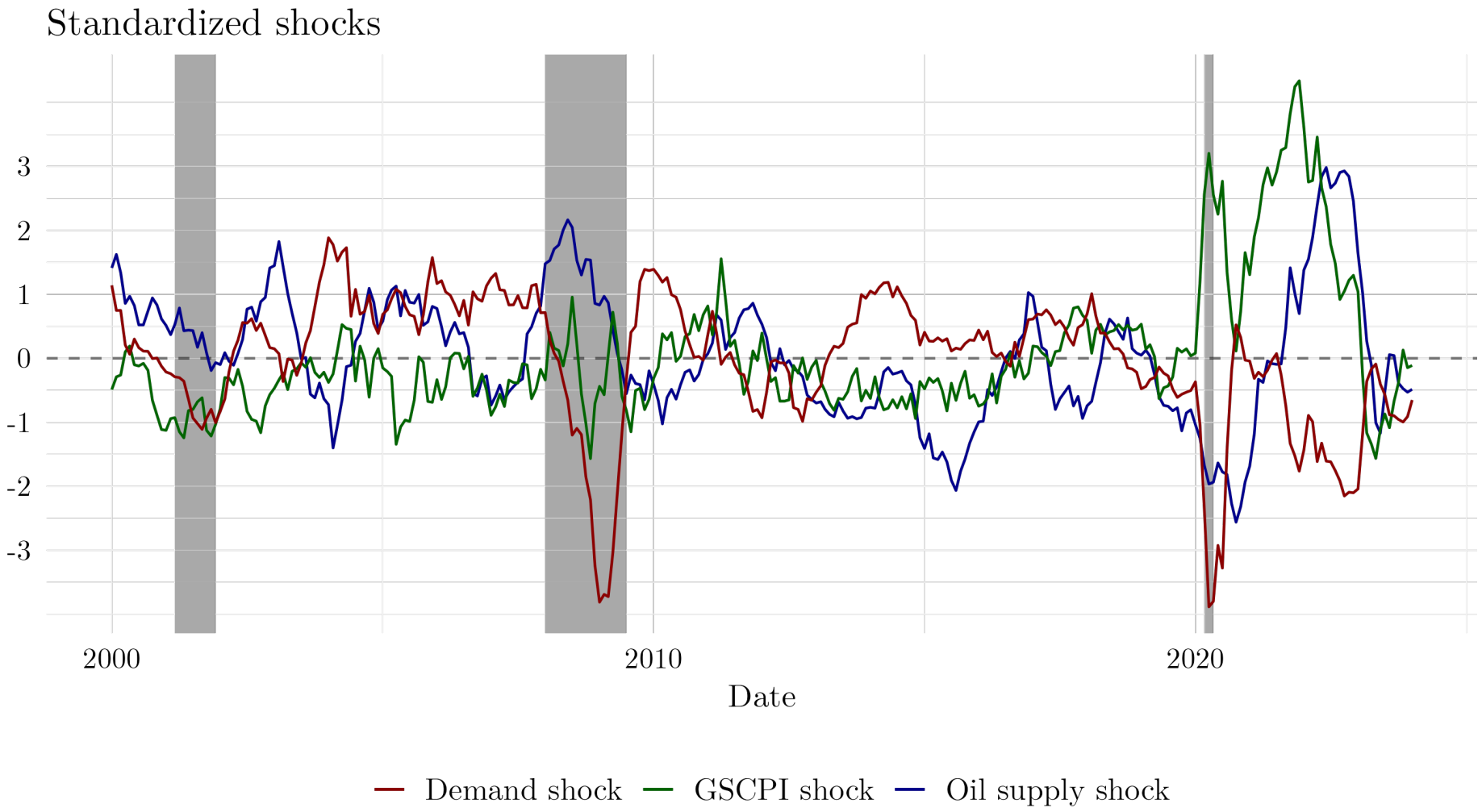


# Global Supply-Side Variable: Oil Prices

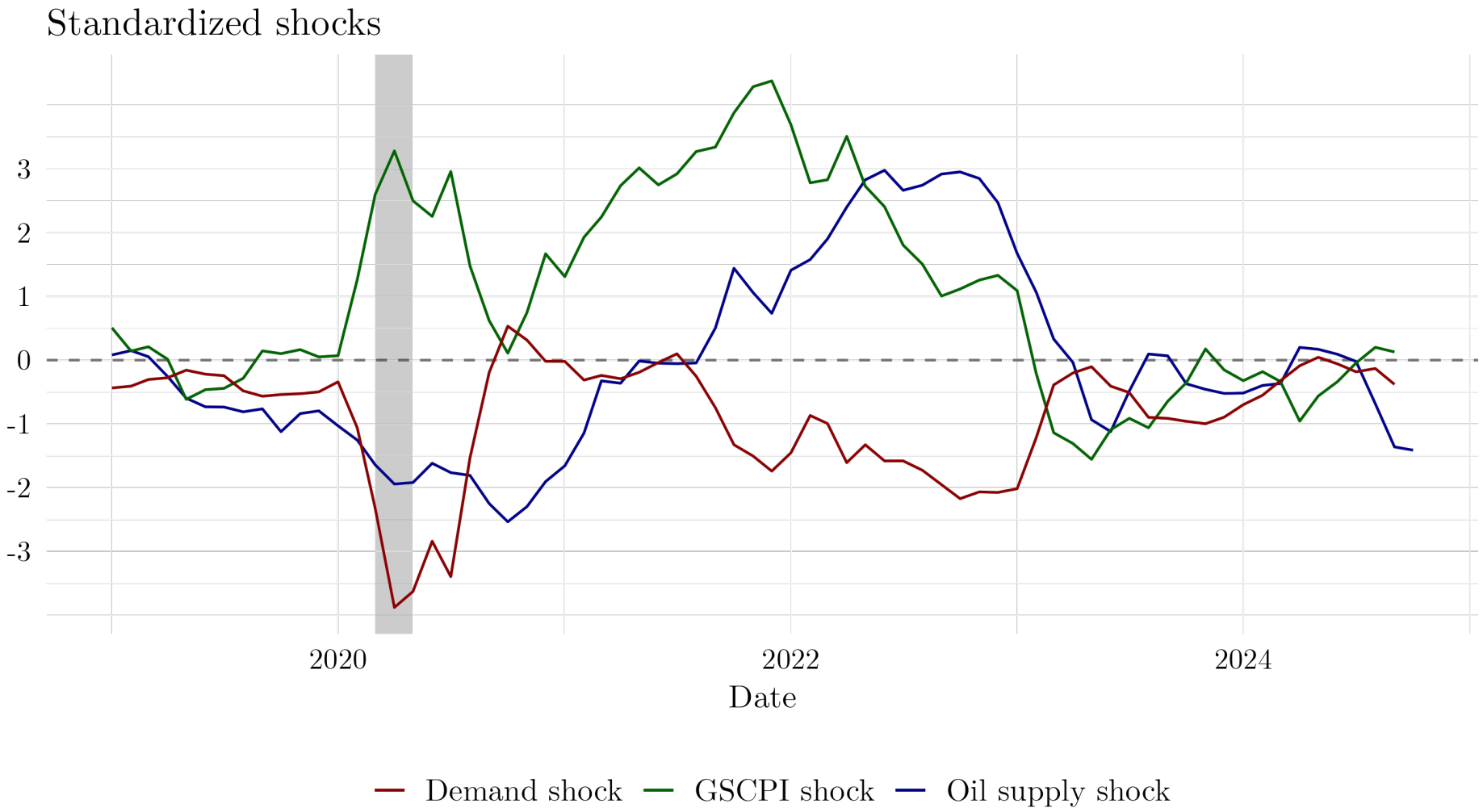
- **Oil Price Decomposition:**
  - Methodology of Groen, McNeil, and Middeldorp (2013) to separate:
    - **Demand Shocks:** Reflect changes in global demand for oil.
    - **Supply Shocks:** Capture variations in oil production or supply disruptions.
  - The approach leverages correlations between oil price changes and a large number of financial variables, assuming that demand and supply shocks generate distinct patterns in these correlations.

- **Details:**
  - The analysis uses the **Brent benchmark oil price** as a proxy for global market conditions.
  - Weekly oil price changes are decomposed into demand and supply effects, along with an unexplained residual.
  - These decompositions were released as the Federal Reserve Bank of New York's *Oil Price Dynamics Report*.

# Evolution of Different Shocks

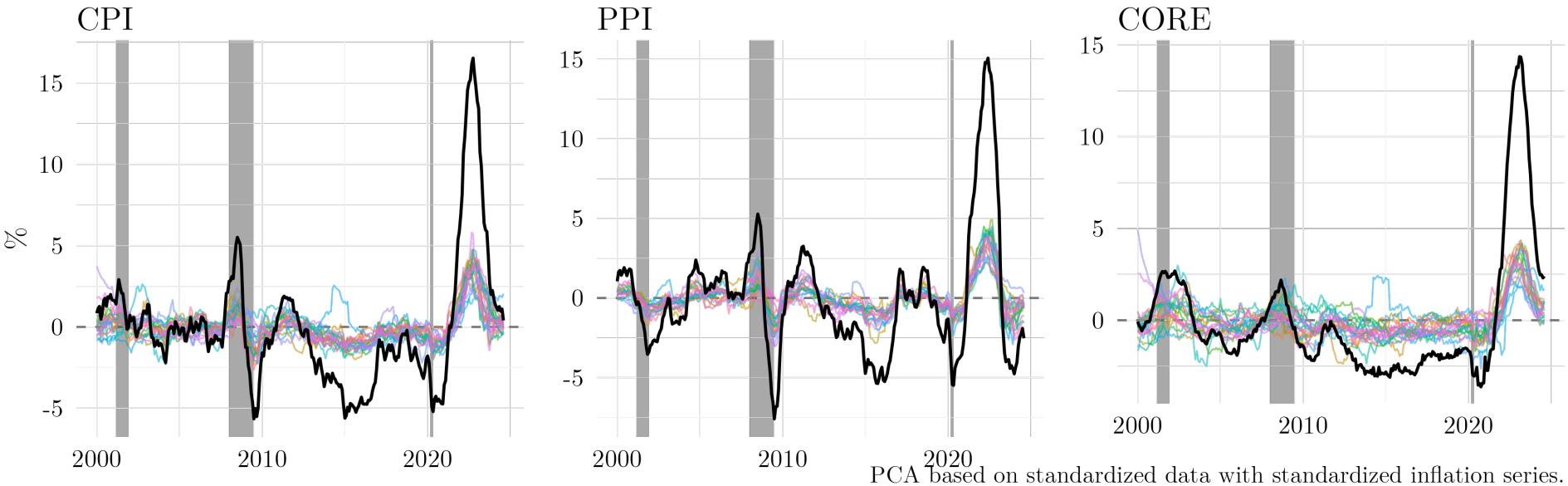


# Evolution of Different Shocks Zooming In



# Data Overview and Principal Component

- Dataset: 22 countries (2000–2024) Year-on-year log changes for CPI, PPI, and Core Inflation




PCA based on standardized data with standardized inflation series.

# Principal Component Analysis: Implications

- Observations
  - The first principal component (PC1) typically captures the largest amount of shared variance across countries' inflation rates, the common global inflation trend.
  - Second principal component: orthogonal to the first component. Represent divergent patterns of inflation (country-specific or regional elements )

Table: Share of inflation variance explained

| | CPI | | PPI | | Core | |
|---|---|---|---|---|---|---|
| Country | PC1 | PC2 | PC1 | PC2 | PC1 | PC2 |
| Euro Area | 97.04 | 0.29 | 93.63 | 4.14 | 92.79 | 0.17 |
| Japan | 20.63 | 57.32 | 60.08 | 13.95 | 11.92 | 37.09 |
| United Kingdom | 78.52 | 8.15 | 84.93 | 3.9 | 56.83 | 18.19 |
| United States | 74.87 | 0.06 | 86.34 | 5.34 | 66.23 | 6.58 |

*Notes:* The values shown the $R^2$ of a regression of the national inflation rate on PCs and a constant.

# Principal Component: Pre and Post-Pandemic

- Dominant Role of global trend also in pre-pandemic.

Table: Share of **CPI** variance explained by the first PC for different periods

| Country | 2000:2024 | 2000:2019 | 2021:2024 |
|---|---|---|---|
| Euro Area | 97.04 | 90.04 | 99.05 |
| Japan | 20.63 | 0.85 | 31.47 |
| United Kingdom | 78.52 | 32.82 | 90.98 |
| United States | 74.87 | 64.79 | 61.18 |

*Notes:* The values show the $R^2$ of a regression of the national inflation rate on the first principal component.

# Principal Component: Pre and Post-Pandemic

- The Role of the common trend component is stronger for producer inflation.

Table: Share of **PPI** inflation variance explained by the first PC for different periods

| Country | 2000:2024 | 2000:2019 | 2021:2024 |
|---|---|---|---|
| Euro Area | 93.63 | 92.09 | 98.5 |
| Japan | 60.08 | 58.09 | 81.91 |
| United Kingdom | 84.93 | 84 | 87.88 |
| United States | 86.34 | 81.38 | 93.33 |

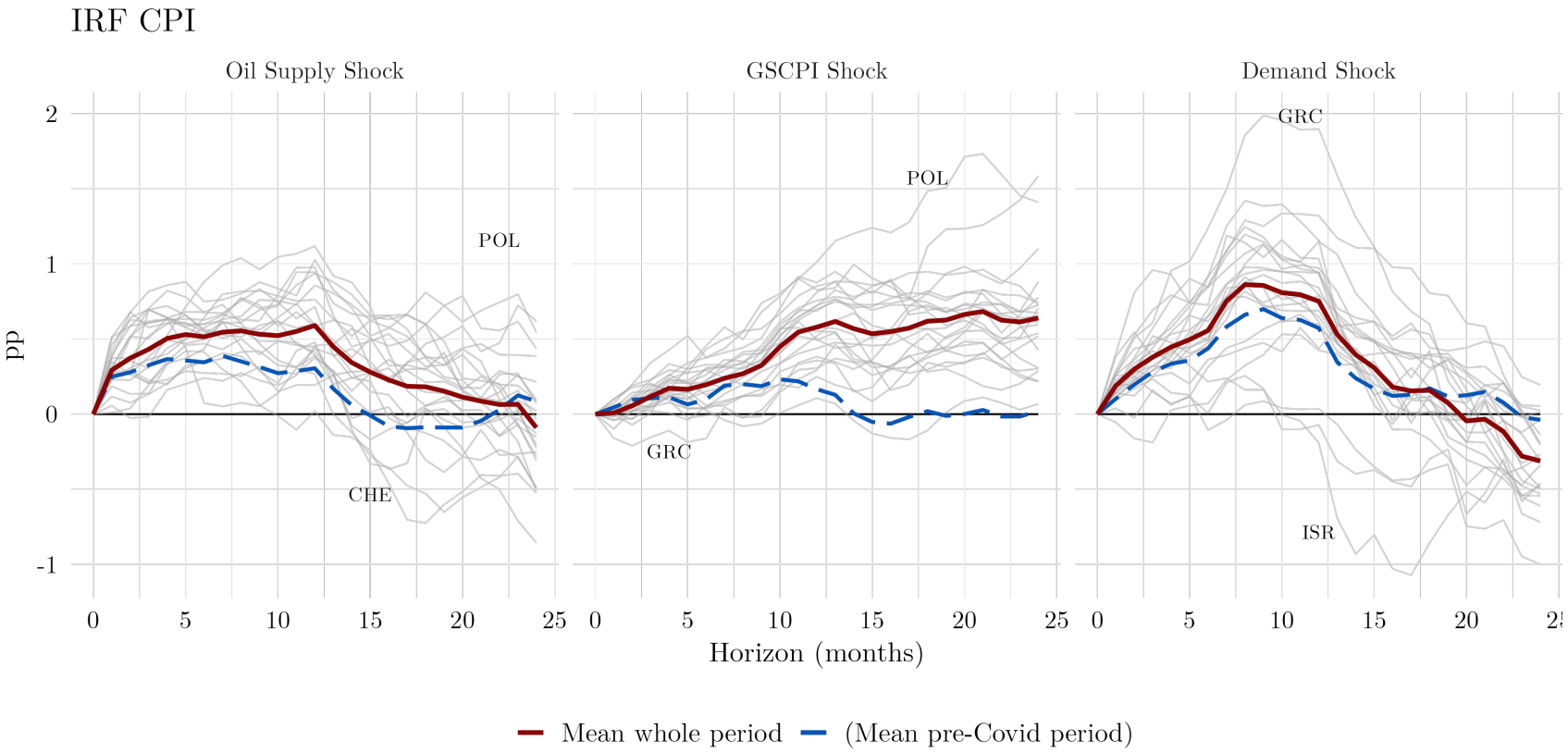
*Notes:* The values show the $R^2$ of a regression of the national inflation rate on the first principal component.

# Methodology: Local Projection

- Local Projection Methods (Jordà, 2005)
- Inflation Measures:
  - CPI, PPI, and Core Inflation
- Shock Identification:
  - Recursive ordering: Oil $\rightarrow$ GSCPI $\rightarrow$ Demand
  - Controls: Lagged inflation, GDP, and shocks
- Local Projection Model: individual country analysis, first principal component, panel analysis.

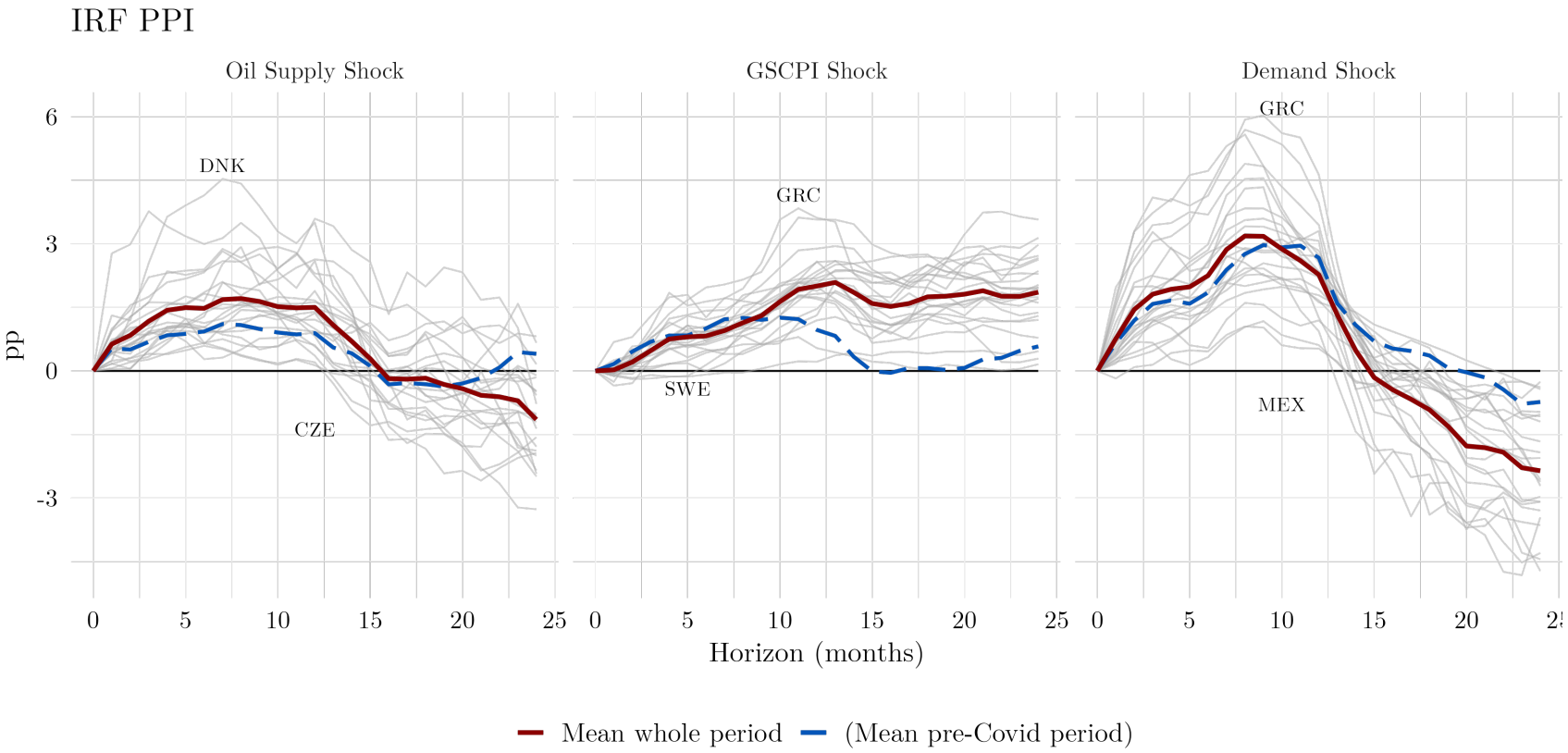
$$y_{t+h} = \alpha^h + \beta^h \, shock_t^k + \boldsymbol{\gamma^h} \cdot \boldsymbol{w_t^{S-k}} + \sum_{i=1}^{p} \boldsymbol{\delta_i^h} \left(shock^S\right)_{t-i}$$
$$+ \sum_{i=0}^{p} \theta_i^h \, gdp_{t-i} + \sum_{i=0}^{p} \vartheta_i^h \, y_{t-i} + \varepsilon_{t+h}$$

# Individual Country Analysis: CPI



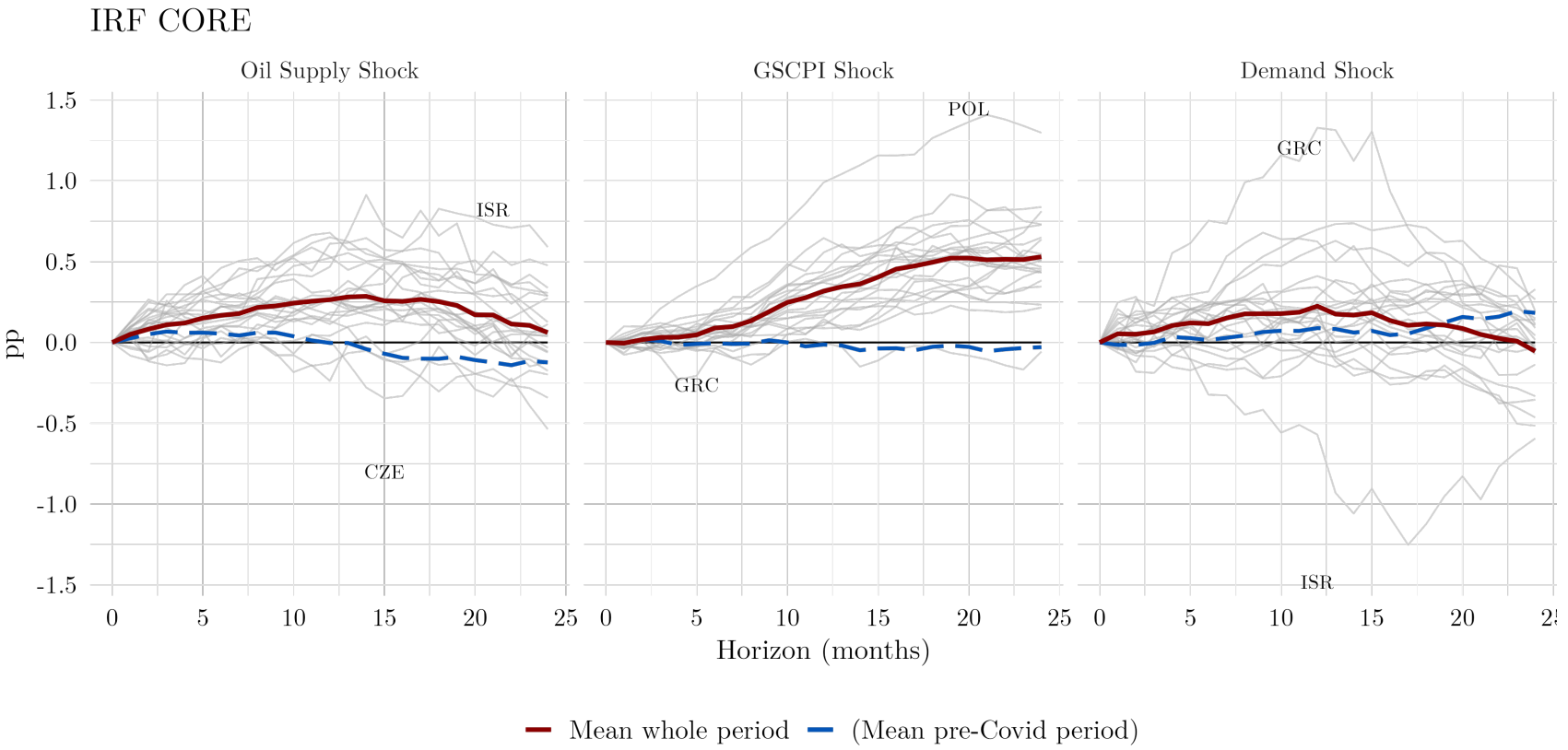

- Strong comovement across countries;
- GSCPI response differs significantly across samples in size and persistence.

# Individual Country Analysis: PPI



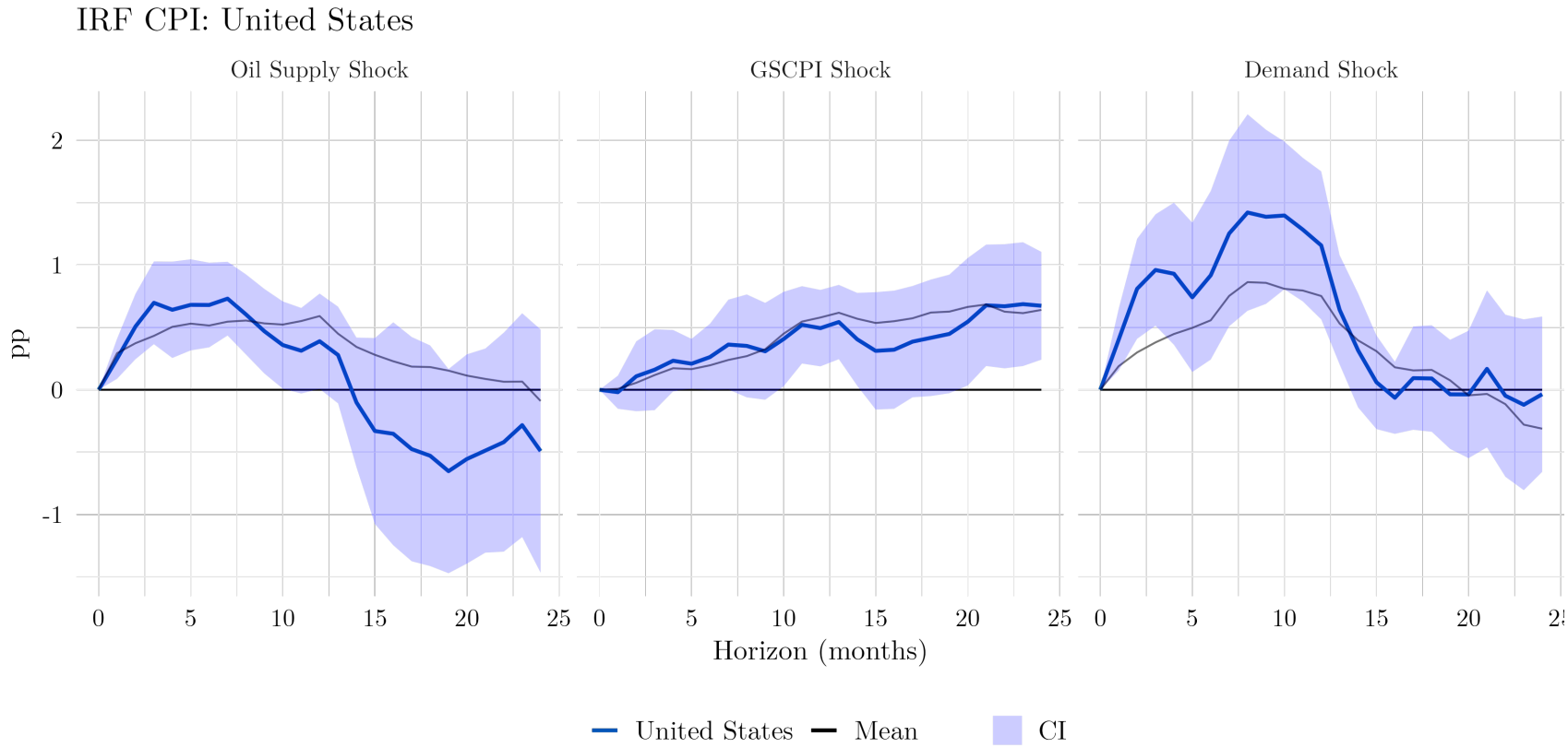

- Size of responses is bigger than CPI but with a similar pattern;

# Individual Country Analysis: Core




- Core inflation is less responsive compared to PPI and CPI.

# Individual Country Analysis: USA

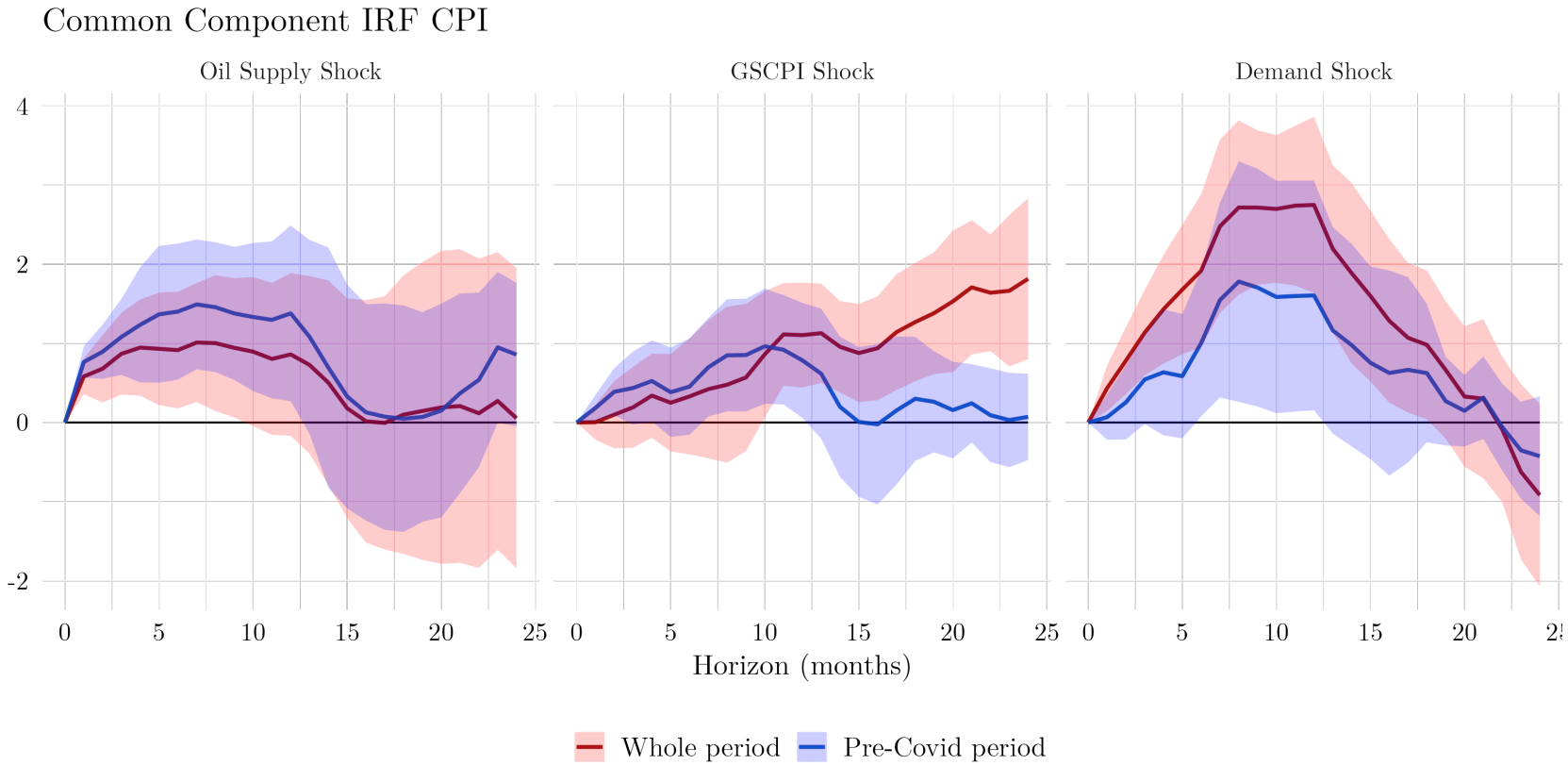



- The response of the USA for CPI inflation is close to the mean response

# Principal Component Approach

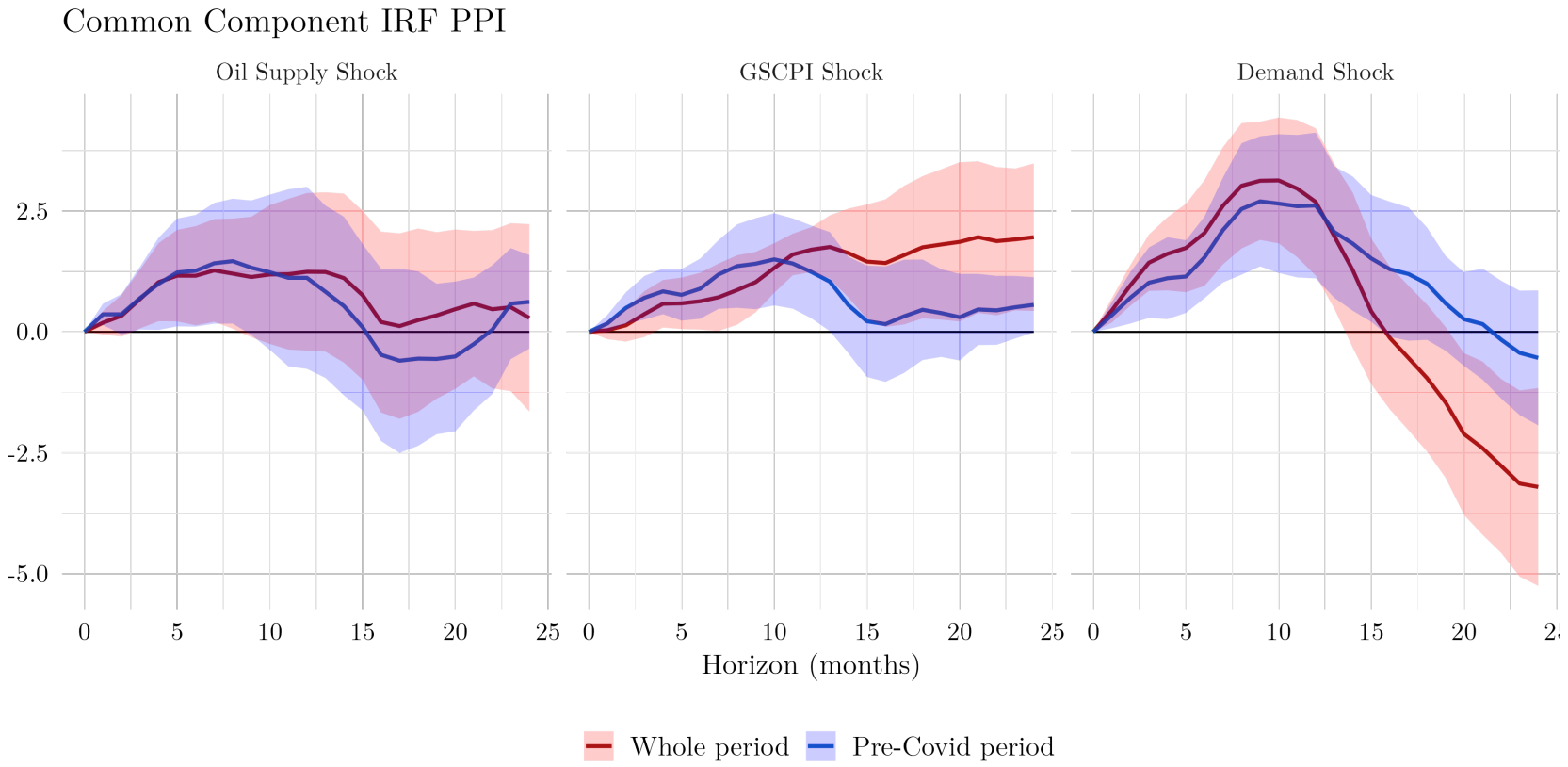
- Methodology:
  - Extract the first principal component of inflation measures
  - Represents shared global inflation trend
- Findings
  - Strong persistence of GSCPI shock during the pandemic
  - Rapid response to oil supply shocks;

# PCA Results: CPI



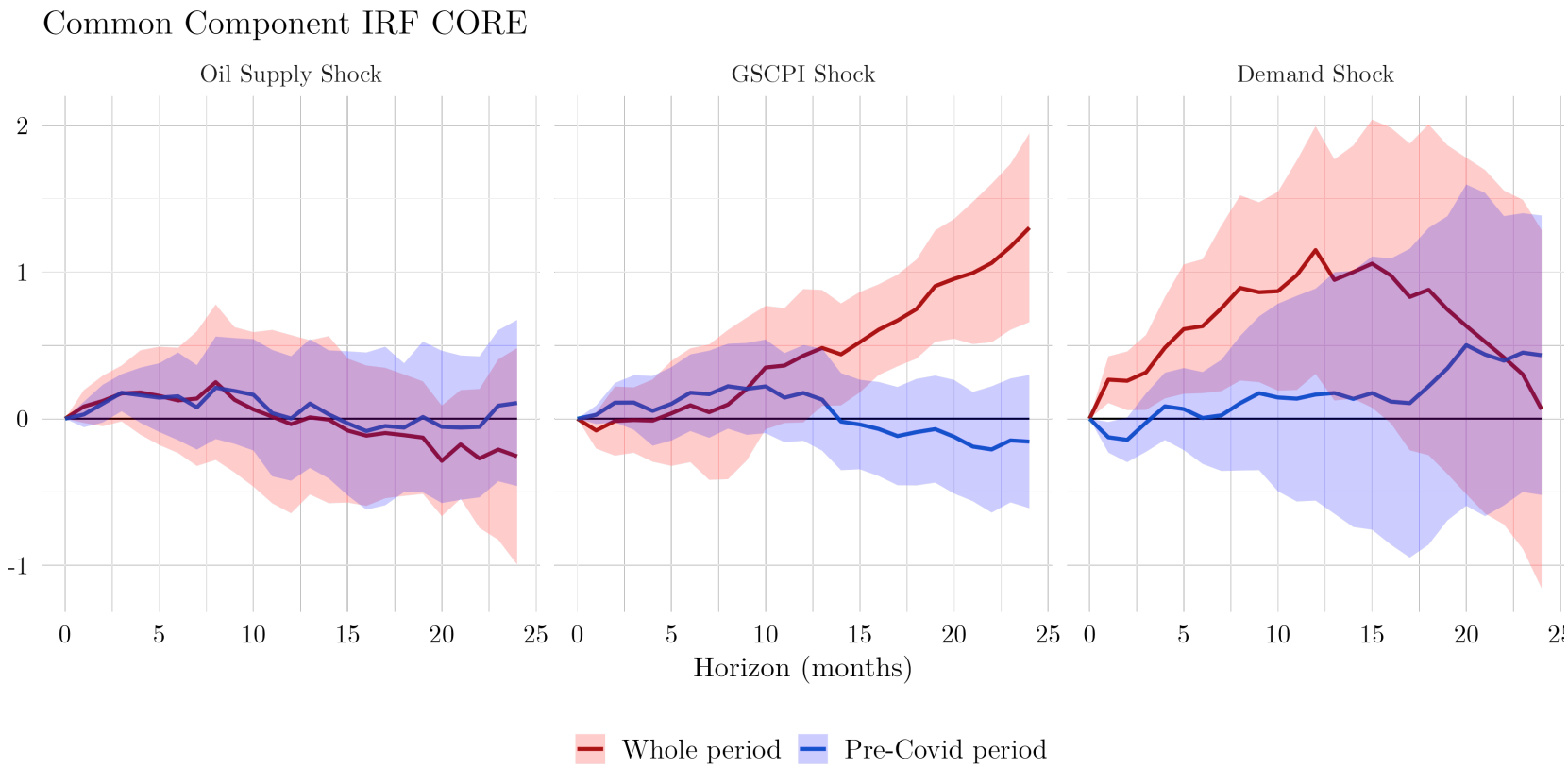

- Result very comparable to the mean response from the individual country approach;

# PCA Results: PPI




- GSCPI shock more persistent when including the COVID period

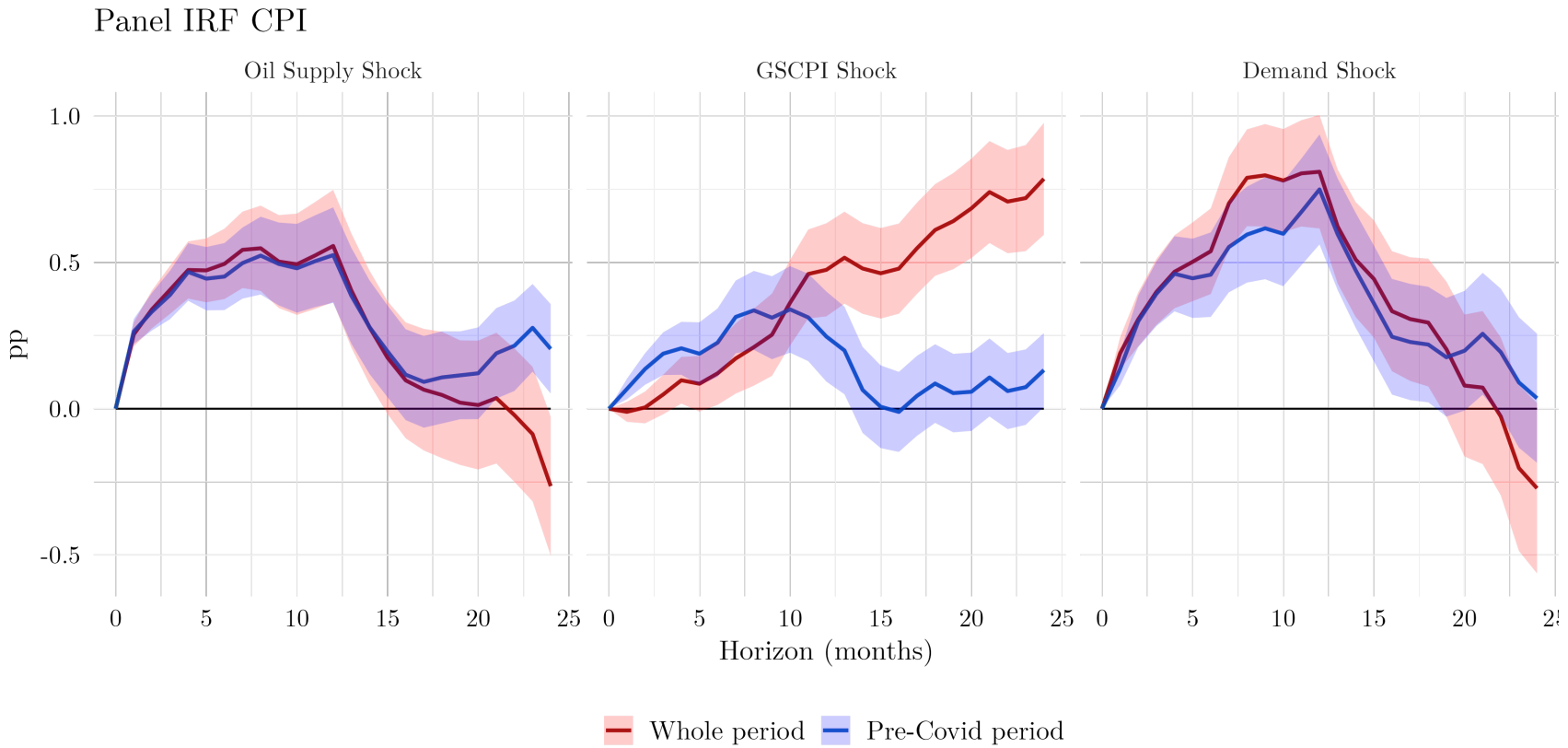
# PCA Results: Core



# Panel Regression Approach

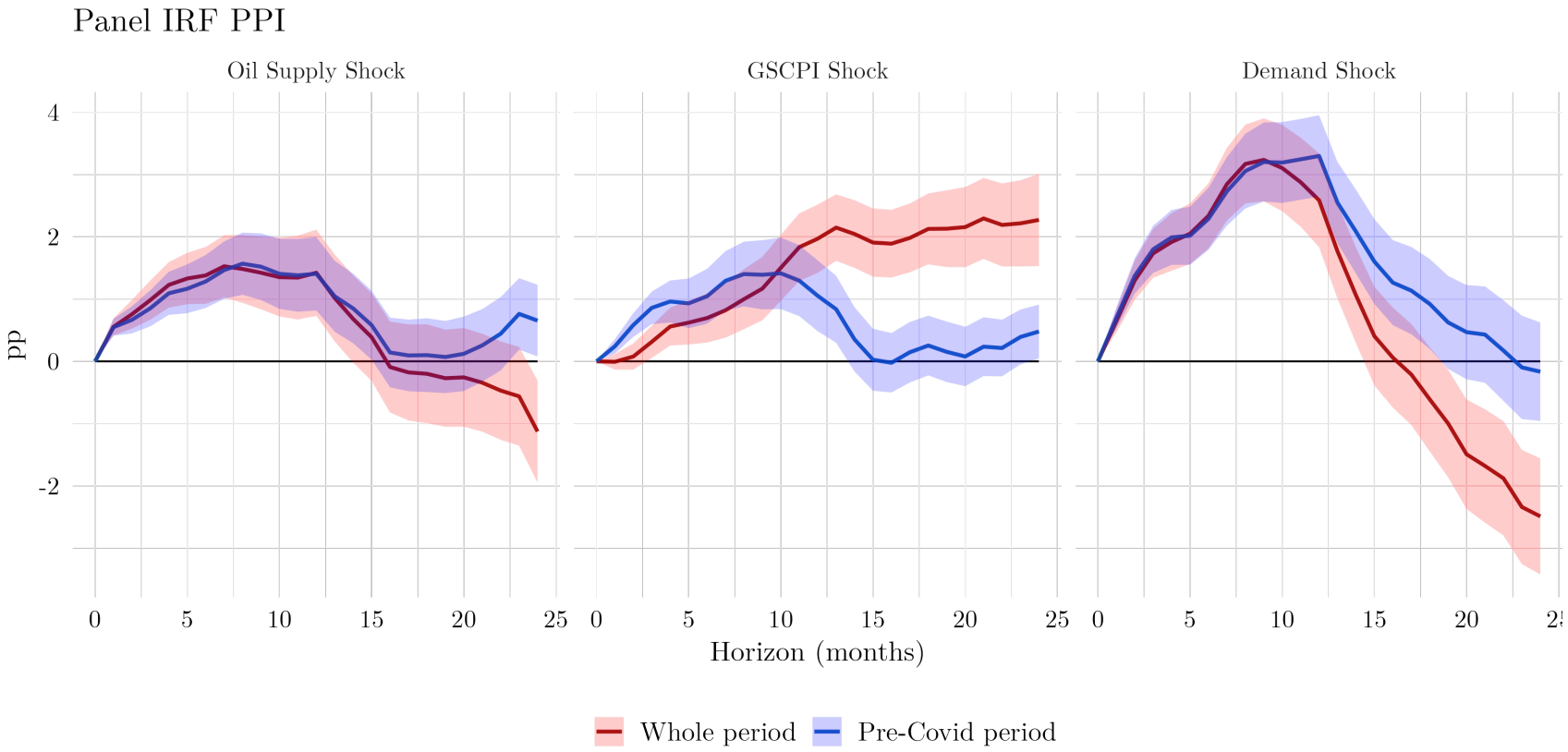
- Methodology:
  - Includes country-fixed effects
  - Leverages cross-country variation
- Findings:
  - Narrower error bands due to higher precision
  - Aligns with PCA and individual regressions

# Panel Results: CPI



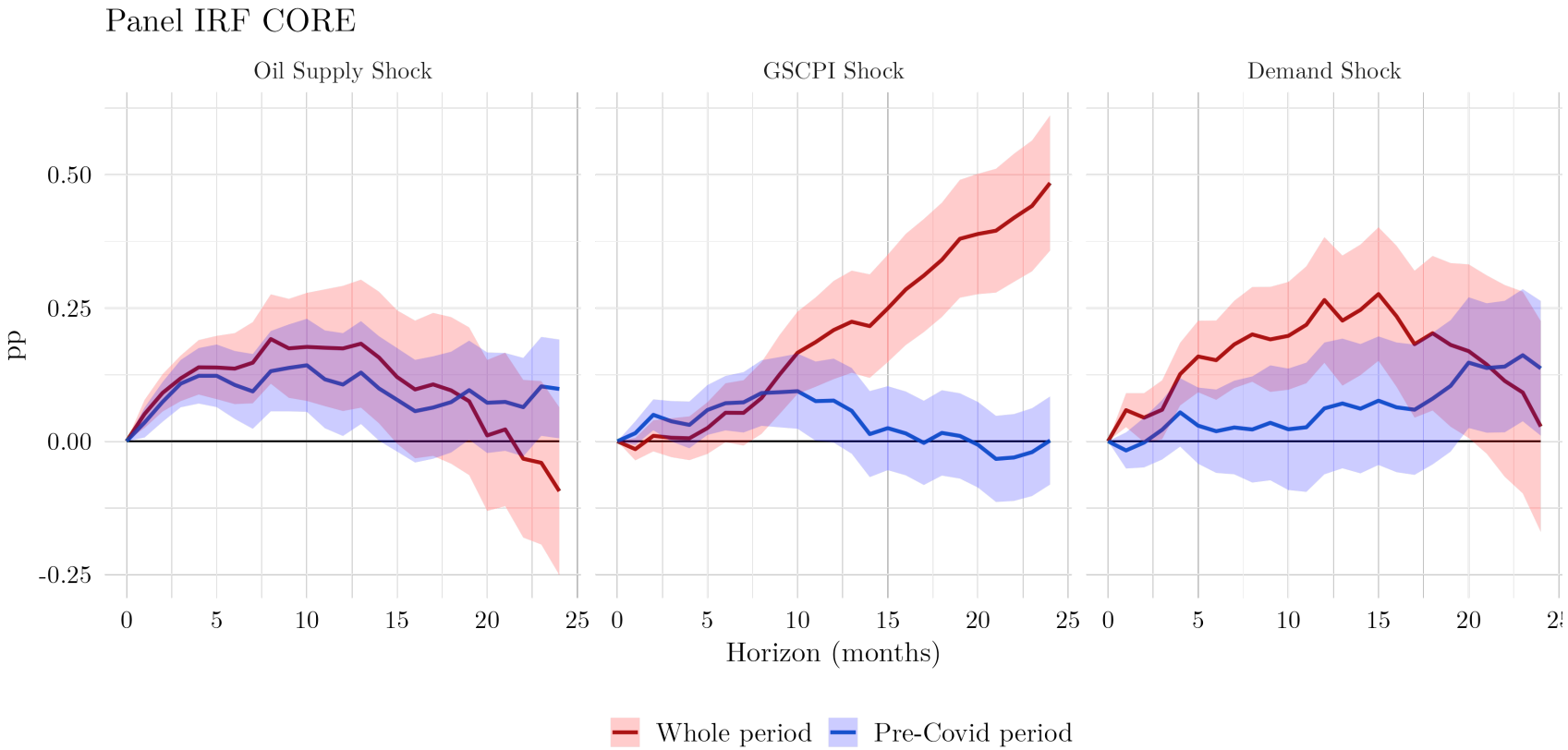

- One difference is the stronger impact to the global demand shock relative to other approaches.

# Panel Results: PPI




- Overall similar to other approaches.

# Panel Results: Core




- More muted responses on core and delayed response of GSCPI on full-sample.

# Comparing Methodologies

- Consistency:
  - Similar inflation responses across PCA, panel regression, and individual country regressions.
  - Robustness of results highlights key drivers.
- Differences:
  - Panel regression: Improved precision with narrower error bands.
  - PCA: Captures global inflation trends over individual-country nuances.
- **Appendix Figure A1: Comparative View of Approaches.**

Comparison approaches

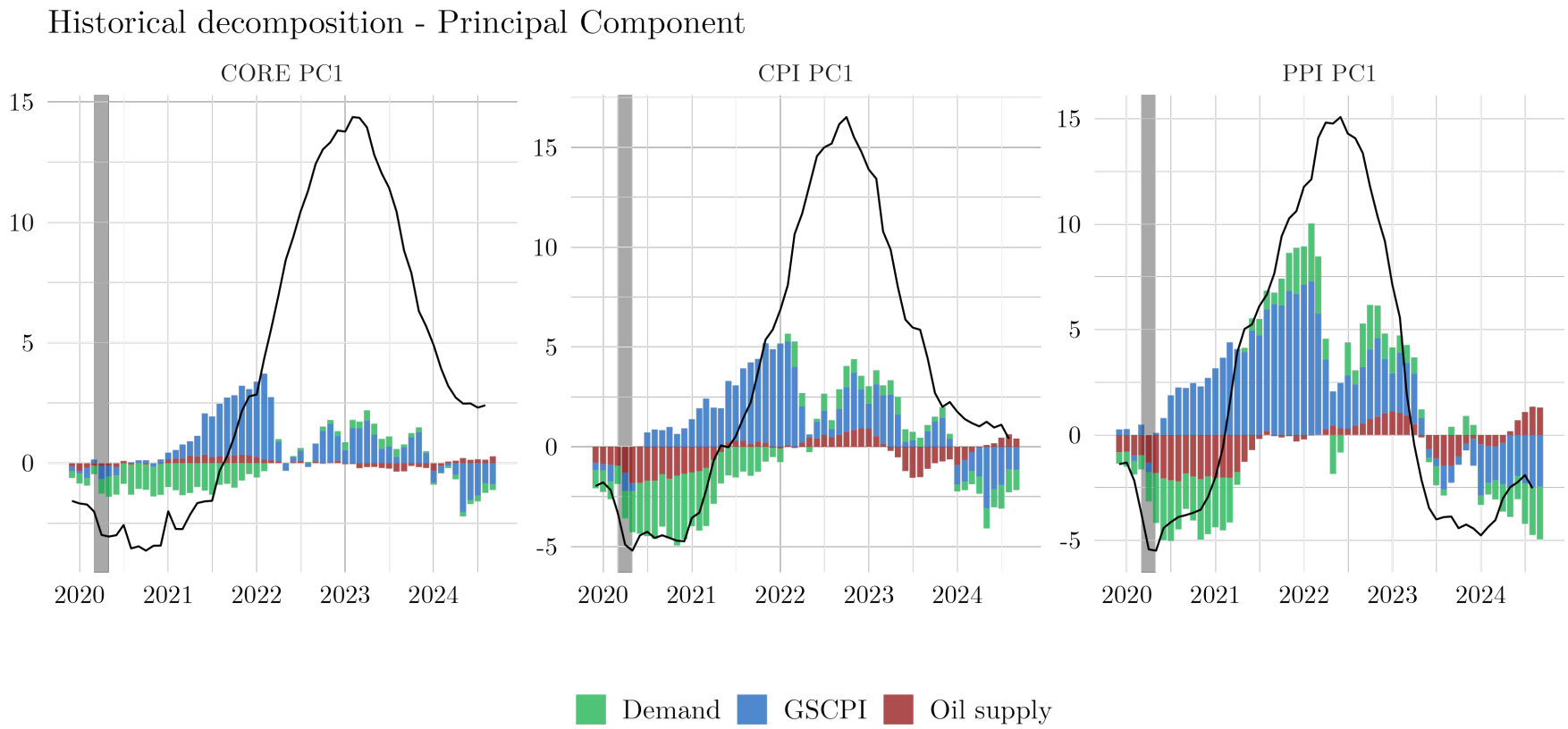
# Historical Decomposition Framework

- Decompose inflation into contributions from global shocks. Equation:

$$y_t = \alpha + \sum_{h=1}^{H} \hat{\beta}^h_{GSCPI} \hat{\varepsilon}^{GSCPI}_{t-h} + \sum_{h=1}^{H} \hat{\beta}^h_{oil} \hat{\varepsilon}^{oil}_{t-h} + \sum_{h=1}^{H} \hat{\beta}^h_{demand} \hat{\varepsilon}^{demand}_{t-h} + \nu_t$$

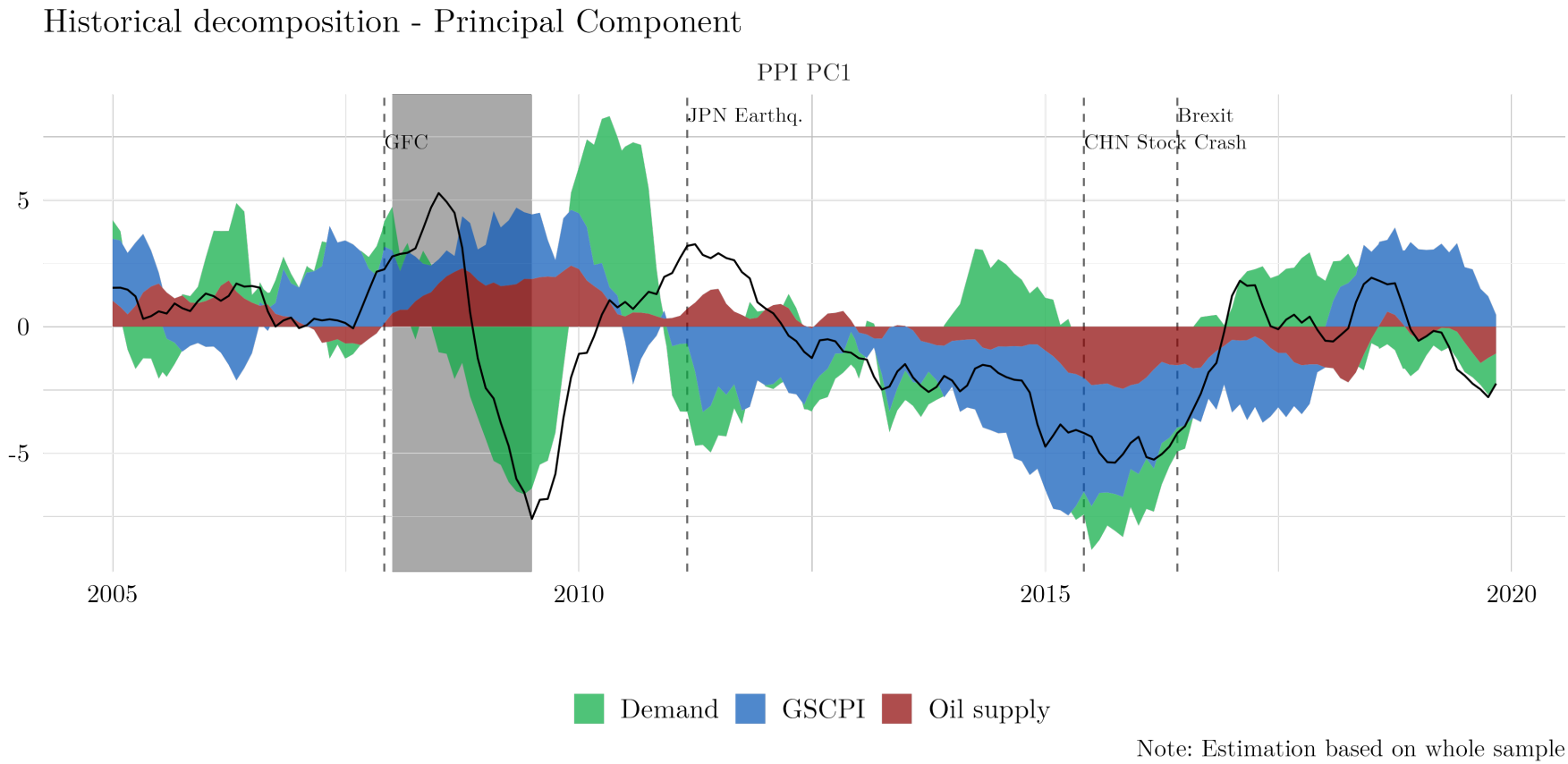
- Key Components:
  - $\alpha$: Historical mean.
  - $\hat{\beta}^h$: Impulse responses.
  - $\hat{\varepsilon}_{t-h}$: Shock series.
  - $\nu_t$: Residual variation.
- Key Insights:
  - Supply chain pressures were dominant during the pandemic.
  - Oil and demand shocks played smaller, yet notable, roles.
- Visualizing Contributions:
  - Stacked time-series representation of shock contributions.

# Historical Decomposition - PCA




- GSCPI important driver in post-pandemic period for principal component of PPI along with oil supply shocks.
- Principal component of Core is less influenced by global shocks.
- PPI highlights the role of global price-setting mechanisms.

# Historical Decomposition PPI (PCA)

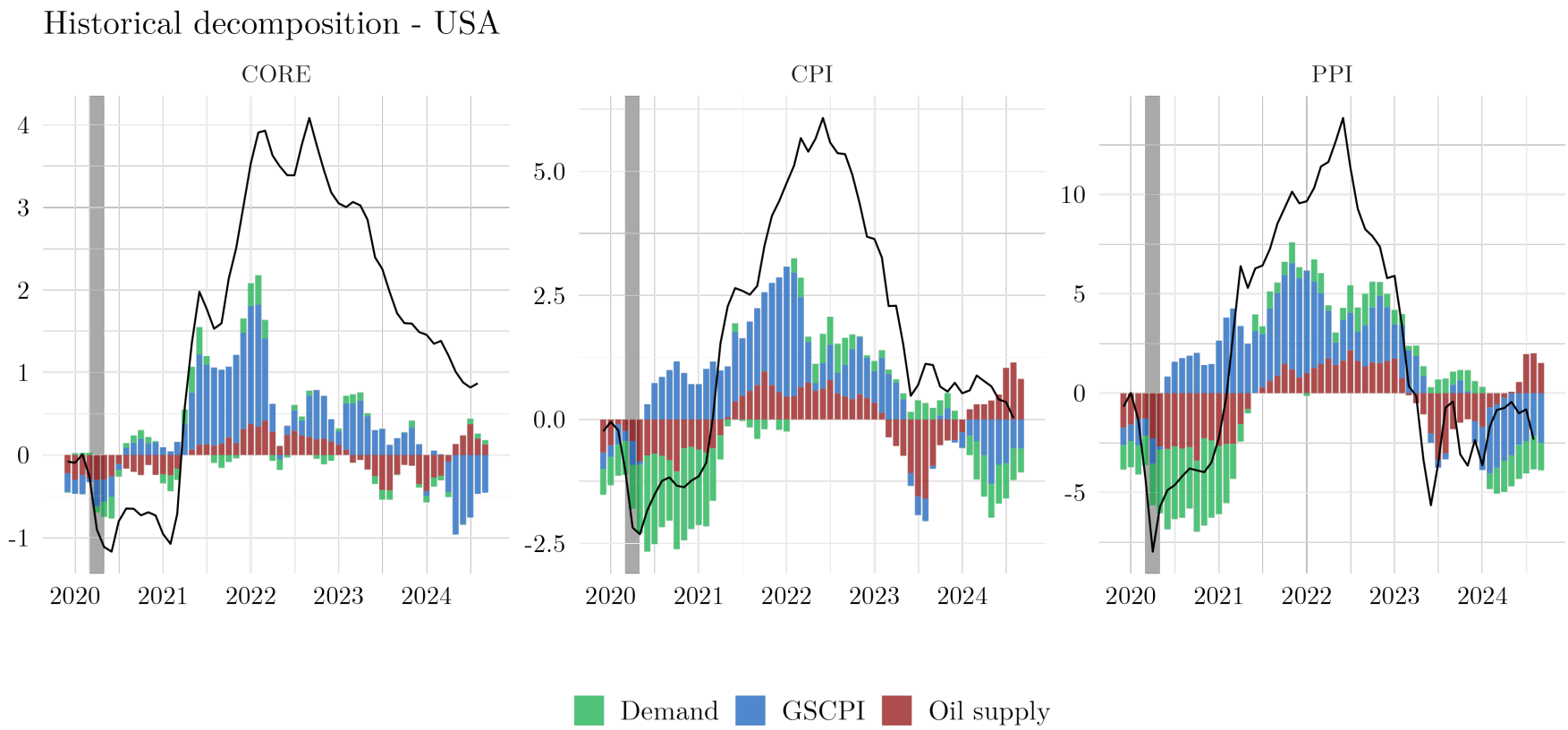



- Pre-pandemic sample suggests that our shocks account for principal component movement.

# Country-Level Insights

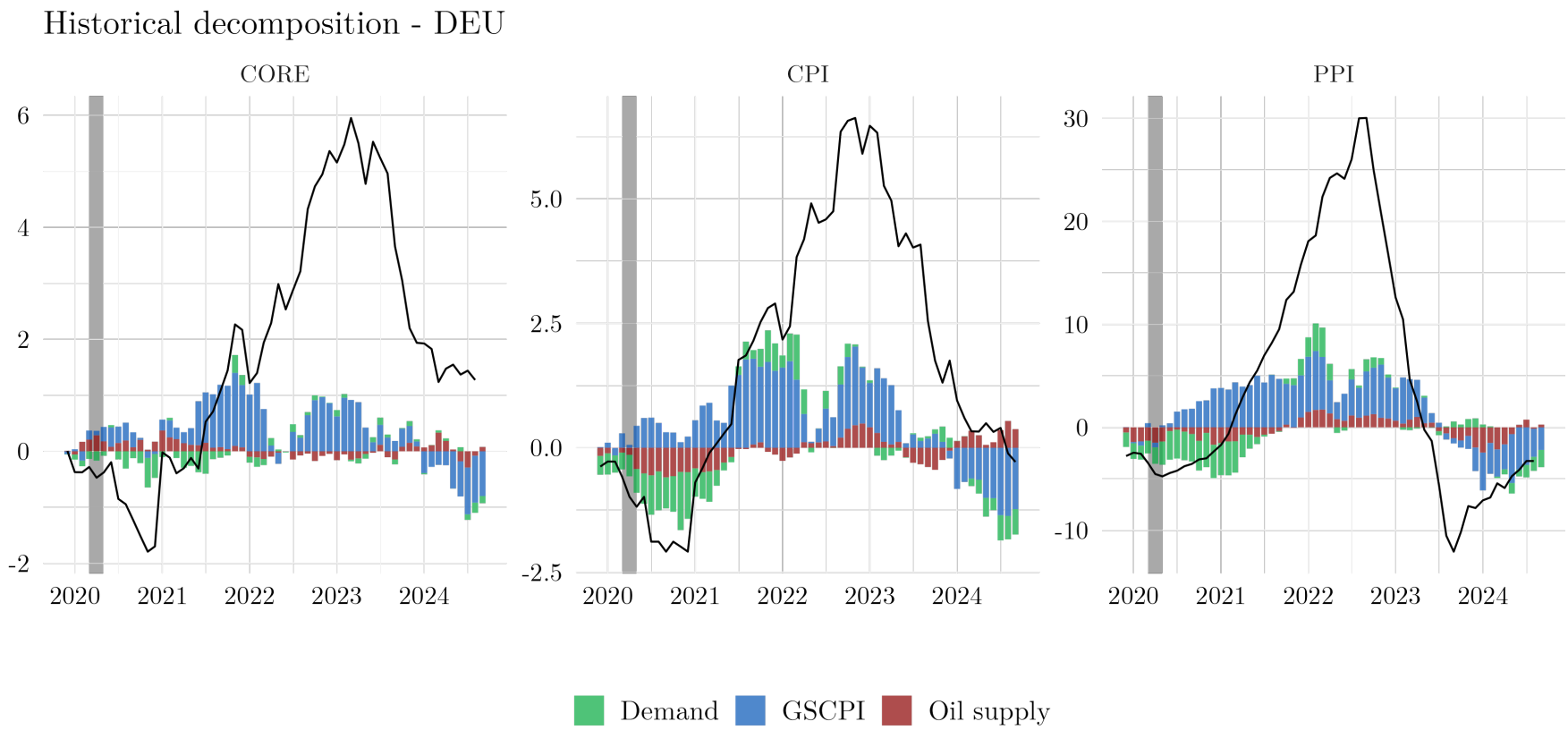
- Examples:
  - U.S.: Dominated by supply chain shocks.
  - Germany: Significant role of energy disruptions.
  - Japan: Currency depreciation effects.
  - Mexico: High sensitivity to oil supply shocks.
  - U.K: strong role of GSCPI in capturing CPI in the post pandemic sample.

# Historical Decomposition: USA



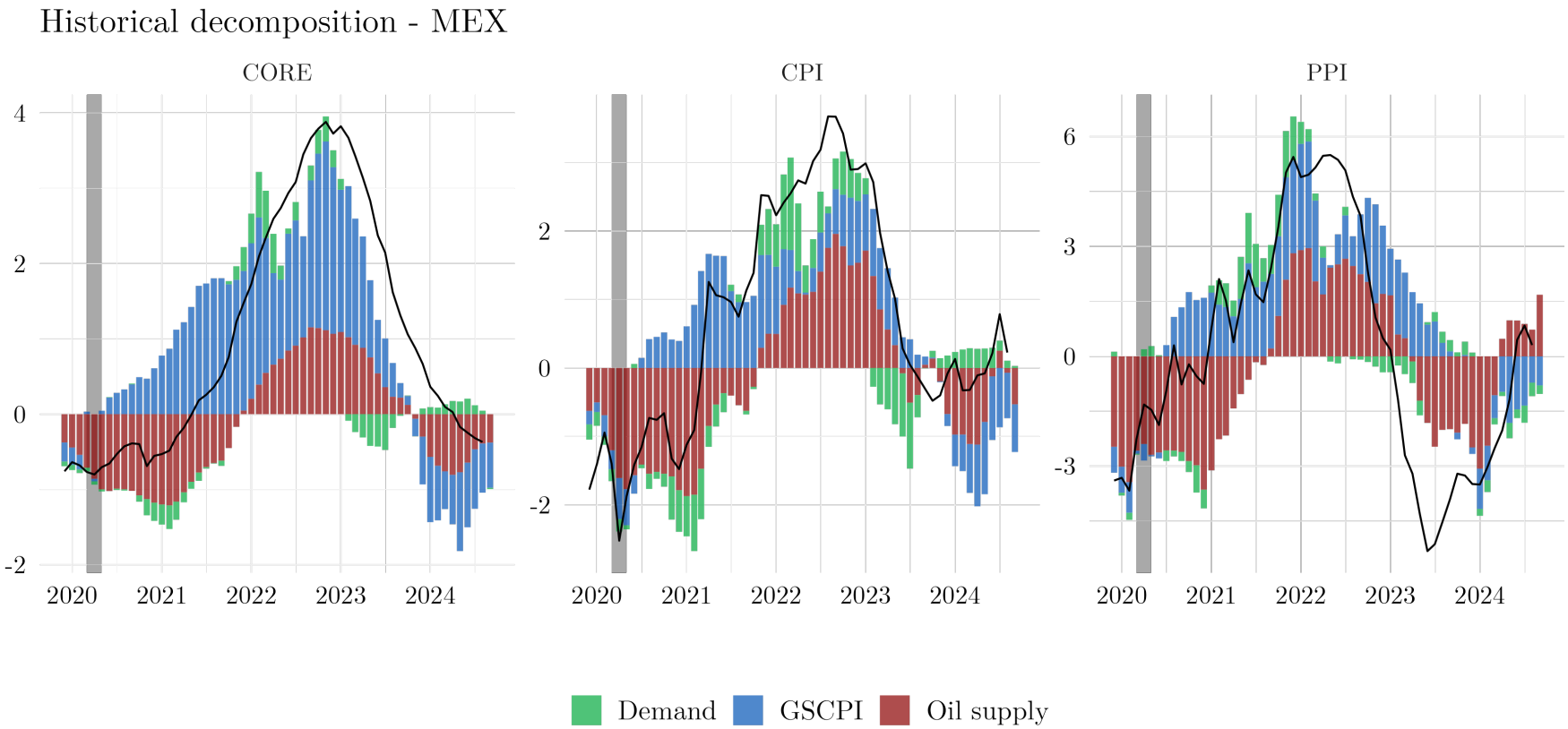

Note: Estimation based on whole sample.

# Historical Decomposition: Germany




Note: Estimation based on whole sample.

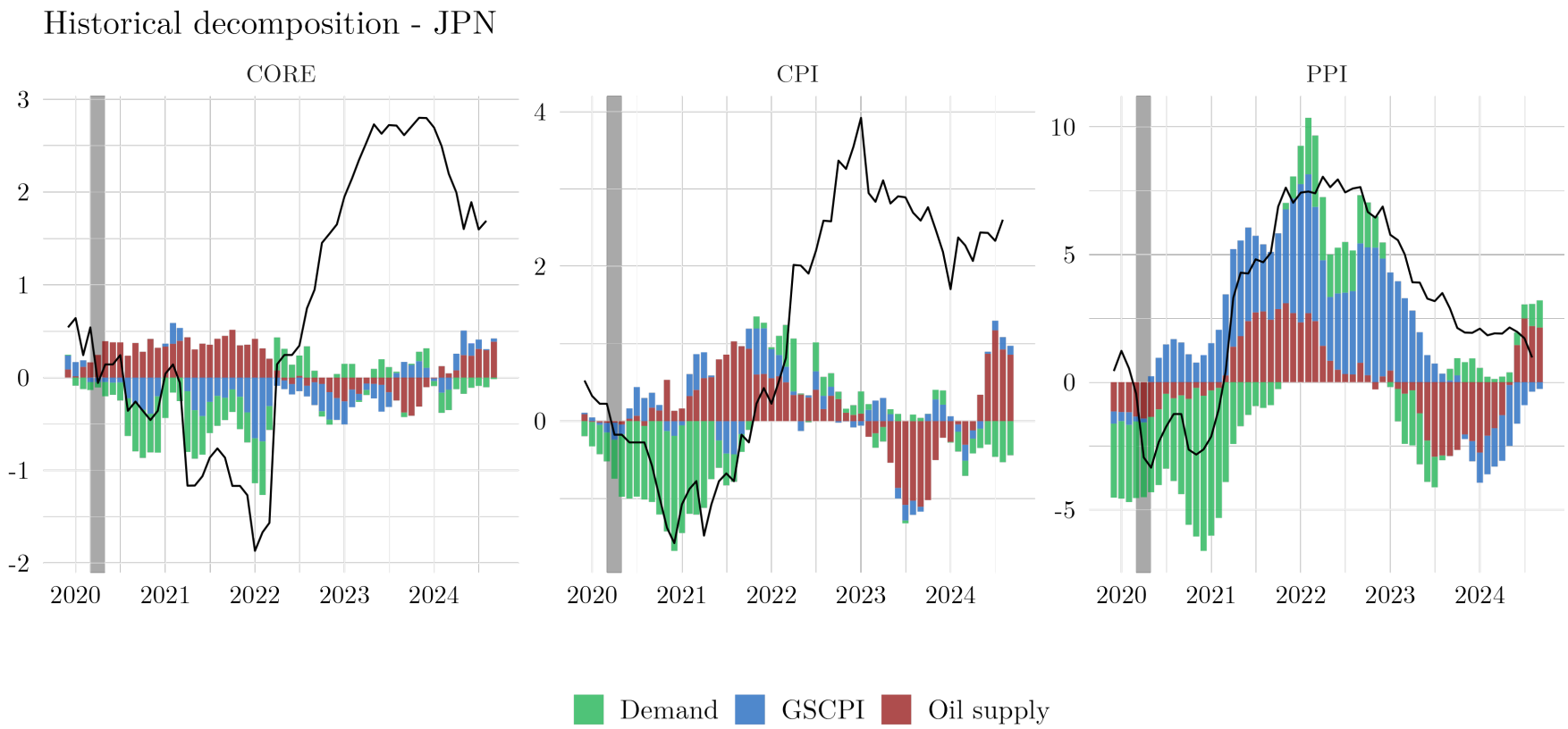
# Historical Decomposition: Mexico




Note: Estimation based on whole sample.

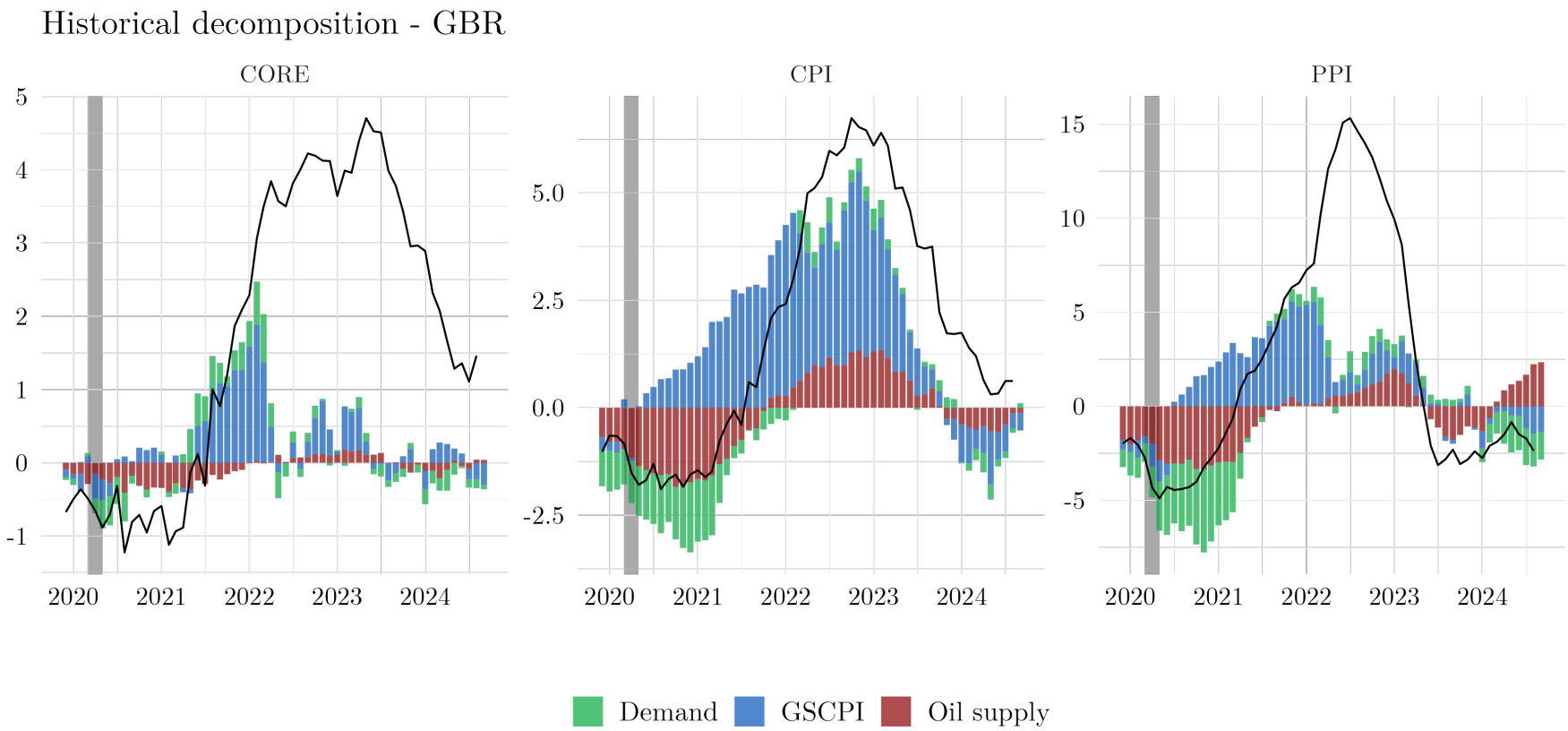
- Oil is relatively more important for Mexico

# Historical Decomposition: Japan




Note: Estimation based on whole sample.

# Historical Decomposition: UK




Note: Estimation based on whole sample.

# Summary of Findings

- GSCPI was the dominant factor during crises.
- Oil supply shocks had immediate but less persistent effects.
- Global demand shocks varied across periods and countries.

# Conclusions

- Takeaways:
  - Global shocks play a pivotal role in inflation dynamics.
  - Results are robust across methodologies and datasets.
  - Global component has sizeable part that needs to be explained during pandemic.
  - Pandemic period special and approach suggests its specificity.
- Future Research:
  - Interaction between domestic and global inflation drivers.
  - Use local supply chain disruptions (regional index).
  - Capture sectoral interactions for understanding propagation.

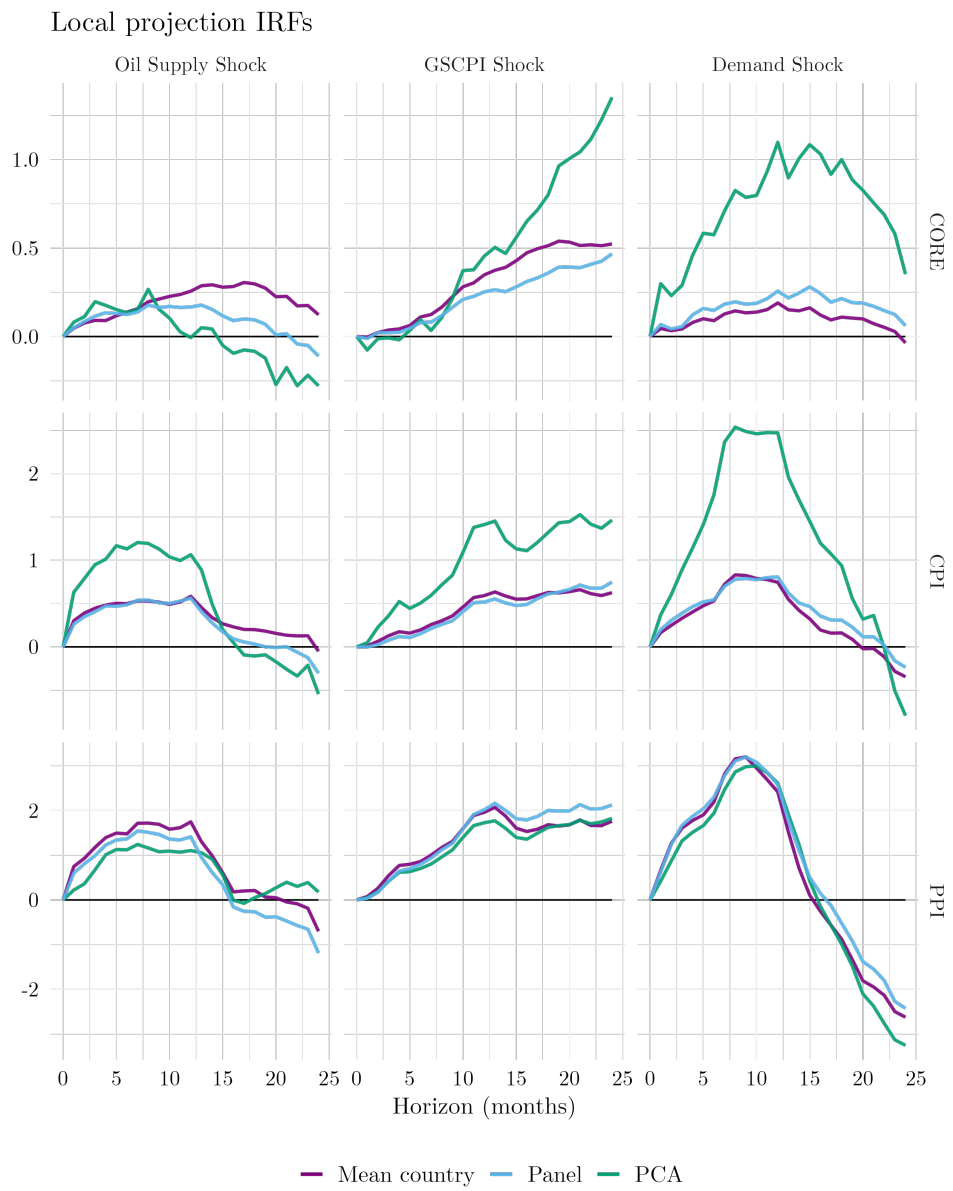
# References


- Akinci, O., Benigno, G., Clark, H., Koechlin, M. (2024). "The Global Inflation Shocks."
- Jordà, O. (2005). "Estimation and Inference of Impulse Responses by Local Projections."

# Components of the GSCPI

- **Global Transportation Costs:**
  - **Shipping Costs:**
    - Baltic Dry Index.
    - Harper Petersen Index.
  - **Air Freight Costs:**
    - BLS In- and Outbound Air Freight Price Indices (U.S. vs. Asia and Europe).
- **Supply Chain Components of PMIs (Purchasing Managers' Indices):**
  - Backlogs.
  - Delivery times.
  - Purchase stocks.
- **Geographic Coverage:**
  - Euro area, U.K., U.S., and the four main East Asian economies.

# Local projection comparison

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