The Global Supply Chain Pressure Index

Gianluca Benigno, views are my own and do not represent the views of the Federal Reserve Bank of New York, the Federal Reserve System or the FOMC

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The Covid-19 Crisis: Supply Chains

- Supply Chains: Production Networks.

- Global Supply Chains: interdependence among countries coming from trade point of view.

  - What is a country's exposure to foreign lockdown? Which sectors are the most exposed?

- Old fashioned way to think about trade: final goods trade.

Background and Motivation

- Globalized economy with complex supply chain interlinkages
- Covid-19 shock along with shift in consumption demand has created stress at supply chains level.
- Question and research applications:

  - How do we measure these disruptions?
  - Macro perspective: Relationship with prices and quantities (PPI, exports and imports).
  - Micro perspective: firms' profitability

- Similar in the spirit of financial condition indices.

The Global Supply Chain Pressure Index

- Several indicators have been used in recent time to capture disruptions caused by delay in goods' delivery.
  - Our aim: to bring these together in one indicator, the GSCPI, that provides a bird-eye perspective on these pressures.
- Global Transportation Costs:
  - Shipping Costs:
    - Baltic Dry Index and Harper Petersen Index
  - Air Freight Costs:
    - BLS In- and Outbound Air Freights Price Indices US vs. Asia and Europe.
- Supply chain components of PMIs for euro area, U.K., U.S. and the 4 main East Asian economies:
  - Backlogs;
  - Delivery times;
  - Purchase Stocks.

GSCPI: Construction, I

- Data specifics:
  - Baltic Dry Index: daily data going back to 1985. Not revised.
  - Harpex container ship rate index: weekly data going back to 2001. Not revised.
  - BLS In- and Outbound price indices: monthly data going back monthly to 2005 and quarterly pre-2005. Typically published mid-month with a one-month lag. With each release, data up to about six months back get revised.
  - PMI data: monthly data, with final survey results pertaining to the previous month published in the first week of the current month. Not revised.
    - China, Korea, Taiwan: going back to 2004.
    - Japan: going back to 2001.
    - Euro area and U.K. going back to 1997.
    - U.S. (Markit & ISM): some back to 1997, some back to 1940s.

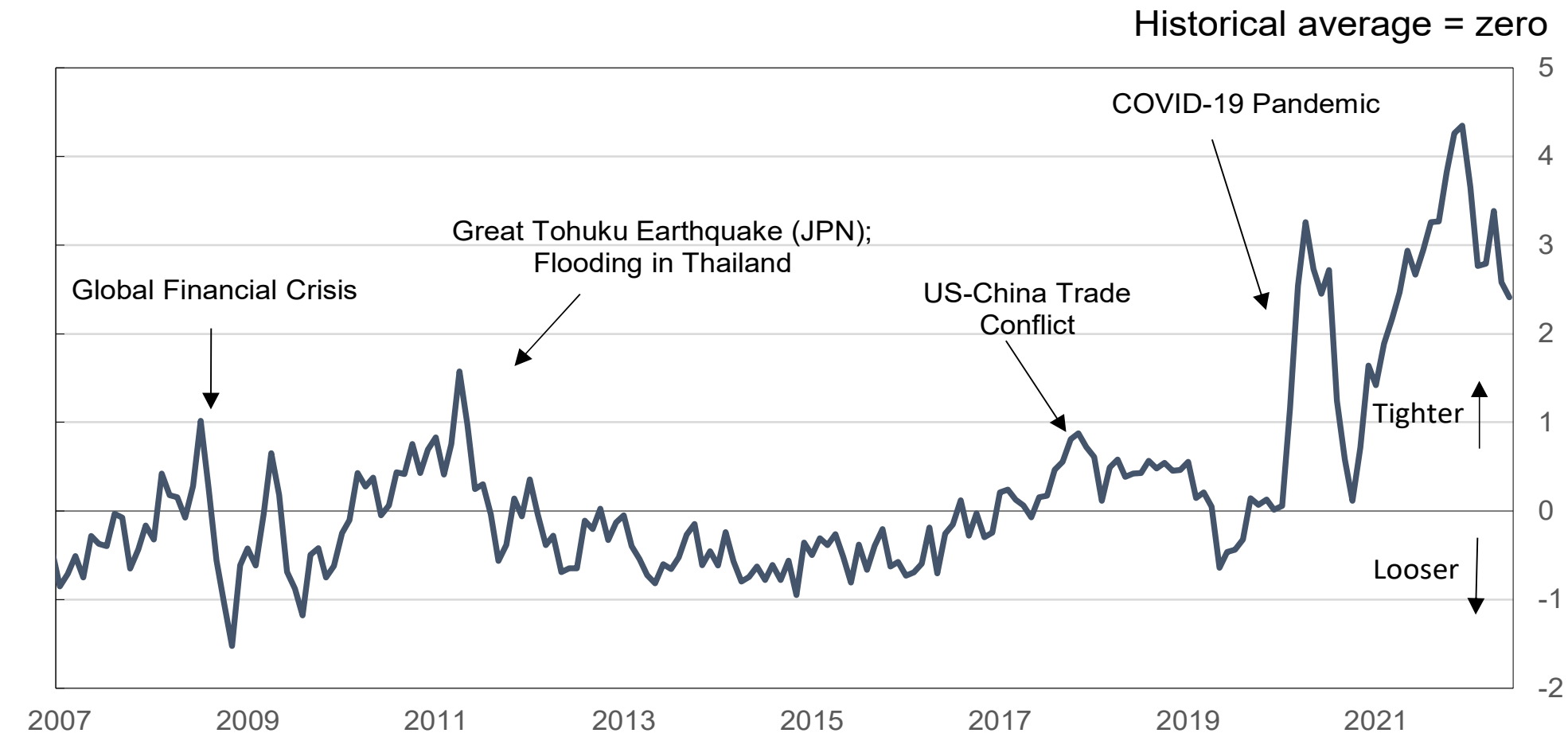
GSCPI, Construction II

- Idea behind GSCPI: construct parsimonious indicator that provides a bird-eye perspective of developments at the supply level.

- Construction:
  - Collect the various indicators;
  - Isolate 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 our national PMIs.
  - Use residuals to run a principal component analysis to extract a common global component: GSCPI.

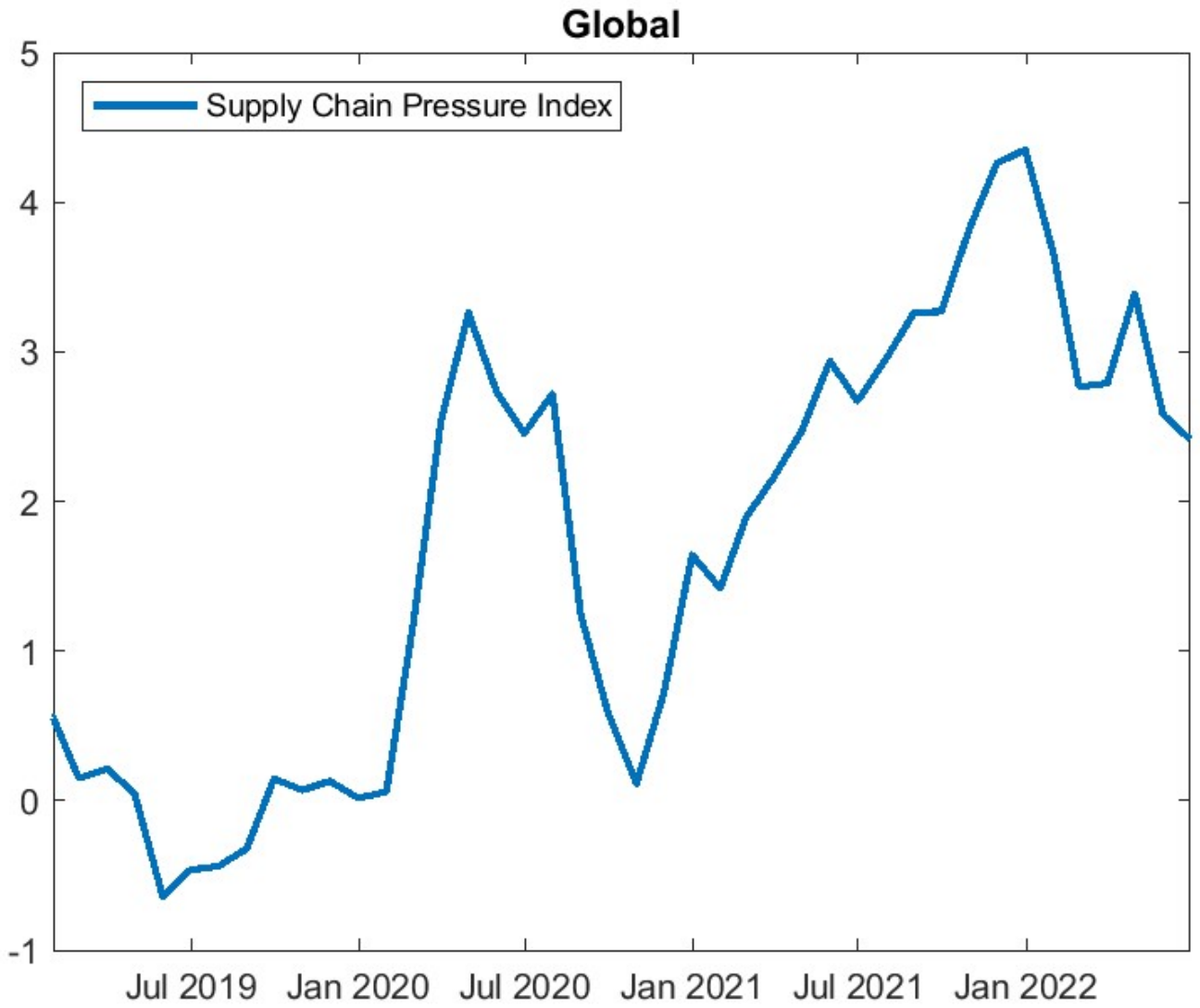
Global Supply Chain Pressure Index

Global Supply Chain Pressure Index

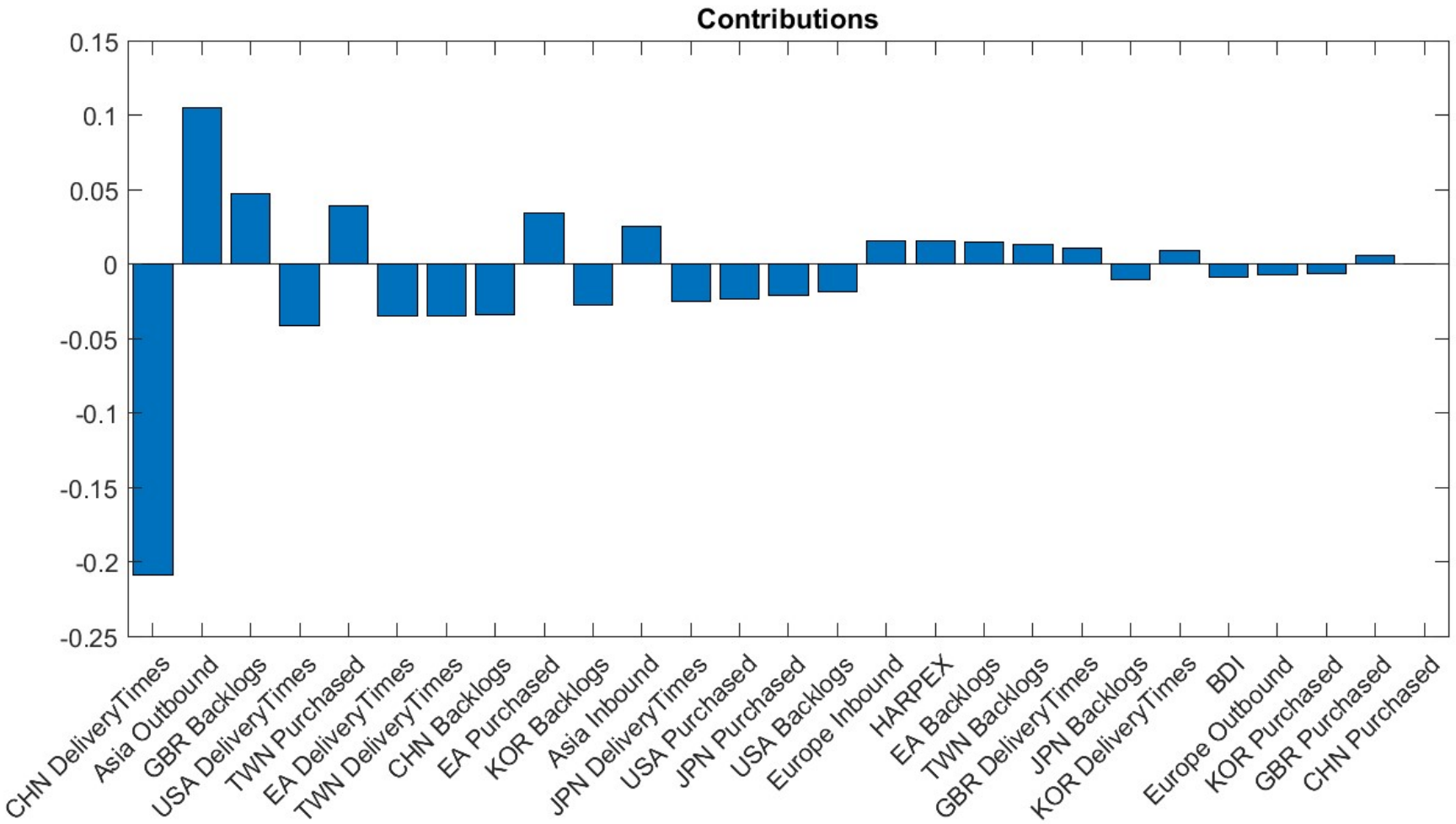


Sources: Bureau of Labor Statistics; Harper Petersen Holding GmbH; Baltic Exchange; IHS Markit; Institute for Supply Management; Haver Analytics; Refinitiv; FRBNY calculations.

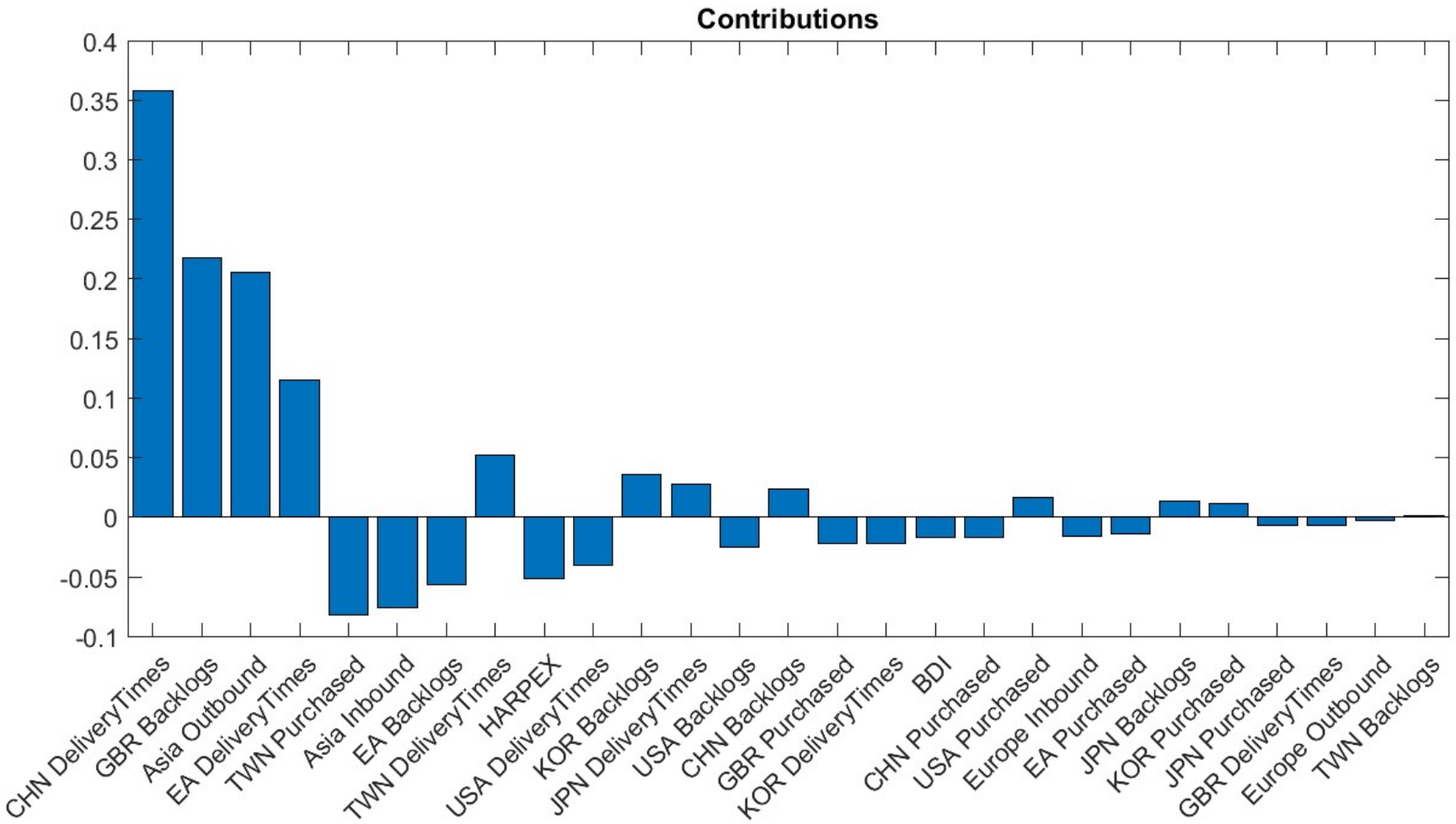
Global Supply Chain Pressure Index



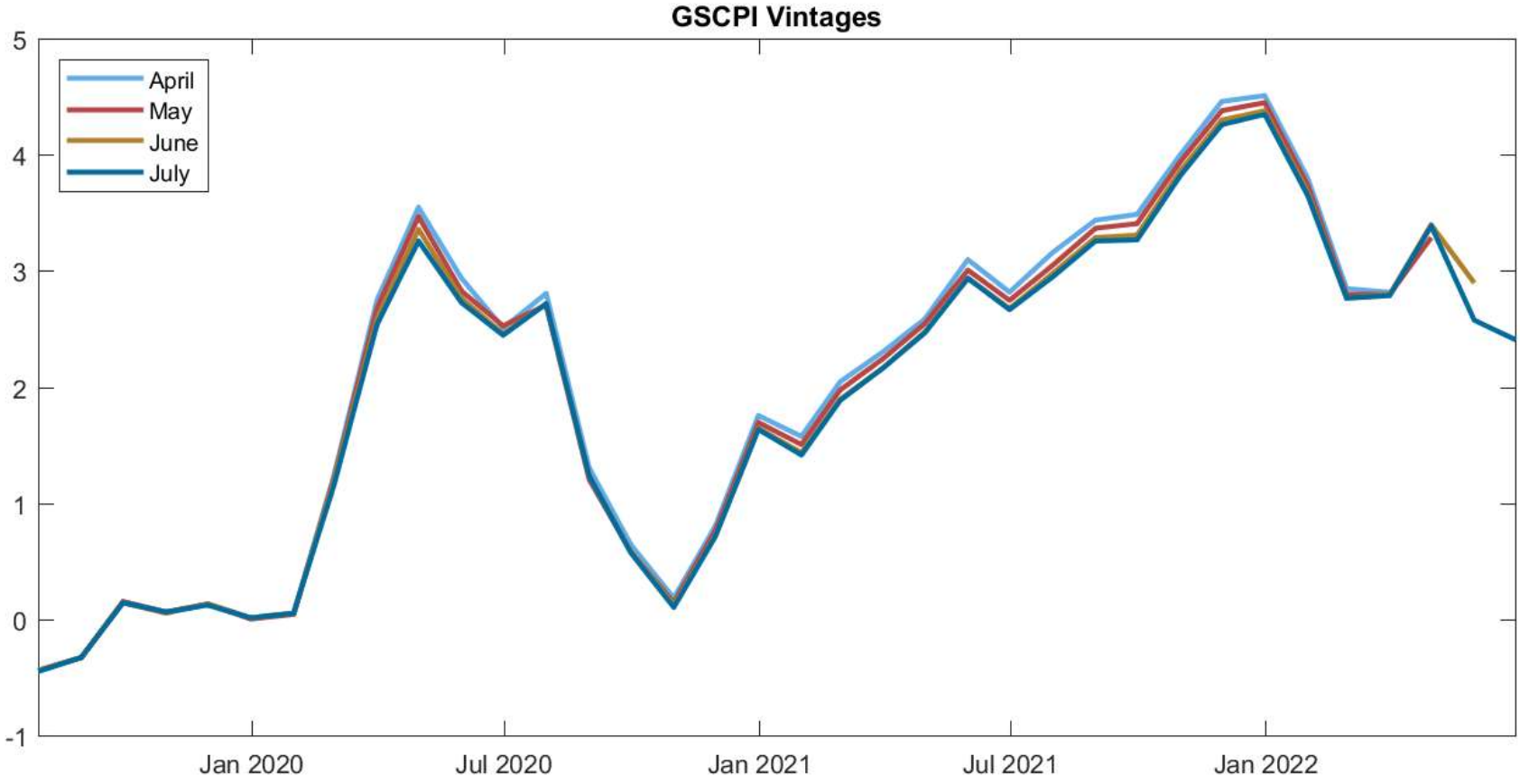
Underlying Contributions in June 2022



Underlying Contributions in March - April 2022



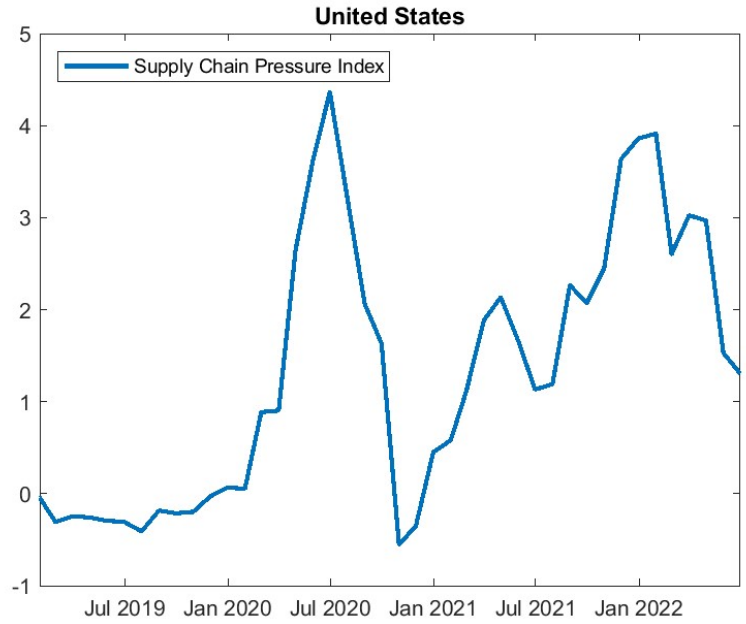
Previous Releases

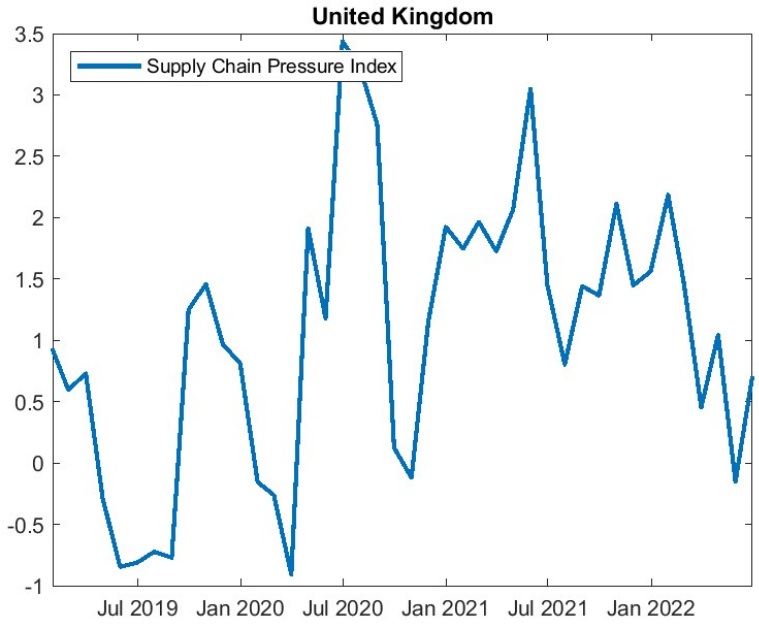


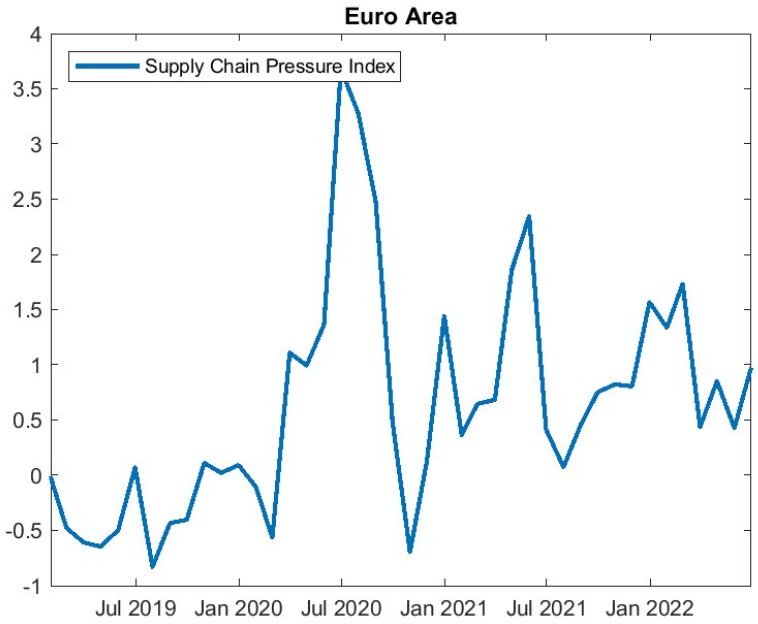
Regional Supply Chain Pressure Indices

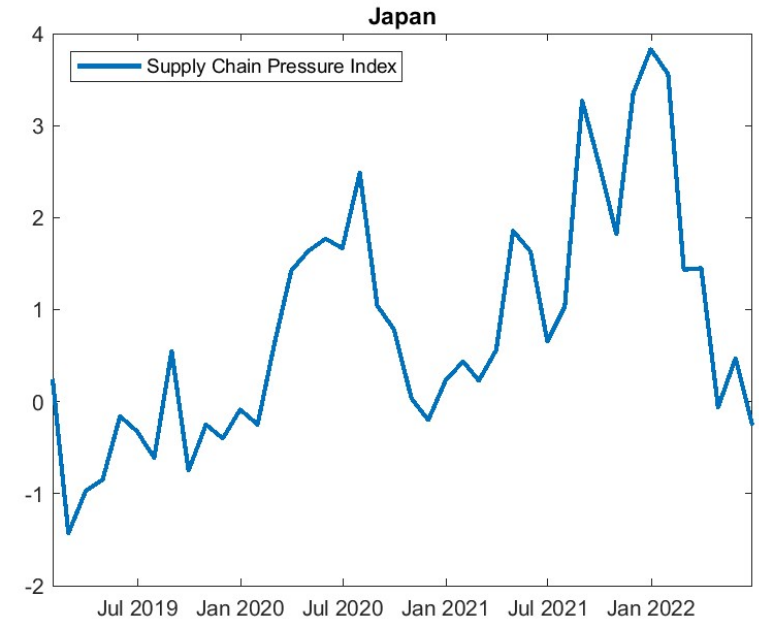
- We also can construct Regional Indicators using similar procedure for
  - U.S.
  - China
  - Japan
  - Euro-area
  - South Korea
  - Taiwan
  - United Kingdom
- Limitations that could cause regional indices to be noisier:
  - Cross-section drops from 27 series for global index to 7 series for each regional index, so less scope to “diversify away” idiosyncratic noise.
  - Does not exploit cross-country interlinkages across national PMI data and transportation costs.

Regional Supply Chain Pressure Indicators









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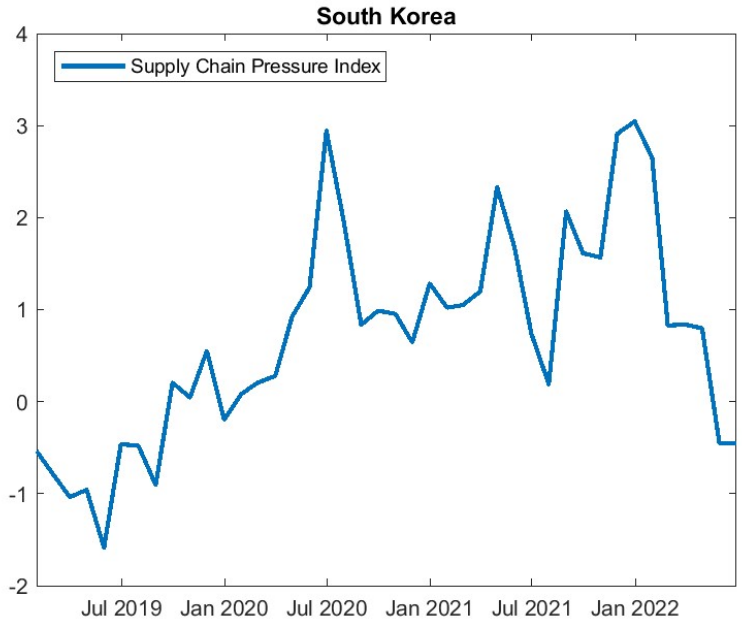
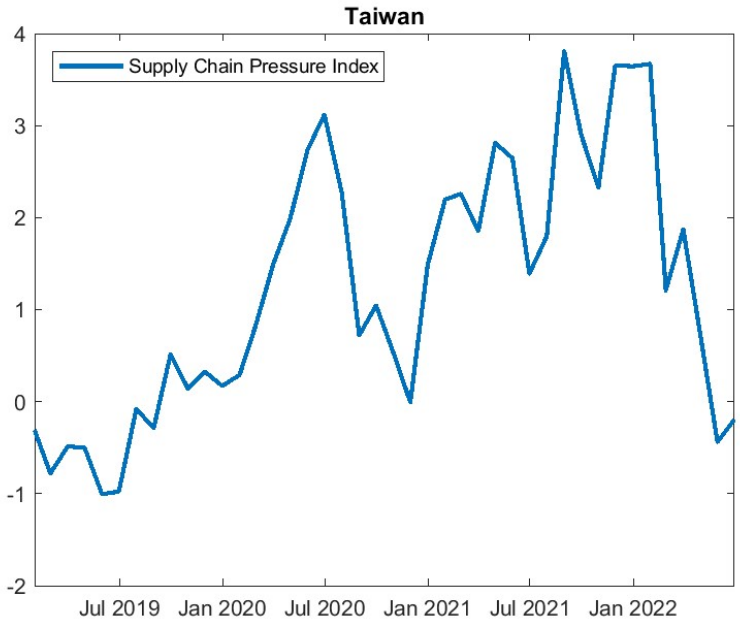
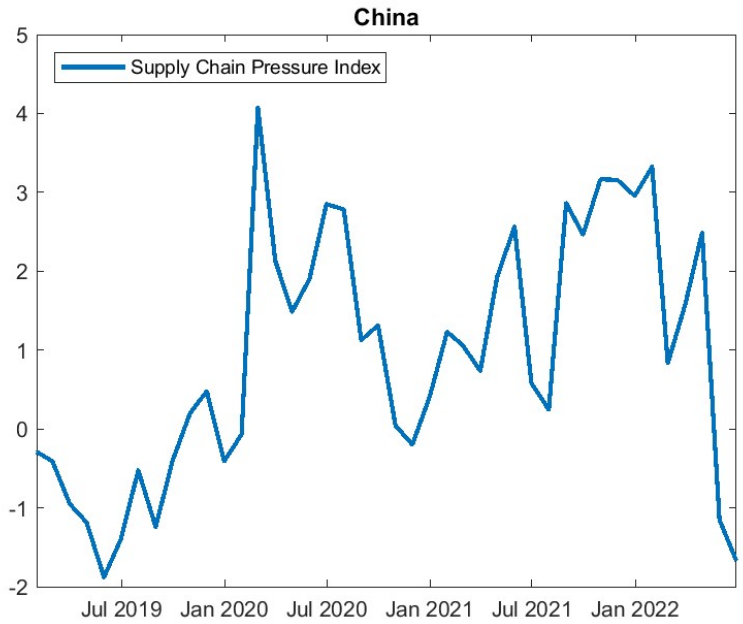






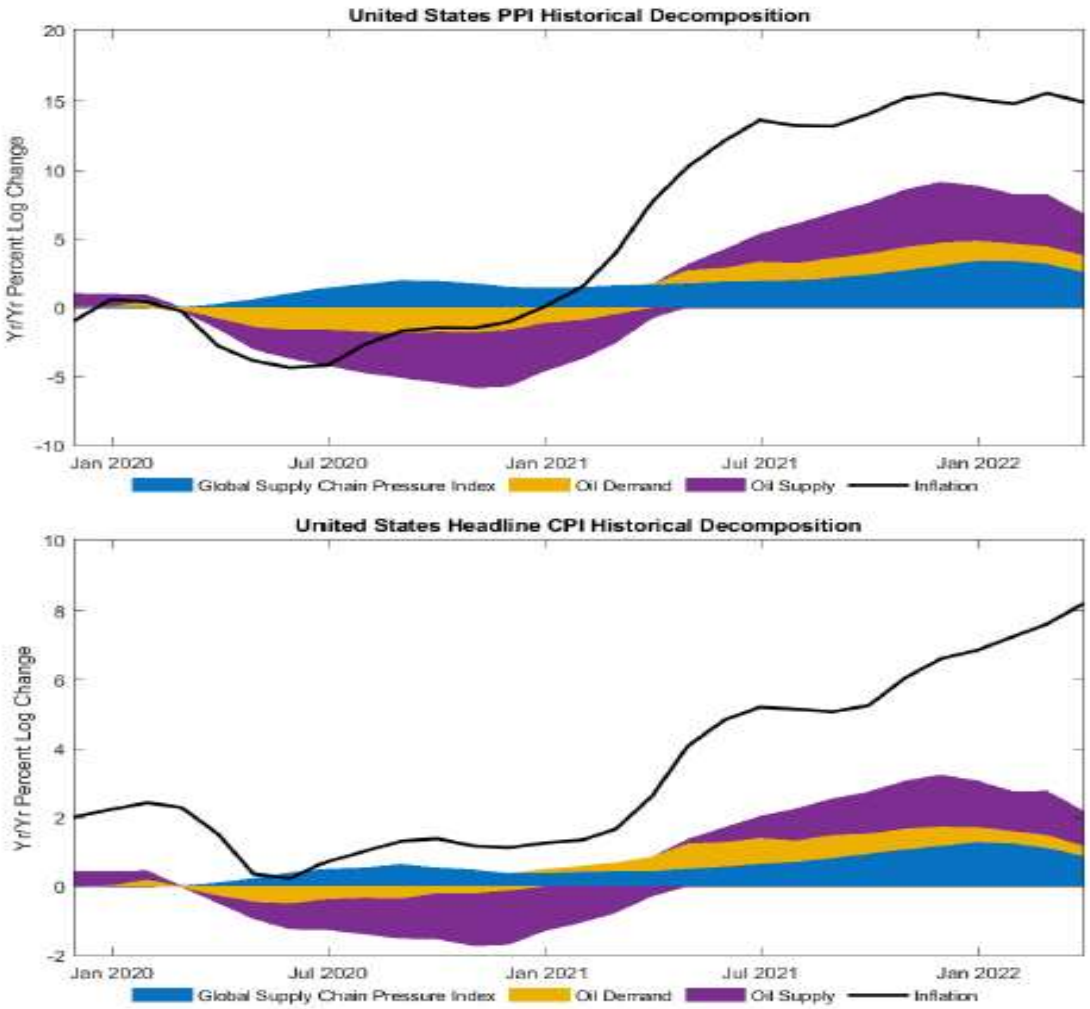
Application: The Global Supply Side of Inflation

- What is the role of supply chain disruptions in explaining current inflationary pressures?

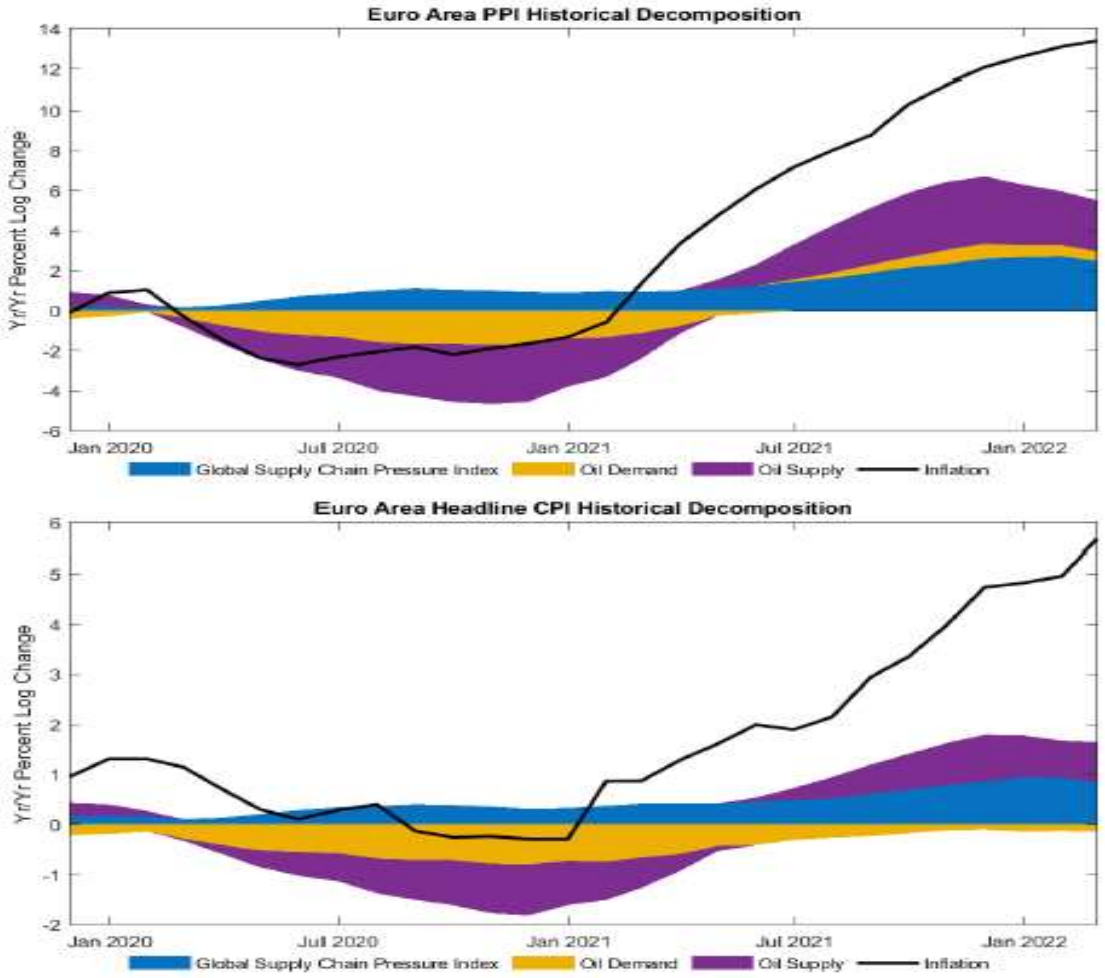
- Is inflation global or local? And at which level?

- Adopt local projection method to study the response of different measures of inflation to shock to our GSCPI index along with global demand and supply component of oil price changes (as in Groen et al. (2013)).

Inflation decomposition: U.S.



Inflation decomposition: Euro area



Conclusions

- Monitoring tool to assess supply chain pressures;
- Geopolitical, climate, cyberattack and pandemic event could affect supply chain operations;
- Monetary policy implications in terms of understanding inflation determinants;
- Further refinements and analysis.

References

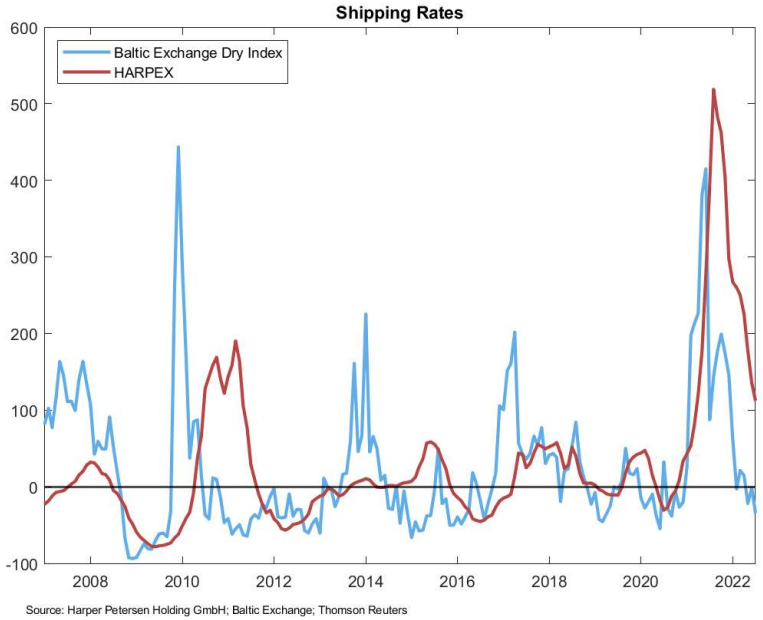
- Based on joint work with J. Groen and A. Noble.

- **Product:** Global Supply Chain Pressure Index
- **Paper:** The GSCPI: A New Barometer of Global Supply Chain Pressures (May 2022)
- **Blogs:**
  Global Supply Chain Pressure index: May 2022 Update (May 2022);
  Global Supply Chain Pressure Index: March 2022 Update (March 2022);
  A New Barometer of Global Supply Chain Pressures (January 2022);
  The Global Supply Side of Inflationary Pressures (January 2022)

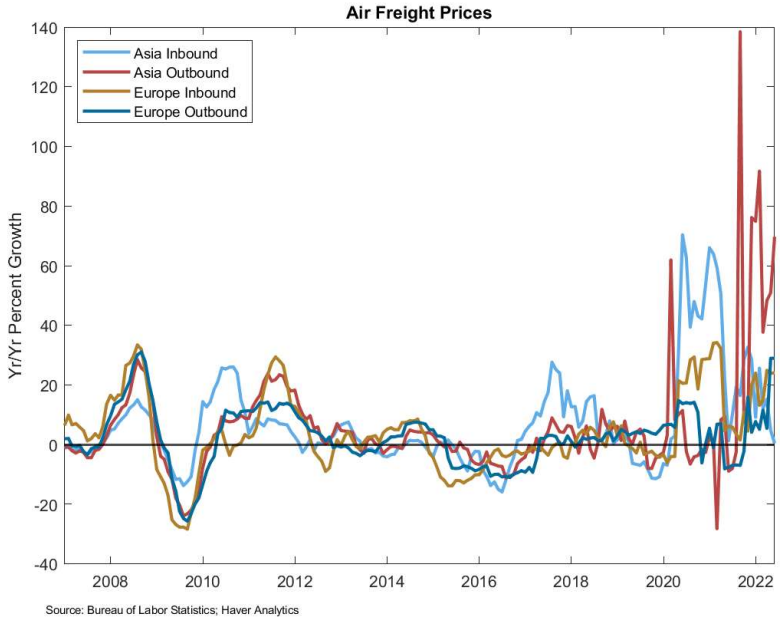
Thank you

Extra slides

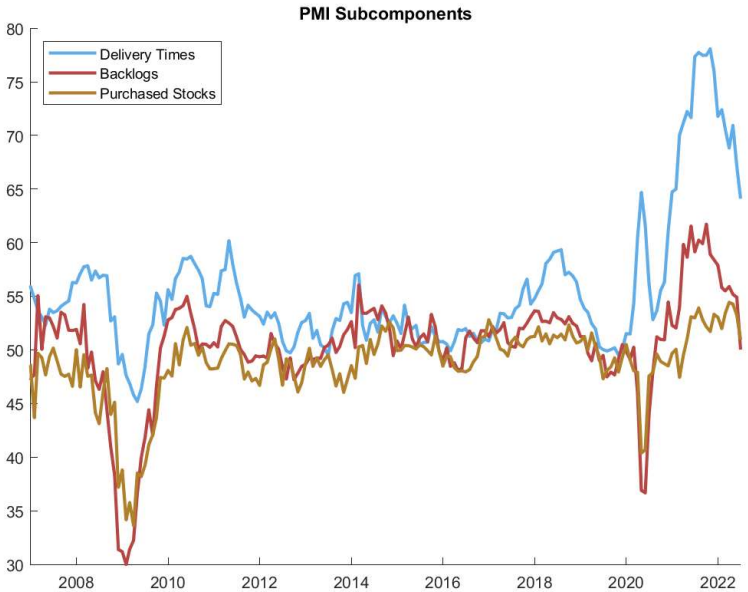
Underlying Data



Source: Harper Petersen Holding GmbH; Baltic Exchange; Thomson Reuters



Source: Bureau of Labor Statistics; Haver Analytics



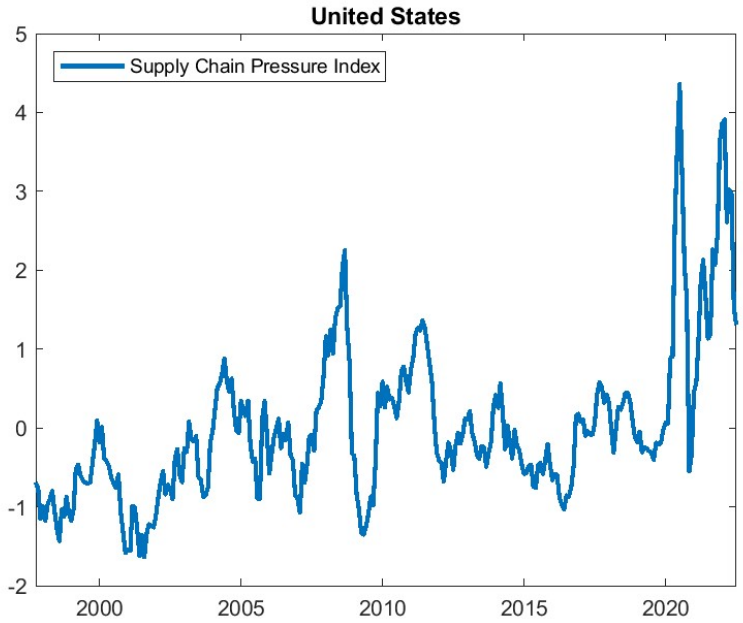
Source: IHS Markit; Institute for Supply Management; Haver Analytic Note: Each subcomponent is constructed by aggregating subcomponents for USA, GBR, EA, CHN, TWN, KOR, JPN via GDP Weights; Delivery Times PMI has been inverted such that +50 indicates longer delivery times

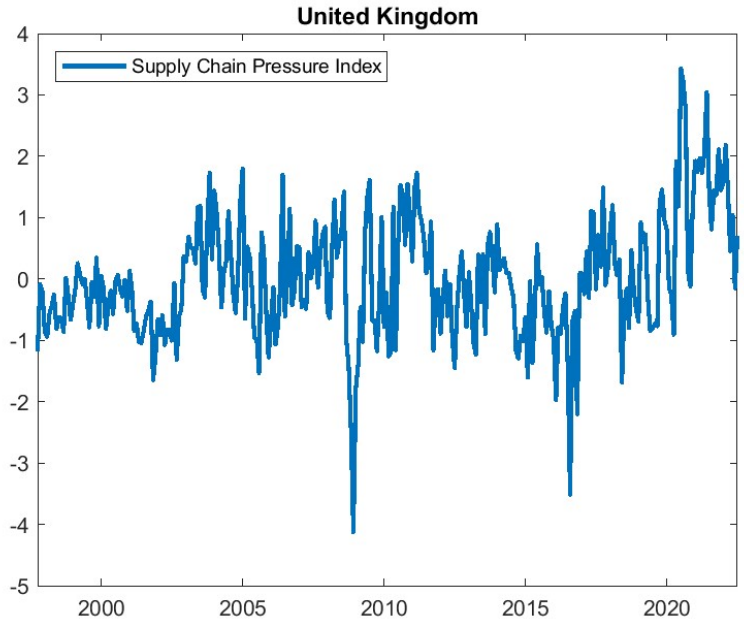
GSCPI Construction, III

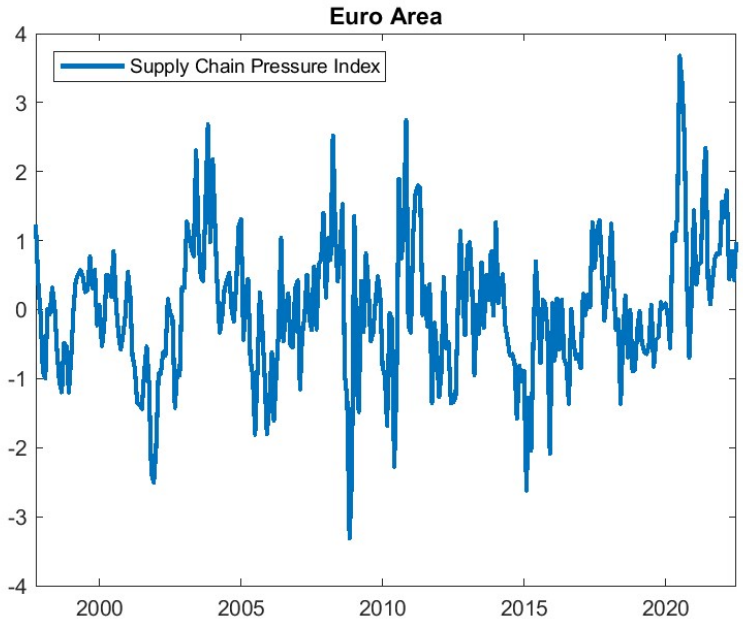
- Total data: unbalanced panel of 27 monthly series $X_t = (x_{1,t} \cdots x_{27,t})'$ for 1997 - present
  - Different starting points between 1997 and 2004.
  - Different endpoints as some data available with a lag only.

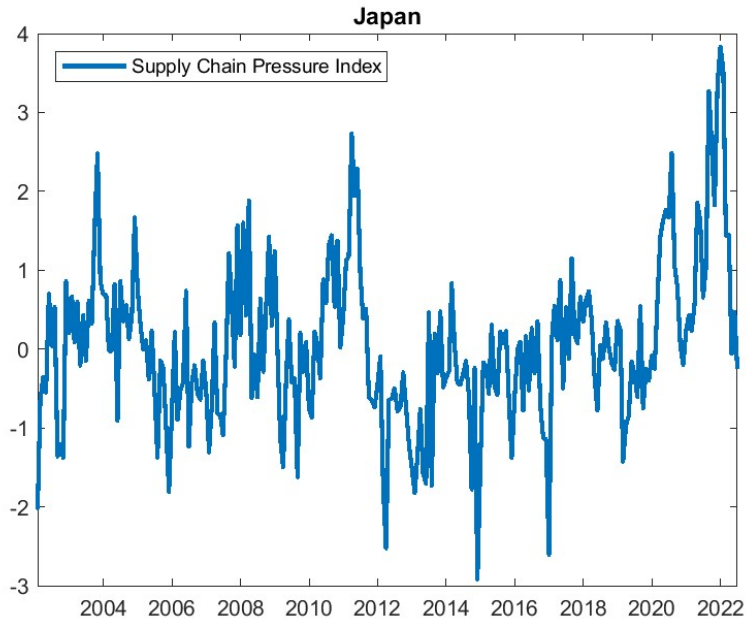
- GSCPI = $\sum_{i=1}^{27} w_i x_{i,t}$,
  - $w_1, \ldots, w_{27}$: eigenvector for largest eigenvalue of $X_t X'_t$.
  - $w_1, \ldots, w_{27}$: rescaled such that resulting GSCPI has mean 0 and standard deviation 1.
  - $w_1, \ldots, w_{27}$: iteratively estimated Stock and Watson (2002)
    - Preliminary estimates of GSCPI and variable-specific components are used to impute data-gaps.
    - New estimates of GSCPI and variable specific components constructed based on data-set with imputations.
    - New imputations data-gaps. Repeat until convergence.

Regional Supply Chain Pressure Indicators









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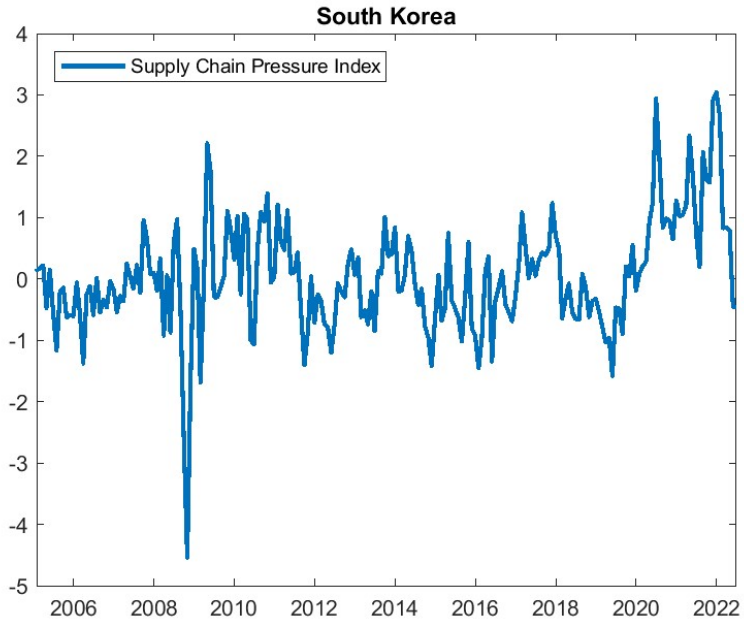
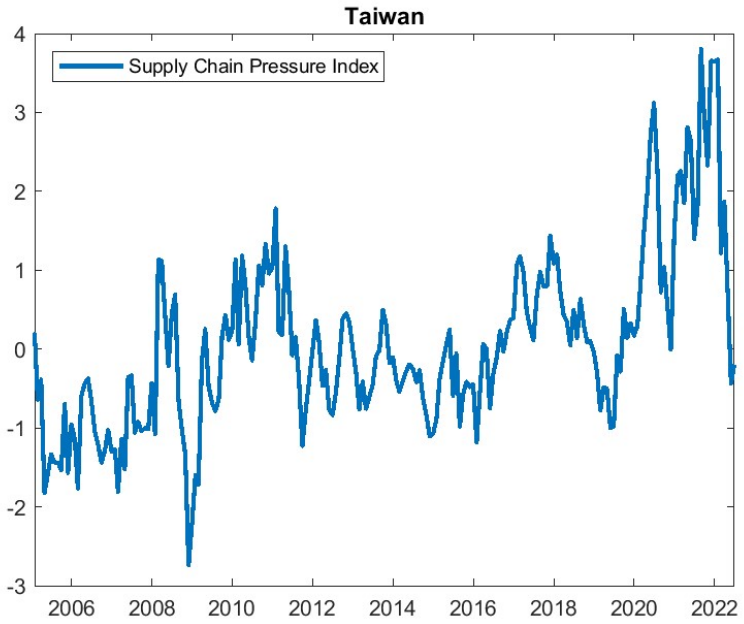
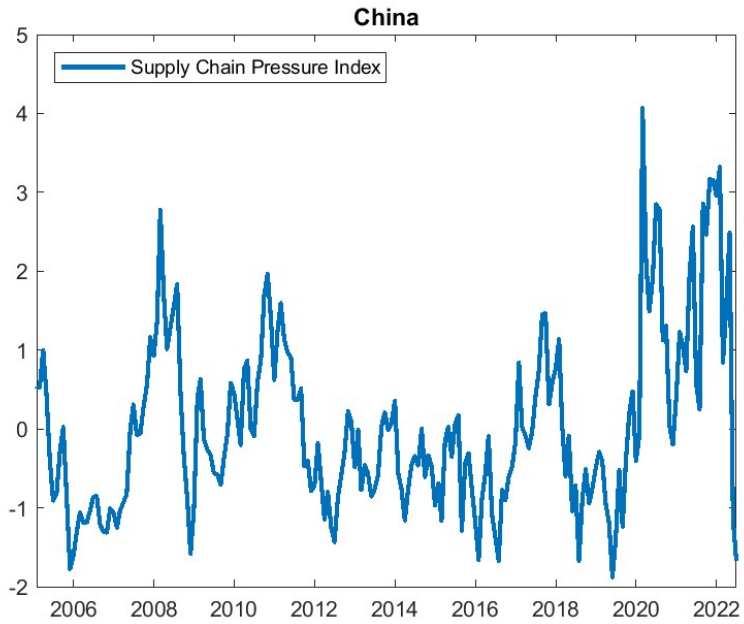
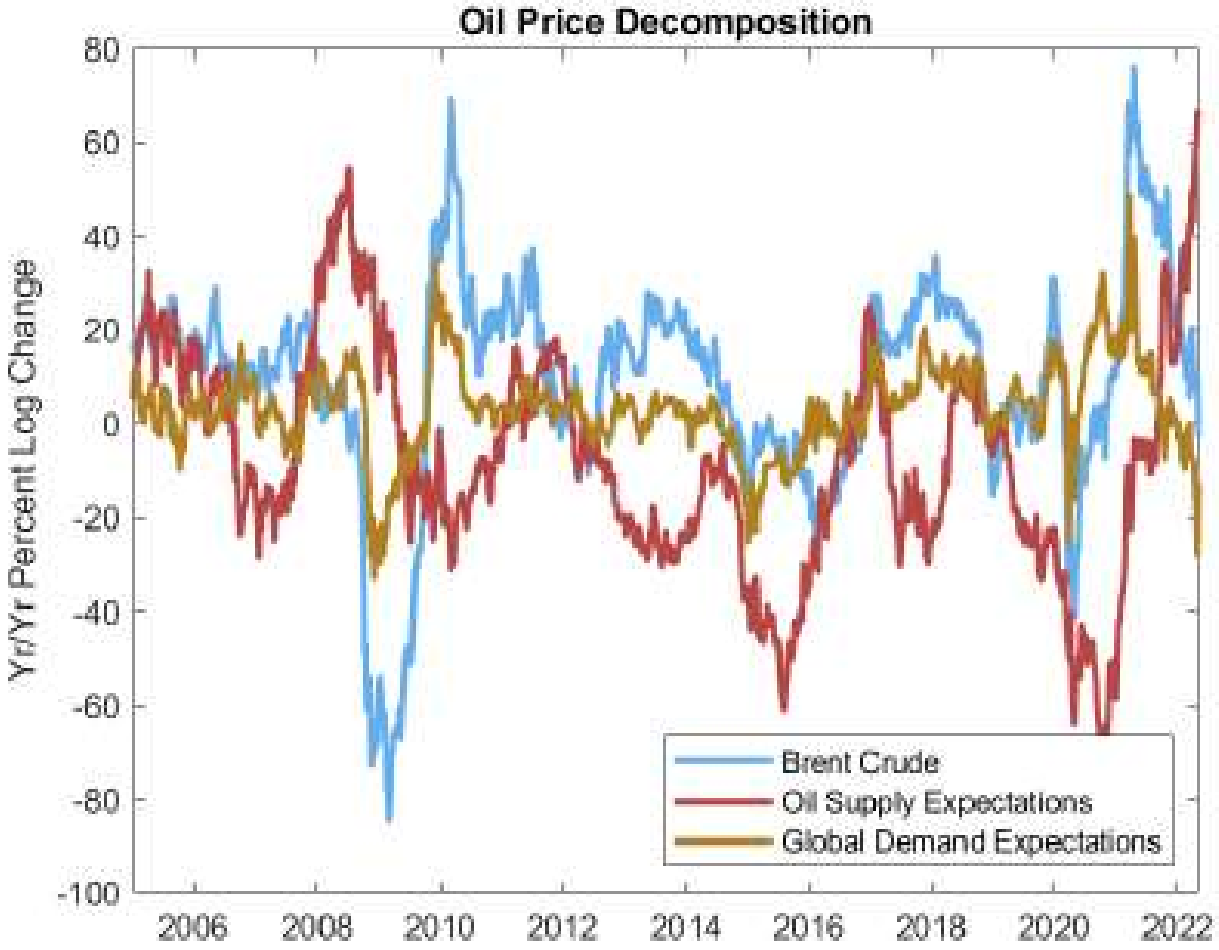






Oil price decomposition (NY Fed model)



Global Supply Side of Inflationary Pressures

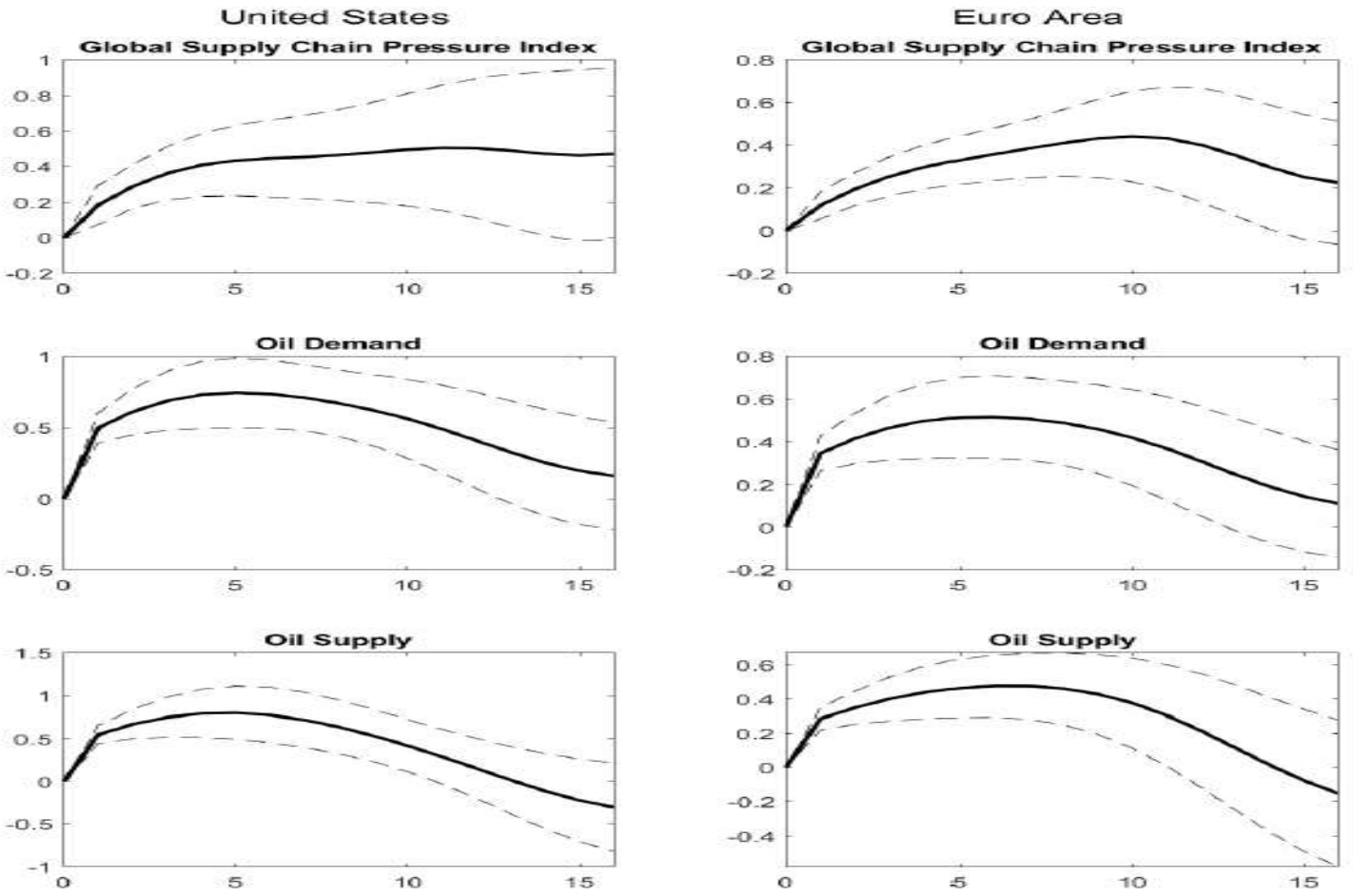
- Regression model (from January 1997 to February 2022)

$$y_{t+h} = \alpha_h + \beta_h x_t + \sum_{l=1}^{p} \delta_l' w_t + \varepsilon_{t+h}. \quad for\ h = 1, \ldots . H,$$

- With y_{t+h} being our measure of inflation rate (CPI or PPI)
- With x_t being our global factors (GSCPI, Oil_D and Oil_S)
- With w_t being a set of control variables including past values of y and x and proxy for monthly real GDP.

PPI inflation

Figure 5: Impulse Responses: PPI Inflation



CPI inflation