Measuring Shortages Since 1900

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3rd Kiel-CEPR Conference on Geoeconomics - October 17, 2024

The views expressed are those of the authors and do not necessarily reflect those of the Federal Reserve Board or the Federal Reserve System.

Motivation & Research Question

- Shortages: lack of sufficient supply of goods, services and factors of production to meet demand in a particular market.
- Shortages have been a recurring feature of economic life
- Limited research on their long-term evolution and effects
- Our approach:
  - Construct long-run shortage index for the United States
  - Examine its relationship with economic activity

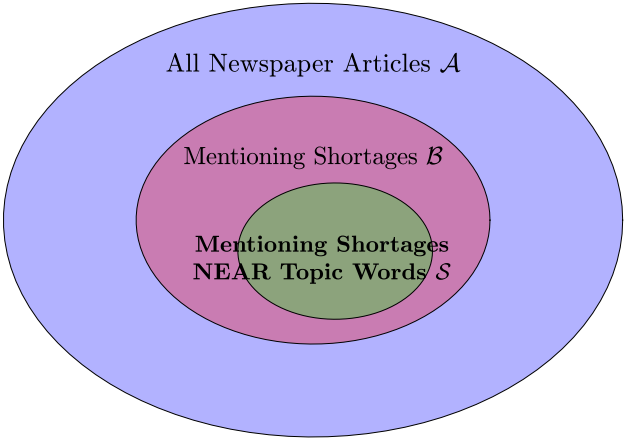
Related Literature

- News-based indicators of shortages:
  - Lamont (1997): Hand-coded indicator using WSJ headlines
  - Chen and Houle (2023): Index for Canada since 2000
  - Burriel et al. (2023): Index for advanced economies since 2000
- Supply chain pressure measure based on transportation costs:
  - Benigno et al. (2022)
- Shortages and inflation during COVID-19 pandemic:
  - Pitschner (2022): corporate filings
  - Bernanke and Blanchard (2023): Google Trends-based shortages
- Contributions of our study:
  - First comprehensive measure of shortages spanning 125 years
  - Univariate regressions, forecasting regressions and structural VAR analysis show persistent effects of shortages on inflation
  - News about shortages combine reflect demand and supply forces as well as “exogenous” shocks

Constructing the Shortage Index

- Sample: Text of 25 million news articles from NYT, WaPo, CT, BG, LAT, WSJ, analyzed at monthly frequency (about 20,000 articles per month)
- Search query: 'shortage' words near 'topic' words (energy, food, industry, labor) + economic terms
- Index is proportional to the share of articles discussing energy, food, industry, and labor shortages each month
- Validation: Audit of articles, comparison to other shortage measures

Grouping of Articles for the Construction of the Index



Search Query for the Shortage Index

Energy Shortages : (*shortages* N/5 *energy*) AND *economics*

Food Shortages : (*shortages* N/5 *food*) AND *economics*

Industry Shortages : (*shortages* N/5 *industry*) AND *economics*

Labor Shortages : (*shortages* N/5 *labor*) AND *economics*

shortages : shortage, bottleneck, scarcity, rationing

energy : oil, gas, coal, electricity, ...

food : food, wheat, meat, agriculture, ...

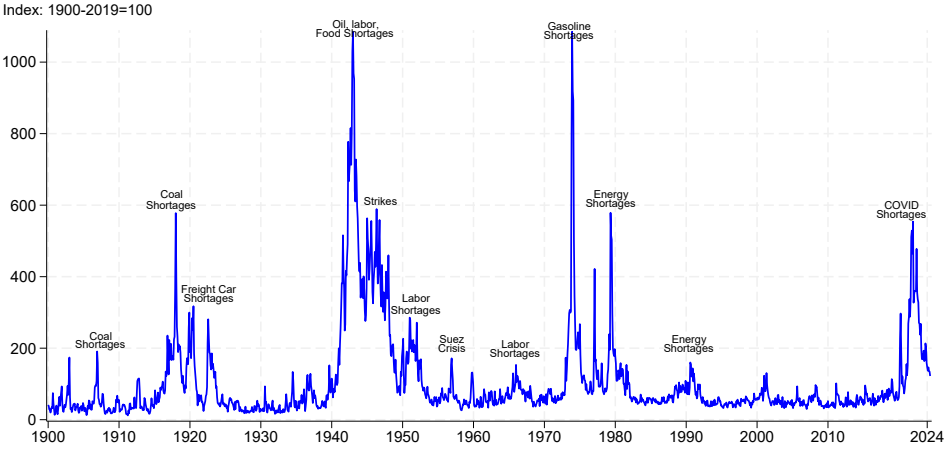
industry : steel, automotive, machinery, ...

labor : labor, workers, employment, ...

economics : economic, production, market, ...

Table: Search query and topic sets used to construct the shortage index.

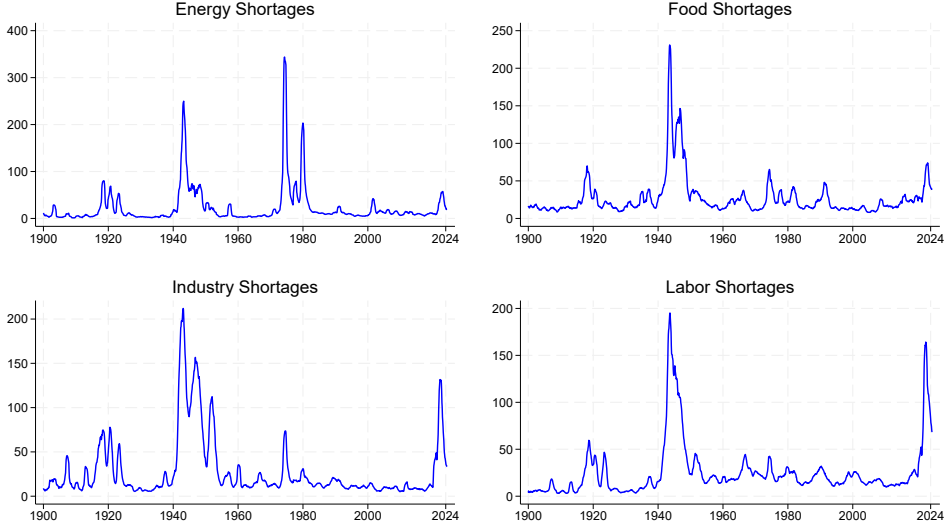
The Shortage Index, 1900-2024



Monthly Data through May 2024.

Updated data at `https://www.matteoiacoviello.com/shortages.html`.

The Shortage Index: Decomposition by Category



12-month moving average. Scale Equal to Contribution to Total Index.

Validating the Shortage Index

Used Claude AI assistant to perform the audit

- Extracted snippets of text from each article;
- Provided training examples to guide Claude's analysis
- Claude classified articles 1/0 and provided explanations

Sampled 872 articles included in the index

- 93.7% of articles correctly mention shortages (False positives: 6.3%)

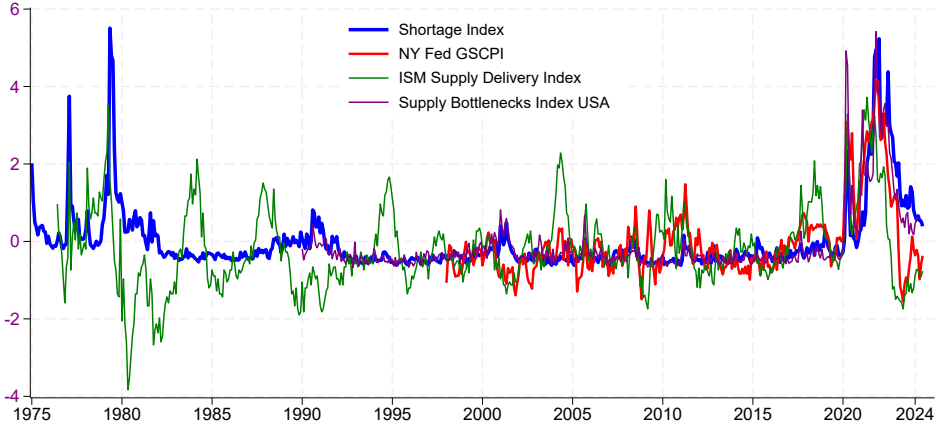
Sampled 298 articles not included in the index

- Only 1 article mentioned shortages (False negatives: 0.33%)

Proximity of shortage words to topic words improves accuracy

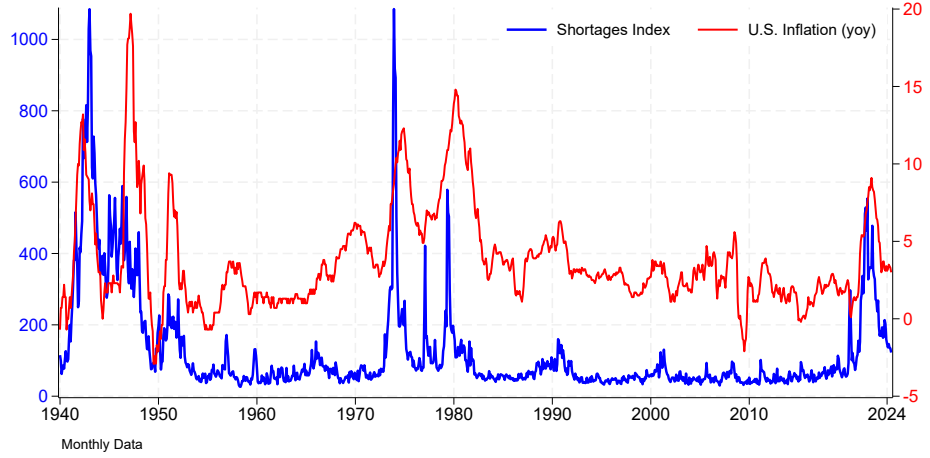
- Without proximity restriction, false positive rate rises to 15.8%

Comparison to Other Measures (starting after 1975)



All Indexes Standardized to have zero mean and unit standard deviation over 2000-2023 Period

Economic Effects: Shortages and U.S. Inflation



Predictive Regressions

- Rolling regressions:

$$\Delta Y_{t+h} = \alpha + \beta \text{ SHORTAGE}_t + \Sigma_{i=0}^{p} \mathbf{X}_{t-p} + \varepsilon_{t+h}$$

where:

- ΔY_{t+h}: change in real pc GDP, or GDP deflator between t and $t+h$
- SHORTAGE_t: shortage index at time t
- $\mathbf{X}$: control variables
- Results robust to controls (oil, commodities, wages, inflation expectations)

Effects vary over time.

Generally positive for inflation, negative for activity.

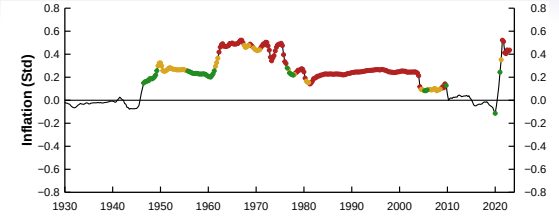


Figure: Effect of Shortages on GDP Deflator (30-Year Window)

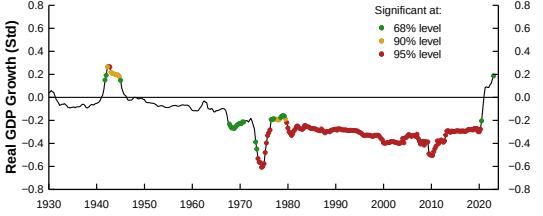


Figure: Effect of Shortages on Real GDP (30-Year Window)

Can Shortages Forecast Inflation?

Model:

$$\pi_{t+12} = c + \beta(L)\,\pi_t + \gamma(L)\,x_t + \delta(L)\,\text{SHORTAGE}_t$$

- π_t: 12-month CPI inflation
- x_t: Unemployment (12-mo MA), 12-mo. change in oil prices (12-mo MA)

Methodology:

- Rolling forecasts: 1990:M1 - 2023:M12
- Start in 1960:M1. 30-year windows, 12 lags.

Results:

- Model with shortage index outperforms model without
- 1990-2019: RMSE 1.19 (with shortages) vs 1.33 (without)
- 2020-2023: RMSE 0.98 (with shortages) vs 1.67 (without)

Forecast Comparison around the Pandemic

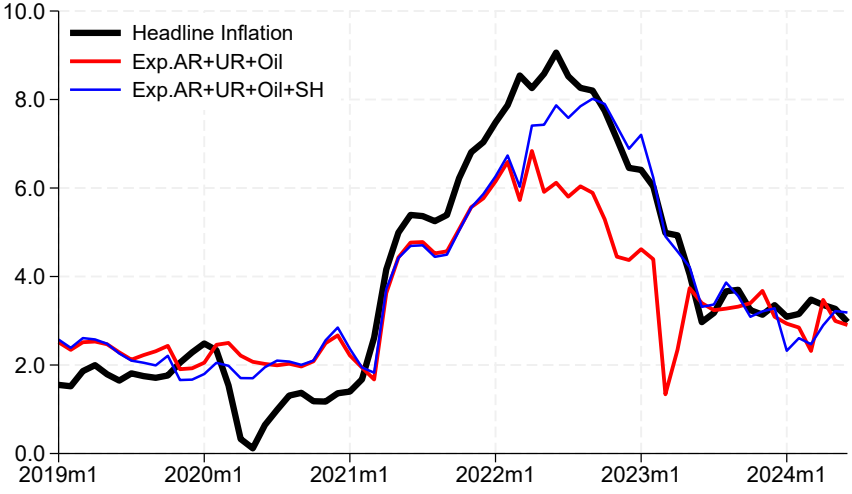


Figure: Model with shortages slower decline of inflation in 2022-23

VAR Analysis: Setup

Structural VAR to identify causes and consequences of shortages.

$$\pi = b_\pi(L)\mathbf{X}_{-1} + \kappa y + u^S$$
$$y = b_y(L)\mathbf{X}_{-1} - \delta\pi + u^D$$
$$c = b_c(L)\mathbf{X}_{-1} + \phi_D u^D + \phi_S u^S + u^C$$
$$h = b_h(L)\mathbf{X}_{-1} + \theta_S u^S + \theta_D u^D + \theta_C u^C + u^H$$
$$r = b_r(L)\mathbf{X}_{-1} + \alpha_\pi \pi + \alpha_Y y + \alpha_H h + \alpha_C c + u^R$$

where $\mathbf{X}_t = (y_t, \pi_t, c_t, h_t, r_t)'$ and:

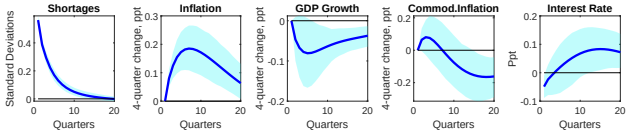
- y: 4-quarter per capita GDP growth
- π: 4-quarter % change CPI
- c: 4-quarter % change in commodity prices
- h: shortages
- r: 3-month interest rate
- u^S, u^D, u^C, u^H, u^R : shocks

VAR Analysis: Identification

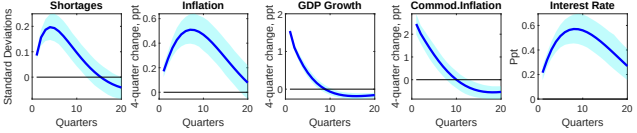
$$\pi = \kappa y + u^S$$
$$y = -\delta\pi + u^D$$
$$c = \phi_D u^D + \phi_S u^S + u^C$$
$$h = \theta_S u^S + \theta_D u^D + \theta_C u^C + u^H$$
$$r = \alpha_\pi \pi + \alpha_Y y + \alpha_H h + \alpha_C c + u^R$$

- System above is under-identified (would be just-identified if κ was known and other parameters were unrestricted)
- To aid identification, we impose priors as in Baumeister and Hamilton (2019) priors
  - Restrict κ, δ to be positive
  - Restrict $\theta_S, \theta_D, \theta_C$ (and ϕ_D, ϕ_S) to be positive
  - Restrict α_π, α_Y to be positive
  - Estimate VAR with standard Bayesian methods posteriors

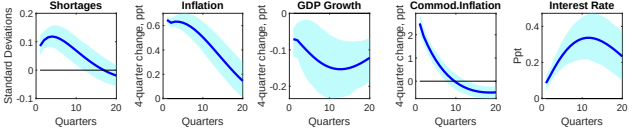
Impulse Responses



Shortages Shocks

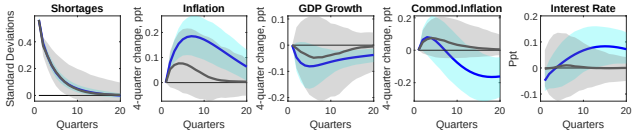


Demand Shocks

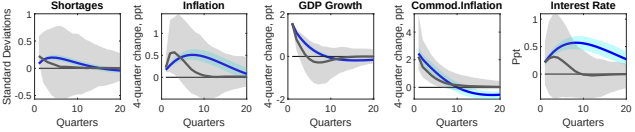


Supply Shocks

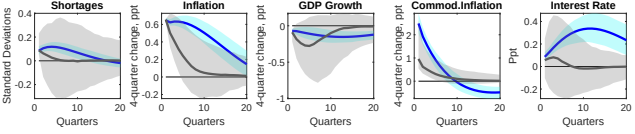
Impulse Responses, Prior vs Posterior



Shortages Shocks



Demand Shocks

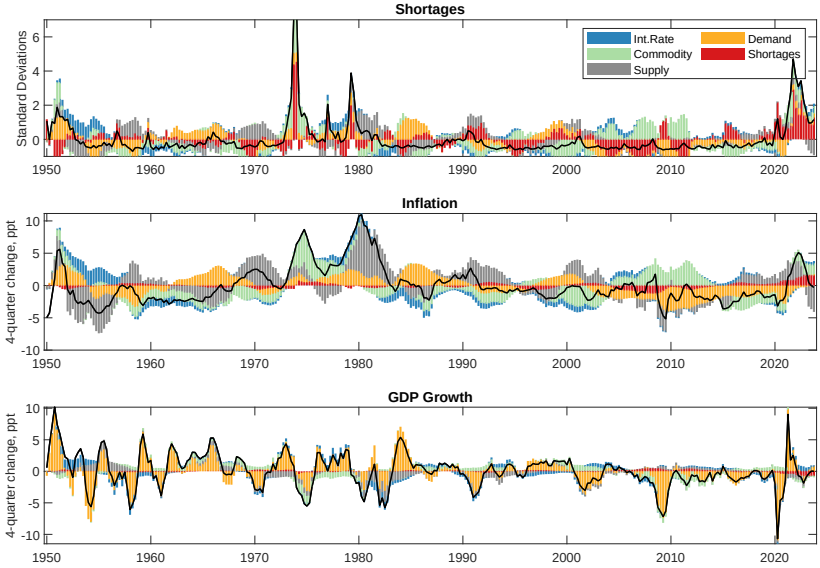


Supply Shocks

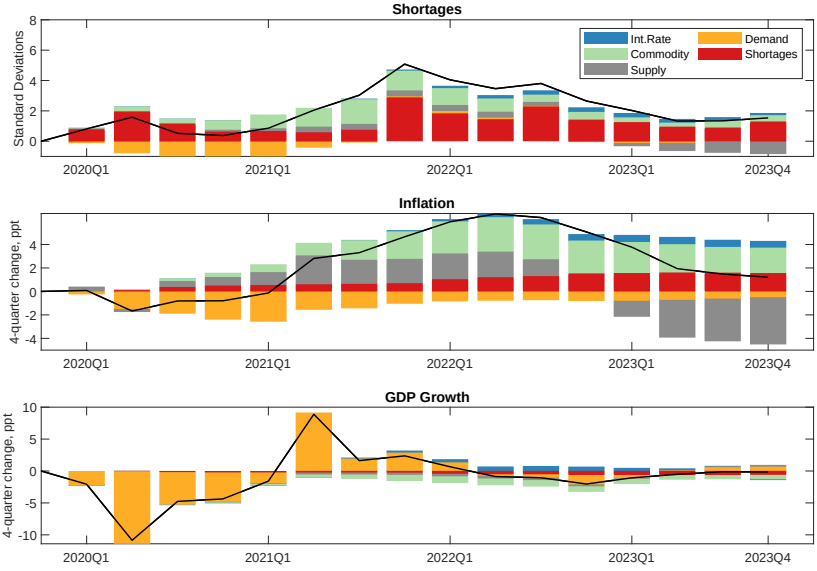
What are Shortage Shocks?

- Fluctuations in shortages reflect:
  - Business cycle-induced movements (supply, demand, commodities)
  - Exogenous shocks (major disruptions to flow of goods, services, and factors of production)
    - Atypical adjustment to sudden shifts in economic conditions, e.g.: demand reallocation causing temporary bottlenecks
    - Geopolitical shocks slowing flow of goods
    - Surge in demand causing rationing when social norms prevent large price adjustments
    - Shocks to regulation (price ceilings, quantity rationing)
- Assumption: All 'exogenous' shortage shocks have same effects

Historical Decomposition: Full Sample



Historical Decomposition: 2020-Present



Summary & Implications

- New long-run shortage index captures historical trends
- Shortages reflect both supply and demand forces, with relative importance varying over time
- Shortages have persistent inflationary effects
- Index provides new tool for researchers and policymakers to understand shortage dynamics

APPENDIX

Validating the Index: Prompt

Prompt for Claude AI

"I give you 872 snippets of text each about 110 characters long. For each of them, can you tell me whether they mention current or perspective shortages or rationing or scarcity or bottlenecks related to goods, labor, materials, food, water? Just return a table with yes=1, no=0, unsure=99, and a brief explanation.

For instance.

Article 1 mentions that steel shortages will prevail in the near future, so it is a 1.

Article 2 says steel shortages caused a plant closure, so it is coded 1.

Article 329 says no shortage of cars has been experienced, so 0."

Back

Validating the Index: Outcome

Articles coded as mentioning Shortages

Steel Shortages To Hit GM Plants If Strike Goes On: A
A WALL STREET JOURNAL News Roundup
Wall Street Journal (1923-); Sep 21, 1959; ProQuest Historical Ne
pg. 3

Steel Shortages To Hit GM Plants If Strike Goes On

Auto Maker Faces Shutdown In Month; Others Said to Have Adequate Steel

First Closings Due in 10 Days

A WALL STREET JOURNAL News Roundup

Strike-caused steel shortages are beginning to hit General Motors Corp.

"strike caused steel shortages are beginning to hit general motors corp. so.."

Claude: 1: Steel shortages are hitting General Motors

Canada Suspends Meat Rationing: OPA Cuts Pork and Beef Points for U. S.
Daily Boston Globe (1928-1960); Mar 1, 1944; ProQuest Historical Newspapers: The Boston Globe
pg. 1

Canada Suspends Meat Rationing

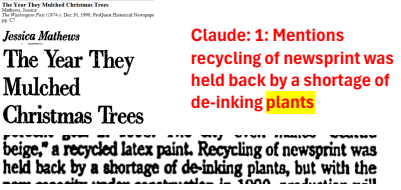
OPA Cuts Pork and Beef Points for U. S.

WASHINGTON, Feb. 29 (AP)—[watch. Canada's action today in] The OPA slashed ration costs of [temporarily suspending meat ra]tion pork and several beef cuts, but cautione

"canada s action today in temporarily suspending meat rationing.."

Claude: 0: Canada temporarily suspending meat rationing

Article coded as NOT mentioning Shortages



The Year They Mulched Christmas Trees
Mathews, Jessica
The Washington Post (1974-); Dec 30, 1998; ProQuest Historical Newspap
pg. C7

Jessica Mathews

The Year They Mulched Christmas Trees

beige," a recycled latex paint. Recycling of newsprint was held back by a shortage of de-inking plants, but with the

Claude: 1: Mentions recycling of newsprint was held back by a shortage of de-inking plants

Note

Brighten Up Indoors With Colorful Plants
JOEL RAPP SPECIAL TO THE TIMES
Los Angeles Times (1996-); Feb 4, 1996; ProQuest Historical Newspapers: Los Angeles Times
pg. K1

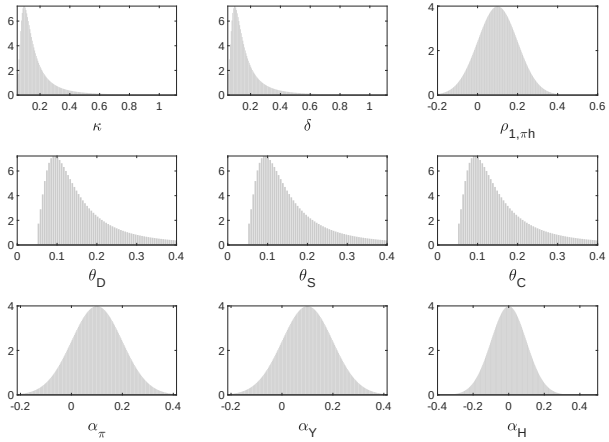
Brighten Up Indoors With Colorful Plants

There's no shortage of plants with brightly colored foliage to liven up your kitchen, living room or den during the dark days of winter, either.

Choose from an endless variety

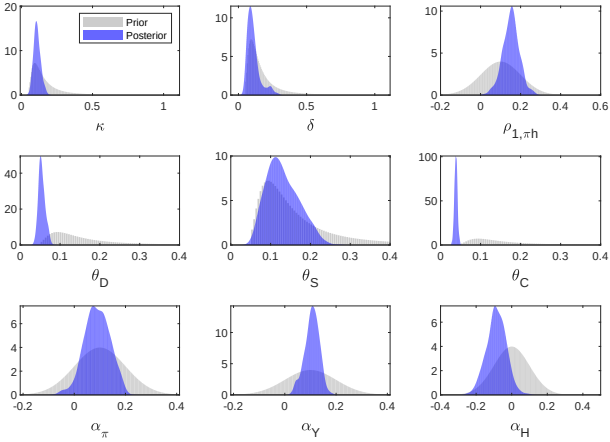
Back

Priors: Baseline Model



Back

Priors and Posteriors: Baseline Model



Back

Baumeister, C. and Hamilton, J. D. (2019). Structural interpretation of vector autoregressions with incomplete identification: Revisiting the role of oil supply and demand shocks. *American Economic Review*, 109(5):1873–1910.

Benigno, G., Di Giovanni, J., Groen, J. J., and Noble, A. I. (2022). The gscpi: A new barometer of global supply chain pressures. *FRB of New York Staff Report*, (1017).

Bernanke, B. and Blanchard, O. (2023). What caused the us pandemic-era inflation? *Peterson Institute for International Economics Working Paper*, (23-4).

Burriel, P., Kataryniuk, I., Moreno Pérez, C., and Viani, F. (2023). A new supply bottlenecks index based on newspaper data. *Banco de Espana Working Paper*.

Chen, L. and Houle, S. (2023). Turning words into numbers: Measuring news media coverage of shortages. Technical report, Bank of Canada.

Lamont, O. (1997). Do" shortages" cause inflation? In *Reducing Inflation: Motivation and Strategy*, pages 281–306. University of Chicago Press.

Pitschner, S. (2022). Supply chain disruptions and labor shortages: Covid in perspective. *Economics Letters*, 221:110895.